Carlsbad Village Railroad Trench

Final Alternative Analysis Report

April 2020

Prepared for:

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1. EXECUTIVE SUMMARY

The San Diego Association of Governments (SANDAG), City of Carlsbad (City), and North County Transit District (NCTD) have initiated this Alternative Analysis Report for the Carlsbad Village Railroad Trench project. This study documents the analysis of alternatives for grade separation of the railroad tracks through the Carlsbad Village area of the City. Proposed improvements include addition of a second main track between Control Point (CP) Longboard (MP 228.4) and CP Carl (MP 229.6) to provide continuous double-tracking in the area. The existing bridge crossing over Buena Vista Lagoon would be replaced and street crossings would be grade separated.

Railroad traffic is expected to increase significantly over the next several decades. Coastal access and traffic circulation are limited due to the minimal number of crossings of the railroad tracks in the area. More frequent trains will increase the delay at the current at-grade crossings, increase the noise in the area due to trains, and increase the opportunity for incidents involving pedestrians and vehicles. Double tracking this segment in a trench directly supports the objective of SANDAG, the City, NCTD, Amtrak and BNSF Railway. Trenching through the City of Carlsbad will provide much improved and safer connections to coastal resources and the coastline for residents, visitors, and train riders; as well as allow increases in railroad volumes without negatively impacting traffic circulation in the City.

Two alternatives were considered in this study as viable alternatives: The Short Trench Alternative and the Long Trench Alternative. Each alternative was analyzed by a Project Development Team (PDT) consisting of representatives from SANDAG, the City, NCTD, T. Y. Lin International (designer), and BRG Consulting (environmental consultant). During a series of two workshops the PDT developed analysis criteria, provided a weighting for each criterion, reviewed relevant information about the proposed designs, and finally scored each alternative using the criteria and weighting. The evaluation criteria agreed upon were Minimize Impacts to Railroad Operations, Minimize Environmental Impacts, Maximize Community Acceptance, Improve Local Circulation/Emergency Response, Maximize Economic Benefit, and Minimize Construction Impacts.

The Long Trench Alternative was scored the highest by the PDT because it provided the most benefit with respect to the analysis criteria developed by the team. This alternative would lower the railroad tracks in a trench from south of Tamarack Avenue to the north side of Carlsbad Village Station. Vehicular overpasses crossing the trench would be provided at Tamarack Avenue, Oak Avenue, Carlsbad Village Drive, and Grand Avenue. At Chestnut Avenue, the project could either construct a vehicular overpass, or a pedestrian and bicycle only overpass. A pedestrian/bicycle overpass would also be constructed near Beech Avenue at the train station. In addition, the existing Carlsbad Boulevard Overpass would need to be replaced. The train platforms at Carlsbad Village Station would be re-constructed within the trench, accessible from street level by both elevators and stairs. Where the Long Trench extends south of Tamarack Avenue, there would be a need to acquire three residential properties due to the narrow right-of-way in that area.

The Short Trench Alternative would be similar to the Long Trench Alternative except that the trench would end north of Tamarack Avenue, outside of where the NCTD right-of-way narrows (to the south), and Tamarack Avenue would remain as an at-grade crossing. At Chestnut Avenue a pedestrian/bicycle overpass would be constructed rather than a vehicular overpass. As an option, improvements to the at-grade crossing at Tamarack Avenue could be included in the Short Trench Alternative to allow for a Quiet Zone. This would help to minimize train horns in the area.

Each alternative would construct a trench below the groundwater level. This requires the trench to be sealed with a watertight floor and walls. The walls are proposed to be secant pile walls with struts across the top of the walls. The floor would be sealed with a thick layer of concrete to both seal out the groundwater and resist the buoyancy of the trench.

The trench would collect rainwater that would require stormwater pump stations to be constructed. Runoff would be collected at the low point in the trench and pumped out to the surface where stormwater treatment BMPs are proposed to be located. After treatment the runoff would enter the City storm drain system.

An evaluation of the potential effects of the trench on the groundwater showed that constructing the trench could cause up to a 4-foot mounding of the groundwater on the east side of the trench, which could result in groundwater levels that are 13 feet below the surface. The mounding would be highest adjacent to the trench and would taper off over around 1,000 feet to the east. This analysis was based on limited groundwater aquifer testing, and soils analysis at 4 locations along the proposed trench and boundary conditions of current average sea level, with an assumed water surface at the eastern limit of the analysis. The groundwater extracted during the testing was found to be non-hazardous in all locations tested. It is recommended that additional testing and modeling of the groundwater be completed during the environmental phase of the project to increase the level of confidence in the amount of mounding caused by the trench.

Both alternatives would require a temporary "shoofly" track to be constructed so that railroad operations can continue throughout construction. Since the existing station parking is on the east side of the right-of-way and the west side is more constricted by the Army-Navy Academy and Washington Street, it was determined that the most feasible location for the temporary track is on the east side of the proposed trench.

Constructing the temporary track on the east side allows riders to park in the parking lot and access the temporary track for boarding without crossing the work zone for the trench. South of the station, the temporary track would impact parking along the east side of the right-of-way during construction and would also require a relocation of the historic train depot, that is currently located between Grand Avenue and Carlsbad Village Drive. There would be a small permanent loss of parking where Oak Avenue is extended across the trench. The construction duration is expected to be 3.5 years for the Short Trench and 4 years for the Long Trench.

The City organized various opportunities to engage the public and identify the community's values, priorities, and questions related to the project. Public input consisted of one large public workshop, community group presentations, and on online survey. The key themes that emerged from the public input included:

- Trenching would improve safety, reduce noise and pollution, and improve accessibility.
- Participants expressed support for the Long Trench Alternative by a large margin, contingent on learning the sources of funding.
- Participants prefer to keep Chestnut as a pedestrian/bicycle only crossing.

The preliminary project costs were estimated based on the 10% design plans included as an attachment to this report. Each estimate includes a 30% contingency due to the preliminary level of design for the project. The total project cost of the Long Trench Alternative was estimated to be between \$375 million and \$395 million, in 2020 dollars, with a construction cost between \$250 million and \$270 million. The total project cost of the Short Trench Alternative was estimated to be between \$245 million and \$265 million, in 2020 dollars, with a construction cost between \$165 million and \$185 million.

Figure 1.1: Project Map

2. PROJECT DESCRIPTION

This Alternative Analysis Report documents the analysis of alternatives for grade separating the NCTD railroad tracks through the Carlsbad Village and Barrio areas of Carlsbad, between Agua Hedionda Lagoon and Buena Vista Lagoon.

2.1. Project Location

The project study area is in San Diego County in the cities of Carlsbad and Oceanside along approximately 2.6 miles of the railroad corridor from Agua Hedionda Lagoon to Cassidy Street. (See Attachment A for a larger location map)

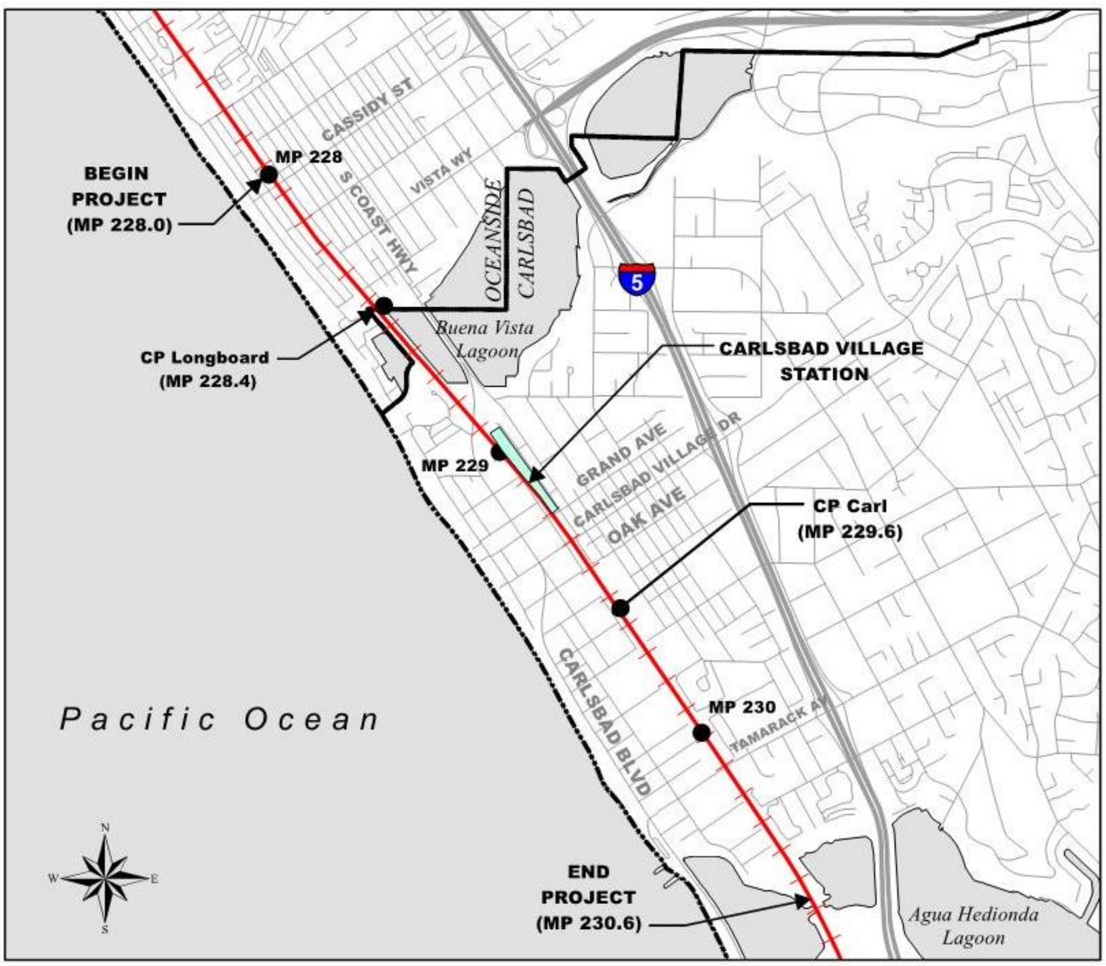

Figure 2.1: Location Map

2.2. Existing Facilities

The California Southern Railroad, a subsidiary of the Atchison, Topeka, and Santa Fe Railway, was constructed from 1881 to 1885. It provided a connection between what is now the City of Barstow and City of San Diego. At its most southern end, the railway began in what is now the City of National City proceeding northward to the City of Oceanside, then northeast through Temecula Canyon and on toward Barstow. The California Southern Railroad formed the original railroad right-of-way through the City of Carlsbad that is still in use today. The San Diego Northern Railway, a subsidiary of NCTD, purchased the tracks from Atchison, Topeka, and Santa Fe Railway in 1994. NCTD dissolved the San Diego Northern Railway Corporation in 2002.

Currently, NCTD, Amtrak, and BNSF Railway operate rail services through the LOSSAN Corridor, operating through the project site. NCTD's COASTER trains stop at the Carlsbad Village station.

The existing tracks consist of a double track section from CP Ponto (MP 234.5), south of Poinsettia Station, to CP Carl (MP 229.6), located at Pine Avenue. At CP Carl the tracks are reduced to a single track going north through Carlsbad Village Station, under the Carlsbad Boulevard Overpass and across Buena Vista Lagoon to CP Longboard (MP 228.4). The tracks return to double track north of the turnout at CP Longboard continuing north through Oceanside.

The area surrounding the railroad right-of-way between Carlsbad Boulevard and Oak Avenue has developed into the downtown commercial area of Carlsbad and is known as Carlsbad Village. The area between Oak Avenue and Tamarack Avenue is known as the Barrio and is considered Carlsbad's first neighborhood, initially settled in the early 1900s. The City has completed several revitalization projects in the area with more planned in the future.

Within the Carlsbad Village area there are three at-grade railroad crossings: one at Carlsbad Village Drive, one at Grand Avenue, and one pedestrian only at-grade crossing at the Carlsbad Village Station platform; and one grade separated crossing at Carlsbad Boulevard. Farther south there is one more at-grade crossing located at Tamarack Avenue. There is approximately 0.8 miles between the crossings at Carlsbad Village Drive and Tamarack Avenue where there is no access for pedestrians or vehicles across the railroad tracks.

The Carlsbad Village Station is located just north of Grand Avenue on the east side of the railroad tracks. It includes a parking lot and a station building with restrooms. Across the tracks there is a bus depot operated by NCTD with six saw-tooth bus bays. Near the center of the station platform, access between the train platforms is provided by an at-grade pedestrian crossing.

Between Grand Avenue and Carlsbad Village Drive, the existing track is bordered by a green space known as Rotary Park to the west and the current location of the historic Carlsbad Santa Fe Depot to the east. The historic Carlsbad Santa Fe Depot is currently utilized by the City of Carlsbad as a Visitor's Center. North of the bus station and immediately west of the NCTD right-of-way is the Army /Navy Academy athletic fields. Farther north, beyond Buena Vista Lagoon, the track corridor is located between single family home developments.

2.3. Current Rail Services

Current rail services that run through the project area include NCTD COASTER, Amtrak Pacific Surfliner, and BNSF freight trains. The following table provides typical numbers of trains per day passing through the project area for the current condition and the future planned condition.

Table 2.1: LOSSAN Service Levels (Oceanside to San Diego)

Operator/Line	2019 Service Levels	2035 Planned Service Levels
Intercity	26	36
Commuter	24	54
BNSF Freight	6	11
TOTAL	56	101

2.4. Previous Studies

Railroad Trench Alternative Economic Analysis and Feasibility Study

In 2017, T.Y. Lin International completed the *Carlsbad Village Double Track - Railroad Trench Alternative Economic Analysis and Feasibility Study* for SANDAG and the City of Carlsbad. The study evaluated the feasibility of constructing a railroad trench through Carlsbad Village. Design constraints were identified, and a preliminary design was developed. It was determined that it is feasible to construct a railroad trench through the area. High groundwater and constrained right-of-way present challenges that must be considered. The study presented several options for constructing a trench in the area of high groundwater. A preliminary opinion of probable construction costs was developed for both a long and short alternative for the trench. The results of the economic analysis were that the Long Trench provides the highest economic benefit, with the Short Trench having a lower benefit. The at-grade alternative did not show an economic benefit in this study of the local economy in Carlsbad. The economic benefits of the two trench alternatives were shown to be far greater than the construction cost over a 99-year period.

The economic analysis evaluated both fiscal and economic impacts of the Short Trench Alternative, Long Trench Alternative, and at-grade double tracking. This included considerations such as the value of lives saved, value of time saved by motorists, property values, property taxes, retail and restaurant sales, sales taxes, construction impacts, transient occupancy taxes, vacancy and lease rates, job creation, emergency response delays, and displacement.

At-Grade Double-Tracking Alternative

Earlier studies of the Carlsbad Village Double Track project have focused on at-grade alternatives for double-tracking. A Project Study Report prepared by RailPros, Inc. in August 2011 (for SANDAG and NCTD) recommended that an at-grade second track alignment be constructed to the east of the existing track maintaining 18-foot track centers through the station area, Grand Ave, and Carlsbad Village Drive.

An Alternatives Analysis Report was prepared by T.Y. Lin International in April 2014 (for SANDAG, NCTD, and FRA) that studied various alternatives for at-grade double-tracking and recommended a preferred alternative that shifted the existing track three feet west and constructed a new track fifteen feet east of the existing track. The project limits for an At-Grade Alternative would be similar to the trench alternatives on the north end, however to the south the at-grade double-tracking would end north of Chestnut Avenue where it meets up with existing double-track.

Local Planning

The Carlsbad Village and Barrio Master Plan completed in October 2019 has listed trenching of the railroad tracks as a key recommendation. The plan also includes reconfiguring the station's State Street entrance into a formal plaza with vehicle access maintained and both transit-oriented development and a mobility hub at or near the existing train station.

3. PURPOSE AND NEED

Project Need

The 351-mile LOSSAN rail corridor serves as a vital link for passenger and freight movements in San Diego County. The LOSSAN corridor is the second busiest intercity passenger rail line in the United States. Additionally, the corridor is the only viable freight rail link between San Diego and the rest of the nation. Currently, because of single track through the northern part of the project area, trains must wait at a siding whenever a COASTER train is loading or unloading passengers at the Carlsbad Village Station. Additionally, meeting or passing trains must take turns using the single track, which reduces operational flexibility and results in cascading delays. Double tracking this segment directly supports the service goals of SANDAG, NCTD, Amtrak, and BNSF Railway to increase the efficiency of this rail corridor, not only to accommodate existing train volumes, but also to provide for future demand for rail services on the LOSSAN corridor.

Railroad traffic, which is expected to increase significantly in the coming years, has adverse effects on the City of Carlsbad, especially in the area between the Agua Hedionda and Buena Vista lagoons. Coastal access and traffic circulation are limited due to the minimal number of crossings of the railroad tracks in the area. More frequent trains will increase the delay at the current at-grade crossings, increase the noise in the area due to trains, and increase the opportunity for incidents involving pedestrians and vehicles.

Project Purpose

Double tracking this segment in a trench directly supports the objective of SANDAG, the City, NCTD, Amtrak and BNSF Railway. Trenching through the City of Carlsbad will provide much improved and safer connections to coastal resources and the coastline for residents, visitors, and train riders; as well as allow increases in railroad volumes without negatively impacting traffic circulation in the City.

4. ALTERNATIVES ANALYSIS

Two PDT workshops were held in May 2019 and June 2019. These workshops were attended by various stakeholders on the project including SANDAG; representatives for the City of Carlsbad Engineering, Communications, and Police Department; NCTD; BRG Consulting, Inc.; and T.Y. Lin International. The alternative analysis method used was a scientific process consisting of the following steps: Preparation, Investigation/Discovery, Evaluation, and Analysis.

Preparation - The Preparation phase included gathering supporting data for the studies and assembling the PDT.

Investigation/Discovery - In this phase members of the PDT conducted site visits, reviewed the existing facilities, researched existing utilities, and reviewed past studies.

Evaluation - During the Evaluation phase the project team developed and weighed a list of evaluation criteria from which the proposed alternatives would be ranked.

Analysis - All viable alternatives were scored on a one to ten scale against weighted criteria to determine an overall score and ranking for each alternative.

4.1. Design Standards and Assumptions

The preliminary designs for each alternative were developed following the SANDAG/NCTD Design Criteria Volume III: LOSSAN Corridor in San Diego County (LOSSAN) (May 2015), the LOSSAN Corridor-San Diego Subdivision Engineering Standard Drawings (ESD), the American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual of Railway Engineering (2018), Code of Federal Regulations Title 49 (CFR49) (Parts 234, 235, & 236), current California Public Utilities Commission (CPUC) General Orders, and California Manual on Uniform Traffic Control Devices (CA MUTCD).

Table 4.1: Summary of Key Geometric Design Standards

Standard	Design Criteria	Notes
Minimum Horizontal Clearance	Minimum of 12 feet from centerline of track to structure (ESD 2101)	Additional 3 feet of clearance is provided to allow for railroad signal equipment and drainage within the trench.
Minimum Vertical Clearance	Preferred vertical clearance from top of rail to structures is 26 feet (LOSSAN 4.2.2)	NCTD has indicated that it may be acceptable to utilize 24-foot vertical clearance, however, this will require concurrence from BNSF.
Design Speed	90 mph (passenger) 60 mph (freight) (LOSSAN 6.3.1)	

Standard	Design Criteria	Notes
Vertical Curve Length	Minimum vertical curve length is the greater of the following: Passenger $LVC=2.15DV^2/0.60$ Freight $LVC=2.15DV^2/0.10$ (LOSSAN 6.4.3)	
Vertical Curve Spacing	The minimum distance between vertical curves shall be 3 times the track speed or 100-ft, whichever is greater. (LOSSAN 6.4.3)	
Track Spacing	Minimum of 15 feet from centerline to centerline (LOSSAN 4.3.1) Minimum of 18 feet from centerline to centerline at station platforms to allow for intertrack fence (LOSSAN 7.3.1)	
Track Grades	Maximum compensated track grade is 2.0% (LOSSAN 6.4.2) Maximum track grade at station platform is 0.50% (LOSSAN 7.3.1)	The maximum grades used were below the limit in the Design Criteria due to requirements for vertical curve length and spacing.
Platform Dimensions	New stations will be constructed with 1,000-foot long platforms. (LOSSAN 7.6.1) Side platforms are preferred to center platforms. Side platforms shall be a minimum of 16 feet wide unless otherwise approved by SANDAG and/or NCTD. (LOSSAN 7.6.4)	

4.2. Development of Evaluation Criteria

The PDT selected the following criteria to use in ranking of the alternatives.

Minimize Impacts to Rail Operations - Minimize impacts to railroad operations in both the temporary and permanent condition.

Minimize Environmental Impacts - Consider environmental impacts such as the environmentally sensitive area (ESA) at Agua Hedionda Lagoon. Permanent noise impacts of the design alternative should be considered. Addition of a quiet zone to the short trench alternative must include the associated cost to implement for evaluation.

Maximize Community Acceptance - Alternative provides benefits to the community and has positive visual impacts to surrounding neighborhoods. Alternative is consistent with City Council vision. Alternative minimizes right-of-way impacts to public/private parcels.

Improve Local Circulation / Emergency Response - Alternative improves circulation for all modes of transportation. When applicable, public input on pedestrian vs vehicular access shall be considered (i.e. Chestnut Ave Grade Separation). Access and response time for emergency personnel improved.

Maximize Economic Benefit - Improvements to property values and business revenue expected as a result of constructing the trench and additional access across the tracks. Alternative has a positive economic impact to the community. This was based on the 2016 *Economic Study Assessing LOSSAN Corridor Improvement Options – Carlsbad Area by* RSG, Inc. / Kimley-Horn and Associates, Inc. / dBF Associates.

Minimize Construction Impacts - Alternative limits impacts to the public. Example impacts include duration, noise, dust, traffic, emergency response/access, and shoofly track.

These Criteria were "weighed" against each other using a simple matrix similar to that shown in Table 4.1 below. The number of times each Criterion "won" was counted and taken as a percentage of the total number of comparisons made, determining the final weight assigned to the criteria. For example, in Table 4.2, when Maximize Economic Benefit (E) was compared to Minimize Construction Impacts (F), the PDT decided that Maximize Economic Benefit (E) was more important, so it "won". Criterion E won two times, so it received a weight of 13.3%.

Table 4.2: Sample Criteria Weighting Table

A	A vs B	A vs C	A vs D	A vs E	A vs F	# of A	% A
	B	B vs C	B vs D	B vs E	B vs F	# of B	% B
		C	C vs D	C vs E	C vs F	# of C	% C
			D	D vs E	D vs F	# of D	% D
				E	E vs F	# of E	% E
					F	# of F	% F
						Total	100%

Table 4.2 below shows the specific criteria selected for this analysis and the corresponding weighting. The highest weighted criterion was Improve Local Circulation and Emergency Response with a weight of 33.3%. Maximize Community Acceptance was the second highest with a weight of 26.7%.

Table 4.3: Criteria Weighting Table

A) Min. Impacts to Rail Operations	A	C	D	E	F	1	6.7%
	B) Min. Environmental Impacts	C	D	B	B	2	13.3%
		C) Max. Community Acceptance	D	C	C	4	26.7%
			D) Improve Local Circulation/Emergency Response	D	D	5	33.3%
				E) Max. Economic Benefit	E	2	13.3%
					F) Min. Construction Impacts	1	6.7%
						Total	100%

4.3. Design Alternatives

During the feasibility study the design team considered several alternatives for the project. There are several ways the tracks could be grade separated from the roadways. The tracks could pass under the road by trenching the tracks, the road could pass under the tracks by dipping the road profile and constructing a track bridge, or the tracks could be built up on a viaduct structure and pass over the roads.

Dipping the road under the tracks was not considered viable because this would affect several roads that parallel the tracks and many driveway and storefront access points. This alternative was not considered viable because these impacts to adjacent properties would be too great and it did not fully address the circulation concerns of the City.

Raising the tracks up on a viaduct structure was not considered viable due to the increases in noise and visual impacts related to a raised railroad track. Also, if the track profile is to pass beneath the Carlsbad Boulevard Overpass and then pass over Grand Avenue, the track slope will be greater than the maximum allowable 0.5% slope through the station platform.

A railroad trench is considered the most viable way to grade separate the road crossings in Carlsbad Village. It would allow for grade separation of the existing roads without impacting the profile of the surrounding roads or access to adjacent properties.

For this study the PDT considered two alternatives for trenching the railroad tracks: A Short Trench and a Long Trench. Both alternatives would provide double tracking throughout the project limits, but the southern limit of the railroad trench would be different for each alternative. A 10% level of design for each alternative was prepared to accompany this alternative analysis. Below is a description of the preliminary 10% designs for each alternative.

SHORT TRENCH ALTERNATIVE

The Short Trench would lower the railroad tracks in a trench to pass under vehicular/pedestrian/bike bridges at Oak Avenue, Carlsbad Village Drive, Grand Avenue, and Carlsbad Boulevard. Beech Avenue and Chestnut Avenue would have a pedestrian/ bicycle overpass only. Tamarack Avenue would remain an at-grade crossing. Double-tracking of the railroad would be provided from Cassidy Street, in Oceanside, to the Agua Hedionda Bridge. This would include replacement of the existing rail bridge over Buena Vista Lagoon with a new double-track bridge. The existing Carlsbad Boulevard Overpass would be replaced with a new longer bridge that would provide the required clearances to the railroad tracks and allow room for the shoofly track to be installed. See Attachment B for preliminary plans.

<u>Track Alignment</u>

Beginning in the south, the track alignment would follow the existing double track alignment north of the Agua Hedionda Lagoon bridge. Tracks would be re-aligned west of the existing alignment across Tamarack Avenue before entering the trench roughly 250 feet to the north. The tracks and trench were shifted west of the existing alignment to avoid impacting the large existing sewer and storm drain located on the east side of the right-of-way.

From Tamarack Avenue, the alignment remains on a tangent for about 2,500 feet. There is a short curve on each track that increases the track spacing from 15 feet to 18 feet. The tracks would be spaced at 18 feet through the station platform area to allow for an inter-track fence. Beginning just north of Carlsbad Village Drive there is a longer curve that extends for roughly 1,400 feet into the middle of the platform. This curve exists in the current track and station. NCTD would need to approve a design standard deviation to allow this curve to remain within the platform. The track alignments are tangent north of the station, across the Buena Vista Lagoon bridge. The tracks match into the existing alignments at Cassidy Street after a roughly 1,000-foot-long curve.

Track Profile

From the south, the profile of the track will match existing until north of Tamarack Avenue. The profile will cross Tamarack Avenue at a top of rail elevation of 43.25 ft., close to the same elevation as the existing road surface. A 1,900-foot vertical curve beginning south of Tamarack leads to a -1.64% grade into the trench. A 1,300-foot vertical curve transitions from -1.64% to -0.06%. The lowest point in the trench occurs just north of Carlsbad Village Drive at a top of rail elevation of 14.38 ft. The track profile transitions from -0.06% to 0.39% with a 400-foot vertical curve. The profile continues at 0.39% through the platform area up to an elevation of 21.80 ft. at the Carlsbad Boulevard Overpass. A 500-foot vertical curve transitions to a -0.17% grade that continues across the Buena Vista Lagoon Bridge. The top of rail elevation of roughly 19.7 ft. at the north end of the bridge provides adequate clearance from the 100-year water surface elevation of 12.7 ft. The proposed track profile would be roughly 5 feet higher than the existing track across the lagoon. An 1,150-foot vertical curve rises from the bridge to a grade of 1.27%, then an 1,100-foot vertical curve ends at -0.06%. The tracks would tie in to existing on the south side of the Cassidy Street at-grade crossing.

Trench Structure

The trench would be constructed below the water table. This requires a design that will prevent water intrusion into the trench. The trench walls must also be able to support loading from the temporary shoofly track as well as provide support for proposed bridge abutments. Based on the findings in the 2017 trench feasibility study, the most feasible design for this are secant pile walls with an invert slab and concrete seal course.

Secant pile walls are formed by top down construction of overlapping concrete piles. The secant piles are reinforced with either steel rebar or with steel beams and are constructed by either drilling under mud or augering. Primary piles are installed first with secondary piles constructed between the primary piles once the latter gain strength. This wall system provides an effective method to seal off water into an excavation, which will eliminate or reduce the expense of pumping and disposing of groundwater during construction.

Walls over 26 feet high will require additional lateral support to resist lateral soil pressure. The use of tiebacks is not preferred because of impacts they would have on existing utilities and right-of-way boundaries. Since there are two opposing walls in the trench, strut braces can be used to support the walls. Past trench projects have utilized precast concrete struts for bracing.

Railroad Crossings

Tamarack Avenue would remain an at-grade crossing in the Short Trench Alternative. The tracks would cross the road further to the west than the existing condition due to the shoofly track location relative to the proposed trench. The at-grade crossing would be modified to accommodate this shift. If the Short Trench Alternative were carried forward an option that can be incorporated into the design is additional improvements to the at-grade crossing to allow implementation of a Quiet Zone. A Quiet Zone is a provision under the Train Horn Rule (49 CFR Part 222) that directs railroads to cease the routine sounding of their horns when approaching a highway-rail grade crossing if certain criteria are met and the Quiet Zone is approved. This would typically include addition of supplemental safety measures including crossing arms and signals on all four quadrants of the crossing, and signage.

A pedestrian and bicycle only overpass would be constructed at Chestnut Avenue. Here the trench is not at full depth, therefore the overpass would need to be roughly 3.5 feet higher than existing grade for vertical clearance above the tracks. Raising the overpass would create too much grade difference for a vehicular crossing. ADA accessible ramps would be provided to the overpass on either side of the trench.

Overpass structures accommodating vehicles, bicycles, and pedestrians would be constructed at Oak Avenue, Carlsbad Village Drive, and Grand Avenue. A bicycle and pedestrian only overpass structure would be constructed near Beech Avenue within the station area to provide access to each side of the trench for train passengers.

The existing Carlsbad Boulevard Overpass would be replaced with a new three-span bridge of similar width, 170-feet long, with center span clearing the railroad tracks. The existing bridge center span columns would restrict lowering the track profile at the beginning of the trench. Additionally, the temporary shoofly track alignment needs to skew in this location to pass to the side of the trench. The following table summarizes the railroad crossings proposed for the Short Trench Alternative.

Table 4.4: Summary of Railroad Crossings for the Short Trench Alternative

Crossing	Type of Crossing	Allowable Uses
Tamarack Avenue	At-Grade (Existing)	Vehicular, Bicycle, Pedestrian
Chestnut Avenue	Overpass	Bicycle, Pedestrian
Oak Avenue	Overpass	Vehicular, Bicycle, Pedestrian
Carlsbad Village Drive	Overpass	Vehicular, Bicycle, Pedestrian
Grand Avenue	Overpass	Vehicular, Bicycle, Pedestrian
Beech Avenue	Overpass	Bicycle, Pedestrian
Carlsbad Boulevard	Overpass (Replace)	Vehicular, Bicycle, Pedestrian

LONG TRENCH ALTERNATIVE

The Long Trench would lower the railroad tracks in a trench to pass under vehicular/pedestrian/bike bridges at Tamarack Avenue, Chestnut Avenue, Oak Avenue, Carlsbad Village Drive, Grand Avenue, and Carlsbad Boulevard. Beech Avenue would have a pedestrian/ bicycle overpass only. Double-tracking of the railroad would be provided from Cassidy Street, in Oceanside, to the Agua Hedionda Bridge. This would include replacement of the existing rail bridge over Buena Vista Lagoon with a new double-track bridge. The existing Carlsbad Boulevard Overpass would be replaced with a new longer bridge that would provide the required clearances to the railroad tracks and allow room for the shoofly track to be installed. See Attachment B for preliminary plans.

Track Alignment

Beginning in the south, the track alignment would follow the existing double track alignment north of the Agua Hedionda Lagoon bridge. Tracks would be re-aligned to the east of the existing alignment across Tamarack Avenue by introducing a compound curve to the existing curve north of the Agua Hedionda Lagoon Bridge. The tracks and trench shift east of the existing alignment to avoid impacting the existing multi-family properties to the west of the existing NCTD right-of-way line where the right-of-way is narrowed to 100 feet. The trench would begin roughly 1,300 feet south of Tamarack Avenue.

From Tamarack, the alignment remains on a tangent for about 2,500 feet. There is a short curve on each track that increases the track spacing from 15 feet to 18 feet. The tracks would be spaced at 18 feet through the station platform area to allow for an inter-track fence. Beginning just north of Carlsbad Village

Drive there is a longer curve that extends for roughly 1,400 feet into the middle of the platform. This curve exists in the current track and station. NCTD would need to approve a design standard deviation to allow this curve to remain within the platform. The track alignments are tangent north of the station, across the Buena Vista Lagoon bridge. The tracks match into the existing alignments at Cassidy Street after a roughly 1,000-foot-long curve.

<u>Track Profile</u>

From the south, the profile will match the existing track profile across the Agua Hedionda Lagoon Bridge. Roughly 400 feet north of the bridge a 1,000-foot crest vertical curve leads to a 1.18% slope into the trench, beginning at elevation 29.36 ft. At the bottom of the 1.18% slope a 1,100-foot sag vertical curve flattens out to a positive 0.17% in the bottom of the trench. A low-point in the track profile occurs at elevation 13.64, roughly 500 feet north of Tamarack Avenue.

A local high point occurs just south of Chestnut Avenue where the 0.17% slope transitions to a -0.06% slope over a 300-foot crest vertical curve. The track profile continues down at -0.06% to a second low point at elevation 14.68 ft. A 400-foot sag vertical curve is located between Carlsbad Village Drive and Grand Avenue. The profile continues at 0.39% through the platform area up to an elevation of 21.81 ft. at the Carlsbad Boulevard Overpass. A 500-foot vertical curve transitions to a -0.17% grade that continues across the Buena Vista Lagoon Bridge. The top of rail elevation of 19.7 ft. at the north end of the bridge provides adequate clearance from the 100-year water surface elevation of 12.7 ft. The proposed track profile would be roughly 5 feet higher than the existing track across the lagoon. An 1,150-foot vertical curve rises from the bridge to a grade of 1.27%, then an 1100-foot vertical curve ends at -0.06%. The tracks would tie in to existing on the south side of the Cassidy Street at-grade crossing.

<u>Trench Structure</u>

The trench structure for the Long Trench Alternative would be identical to that of the Short Trench Alternative. Secant pile walls with an invert slab and concrete seal course are proposed.

<u>Railroad Crossings</u>

Overpass structures accommodating vehicles, bicycles, and pedestrians would be constructed at Tamarack Avenue, Oak Avenue, Carlsbad Village Drive, and Grand Avenue. A bicycle and pedestrian only overpass structure would be constructed near Beech Avenue within the station area. At Chestnut Avenue the crossing could either accommodate vehicles, bicycles, and pedestrians or only bicycles and pedestrians only. This will be determined in the next phase of the project should the Long Trench Alternative be carried forward.

The existing Carlsbad Boulevard Overpass would be replaced with a new three-span bridge of similar width, 170-feet long, with a center span clearing both railroad tracks. The existing bridge center span columns would restrict lowering the track profile at the beginning of the trench. Additionally, the temporary shoofly track alignment needs to skew in this location to pass to the side of the trench.

The following table summarizes the railroad crossings proposed for the Long Trench Alternative.

Table 4.5: Summary of Railroad Crossings for the Long Trench Alternative

Crossing	Type of Crossing	Allowable Uses
Tamarack Avenue	Overpass	Vehicular, Bicycle, Pedestrian
Chestnut Avenue	Overpass	Vehicular*, Bicycle, Pedestrian
Oak Avenue	Overpass	Vehicular, Bicycle, Pedestrian
Carlsbad Village Drive	Overpass	Vehicular, Bicycle, Pedestrian
Grand Avenue	Overpass	Vehicular, Bicycle, Pedestrian
Beech Avenue	Overpass	Bicycle, Pedestrian
Carlsbad Boulevard	Overpass (Replace)	Vehicular, Bicycle, Pedestrian

***Chestnut Avenue Crossing may or may not include a vehicle crossing.**

4.4. Alternative Ranking

At a second workshop the PDT worked as a group to assign scores from 1 through 10 to each alternative for all the evaluation criteria. A higher numbered score means that the alternative would provide the most benefit or least impact for that criterion. The PDT reviewed the issues associated with each criterion and discussed their opinions on how they should be scored. As a group a consensus score was reached by the PDT for each criterion. The table below is a summary of the scoring.

Table 4.6: Alternative Evaluation Results

Alternatives	Minimize Impacts to Rail Operations	Minimize Environmental Impacts	Maximize Community Acceptance	Improve Local Circulation/ Emergency Response	Maximize Economic Benefit	Minimize Construction Impacts	Total Weighted Score
Weight	6.7%	13.3%	26.7%	33.3%	13.3%	6.7%	
Short Trench Raw Score	**7**	**7**	**8**	**6**	**9**	**6**	
Weighted Score	46.9	93.1	213.6	199.8	119.7	40.2	**713**
Long Trench Raw Score	**10**	**7**	**9**	**10**	**10**	**4**	
Weighted Score	67	93.1	240.3	333	133	26.8	**893**

After adding the weighted scores for each alternative, the PDT determined that the Long Trench Alternative had the highest score.

5. ENVIRONMENTAL COMPLIANCE

The white paper prepared in January 2020 by BRG Consulting, Inc. (See Attachment C) provided the following environmental recommendations for the project development:

For NEPA Compliance, assuming federal action is associated with the project, SANDAG should request FRA rely on a Categorical Exclusion (CE) from NEPA (23 CFR Part 771.116 (c) (12)) supported by technical reports to document that no impacts are significant with project features to reduce impacts. In the event FRA does not agree the project falls under a CE, an Environmental Assessment / Finding of No Significant Impact (EA/FONSI) would have to be prepared.

For CEQA Compliance, BRG recommends the project is likely eligible under the Statutory Exemption at Public Resources Code Section 21080.13, Railroad Grade Separation Projects.

The following technical reports are recommended to be updated or prepared for the Project in support of the environmental process (See Table 5.1). Reports listed as "Update" are reports that were prepared for the earlier at-grade version of the Carlsbad Village Double Track project. These studies covered much of the same area and can be used with modifications to account for the new project features and project footprint.

Table 5.1: Status of Environmental Technical Studies

Study	Recommended Action
Community Impact Assessment	Update
Noise and Vibration Impact Assessment	Update
Section 4f Evaluation	Update
Preliminary Water Quality Technical Report	Update
Visual Impact Assessment	Update
Air Quality and GHG Impact Analysis	Update
Preliminary Drainage Report	Update
Land Use Technical Report	Update
Utility Impacts Report	Update
Biological Technical Report	Update
Cultural and Historical Resources Report	Update
Phase 1 Environmental Site Assessment	Update
Traffic Study	Prepare New Study

6. RIGHT-OF-WAY IMPACTS

The project area is tightly constrained by existing development adjacent to the existing railroad right-of-way (ROW). For most of the project limits the ROW is 200 feet wide. At Tamarack Avenue the ROW narrows to 100 feet for a short distance to the south then gradually widens back out approaching Agua Hedionda Lagoon.

In the Long Trench Alternative, the trench extends across Tamarack Avenue. The trench takes up roughly 60' of the 100-foot ROW in this narrow area. Roughly 20 feet of space is required on the west side of the trench in this area to allow for utilities and drainage facilities to pass alongside the trench. On the east side there is a 48-inch sewer, an 84-inch storm drain, a gas line, and a water line that must be relocated to avoid the proposed trench. In addition to these utilities the temporary shoofly track is proposed to follow the east side of the trench at a minimum distance of 25 feet. These utility relocations and the shoofly track require additional ROW. The preliminary design for the Long Trench Alternative would require three adjacent properties to be acquired for the project along the east side of the existing ROW. The Short Trench Alternative would not require an acquisition of property.

South of Carlsbad Village Drive, there are parking lots owned by the City on both sides of the tracks. These are each within the NCTD ROW under a lease agreement (from NCTD to the City). The proposed extension of Oak Avenue across the trench would permanently remove portions of each parking lot.

The Historic Train Depot is located within the NCTD ROW on the east side of the tracks between Grand Avenue and Carlsbad Village Drive. It is currently used by the Carlsbad Village Association as a visitor's center under a lease agreement to the City. In the same area there is public parking under the same lease agreement. The preliminary plan for the shoofly track would require temporary relocation of the Historic Train Depot and would temporarily impact the parking lot.

The Vine Church is located to the west of the tracks just south of Carlsbad Village Drive under a lease agreement with NCTD. It is expected that the existing church can be protected in place. Access will be required to the property during construction for either alternative.

A relocation plan and co-operative agreements should be initiated early in the final design phase of the project to allow time in the schedule. These items can take a year or more to execute.

7. UTILITY IMPACTS

Utility information was obtained from AT&T, Carlsbad Municipal Water District (CMWD), City of Carlsbad, City of Oceanside, Cox Communication, Crown Castle International, Southern California Gas Co., San Diego Gas and Electric (SDG&E), Charter/Spectrum, and Verizon. Letters were sent to each utility owner requesting electronic media or hard copies of record as-built drawings. The Utility Matrix in Attachment D provides a summary of the potentially impacted utilities.

AT&T Transmission, Crown Castle International, and City of Oceanside Traffic Signals provided response letters stating that they have no active facilities within the project vicinity. The remaining utility companies provided mapping of their facilities in the area (the City of Carlsbad and Carlsbad Municipal Water District provide access to as-built drawings online through its HP Records Manager. As-built research in the City of Oceanside was completed at the City Engineering Counter).

Existing utilities in the project area were mapped based on the provided as-built drawings, aerial topography, aerial photos, site visits, and survey data. The existing utilities mapped were overlaid onto the proposed design and all mapped impacts were noted.

It is anticipated that all water lines, gas lines, underground electrical, and communication lines crossing the trench can be relocated to either be attached to the proposed overpass bridges or placed on separate utility structures. Where gravity sewer lines cross the trench, the system would be modified to flow parallel the trench to a point where the track profile is high enough for the sewer to pass under while maintaining the proper slope and clearances.

An existing 48-inch sewer trunk line exists along the east side of the existing tracks. The pipe has approximately 16 feet of cover. The Long Trench Alternative would require relocation of the sewer line. This occurs near Tamarack Avenue where the ROW narrows to 100 feet. The current location is roughly 13 feet east of existing Main Track 1 (MT1) track centerline and would conflict with the trench.

There is a Verizon fiber optic duct bank that runs parallel to, and near the existing tracks which will require relocation. This duct bank contains four 2-inch conduits that are shared by Verizon and NCTD. See Section 11 on Railroad Systems for more information on the NCTD fiber optic lines. This relocation would occur through the trench and at the Buena Vista Lagoon crossing where the line would be relocated from the existing bridge to the new bridge.

A 12-inch gas line owned by SDG&E parallels the tracks within the right-of-way. Between Carlsbad Boulevard and the proposed station, the gas line would need to be relocated. This should be completed prior to construction of the trench.

In future design of the project the PDT may consider advancing the relocation of parallel utilities such as the 12-inch gas line, 48-inch sewer line, and 84-inch storm drain. This would help expedite the construction schedule and avoid multiple contractors working at the site.

Relocation of some utilities may require temporary high lining or temporary relocations while the permanent installations are constructed. These can require additional utility easements or license agreements from NCTD or the City.

8. GROUNDWATER IMPACTS

Investigation

A groundwater investigation was conducted by Kleinfelder to assess the impact that construction of the trench may have on the groundwater in the area (See Attachment E). Three new groundwater monitoring wells were installed: MW-1 was located in the cul-de-sac at the north end of the Carlsbad Village Station parking lot, MW-2 was located at the end of Juniper Avenue just west of the NCTD right-of-way, and MW-3 was located at the end of Chinquapin Avenue just east of the NCTD right-of-way. One existing groundwater monitoring well, which was installed earlier by another consultant, was also used and was identified as MW-4. Soil samples were collected during installation of the three new wells and were analyzed for grain size distribution at five-foot depth intervals. Soil samples were collected in the saturated zone for laboratory analysis of hydraulic conductivity.

Aquifer testing, consisting of slug testing, was performed on the monitoring wells. Slug testing provides an estimate of hydraulic conductivity for a small volume of in-situ material near the well. Evaluation of hydraulic conductivity representative of a larger volume or area may warrant additional long-term aquifer pumping tests. After testing was complete MW-1, MW-2, and MW-3 were decommissioned by over drilling and pressure grouting to the surface.

Wastewater from the aquifer testing was analyzed for hazardous materials prior to disposal. All samples tested were non-hazardous.

Numerical Modelling

Next, a simplified numerical groundwater flow model was developed. The model grid was developed over approximately 2.25 square miles of area surrounding the project site. The site was represented by five layers to provide future flexibility in the model if needed. Layers 1 through 4 represented the site quaternary soil and Layer 5 represented the bedrock (Santiago Formation).

The ocean and the two water bodies on the northwest (Buena Vista Lagoon) and southeast (Agua Hedionda Lagoon) were assigned as a constant head boundary with the value set at mean sea level. Spatially and temporally, insufficient groundwater data are available from monitoring wells upgradient of the site to determine a head boundary condition. The northeast boundary conditions were estimated to reflect the observed groundwater levels at the site. The selection of the head boundary conditions for the numerical model involved considerable simplification of the actual hydrogeologic conditions.

Hydraulic conductivities were assigned based on slug tests conducted at the site and hydraulic conductivities calculated using grain size distribution. Values for storage parameters and effective porosity were adapted from the literature for similar types of soils. The distribution of hydraulic parameters, outside of the trench wall and its vicinity, were assumed to be constant throughout the model domain in each layer.

Groundwater elevations from October 2019 (MW1 through MW-4) were used as calibration targets for the groundwater flow model. In addition, groundwater elevation values obtained from the California Geotracker website were used for calibrating the model.

Once calibration was completed a uniform 50-foot-deep non-permeable trench wall along the project location was included in the numerical model to simulate its effect compared to the model without the wall.

Results of Numerical Modeling

The numerical model indicated a mounding effect along the upgradient side of the trench wall (east side of the trench). The potential groundwater mounding along the upgradient side of the proposed trench wall ranged from approximately 0.2 foot to approximately 4 feet at various locations along the trench. The groundwater level along the trench varies in depth. The shallowest groundwater level observed during well installation was 17 feet below the surface. Four feet of mounding could result in the groundwater level at less than 13 feet below the surface.

To evaluate and assess the flow path and behavior at the trench wall, forward particle tracking simulations were performed. Particles were released at the water table in Layer 1 upgradient of the trench wall. The particle tracking simulations without the trench wall indicate that the overall pathways of groundwater flow are from the northeast to the southwest with uniform hydraulic gradient across the proposed trench wall. When the trench is included the particles originating upgradient of the trench were deflected by the wall and forced to flow under and/or around the wall.

The model simulates steady state conditions, water level mounding in the short term may differ from steady state modeling results. The model is a simplified version of very complex real-world conditions. The modeling results present an optimal solution of potential future conditions with the available data. Improvements in precision of modeling results may be obtained with additional field data such as water levels from additional wells, long term monitoring of water levels, hydraulic testing at additional locations. It is recommended that additional groundwater testing and modeling be completed in the environmental phase of the project to gain a higher level of confidence in the amount of rise in groundwater due to the trench.

9. HYDROLOGY AND HYDRAULICS

Buena Vista Lagoon Bridge Hydraulics

The profile elevation and preliminary design of the Buena Vista Lagoon Bridge was developed based on the Fluvial Hydraulic Analysis Report prepared by Everest International Consultants, Inc., dated February 2014. This report was prepared during the 30% design for the at-grade version of the Carlsbad Village Double Track project.

A two-dimensional numerical model, TUFLOW, was used to conduct the fluvial and tidal hydraulic analysis. Scour analysis was completed using the guidance provided in HEC-18. The analysis included an evaluation of flood conditions under existing sea levels as well as predicted future sea levels. Three sea level conditions were considered for the analysis: Year 2015, Year 2050, and Year 2100. The year 2015 was selected to represent the mean sea level condition during the expected time of construction. The high end of the mean sea level range projections for Year 2050 and Year 2100 identified in the March 2013 sea level rise guidance developed by the Coastal and Ocean Working Group of the California Climate Action Team (CO-CAT) were selected for consideration of sea level rise.

The 2018 Update of the State of California Sea-Level Rise Guidance contains the most recent update of the CO-CAT data. The La Jolla Tide Gauge is the nearest data point provided in the guidance document. The sea-level rise projection for 2050 is 2.0 feet for a Medium - High Risk Aversion (0.5% probability), and for 2100 the projected sea-level rise is 5.8 feet for a Medium - High Risk Aversion (0.5% probability) under a low emissions scenario. Based on the uncertainty inherent in hydrology and hydraulic analysis this is considered within an acceptable tolerance to the sea-level rise used in the 2014 report for 2100 of 5.5 feet.

Additionally, there is a separate Buena Vista Lagoon Enhancement Project (BVLEP) planned that may modify Buena Vista Lagoon. One of the alternatives for the BVLEP would return the lagoon to salt water condition by removing the existing weir at the mouth of the lagoon and allowing sea water to freely flow in and out of the lagoon. The hydraulic study showed the highest 100-year water surface elevation with the existing condition of the lagoon. This water surface elevation was used for setting the track profile across the bridge. The saltwater condition was used when evaluating the scour for the bridge because that scenario had the deepest scour potential.

The 2014 hydraulic report concluded that if the railroad bridge were designed for a maximum water elevation of 12.7 ft, National Geodetic Vertical Datum of 1929 (NGVD29) then the bridge should be sufficiently high to avoid flood risks associated with the 100-year storm event occurring coincident with a mean higher high water in the year 2100 with a projected increase in mean sea level of 5.5'. This should also be sufficiently high to accommodate the additional risk with flow changes attributed to the currently anticipated future improvements to the I-5 Bridge and Coast Highway. The bridge was designed to accommodate 1' of freeboard per FRA standards.

Onsite and Offsite Hydrology

The Preliminary Drainage Report included in Attachment F delineates the onsite and offsite drainage basins affected by the improvements and compares existing and proposed hydrologic conditions.

The project area drains into two major water bodies, Buena Vista Lagoon and Agua Hedionda Lagoon. In general, the ridgeline between the two watersheds is at Carlsbad Village Drive. The existing alignment of the tracks is in a local valley which collects runoff from a significant amount of off-site run-on from both sides of the track. The off-site areas fully developed and are from predominantly residential and commercial land uses. In some areas, drainage is collected into a storm drain system that runs parallel to the tracks, whereas in many other locations, there are earthen drainage channels parallel to the tracks conveying runoff into either lagoon.

A portion of the project north of Buena Vista Lagoon is in the City of Oceanside. This area of the right-of-way drains south toward Buena Vista Lagoon. Two shallow earthen channels, parallel to the tracks on each side convey runoff to the lagoon. These channels will be re-aligned with both the Long Trench Alternative and the Short Trench Alternative to follow the new alignment of the tracks.

In the area between Carlsbad Village Drive and Buena Vista Lagoon drainage from the east of the tracks is collected in a 66-inch storm drain east of the station parking lot. The storm drain leads to an outfall into Buena Vista Lagoon east of Carlsbad Boulevard. Drainage from west of the tracks flows into an earthen drainage channel located west of the tracks that conveys runoff north to Buena Vista Lagoon.

The area south of Carlsbad Village Drive discharges into Agua Hedionda Lagoon to the south. Similar to the other major watershed, there is a mainline storm drain system located on the west side of the tracks and earthen channels located along the west side of the tracks conveying flows; however, there are several lateral storm drain systems on the west side of the tracks which tie into the mainline storm drain to the east. This mainline storm drain system, the Santa Fe Storm Drain, is an 84-inch reinforced concrete pipe (RCP) which flows in a southerly direction and discharges into Agua Hedionda Lagoon. In all, there are four (4) lateral storm drain systems which cross the tracks from west to east at Oak Avenue, Chestnut Avenue, Acacia Avenue, and Tamarack Avenue and connect into an 84-inch RCP mainline system. On the east side of the tracks, the drainage areas immediately adjacent to the tracks are analyzed as part of this project at key outlet point connections to the 84-inch RCP.

In both the Short Trench and Long Trench Alternatives, the overall drainage characteristics are the same as the Existing Condition for the areas east of the proposed trench and for all areas within the City of Oceanside. Since the entire length of the proposed trench is within the City of Carlsbad for both the Short and Long Trench Alternatives, the trench just slightly reduces the amount of drainage area for areas east of the track. There are no other significant changes in these areas because the drainage will continue to connect to the existing mainline storm drain systems—66-inch RCP flowing north to Buena Vista Lagoon and 84-inch RCP flowing south to Agua Hedionda Lagoon.

Since the mainline storm drains are located on the east side of the tracks, there are much greater impacts to the drainage flow path on the west side of the tracks since it is no longer feasible to connect storm drains from west to east at several street crossings. In the Short Trench Alternative, this eliminates the existing storm drain crossings at Oak Avenue, Chestnut Avenue, and Acacia Avenue and contains the runoff to the west of the tracks and the first connection that's feasible is at Tamarack Avenue. In the Long Trench Alternative, all four existing storm drain crossings are impacted, thus all drainage from approximately Chestnut Avenue and south the Agua Hedionga Lagoon are restricted to the west side of the tracks. A combination of an open channel transitioning to a storm drain system is proposed to collect runoff from these drainage areas and to cross the tracks just south of the trench to connect to the existing 84-inch RCP.

In both alternatives, the drainage west of the tracks, north of approximately Chestnut Avenue, are also restricted to the west; thus, a trackside channel to storm drain system design is proposed to bring the runoff all the way north to outfall directly into Buena Vista Lagoon. Given the large peak flow rate and restriction, the Carlsbad Boulevard bridge overpass, an underground storm drain solution was determined to be more feasible.

The proposed trench corridor would be located deep within the groundwater table; therefore, the runoff must be collected and pumped to the surface to discharge into surface-based drainage conveyance systems. Proposed pump stations are located on the west side of the tracks since the temporary shoofly tracks are located on the east side and the pump stations would be in conflict. In the Short Trench Alternative, only one sump is proposed just north of Carlsbad Village Station. In the Long Trench Alternative, a second sump is proposed just south of Hemlock Avenue.

During the earlier feasibility study drainage other alternatives for draining the trench were analyzed. A bored storm drain from the trench to either the lagoon or the ocean was considered. It was determined not feasible because the elevation of the trench would be too close to the water level in the lagoon or ocean. This would not allow enough slope on the pipe and would create a risk of water backflowing into the trench during extreme flooding or high tides. Additionally, any penetration through the floor of the trench would be difficult to waterproof and would become a constant maintenance issue.

10. WATER QUALITY

The Preliminary Water Quality Technical Report (WQTR) included in Attachment G has evaluated and addressed potential pollutants associated with the Project and its effects on water quality. The project is located within NCTD right-of-way. NCTD is designated as a non-traditional permittee under the Phase II Small MS4 statewide general storm water permit. Post-construction permanent storm water BMPs are required per the Phase II Small MS4 permit and the NCTD Storm Water Management Plan.

The project would create over 5,000 square feet of impervious surface and is considered a Regulated Project according to the NCTD Storm Water Management Plan. Regulated Projects are required to implement measures for site design, source control, runoff reduction, storm water treatment, and baseline hydromodification management.

The receiving waters for the project are Buena Vista Lagoon to the north and Agua Hedionda Lagoon to the south. Buena Vista Lagoon is 303(d) listed for Indicator Bacteria, Nutrients, Sedimentation/Siltation, and Toxicity. Agua Hedionda Lagoon is 303(d) listed for Toxicity.

<u>Trench Runoff</u>

The proposed impervious areas are located within the redeveloped train station and throughout the proposed limits of the trench. The remainder of the project is located within pervious areas and therefore is not subject to the water quality treatment requirements.

For each of the two trench alternatives rainfall captured within the trench would be directed into sumps and collected in a wet well where pumps would discharge the water to the storm drain system outside the trench. Low flows would be diverted into BMPs located at the surface level after being pumped to the surface. Compact biofiltration BMPs, such as Modular Wetland Systems, are proposed for treatment of the trench runoff. These compact BMPs are comprised of a pretreatment filter system which first filters out sediment, trash, and debris before flow enters a second chamber for filtering through the high rate filtration median. The preliminary design for the Long Trench would include two low points within the trench that would each have an associated storm drain pump station. The Short Trench would only have one low point and pump station.

Station Runoff

In addition to treatment of the trench area the station parking lot area would also require treatment. The entire parking lot would be reconfigured during the project. As a result, permanent BMPs would be included in the final parking lot design. The proposed concept for treatment would construct more traditional biofiltration BMPs with the planter areas of the parking lot. Runoff from the parking lot would be directed into the planters.

Drainage from the proposed improvements to the existing train station are subject to the State Trash Amendment requirements since the train station is classified as a transportation center; one of the five Priority Land Uses (PLUs) for high trash generation. The project aimed to address trash capture requirements for drainage areas at the existing station to help NCTD meet their implementation goals set forth in the State Trash Amendment.

Regional BMP Opportunities

The Long Trench Alternative requires acquisition of three parcels located near Tamarack Avenue, where the existing ROW narrows. The acquisition of this land presents an opportunity to incorporate a regional, multi-benefit storm water basin for serving a range of potential purposes, such as water quality treatment, Trash Amendment compliance, and flood control detention. Additionally, the land could serve as a pocket park which would serve as a community amenity.

Since the proposed Long Trench Alternative requires the relocation of the 84-inch storm drain on the east side of the tracks, there is an opportunity to install an offline full trash capture BMP to comply with the Trash Amendment requirements. The cost of a regional BMP is not included in the cost estimates provided with this study.

11. RAILROAD SYSTEMS

Existing Train Control Systems

Train movements through the project limits are currently managed by a Centralized Traffic Control (CTC) system from NCTD Rail Operations Center (ROC) facility located in Escondido, CA. At Control Points the CTC route selection and wayside apparatus status is transported via a wireless Advanced Train Control System (ATCS) which is interfaced with wayside microprocessor-based controllers. Automatic (or Intermediate) Signal locations are utilized between Control Points to segment long distances into signal blocks that allow for safe passenger and freight braking while increasing operating capacity of the railroad. Solid-state coded track circuits are utilized to detect train occupancy in these signal blocks and to transport signal system data between locations.

Fiber optic cabling owned by NCTD (24F/72F) and Verizon (44F/96F) are present and in-service throughout the project limits. These fiber cables are installed within four (4) two (2) inch HDPE conduits that run on the ocean side and adjacent to the existing track alignment through the project limits, except at Carlsbad Village Station where the fiber runs on the inland side of the track and through the station parking lot in order to interface with the existing Communications Shelter. The NCTD 24-strand fiber optic cable is used to backhaul critical Positive Train Control (PTC) information from field locations back to the ROC, which then uses the same 24-strand fiber cable and 220 MHz radio frequency to push PTC messages from various locations along the right-of-way to train equipment. The NCTD 72-strand fiber optic cable is used to backhaul data related to Information Technology (IT) and security purposes. Both NCTD cables, along with the Verizon cables, are in-service and need to be maintained throughout the duration of construction activities.

Existing Grade Crossing Warning Systems

Grade crossing warning systems currently in-service within the limits of the project are facilitated by microprocessor-based train motion detection equipment in conjunction with solid-state crossing control units and California compliant grade crossing warning devices. The motion detection equipment establishes a grade crossing approach circuit, several thousand feet along the track in both directions, in order to detect motion and determine the speed of a train as it nears the grade crossing. Once the motion detection equipment has determined that the train will enter the grade crossing within a pre-determined amount of time (typically about 30 seconds), a signal is sent to the solid-state crossing controller which controls the activation of the warning device lights and bells, with a subsequent delayed lowering of the barrier gate arm. Once the train has completed movement through the grade crossing, all equipment returns to a default state and the warning system is deactivated.

<u>Summary of Rail Systems Constraints</u>

Passenger and freight train operations on the San Diego Subdivision must be maintained throughout the duration of constructing temporary shoofly and final double track alignments. Existing and proposed rail systems, while able to be temporarily modified to support construction activities, must remain active throughout all phases of construction except during scheduled work window outages. Shifting from the current at-grade track alignment to the temporary shoofly alignment, then from the temporary shoofly alignment into the double track trench alignment will require a great deal of coordination during the design process and subsequently into construction activities. This coordination will be required for train control systems (wayside signal and fiber communications) as well as grade crossing warning systems.

The existing fiber cable duct bank currently resides in direct conflict with the railroad trench proposed for both the short trench and long trench alternatives. Prior to excavating the railroad trench, this fiber duct bank will need to be relocated and protected outside of this conflict. The method for relocating and securing the fiber duct bank should be coordinated and documented during the design process to facilitate construction and coordination activities with Verizon. Failure to adequately coordinate the fiber duct bank relocation prior to construction will place the project at risk for delays during construction.

Throughout the duration of construction activities, any PTC Critical features that are removed, relocated or installed will need to be closely coordinated with the NCTD Change Control Board (CCB) and their PTC Maintenance Contractor. This coordination requires the identification of proposed changes to wayside signals, switches, track alignments, crossing edges, milepost signs, speed signs and networking components well in advance of the work window in which the changes will take place. The NCTD CCB requires that a PTC Change Request (CR) submittal be delivered a minimum of ninety (90) days prior to the approved work window. The PTC CR typically is comprised of a 1) written narrative of the changes to take place on the approved PTC Change Request form, 2) a PTC Critical Assets diagram illustrating proposed changes, 3) a matrix of all PTC Critical Assets along with a designation for removal or installation, dates of removal or installation/in-service, and geographic location information for all PTC Critical Assets and a 4) a Train Management Dispatch System (TMDS) diagram for proposed changes to the dispatch system. It is critical that the project have clearly identified phasing to facilitate the complete development and coordination of PTC systems. Failure to adequately coordinate PTC Systems will place the project at risk for delays during construction.

The installation of the temporary shoofly track will require a phased relocation of warning devices at all three (3) vehicular at-grade crossings within the project limits. During construction, it is assumed that the Contractor will pre-install track and crossing panels through Grand Avenue, Carlsbad Village Drive and Tamarack Avenue to accommodate the temporary shoofly track alignment. Upon the installation of the track and crossing panels, the associated warning devices will have to be relocated to encompass the entire at-grade crossing, even though there will be no trains operating on the temporary shoofly at the time. This may affect the calculated warning time at each of these crossings, as the increased time for a vehicle to traverse the at-grade crossing may require an increase to the warning time provided by the warning system. An increase in warning time at these at-grade crossings will require calibration and full in-service testing of the crossing warning detections circuits and warning times. Subsequently, when the temporary shoofly track is placed into revenue service, a recalibration and another full in-service test will be required as the crossing approach detection circuits will be removed from the main line and placed onto the shoofly track. In-service testing of the grade crossing warning systems will require the observation of a minimum of twelve (12) train moves at Grand Avenue and Carlsbad Village Drive, and sixteen (16) train moves at Tamarack Avenue. Recently, NCTD has required that test trains be used to facilitate this testing during work windows in order to not impact revenue train service. These issues should be coordinated at the design level in order to maximize the Contractor's ability to perform the work while minimizing redundancy for required testing. Failure to adequately coordinate grade crossing panel installations and warning device relocations will increase the complexity and cost to construct this project.

Project Specific Modifications for the Short Trench Alternative

Under the short trench alternative, the project proposes to install two Control Points to facilitate access to the temporary shoofly track. On the north end of the short trench, between Buena Vista Lagoon bridge and Carlsbad Boulevard overpass, a new #24 turnout will be installed. This switch will be signalized, and absolute control signals will be installed to control access through this Control Point Laguna MP 228.8. On the south end of the short trench, just south of the existing Tamarack Avenue at-grade crossing, a new #24 turnout will be installed. This switch will be signalized, and absolute control signals will be installed to control access through this Control Point Tamarack MP 230.1. Both temporary Control Points will require new signal shelters pre-wired with the necessary components to operate the signal system.

Prior to commencing construction activities on the temporary shoofly track, it will be imperative that existing fiber cabling within the proposed railroad trench/shoofly track limits be relocated to an above-ground configuration, outside of conflict with all proposed improvements. At the north and south end, in the areas where the new turnouts will be installed, large concrete vaults can be used as an interception point for both

NCTD and Verizon fiber duct bank and associated fiber optic cables. Between these two vault locations, a series of poles may be used to secure the fiber cables above ground level. Challenges associated with this method of temporarily relocating the fiber duct bank include maintaining the existing fiber connections to the Communications Shelter at Carlsbad Village Station and installing a new connection to the new signal house proposed at MP 229.3.

Prior to placing the temporary shoofly track into operation, the Communications Shelter at Carlsbad Village Station needs to be relocated and new warning devices will need to be installed at Grand Avenue, Carlsbad Village Drive and Tamarack Avenue to provide warning for the temporary track alignment. Initially, upon placing new grade crossing panels and track through the temporary at-grade crossing, new warning devices will be commissioned to cover both the temporary shoofly track and the existing main track(s). New warning devices will be staged in such a way that facilitates a quick changeover. The calculated vehicle clear-out time is anticipated to increase by approximately five (5) to six (6) seconds due to the wide crossing, and the crossing approach train detection circuits will be extended and commissioned to account for this change to the warning system.

In order to eliminate delays to trains leaving the temporary platform at Carlsbad Village Station, wayside signals need to be visible as the train departs the station. For westbound trains, the westbound control signal at CP Laguna is sufficient to provide signal preview leaving the temporary platform. For eastbound trains, a new signal house at MP 229.30 and a temporary wayside signal 2292 will be required just south of Carlsbad Village Drive. While the wayside signal is temporary to provide a signal for the temporary shoofly track, the new signal house will be permanent and serve future signals located in the trench in this area.

The commissioning of the temporary shoofly track will effectively place in-service CP Laguna, 2292 Signal, CP Tamarack, and necessary modifications to the existing at-grade crossing warning systems at Grand Avenue, Carlsbad Village Drive and Tamarack Avenue. Existing CP Longboard MP 228.4, Pedestrian Crossing at Carlsbad Village Station MP 229.15 and CP Carl MP 229.4 will be retired from service.

Following the commissioning of train control and grade crossing warning systems for the temporary shoofly track, the existing crossing houses at Grand Avenue, Carlsbad Village Drive and Tamarack Avenue will have to be relocated to the east to eliminate conflict with the proposed short trench and track alignment. This work can be performed without affecting the in-service warning systems. Also, upon removal of the retired grade crossing panels at Grand Avenue and Carlsbad Village Drive, associated warning devices will need to be relocated to fifteen (15) feet from the centerline of the temporary shoofly track. No modifications to crossing approach train detection circuits will be proposed at this time.

Prior to completion of the railroad trench, preparations for the final signal system configuration will commence. This includes the installation of a new signal house at Cassidy Street MP 228.00 along with new back-to-back intermediate signals for both main tracks, and modification to the CP Tamarack house anticipating changeover from a control point to a back-to-back intermediate signal location. New westbound only intermediate signals MP 228.8 can be pre-installed between the north end of the new platforms and south of Carlsbad Boulevard overpass to be controlled out of the CP Laguna signal house, and eastbound only intermediate signals can be pre-installed near the Carlsbad Village Drive overpass MP 229.30 to be controlled out signal house MP 229.31.

Additionally, provisions along the railroad trench to provide long-term security of NCTD and Verizon fiber cables will be installed. Prior to rerouting train traffic into the railroad trench, the fiber that was temporarily suspended on poles will be permanently relocated into a duct bank that is installed along the new trench alignment.

The commissioning of the double track alignment through the railroad trench will effectively retire CP Laguna, CP Tamarack, grade crossing warning systems at Grand Avenue and Carlsbad Village Drive, and place in-service new bi-directional double track intermediate signals at MP 228.0, new westbound only double track intermediate signals at MP 228.8, new eastbound only double track intermediate signals at MP 229.31 and new bi-directional double track intermediate signals at MP 230.1.

<u>Project Specific Modifications for the Long Trench Alternative</u>

The long trench alternative is nearly identical to the short trench alternative, with the major exception being that Tamarack Avenue will be grade separated with the trench continuing approximately 1,400' south of the grade crossing. The temporary #24 turnout on the south end of the project will be located between the Agua Hedionda Lagoon Bridge and the SDG&E Private Crossing, near the Encina Power Station. This switch will be signalized, and absolute control signals will be installed to control access through this Control Point Encina MP 230.9. This temporary control point will require new signal shelters pre-wired with the necessary components to operate the signal system.

The commissioning of the temporary shoofly track will effectively place in-service CP Laguna, 2292 Signal, CP Encina, and necessary modifications to the existing at-grade crossing warning systems at Grand Avenue, Carlsbad Village Drive and Tamarack Avenue. Existing CP Longboard MP 228.4, Pedestrian Crossing at Carlsbad Village Station MP 229.15 and CP Carl MP 229.4 will be retired from service.

In the long trench alternative, the final location of the bi-directional double track intermediate signals near Tamarack Avenue in the short alternative move further south out of the railroad trench to MP 230.4. This installation will require a new signal house and wayside signal assemblies to be pre-installed prior to commissioning the railroad trench and final double track alignment.

The commissioning of the double track alignment through the railroad trench will effectively retire CP Laguna, CP Encina, grade crossing warning systems at Grand Avenue, Carlsbad Village Drive and Tamarack Avenue, and place in-service new bi-directional double track intermediate signals at MP 228.0, new westbound only double track intermediate signals at MP 228.8, new eastbound only double track intermediate signals at MP 229.31 and new bi-directional double track intermediate signals at MP 230.4.

12. CONSTRUCTION CONSIDERATIONS

Due to the ongoing operations through the LOSSAN corridor, project construction would require phasing to maintain operation of the tracks. Construction of the trench would require a temporary shoofly track and temporary station platform. The first phase of construction could include replacement of the Carlsbad Boulevard Overpass, construction of the new double track Buena Vista Lagoon Bridge, installation of a temporary No. 24 turnout on either end of the trench, and construction of a temporary shoofly track. The temporary station platform would be located within the existing station parking lot on the east side of the shoofly track. The second phase of construction could include construction of the trench, overpasses, two new tracks, COASTER station, and then removal of the shoofly track and temporary station.

Construction of the Buena Vista Lagoon Bridge would require a phased bridge construction. First the more easterly MT1 track bridge would be installed. Since the proposed bridge would be about five feet higher than the existing bridge temporary shoring would be required between the existing and proposed tracks on either end of the lagoon bridge. Once train traffic is cut-over to the MT1 bridge and shoofly track the westerly MT2 track bridge could be constructed.

Because of the construction of the shoofly track and temporary station platform there will be a temporary loss of parking. Approximately half of the existing parking lot at the station would be taken out during construction. This could necessitate the construction of additional parking on a vacant lot just north of the existing parking lot. To construct the temporary shoofly track parking would be temporarily removed adjacent to the Carlsbad Santa Fe Depot between Grand Avenue and Carlsbad Village Drive, and between Carlsbad Village Drive and Oak Avenue.

In addition to keeping railroads operating during construction, the on-street traffic must also be maintained. Construction on existing streets crossing the tracks should be planned to minimize disruptions. One possible solution includes the use of precast bridge elements to install bridges over one shorter duration road closure. Construction of the Oak Avenue Overpass first could provide relief during closures of Grand Avenue and Carlsbad Village Drive by maintaining two railroad crossings open at all times, which would be similar to the existing condition. The overpass at Carlsbad Boulevard could be replaced by constructing the bridge in phases, half at a time. This would allow the road to remain open during construction.

The construction of temporary at-grade crossings along the shoofly track would require California Public Utilities Commission (CPUC) GO 88-B authorization to modify an existing public crossing. A GO 88-B application would be required for the crossing at Carlsbad Boulevard, Grand Avenue, Carlsbad Village Drive, Tamarack Avenue, and the pedestrian crossing at the existing station. A Formal Application for a new public crossing would be required at Oak Avenue and at Chestnut Avenue, these would then require a GO 88-B authorization to modify them to grade separated at the end of construction.

The excavation of the trench would require removal of almost 400,000 cubic yards of earth for the Short Trench and over 600,000 cubic yards of earth for the Long Trench. The logistics of disposal need to be investigated during preliminary engineering of the project. An analysis of the soil should be conducted during the design phase to determine if the exported soil contains beach quality sand that could be used for beach replenishment. It is anticipated that the removal would be trucked offsite to an approved disposal location by the contractor. The most direct path for trucks removing materials would be along Tamarack Avenue to I-5 or Carlsbad Village Drive to I-5. The export of materials would take roughly eight to twelve months to complete. Additional truck traffic is expected due to the delivery of materials and equipment; however, the volume would be small compared to during export of soil.

13. PUBLIC INPUT

To gain public input about the proposed railroad trench alternatives, the City of Carlsbad organized various opportunities to engage the public and identify the community's values, priorities and questions. Public input consisted of one large public workshop, community group presentations and an online survey.

The City of Carlsbad, SANDAG and NCTD held a public input workshop on Nov. 20, 2019 to inform the community about the potential project and to seek input about the two proposed alternatives, the short trench and long trench options. Following a project overview from SANDAG project manager Linda Culp, questions were posed to the 100+ community members in attendance, organized in small groups for discussions to identify values, benefits and concerns about the two alternatives.

Presentations were also given to the following community groups:

- Carlsbad Chamber of Commerce Government Affairs Committee Meeting
- Army and Navy Academy board of directors
- Carlsbad Village Association/Village Voices
- Friends of the Barrio

The online survey provided an opportunity for members of the public to provide input at a time convenient to them. Topic areas identified at the public workshop helped inform the questions on the online survey. The survey was available in English and in Spanish.

Key themes that emerged from public input included:

- Trenching improves safety
- Reduces noise and pollution
- Improves accessibility
- Participants expressed support for the long trench option by a large margin, contingent on learning the sources of funding
- Preference to keep Chestnut pedestrian/bike only (several people listed the short trenching option as their preferred alternative solely due to this difference between the two concepts presented)

The full public input report is included in the Attachment I.

14. PROJECT SCHEDULE

The project schedule is dependent on securing funding, first for further preliminary design and environmental studies, known as PA&ED, then for final design (PS&E) and construction. Table 13.1 below provides an estimated schedule based on securing funding for PA&ED by the end of 2020. Construction is expected to last four years for the Long Trench and 3.5 years for the Short Trench.

Table 14.1: Estimated Project Schedule

Project Milestone	Milestone Target Date
Begin Environmental	3/2021
Circulate Draft Environmental Document	9/2022
PA & ED	3/2023
Begin PS&E	TBD
Ready to List	TBD
Award	TBD
Construction Complete	TBD

15. PROJECT FUNDING

Project funding sources for future phases of the project have not been identified. It is expected that funding would come from several public sources at the federal, state, and local levels.

16. PROJECT COST

The Opinion of Probable Costs included in Attachment H was established based on preliminary 10% design data and cost data from Caltrans, recent projects, drilling sub-contractors, field experts and engineers. The project costs shown are inclusive of all of the overpasses listed in this report. A contingency totaling 30% of the construction cost is added to each estimate to account for the preliminary nature of the design included with this report. Costs are escalated from 2020 dollars to 2026 dollars based on the TransNet Early Action Program Construction Cost Inflation Rates. (https://www.transnettrip.com/TrendsRisksIssues/Escalation.aspx).

At this preliminary 10% level of design, costs are shown as ranges. More specific cost estimates, based on the 10% design, may be found in Attachment H.

Short Trench

The total estimated cost of the Short Trench Alternative, which includes a 30% contingency, ranges between $245 million and $265 million in 2020 dollars, with a construction cost between $165 million and $185 million. That is roughly an 13% increase in cost over the estimated cost from the feasibility study completed in 2016 dollars. The escalated project cost in 2026 dollars is between $290 million and $310 million.

Long Trench

The total estimated cost of the Long Trench Alternative, which includes a 30% contingency, ranges between $375 million and $395 million in 2020 dollars, with a construction cost between $250 million and $270 million. That is roughly a 15% increase in cost over the estimated cost from the feasibility study completed in 2016 dollars. The escalated project cost in 2026 dollars is between $445 million and $465 million.

Potential Cost Savings with Change in Vertical Clearance Required

NCTD has indicated that the minimum vertical clearance may be changed to 24 feet with concurrence from BNSF Railway. The estimated change in costs due to the lower vertical clearance are shown in Table 15.1 below.

Table 16.1: Costs for 24-foot and 26-foot Vertical Clearance

	Long Trench		Short Trench	
	26-ft Vertical Clearance	24-ft Vertical Clearance	26-ft Vertical Clearance	24-ft Vertical Clearance
Construction Cost (in 2020$)	$250m-$270m	$234m-$254m	$165m-$185m	$156m-$176m
Construction Cost Change	N/A	-$16m	N/A	-$9m
Project Cost (in 2020$)	$375m-$395m	$352m-$372m	$245m-$265m	$232m-$252m
Project Cost Change	N/A	-$23m	N/A	-13m

17. FUTURE DESIGN CONSIDERATIONS

Throughout the development of preliminary plans and reports the PDT identified various items that should be considered or reviewed during future phases of the project. Table 17.1 below is a record of the notable issues.

Table 17.1: Future Design Considerations

Item No.	Description
1	Look into areas where the trench wall heights could be reduced to the design groundwater depth and add a slope above the wall. This may not be feasible in the station area due to proximity of Washington Street. Other areas would need to consider utility impacts.
2	Review all licenses and easement documents within NCTD right-of-way to determine costs that will be incurred by the project. This includes both utilities and other lease agreements between the NCTD and others for parking. Determine rights of utilities to be relocated.
3	Utility relocations along Washington Street should be looked at carefully during the next phase of the project. There may be additional relocations required there.
4	If the Long Trench Alternative is carried forward, additional survey is needed farther south to design the temporary turnout south of Agua Hedionda Lagoon.
5	Look into potential locations for disposal of exported soil during the environmental phase of the project. Determine if the soil export will contain beach quality sand.
6	Identify service laterals that may connect parallel utilities to individual properties and determine if these need to be replaced.
7	Study temporary and permanent impacts to bus stops on Washington Street. Look at potential ways to relocate during construction and final condition.
8	Review potential for adding temporary parking during construction.
9	Include laydown areas in environmental footprint.
10	Additional groundwater testing and modeling is recommended to increase the level of confidence in the amount of rise in groundwater levels due to the trench.

18. REFERENCES

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RailPros, Inc.

2011 *Project Study Report: Carlsbad Village Double Track Project*. August.

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T.Y.Lin International

2014 *Carlsbad Village Double Track Improvements Alternative Analysis Report*

2017 *Carlsbad Village Double Track - Railroad Trench Alternative Economic Analysis and Feasibility Study*. January.

19. PROJECT PERSONNEL

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ATTACHMENT A:

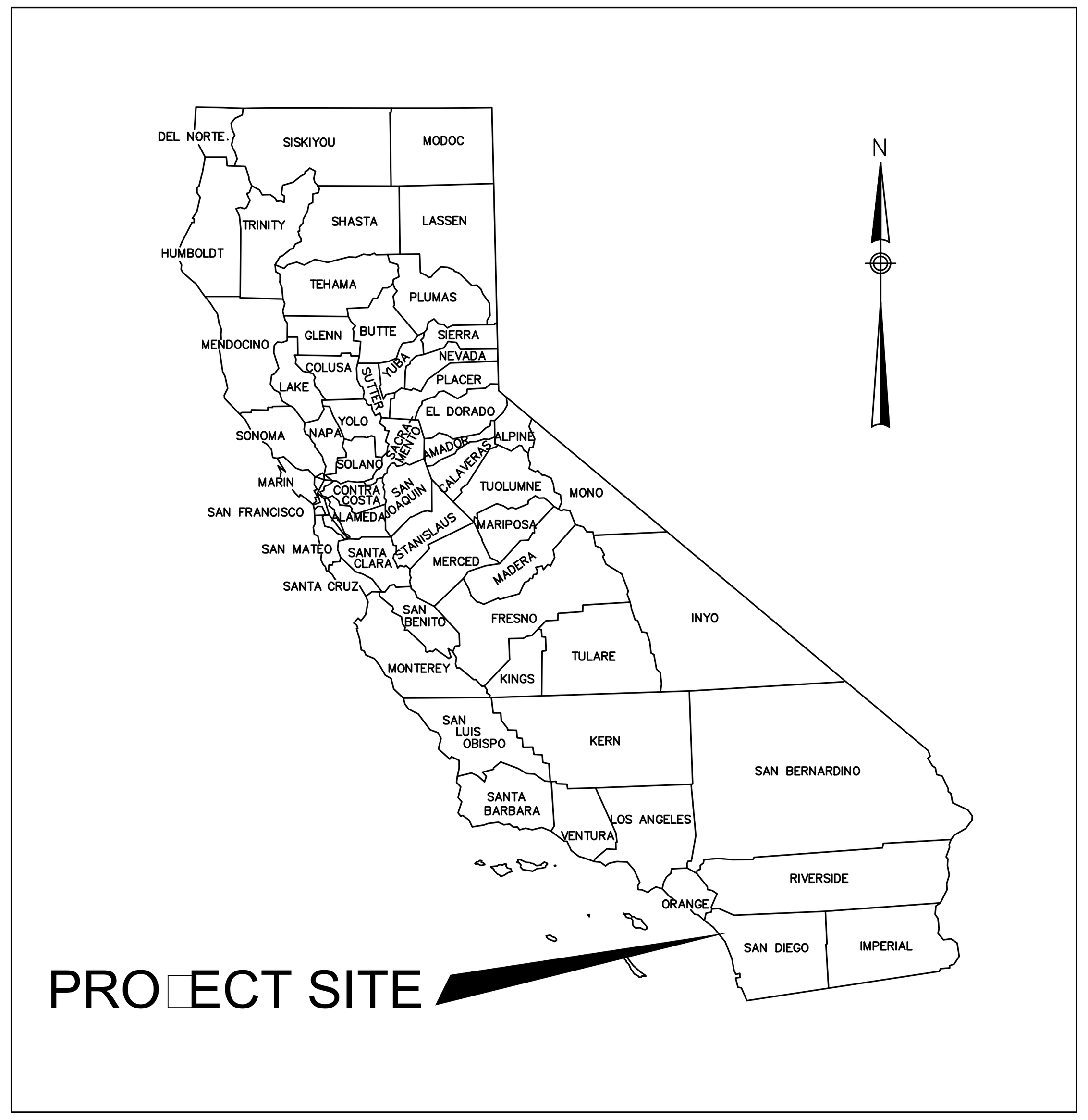
LOCATION MAP

CARLSBAD VILLAGE RAILROAD TRENCH
ALTERNATIVE ANALYSIS REPORT
LOCATION MAP

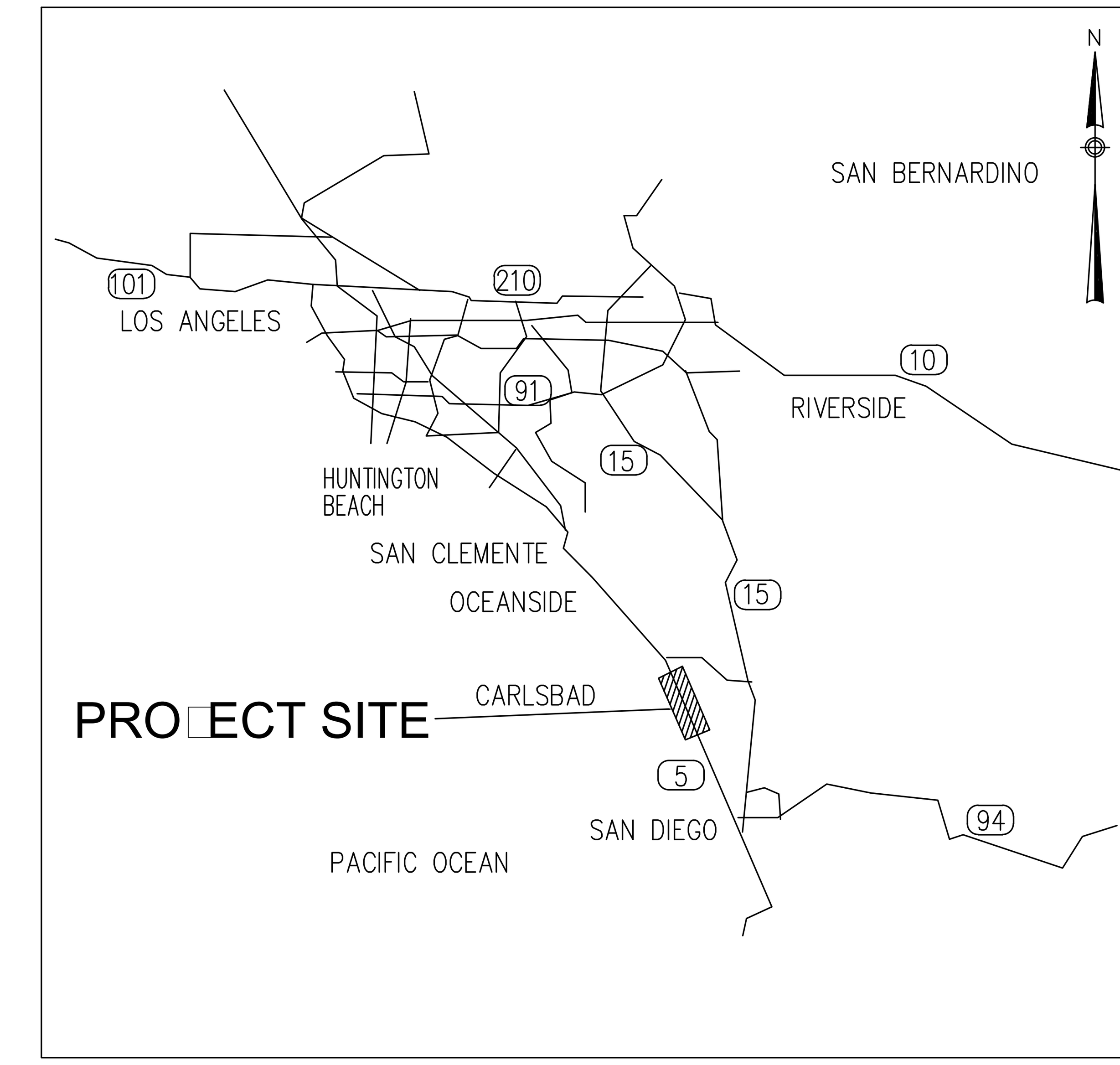
ATTACHMENT B:

10% DESIGN PLANS

10□ PRO□ECT PLANS FOR OF THE
CARLSBAD VILLAGE RAILROAD TRENCH
NCTD □COASTER ML
SAN DIEGO SUBDIVISION
MP 22□95 TO MP 231□00
SAN DIEGO ASSOCIATION OF GOVERNMENTS
10□ SUBMITTAL



LOCATION MAP



VICINITY MAP

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DRAWN BY	VE	10/19
CHECKED BY	MW	10/19
PRJ. ENG.	PB	10/19

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CARLSBAD VILLAGE RAILROAD TRENCH

TITLE SHEET

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CONTRACT NO.
DRAWING NO. G-01
SHEET NO. 1

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GENERAL		
1	G-01	TITLE SHEET
2	G-02	INDEX OF DRAWINGS
TRACK TYPICAL SECTIONS		
3	TS-01	TRACK TYPICAL SECTIONS
4	TS-02	TRACK TYPICAL SECTIONS
LONG TRENCH ALTERNATIVE		
5	TPP-01	TRACK PLAN & PROFILE 2415+00 TO 2390+00
6	TPP-02	TRACK PLAN & PROFILE 2390+00 TO 2365+00
7	TPP-03	TRACK PLAN & PROFILE 2365+00 TO 2340+00
8	TPP-04	TRACK PLAN & PROFILE 2340+00 TO 2315+00
9	TPP-05	TRACK PLAN & PROFILE 2315+00 TO 2290+00
10	TPP-06	TRACK PLAN & PROFILE 2290+00 TO 2265+00
11	TPP-07	TRACK PLAN & PROFILE 2265+00 TO 2246+00
12	TPP-08	SHOOFLY TRACK PLAN & PROFILE 2390+00 TO 2365+00
13	TPP-09	SHOOFLY TRACK PLAN & PROFILE 2365+00 TO 2340+00
14	TPP-10	SHOOFLY TRACK PLAN & PROFILE 2340+00 TO 2315+00
15	TPP-11	SHOOFLY TRACK PLAN & PROFILE 2315+00 TO 2290+00
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17	TPP-13	SHOOFLY TRACK PLAN & PROFILE 2265+00 TO 2246+00
18	U-01	EXISTING UTILITIES 2415+00 TO 2365+00
19	U-02	EXISTING UTILITIES 2365+00 TO 2315+00
20	U-03	EXISTING UTILITIES 2315+00 TO 2265+00
21	U-04	EXISTING UTILITIES 2365+00 TO 2246+00
22	PP-01	CONSTRUCTION STAGING
23	PP-02	CONSTRUCTION STAGING
SHORT TRENCH ALTERNATIVE		
24	TPP-14	TRACK PLAN & PROFILE 2415+00 TO 2390+00
25	TPP-15	TRACK PLAN & PROFILE 2390+00 TO 2365+00
26	TPP-16	TRACK PLAN & PROFILE 2365+00 TO 2340+00
27	TPP-17	TRACK PLAN & PROFILE 2340+00 TO 2315+00
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36	U-06	EXISTING UTILITIES 2365+00 TO 2315+00
37	U-07	EXISTING UTILITIES 2315+00 TO 2265+00
38	PP-03	CONSTRUCTION STAGING
39	PP-04	CONSTRUCTION STAGING
RAILROAD SYSTEMS		
40	SA-01	SHORT TRENCH TEMPORARY SHOOFLY TRACK (INTERIM CONDITION)
41	SA-02	SHORT TRENCH ALTERNATIVE DOUBLE TRACK (FINAL CONDITION)
42	SA-03	LONG TRENCH TEMPORARY SHOOFLY TRACK (INTERIM CONDITION)
43	SA-04	LONG TRENCH ALTERNATIVE DOUBLE TRACK (FINAL CONDITION)

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CARLSBAD VILLAGE RAILROAD TRENCH

INDEX SHEET

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SHEET NO. 2

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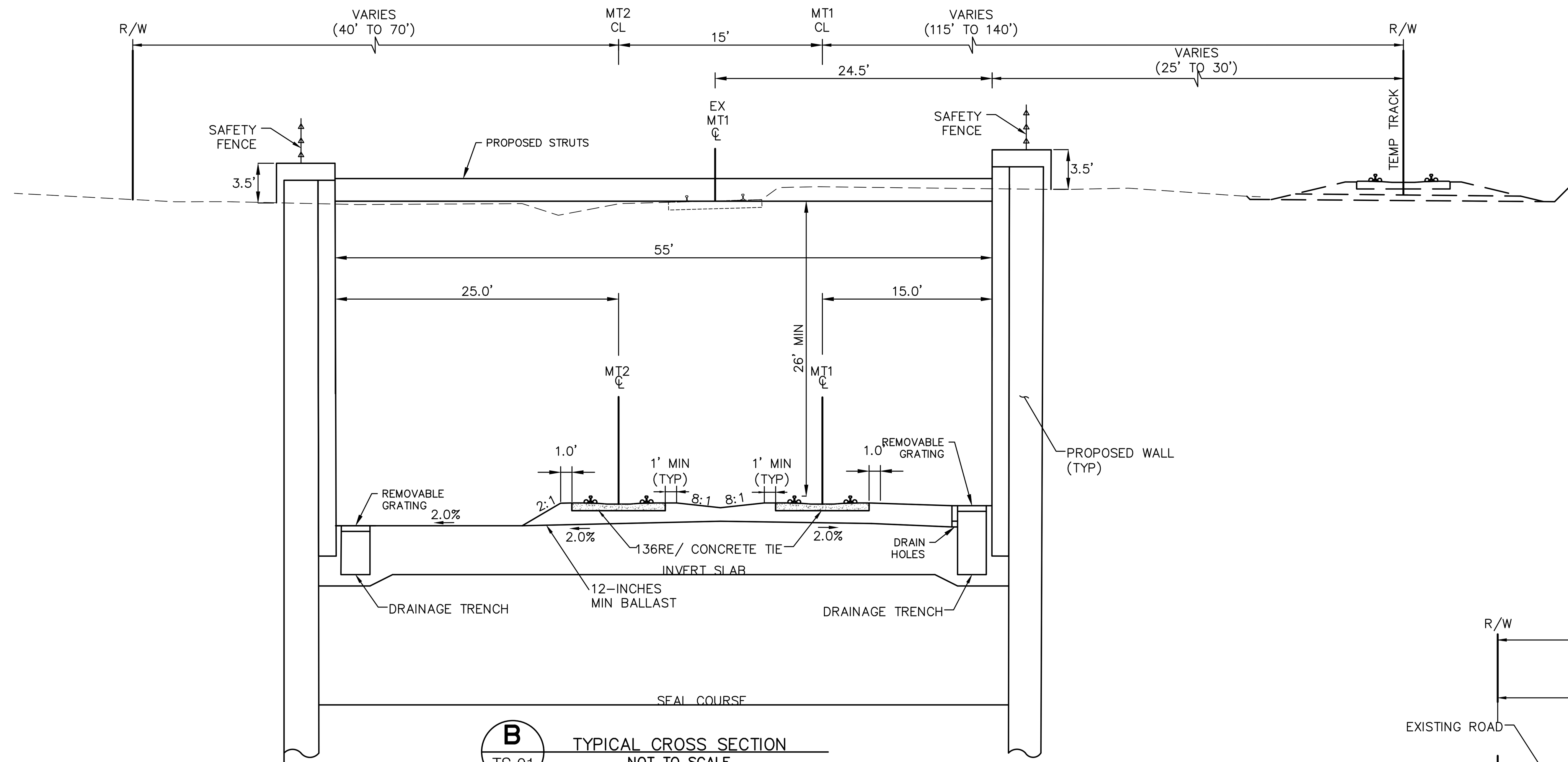

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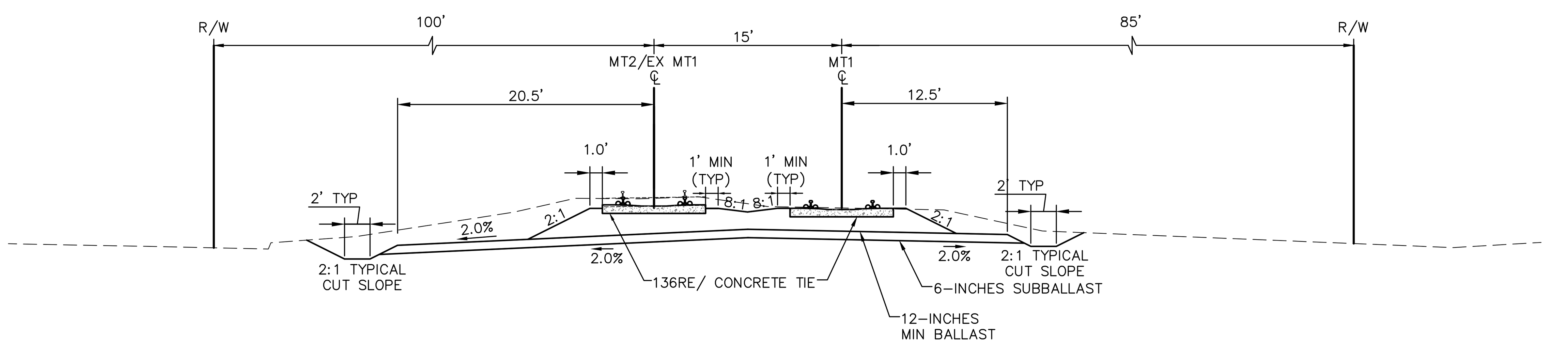

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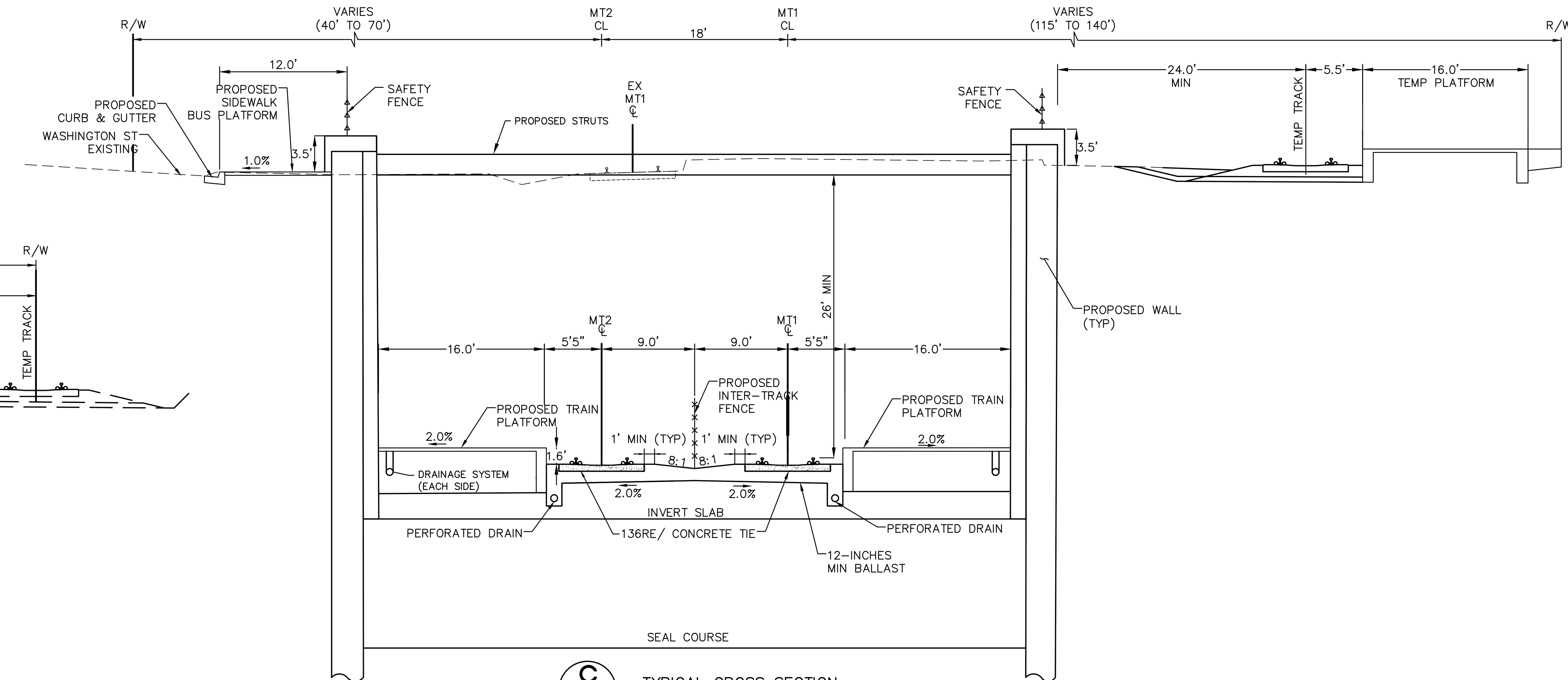

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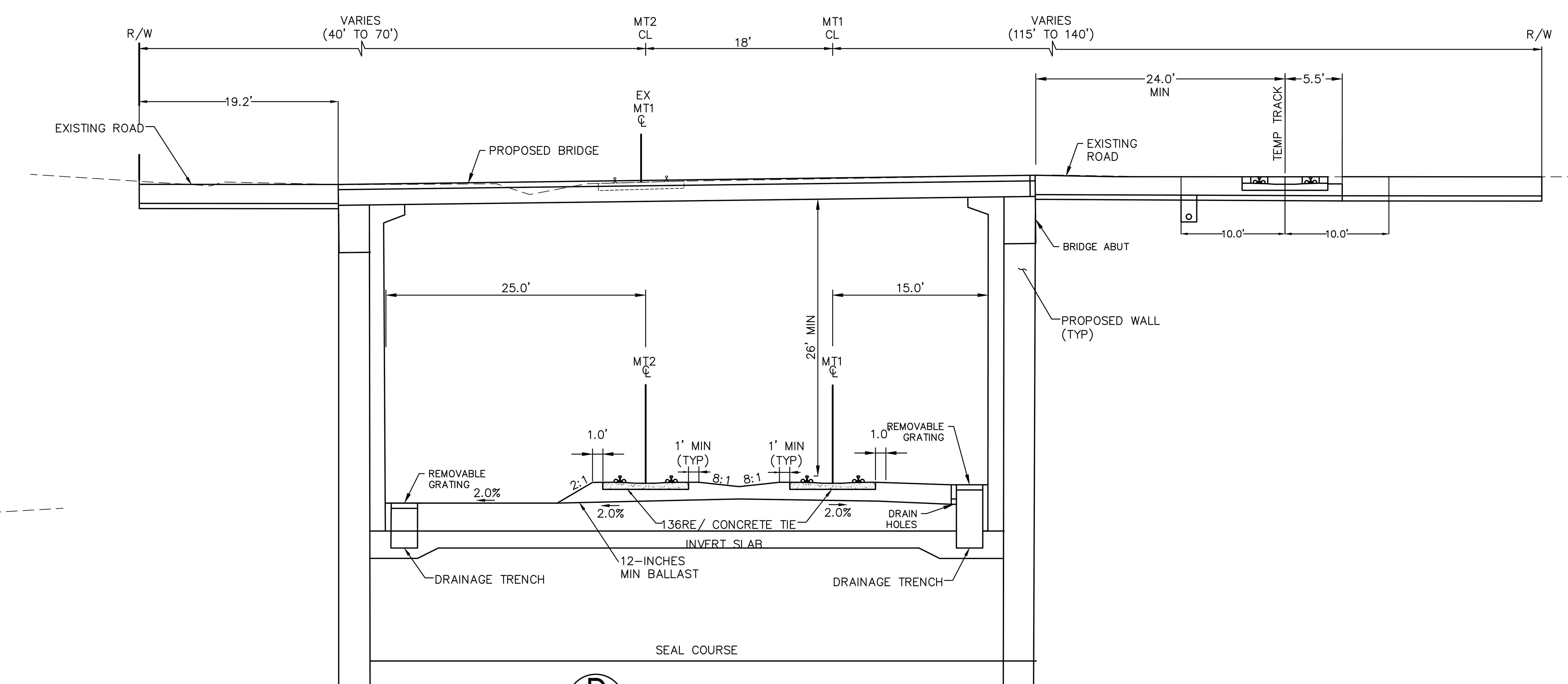

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ROAD CROSSINGS AT CARLSBAD VILLAGE DR, OAK AVE
CHESTNUT AVE, AND TAMARACK AVE

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CARLSBAD VILLAGE RAILROAD TRENCH

TRACK TYPICAL SECTIONS

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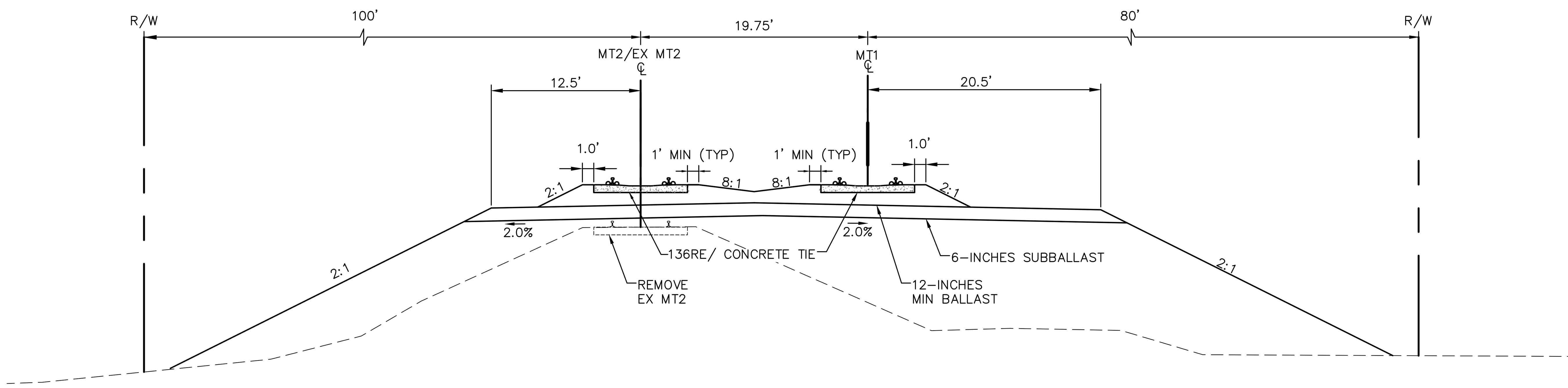

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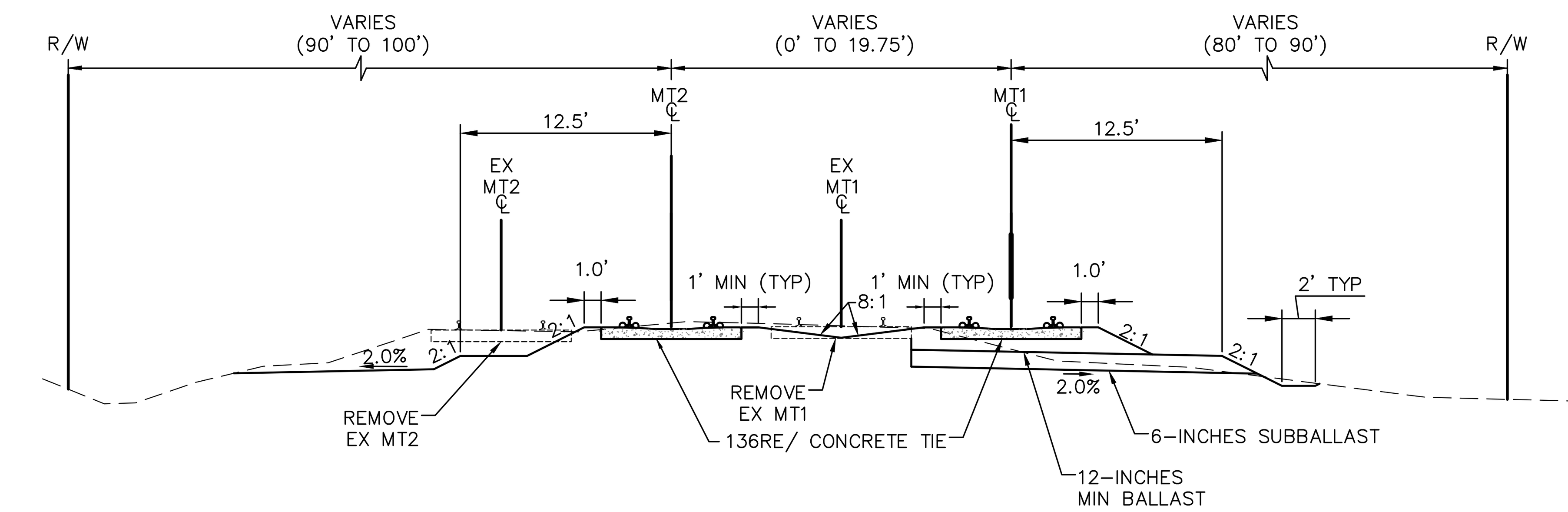

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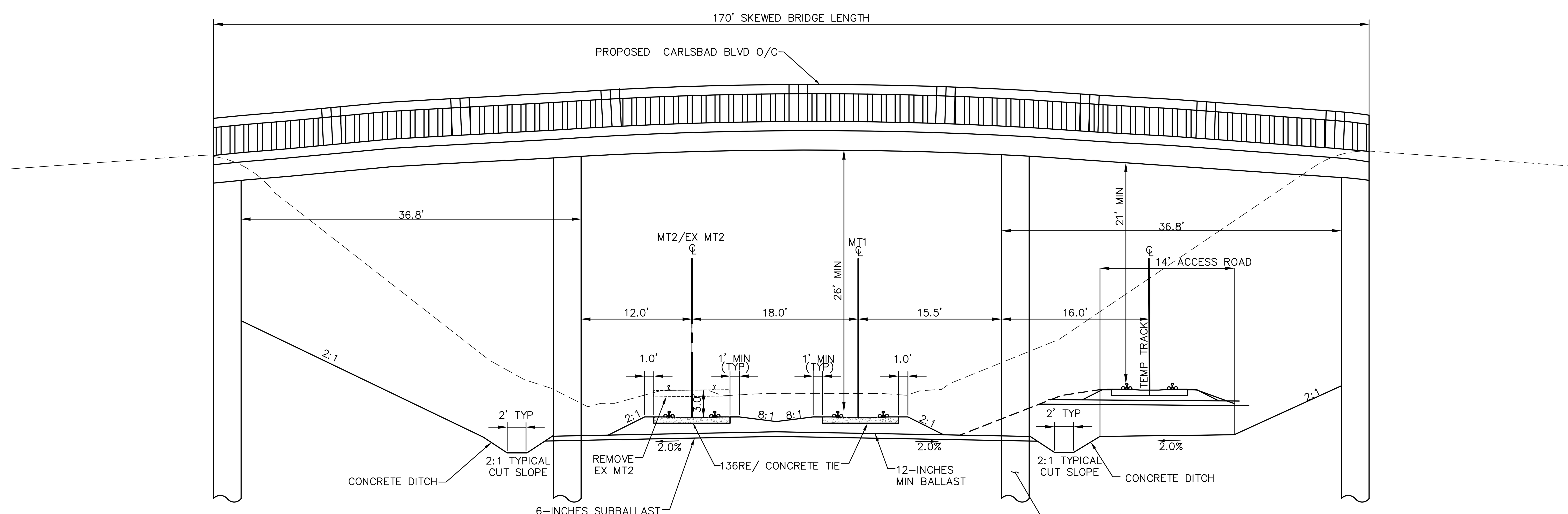

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TS-01
TYPICAL CROSS SECTION
NOT TO SCALE

10%- NOT FOR CONSTRUCTION

Revised: February 27, 2020
Path: T:\SanDiego\Projects\701290.15\600_CADD\05_Official\70129015_TS-02 Typical Sections Printed:3/4/2020 3:21 PM

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DRAWN BY	VE	10/19
CHECKED BY	MW	10/19
PRJ. ENG.	PB	10/19

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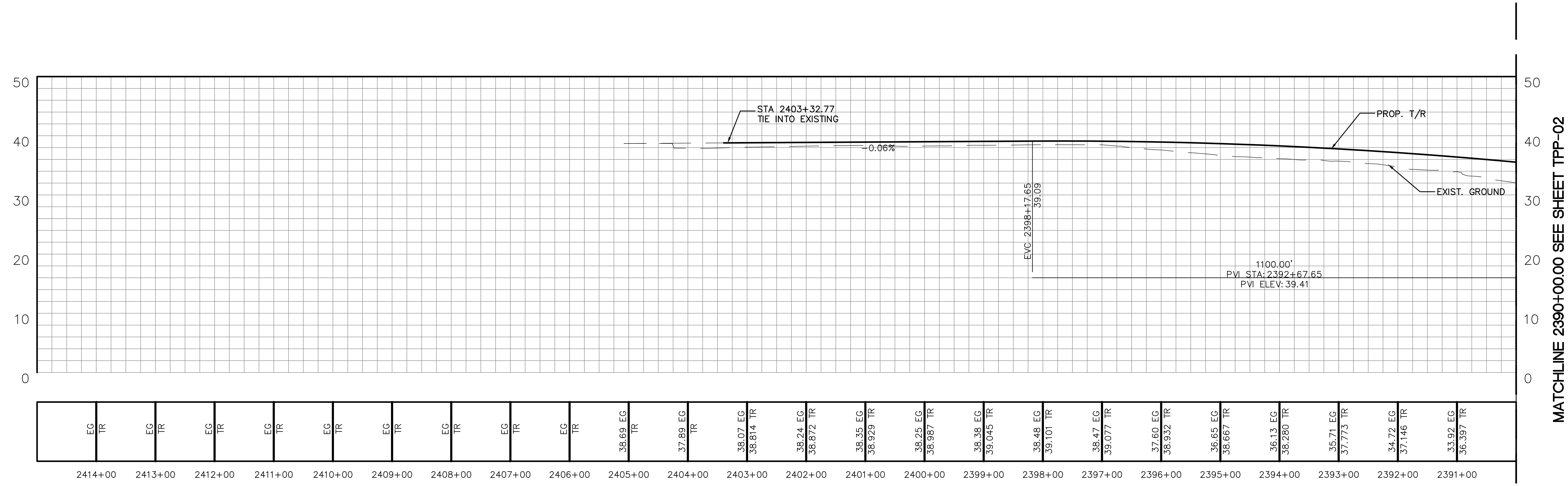
CARLSBAD VILLAGE RAILROAD TRENCH

TRACK TYPICAL SECTIONS

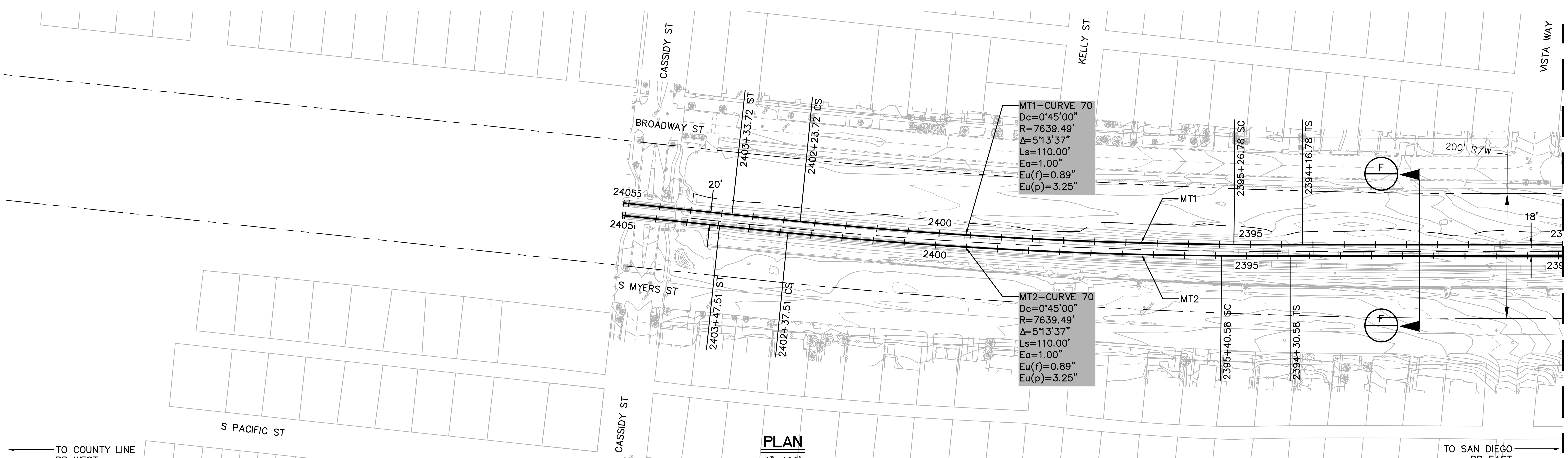
SCALE: NO SCALE
CONTRACT NO.
DRAWING NO.: TS-02
SHEET NO.: 4

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES
0 1 2 3



PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

HORIZONTAL SCALE 1"= 100' (100 50 0 100 200)

VERTICAL SCALE 1"= 10' (10 5 0 10 20)

10%- NOT FOR CONSTRUCTION

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

NO.	DATE	REVISIONS	BY	CHK	APRV

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PRJ. ENG.	PB	10/19

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CARLSBAD VILLAGE RAILROAD TRENCH

LONG TRENCH ALTERNATIVE
TRACK PLAN AND PROFILE

STA 2390+00 TO STA 2415+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-01
SHEET NO.: 5

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES
0 1 2 3

NOT FOR CONSTRUCTION

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CHECKED BY MW	10/19
PRJ. ENG. PB	10/19

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CARLSBAD VILLAGE RAILROAD TRENCH

LONG TRENCH ALTERNATIVE
TRACK PLAN AND PROFILE

STA 2365+00 TO STA 2390+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-02
SHEET NO.: 6

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES

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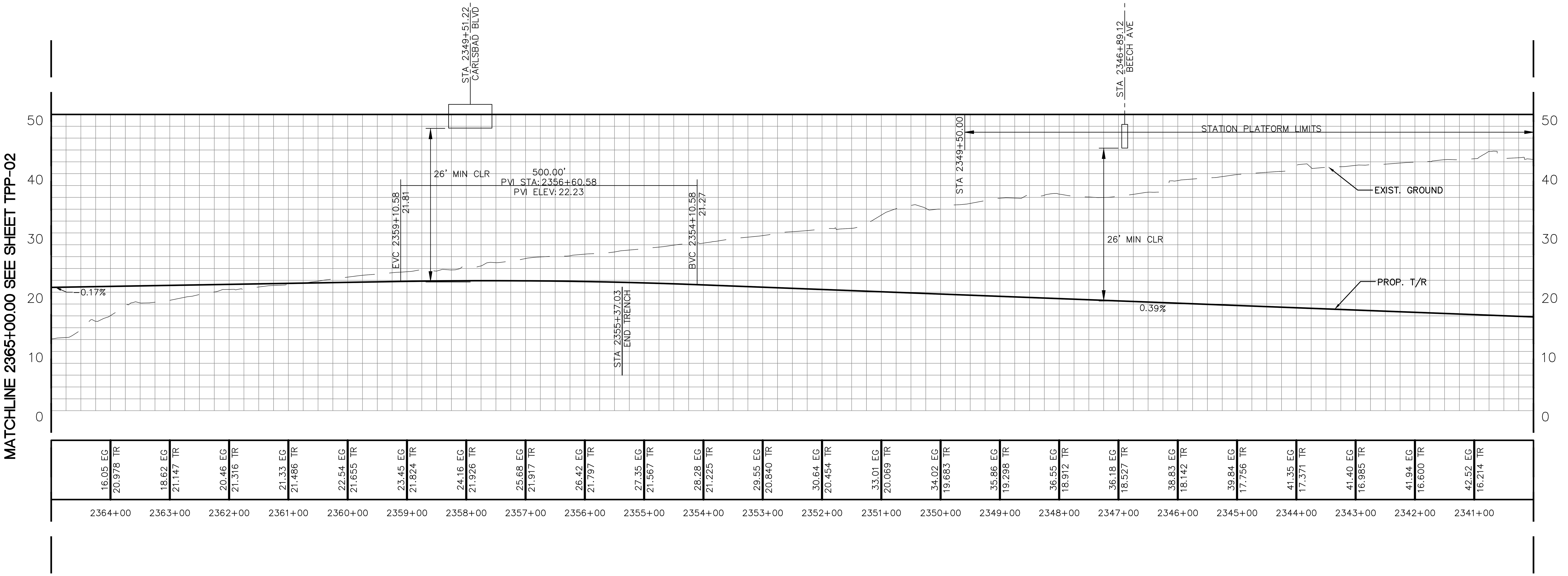
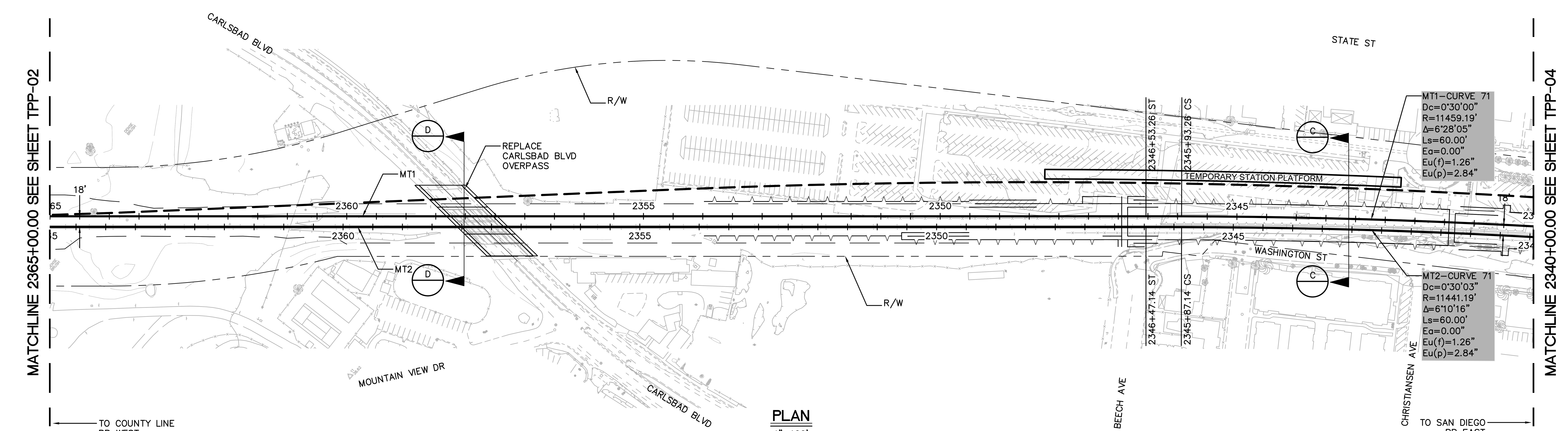


Station	EG	TR
2364+00	16.05	20.978
2363+00	18.62	21.147
2362+00	20.46	21.316
2361+00	21.33	21.486
2360+00	22.54	21.655
2359+00	23.45	21.824
2358+00	24.16	21.926
2357+00	25.68	21.917
2356+00	26.42	21.797
2355+00	27.35	21.567
2354+00	28.28	21.225
2353+00	29.55	20.840
2352+00	30.64	20.454
2351+00	33.01	20.069
2350+00	34.02	19.683
2349+00	35.86	19.298
2348+00	36.55	18.912
2347+00	36.18	18.527
2346+00	38.83	18.142
2345+00	39.84	17.756
2344+00	41.35	17.371
2343+00	41.40	16.985
2342+00	41.94	16.600
2341+00	42.52	16.214

PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

10%- NOT FOR CONSTRUCTION

HORIZONTAL SCALE 1"= 100'

VERTICAL SCALE 1"= 10'

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

NO.	DATE	REVISIONS	BY	CHK	APRV

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CARLSBAD VILLAGE RAILROAD TRENCH

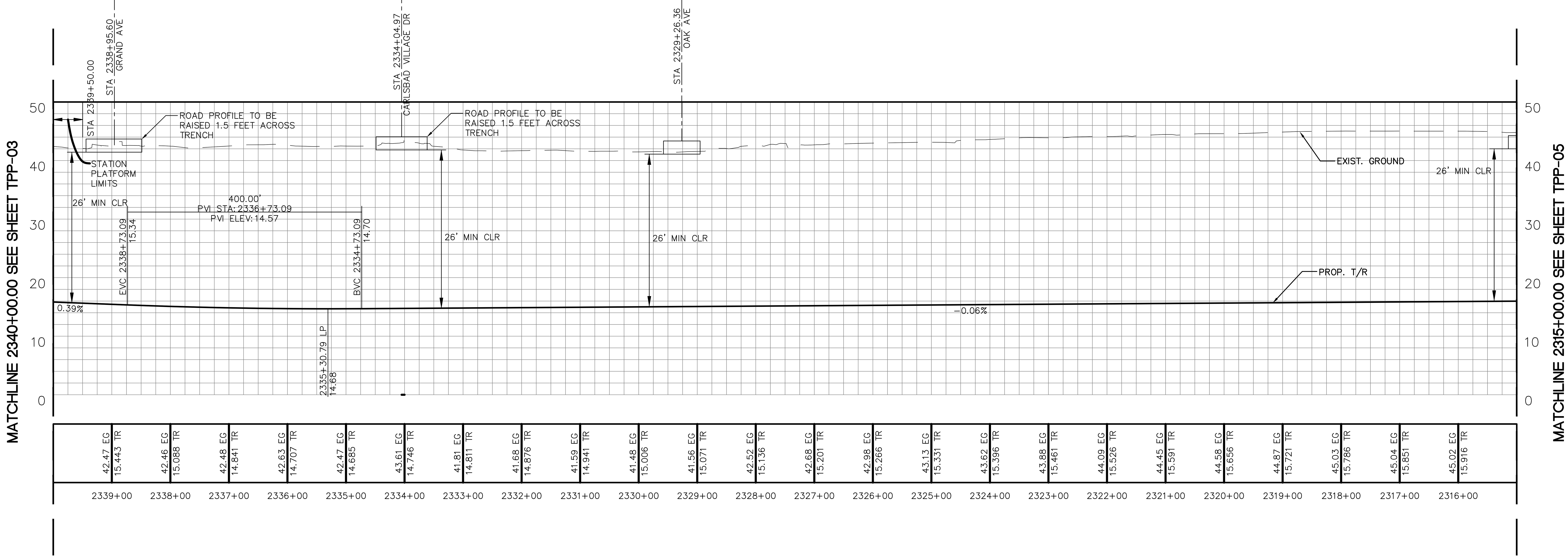
LONG TRENCH ALTERNATIVE
TRACK PLAN AND PROFILE

STA 2340+00 TO 2365+00

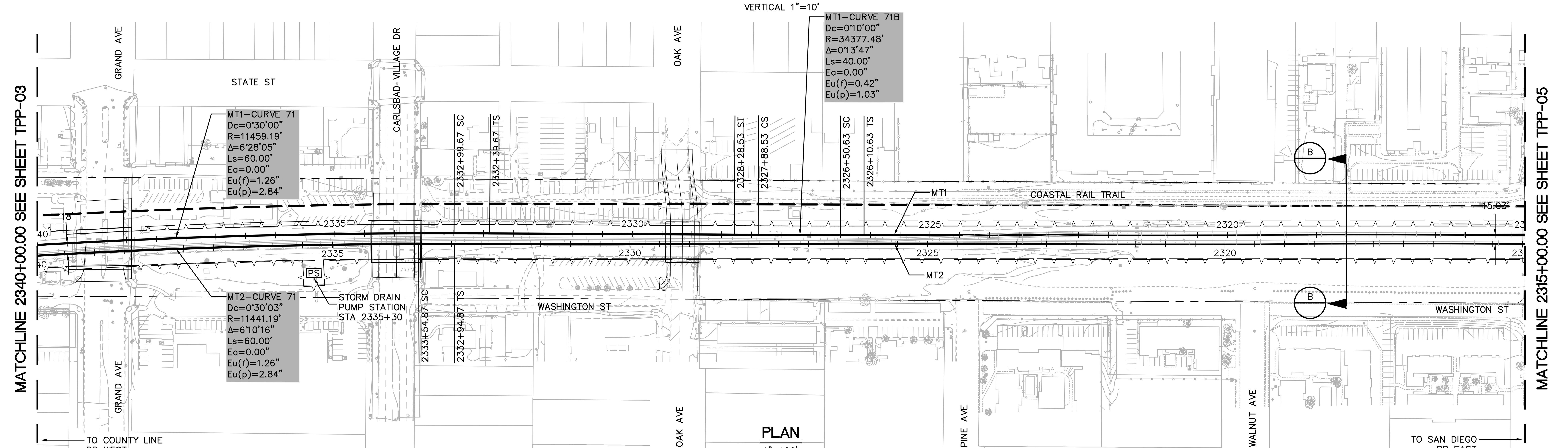
SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-03
SHEET NO.: 7

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES

Revised: October 31, 2019
Path: T:\SanDiego\Projects\701290.15\600_CADD\05_Official\70129015_TPP-03 Long Printed:3/4/2020 3:23 PM



PROFILE
HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN
1"=100'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10 5 0 10 20
VERTICAL SCALE 1"= 10'

10%- NOT FOR CONSTRUCTION

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

NO.	DATE	REVISIONS	BY	CHK	APRV

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CHECKED BY	MW	10/19
PRJ. ENG.	PB	10/19

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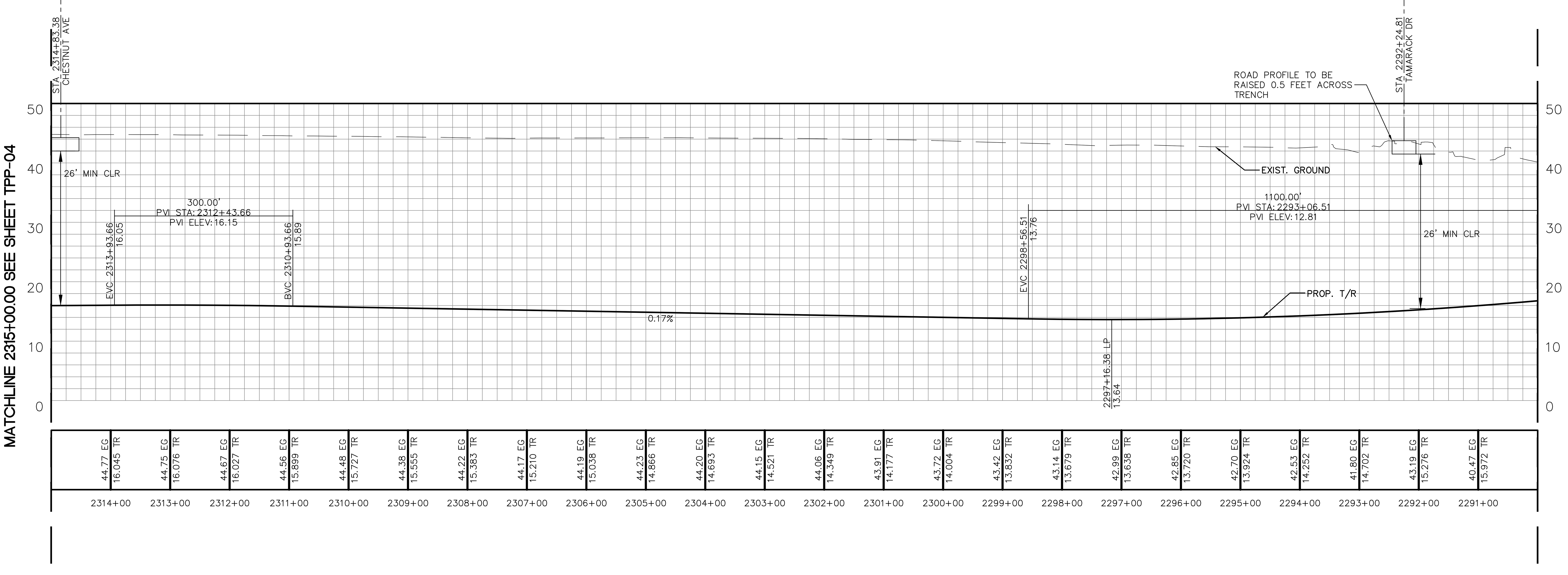
CARLSBAD VILLAGE RAILROAD TRENCH

LONG TRENCH ALTERNATIVE
TRACK PLAN AND PROFILE
STA 2315+00 TO 2340+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-04
SHEET NO.: 8

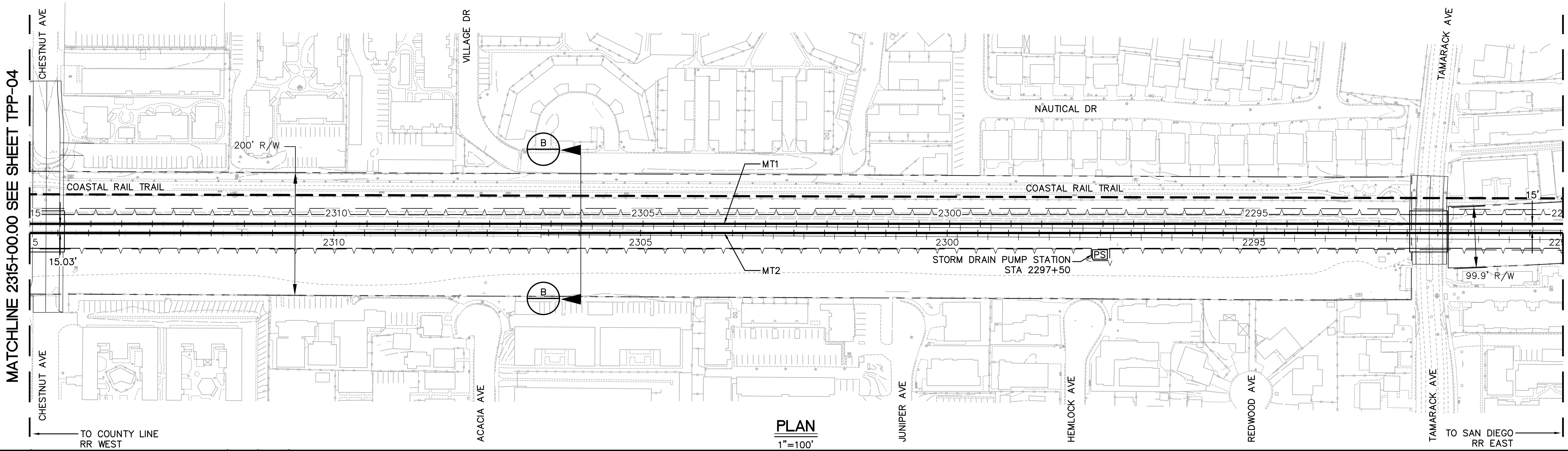
FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES
0 1 2 3

Revised: February 4, 2020
Path: T:\SanDiego\Projects\701290.15\600_CADD\05_Official\70129015_TPP-04 Long Printed:3/4/2020 3:24 PM



PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

HORIZONTAL SCALE 1"= 100' (100 50 0 100 200)

VERTICAL SCALE 1"= 10' (10 5 0 10 20)

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

10%- NOT FOR CONSTRUCTION

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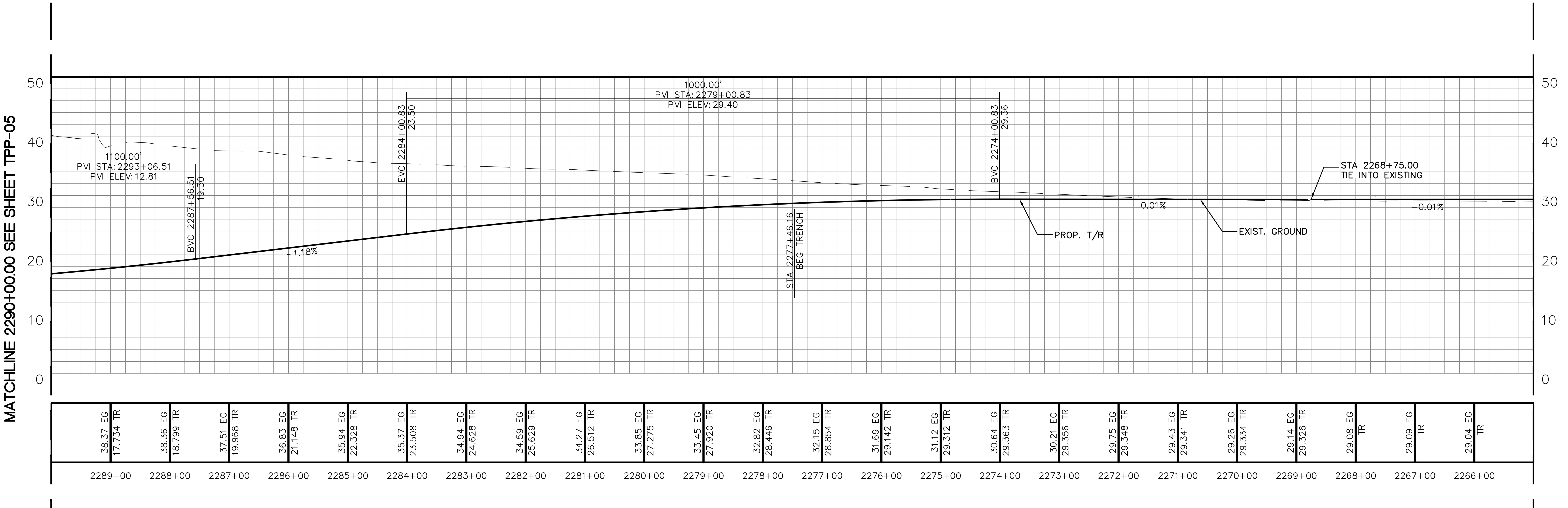
CARLSBAD VILLAGE RAILROAD TRENCH

LONG TRENCH ALTERNATIVE TRACK PLAN AND PROFILE

STA 2290+00 TO 2315+00

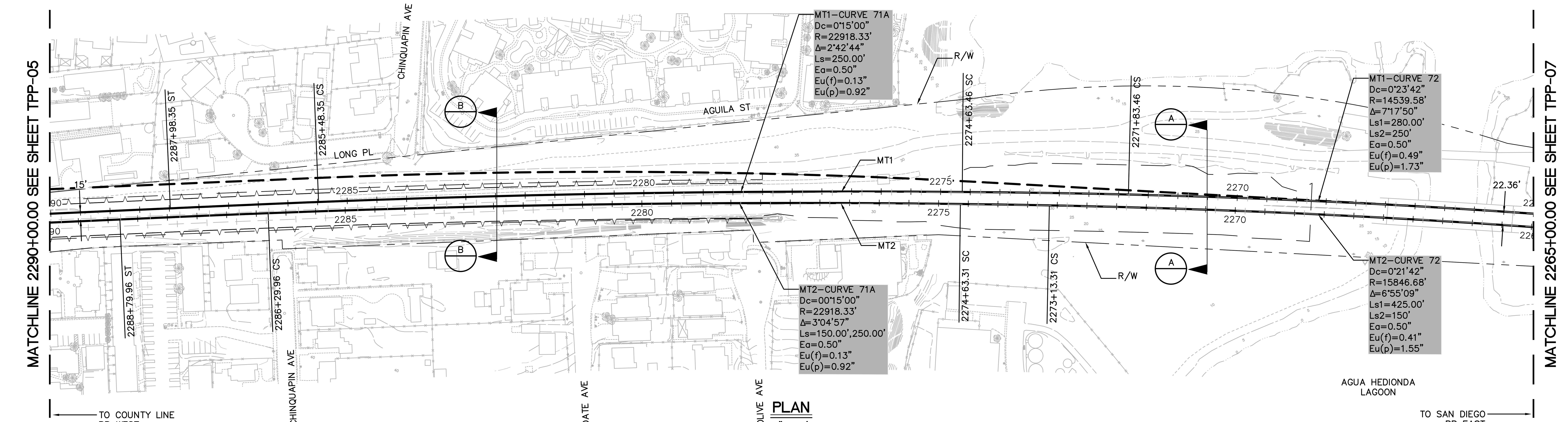
SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-05
SHEET NO.: 9

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3



PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

HORIZONTAL SCALE 1"= 100'

VERTICAL SCALE 1"= 10'

10%- NOT FOR CONSTRUCTION

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

NO.	DATE	REVISIONS	BY	CHK	APRV

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CHECKED BY	MW	10/19
PRJ. ENG.	PB	10/19

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CARLSBAD VILLAGE RAILROAD TRENCH

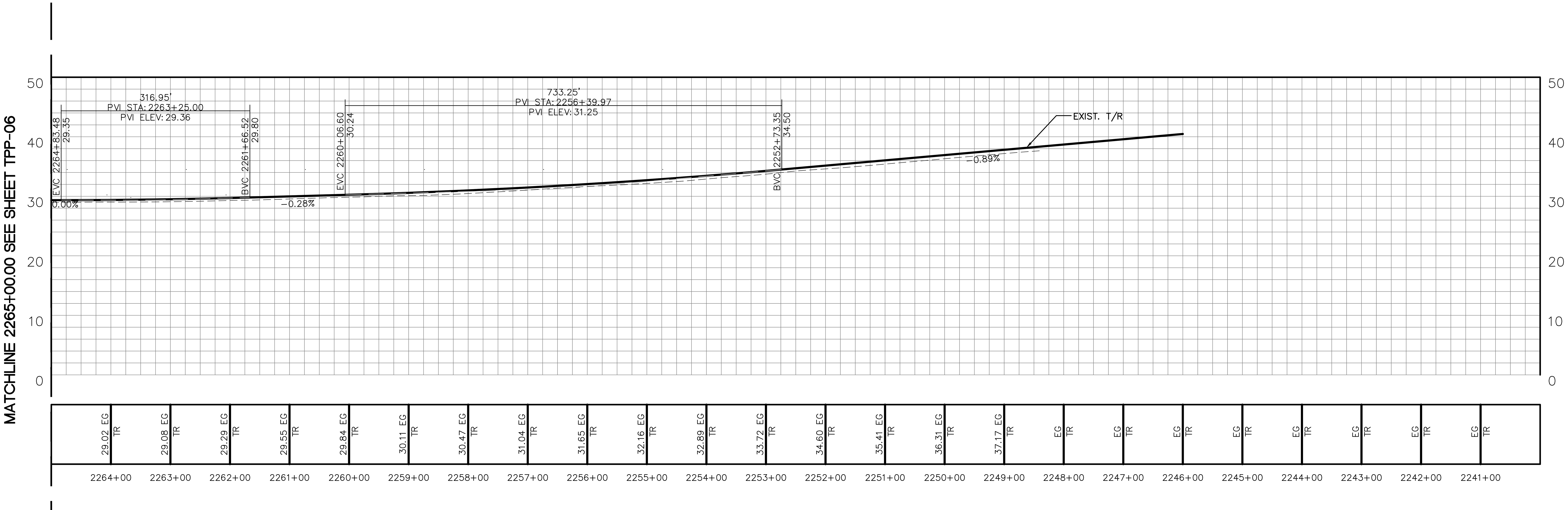
LONG TRENCH ALTERNATIVE TRACK PLAN AND PROFILE

STA 2290+00 TO 2265+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-06
SHEET NO.: 10

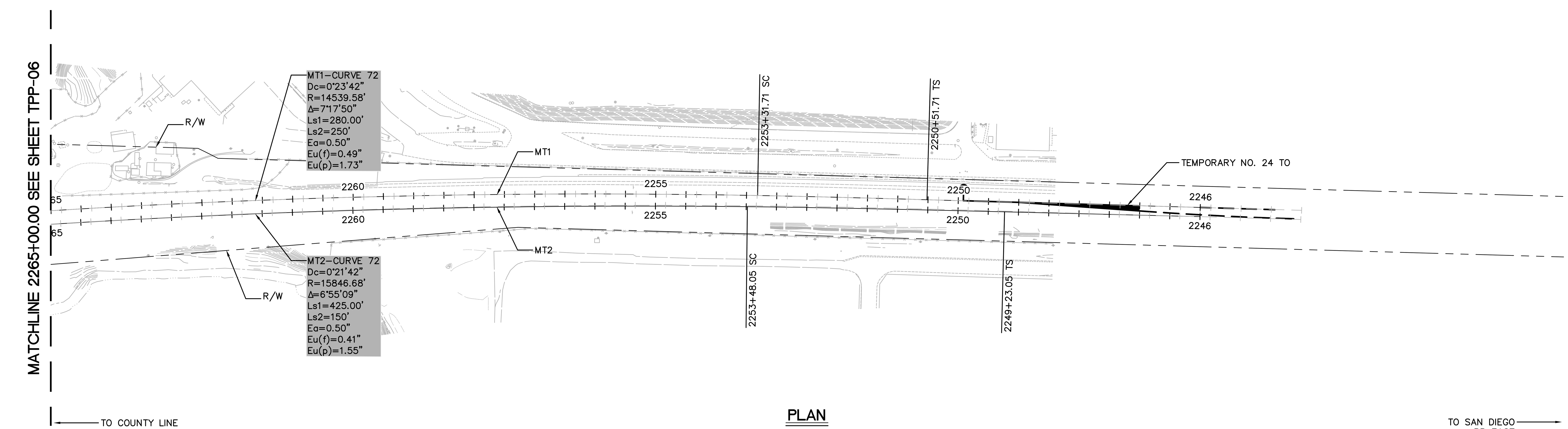
FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES

Revised: March 4, 2020
Path: T:\SanDiego\Projects\701290.15\600_CADD\05_Official\70129015_TPP-06 Long Printed:3/4/2020 3:25 PM



PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10 5 0 10 20
VERTICAL SCALE 1"= 10'

10%- NOT FOR CONSTRUCTION

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

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CHECKED BY	MW	10/19
PRJ. ENG.	PB	10/19

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CARLSBAD VILLAGE RAILROAD TRENCH

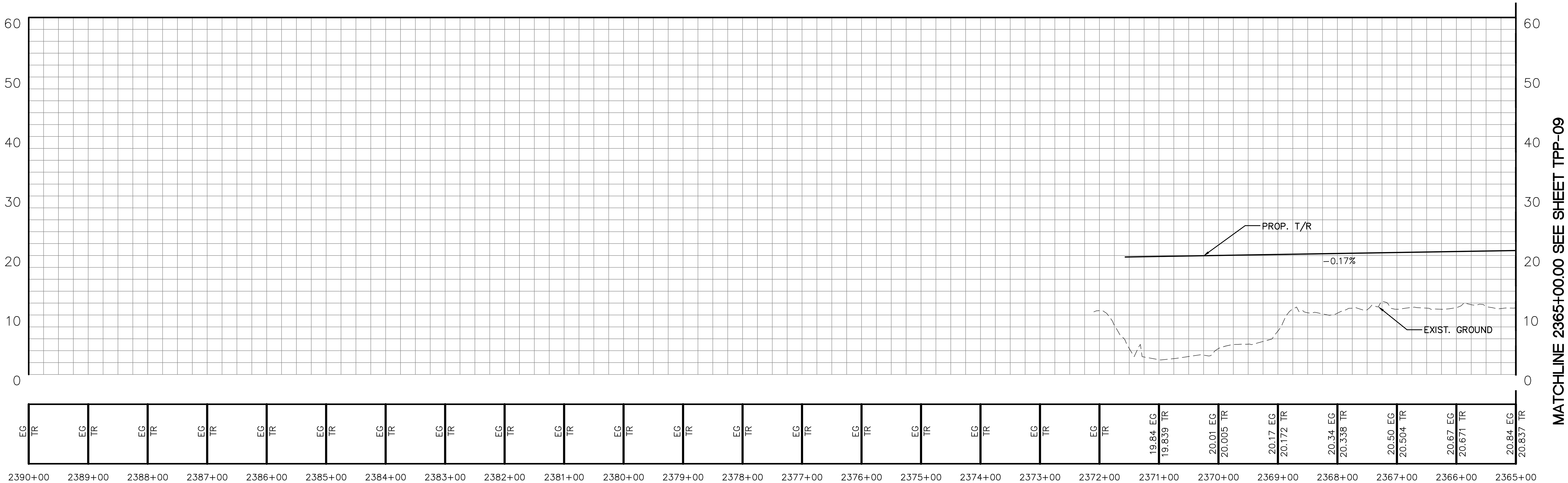
LONG TRENCH ALTERNATIVE TRACK PLAN AND PROFILE

STA 2240+00 TO 2265+00

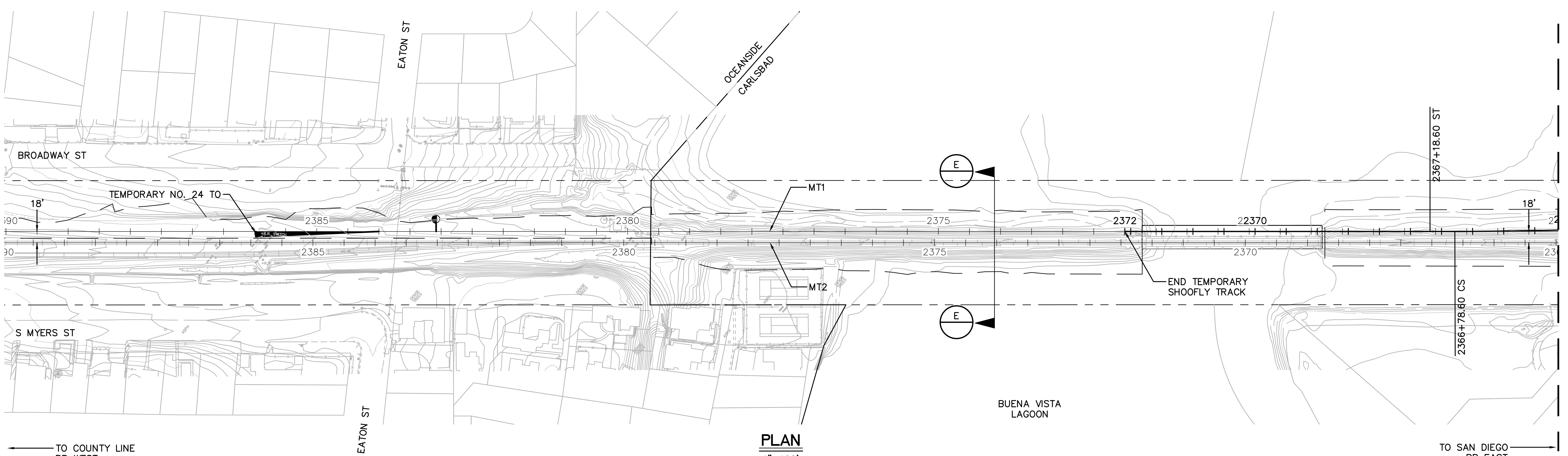
SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO. TPP-07
SHEET NO. 11

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES
0 1 2 3

Revised: March 4, 2020
Path: T:\SanDiego\Projects\701290.15\600_CADD\05_Official\70129015_TPP-07 Long Printed: 3/4/2020 3:26 PM



PROFILE
HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN
1"=100'

10%- NOT FOR CONSTRUCTION

HORIZONTAL SCALE 1"= 100'
VERTICAL SCALE 1"= 10'

LEGEND:
- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

NO.	DATE	REVISIONS	BY	CHK	APRV

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PRJ. ENG.	PB	10/19

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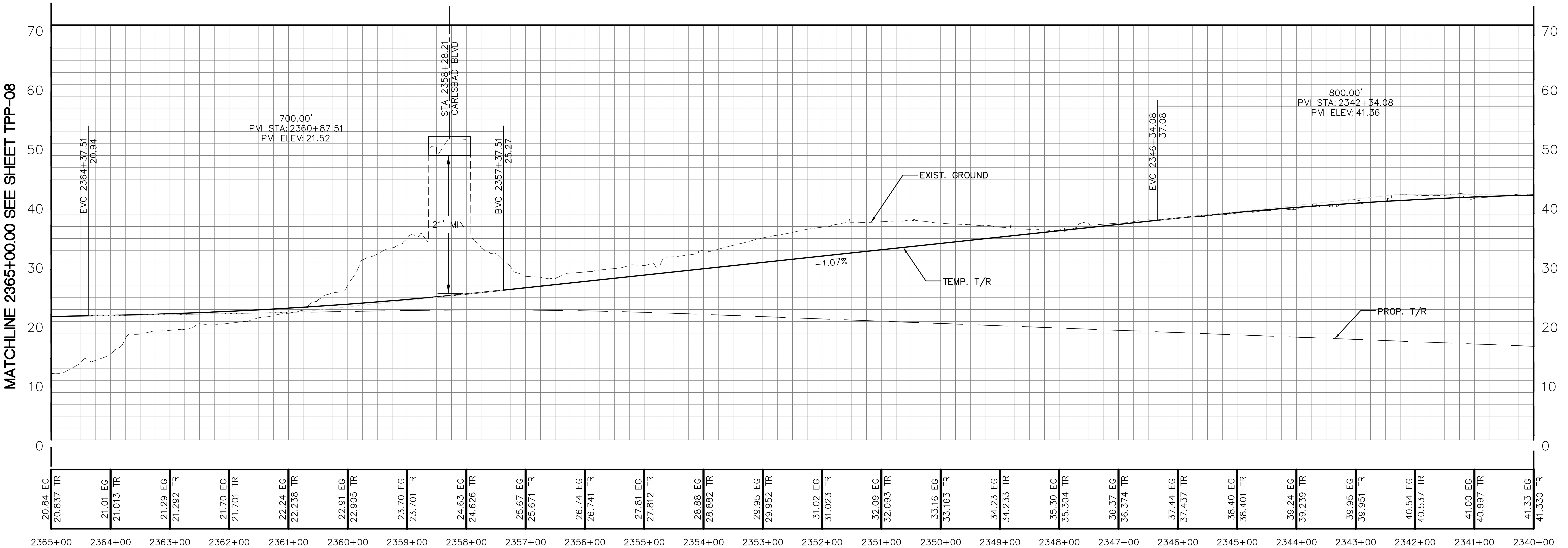
CARLSBAD VILLAGE RAILROAD TRENCH

LONG TRENCH SHOOFLY
TRACK PLAN AND PROFILE
STA 2365+00 TO STA 2390+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-08
SHEET NO.: 12

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES

Revised: February 26, 2020
Path: T:\SanDiego\Projects\701290.15\600_CADD\05_Official\70129015_TPP-01 Temp_Long Printed:3/4/2020 3:27 PM



PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'

PLAN

1"=100'

HORIZONTAL SCALE 1"= 100'

VERTICAL SCALE 1"= 10'

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

NOT FOR CONSTRUCTION

NO.	DATE	REVISIONS	BY	CHK	APRV

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PRJ. ENG.	PB	10/19

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CARLSBAD VILLAGE RAILROAD TRENCH

LONG TRENCH SHOOFLY TRACK PLAN AND PROFILE

STA 2340+00 TO 2365+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO. TPP-09
SHEET NO. 13

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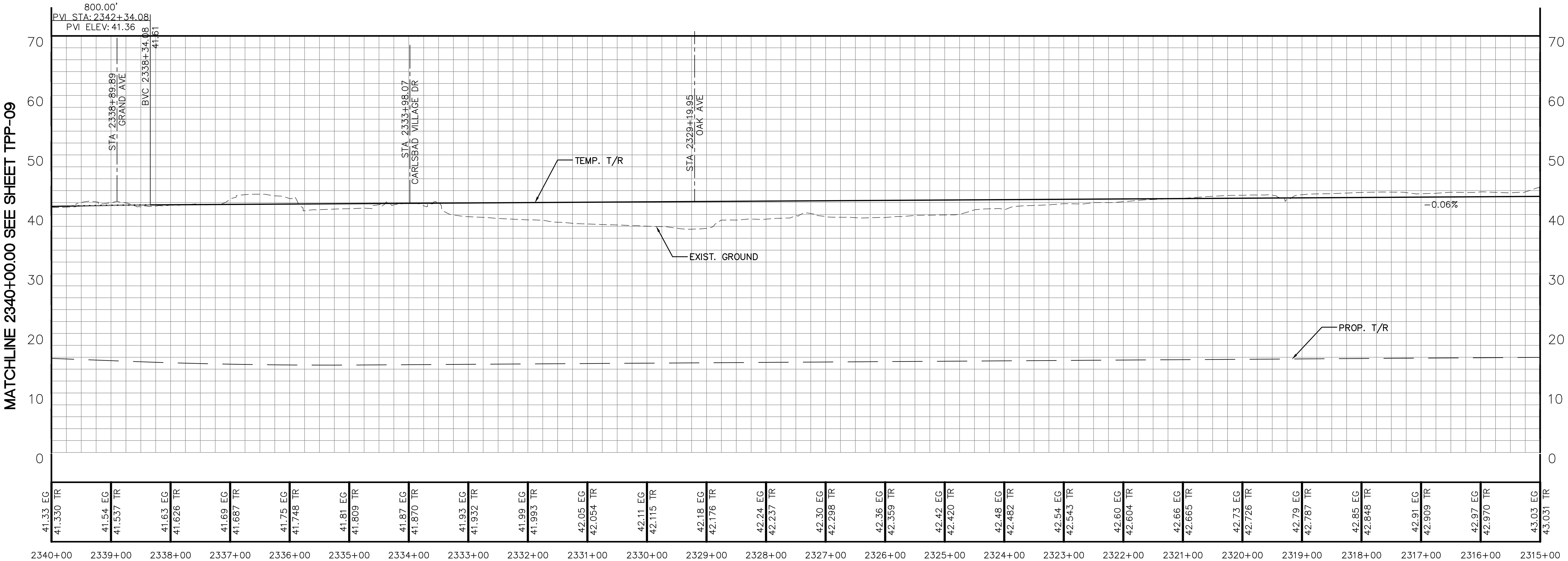
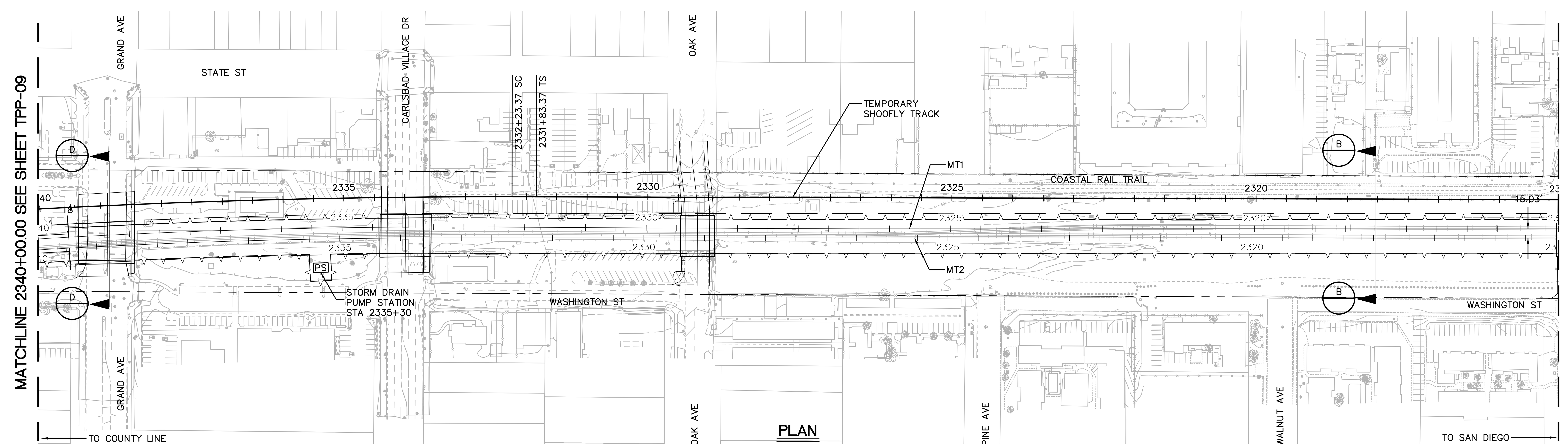


PROFILE
HORIZONTAL 1"=100'
VERTICAL 1"=10'

10%- NOT FOR CONSTRUCTION



PLAN
1"=100'

NO.	DATE	REVISIONS	BY	CHK	APRV

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CARLSBAD VILLAGE RAILROAD TRENCH

LONG TRENCH SHOOFLY
TRACK PLAN AND PROFILE

STA 2315+00 TO 2340+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-10
SHEET NO.: 14

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES
0 1 2 3

Revised: February 6, 2020
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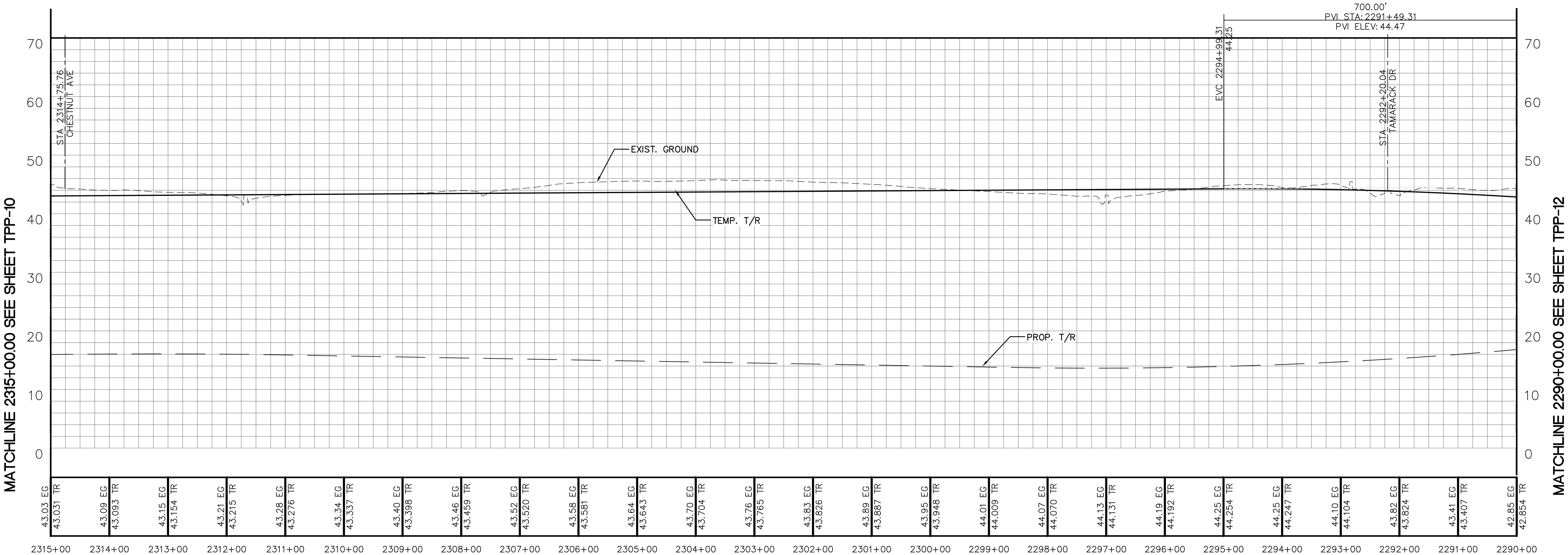
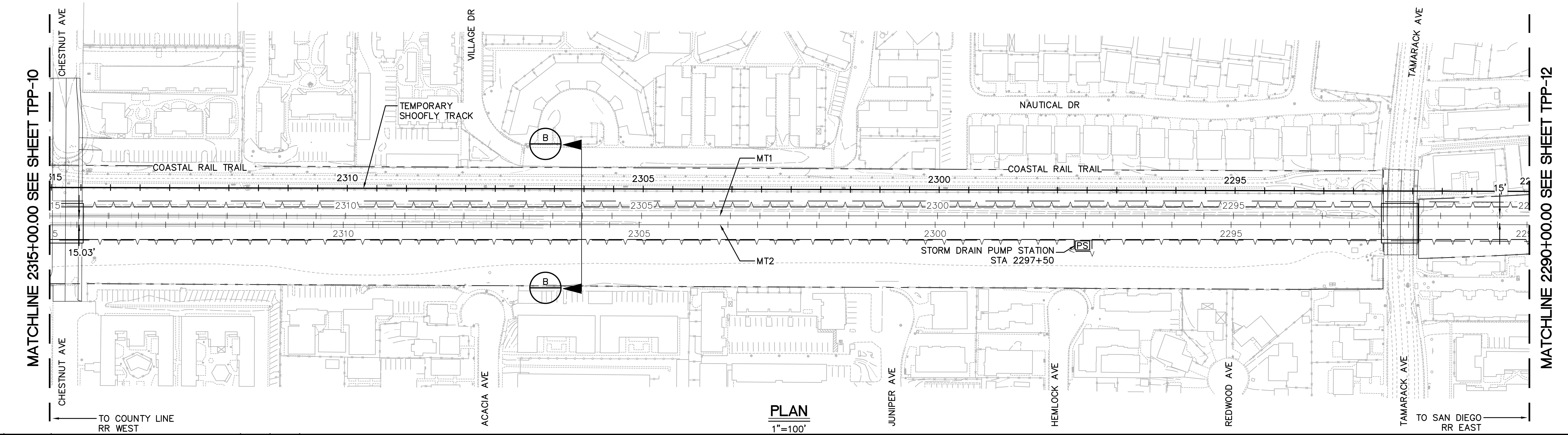


PROFILE
HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN
1"=100'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10 5 0 10 20
VERTICAL SCALE 1"= 10'

LEGEND:
- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

10%- NOT FOR CONSTRUCTION

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STATE OF CALIFORNIA

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CHECKED BY	MW	10/19
PRJ. ENG.	PB	10/19

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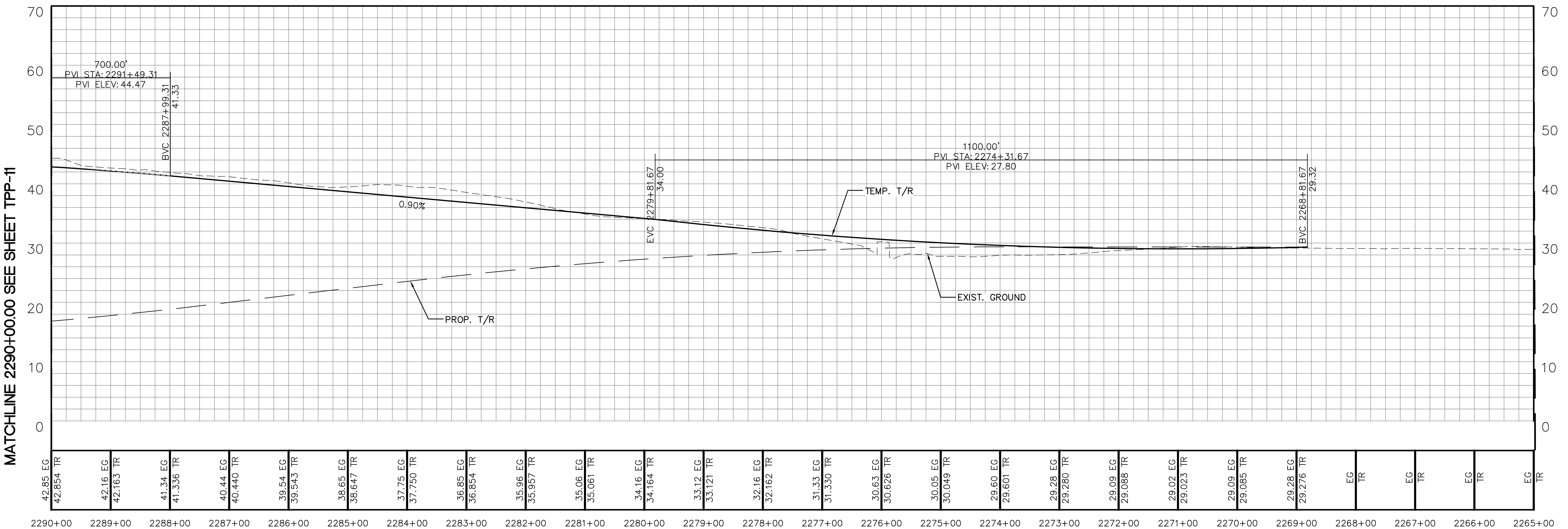
CARLSBAD VILLAGE RAILROAD TRENCH

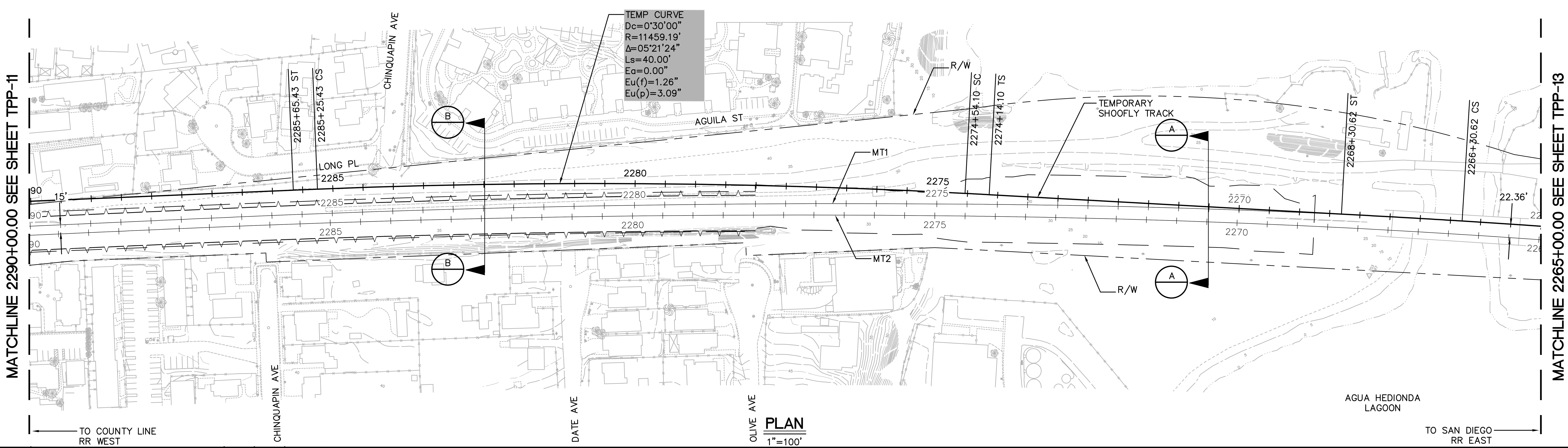
LONG TRENCH SHOOFLY
TRACK PLAN AND PROFILE
STA 2290+00 TO 2315+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO. TPP-11
SHEET NO. 15

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES
0 1 2 3



PROFILE
HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN
1"=100'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10 5 0 10 20
VERTICAL SCALE 1"= 10'

NOT FOR CONSTR□CTION

LEGEND:
- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

NO.	DATE	REVISIONS	BY	CHK	APRV

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Exp. ------
CIVIL
STATE OF CALIFORNIA

DESIGNED BY PB	10/19
DRAWN BY VE	10/19
CHECKED BY MW	10/19
PRJ. ENG. PB	10/19

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CARLSBAD VILLAGE RAILROAD TRENCH

LONG TRENCH SHOOFLY
TRACK PLAN AND PROFILE
STA 2290+00 TO 2315+00

SCALE AS SHO□N
CONTRACT NO.
DRAWING NO. TPP-12
SHEET NO. 16

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES
0 1 2 3

Revised: April 16, 2020
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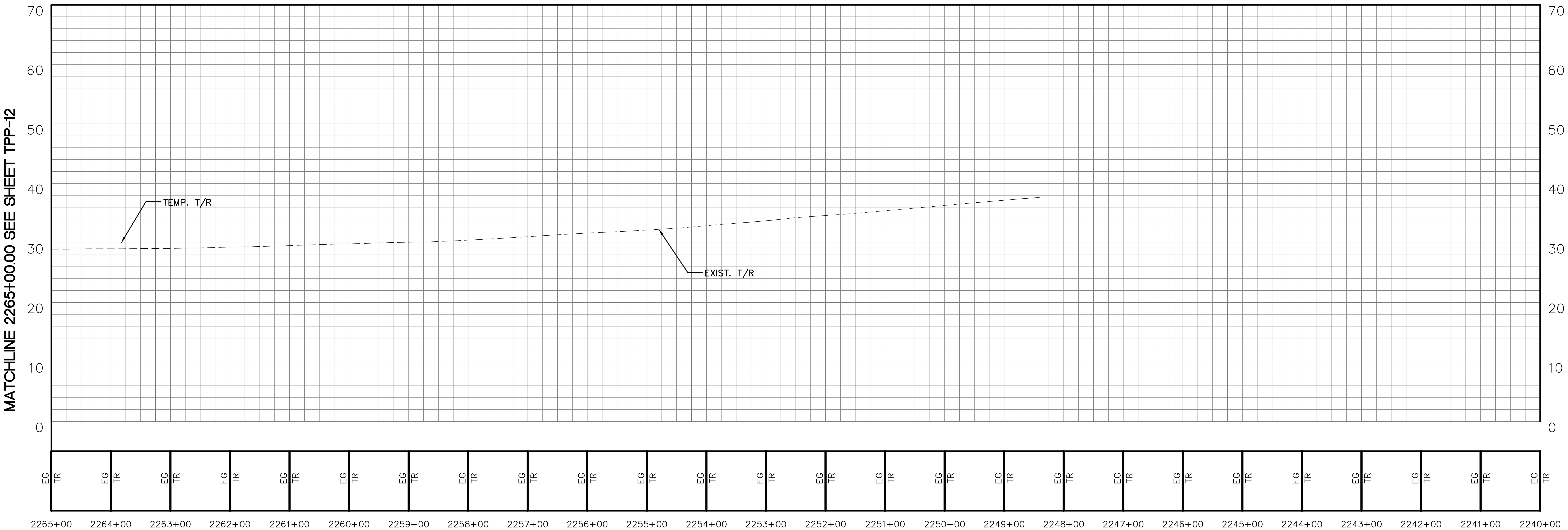
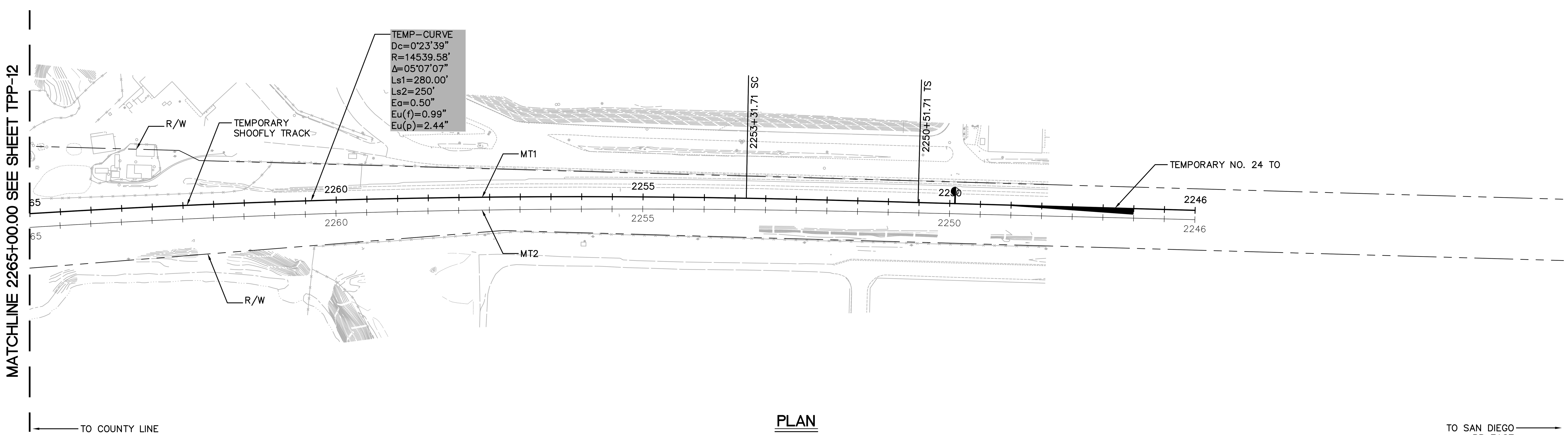


PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

10%- NOT FOR CONSTRUCTION

HORIZONTAL SCALE 1"= 100'

VERTICAL SCALE 1"= 10'

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

NO.	DATE	REVISIONS	BY	CHK	APRV

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DESIGNED BY PB	DATE 10/19
DRAWN BY VE	10/19
CHECKED BY MW	10/19
PRJ. ENG. PB	10/19

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San Diego's Regional Planning Agency

CARLSBAD VILLAGE RAILROAD TRENCH

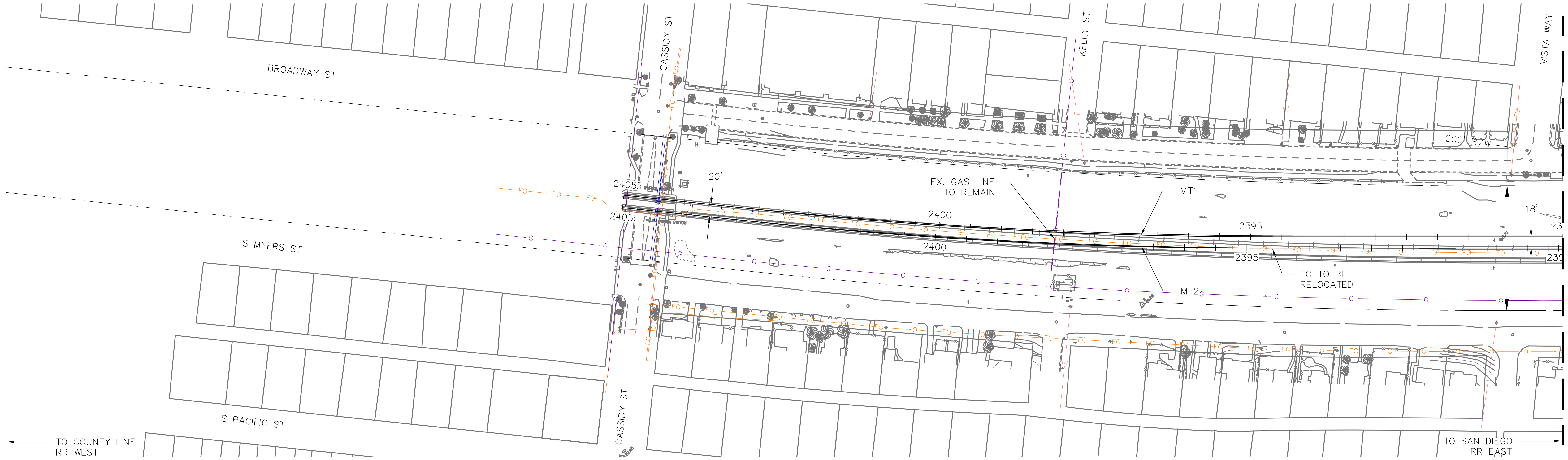
LONG TRENCH SHOOFLY TRACK PLAN AND PROFILE

STA 2240+00 TO 2265+00

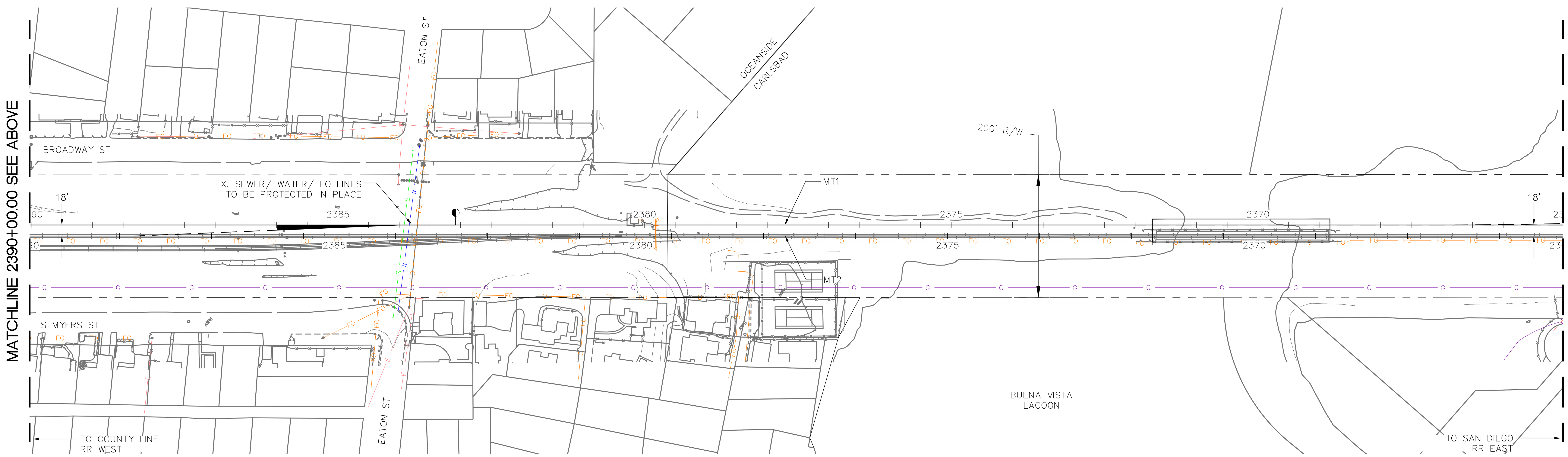
SCALE AS SHOWN
CONTRACT NO.
DRAWING NO. TPP-13
SHEET NO. 17

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES

Revised: March 4, 2020
Path: T:\SanDiego\Projects\701290.15\600_CADD\05_Official\70129015_TPP-06 Temp_Long Printed: 3/4/2020 3:31 PM



PLAN
1"=100'



PLAN
1"=100'

10%- NOT FOR CONSTRUCTION

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS
- E — EXISTING ELECTRIC LINE
- FO — EXISTING FIBER OPTIC LINE
- G — EXISTING GAS LINE
- S — EXISTING SEWER LINE
- SD — EXISTING STORM DRAIN LINE
- T — EXISTING TELECOM LINE
- W — EXISTING WATER LINE
- G — PROPOSED GAS LINE
- S — PROPOSED SEWER LINE
- SD — PROPOSED STORM DRAIN LINE
- PROPOSED CONCRETE CHANNEL

NO.	DATE	REVISIONS	BY	CHK	APRV

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DRAWN BY	VE	10/19
CHECKED BY	MW	10/19
PRJ. ENG.	PB	10/19

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CARLSBAD VILLAGE RAILROAD TRENCH

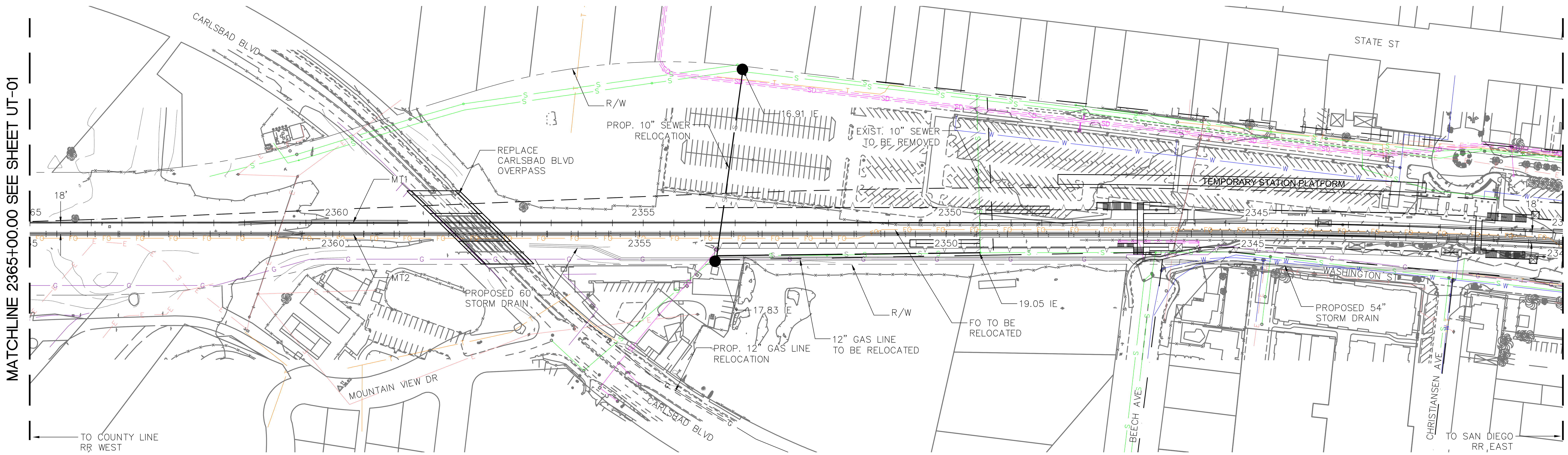
LONG TRENCH ALTERNATIVE
UTILITY PLAN

STA 2365+00 TO STA 2405+00

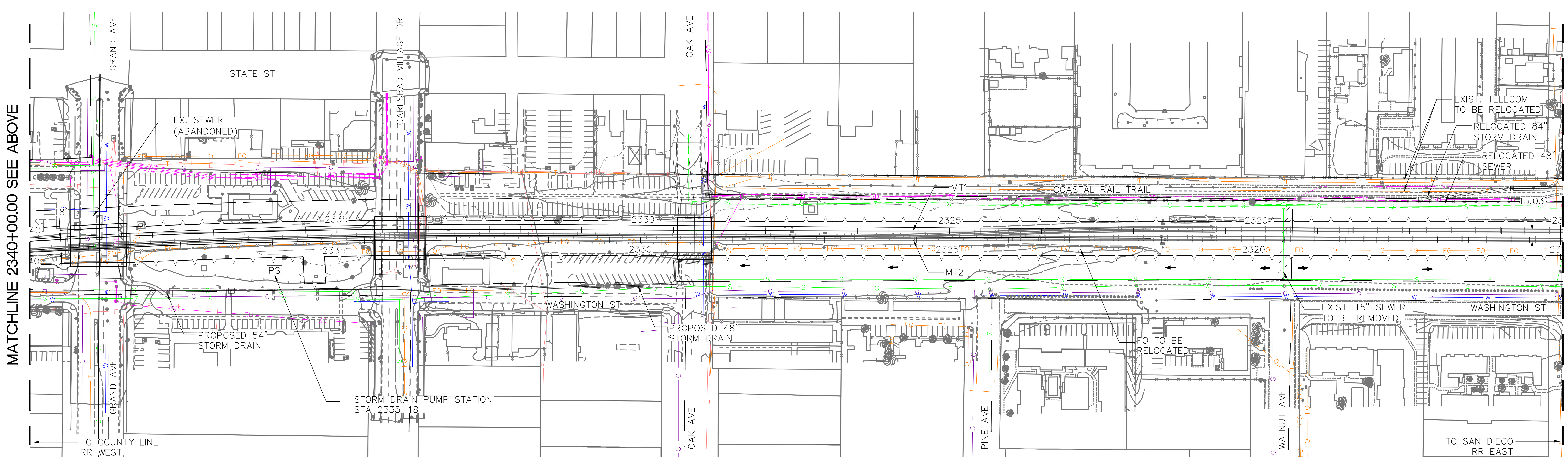
SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO. UT-01
SHEET NO. 18

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES
0 1 2 3

Revised: February 6, 2020
Path: T:\SanDiego\Projects\701290.15\600_CADD\05_Official\70129015_UT-01 Long Printed:3/4/2020 3:32 PM



PLAN
1"=100'



PLAN
1"=100'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

NOT FOR CONSTRUCTION

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS
- E — EXISTING ELECTRIC LINE
- FO — EXISTING FIBER OPTIC LINE
- G — EXISTING GAS LINE
- S — EXISTING SEWER LINE
- SD — EXISTING STORM DRAIN LINE
- T — EXISTING TELECOM LINE
- W — EXISTING WATER LINE
- G — PROPOSED GAS LINE
- S — PROPOSED SEWER LINE
- SD — PROPOSED STORM DRAIN LINE
- PROPOSED CONCRETE CHANNEL

NO.	DATE	REVISIONS	BY	CHK	APRV

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Exp. ____
CIVIL
STATE OF CALIFORNIA

		DATE
DESIGNED BY	PB	10/19
DRAWN BY	VE	10/19
CHECKED BY	MW	10/19
PRJ. ENG.	PB	10/19

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CARLSBAD VILLAGE RAILROAD TRENCH

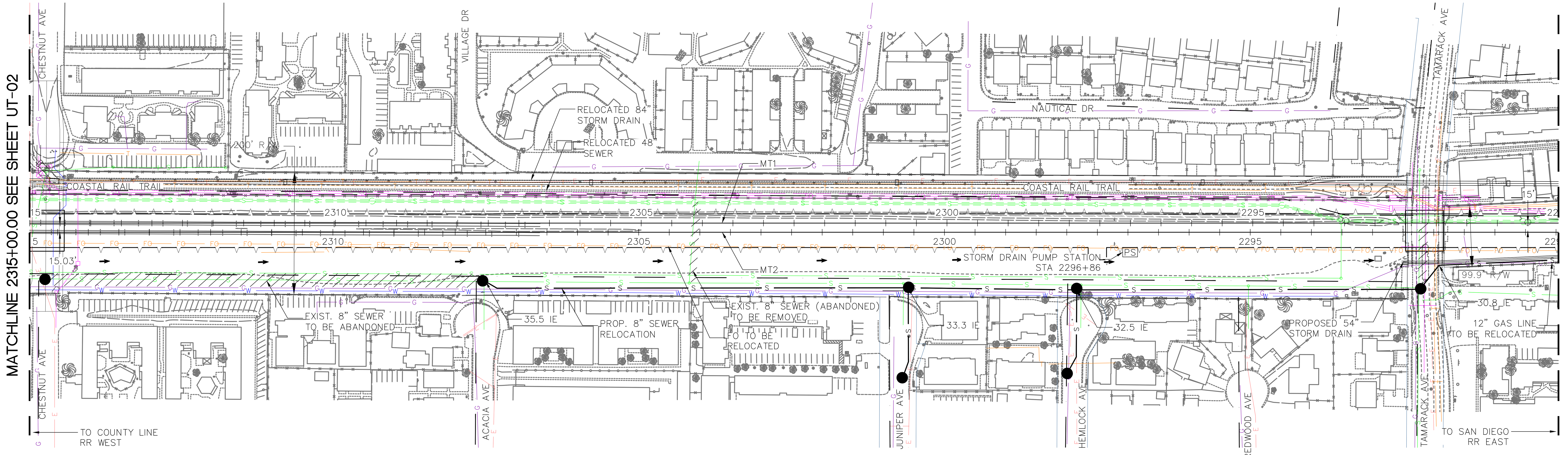
LONG TRENCH ALTERNATIVE
UTILITY PLAN

STA 2315+00 TO 2365+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO. UT-02
SHEET NO. 19

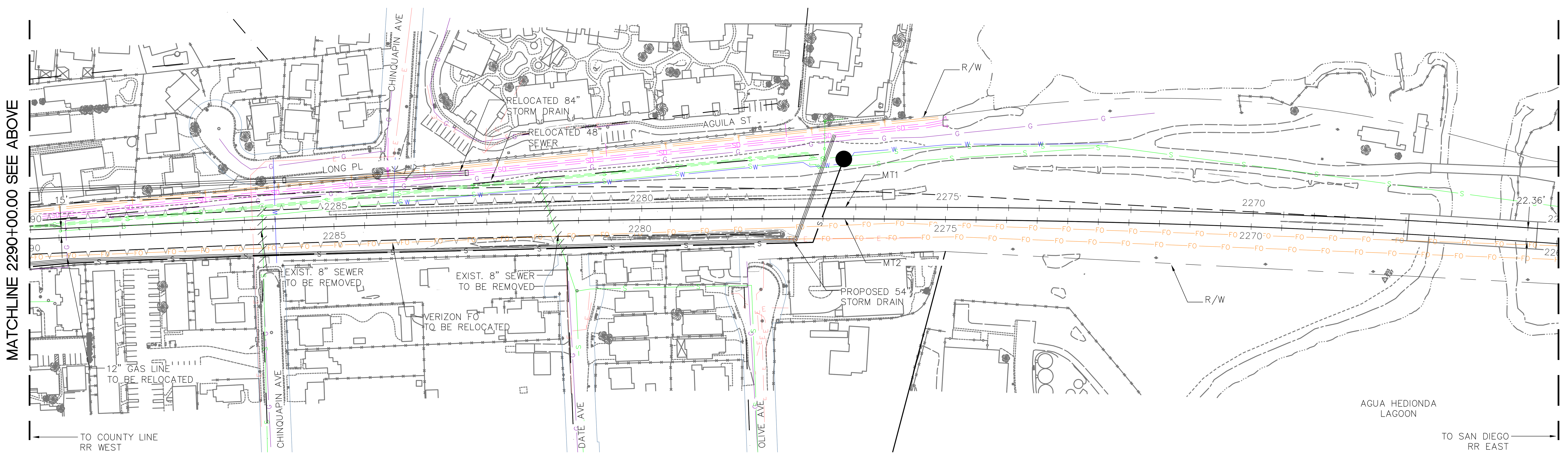
FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES
0 1 2 3

Revised: April 14, 2020
Path: T:\SanDiego\Projects\70129015\600_CADD\05_Official\70129015_UT-02 Long Printed:4/14/2020 3:32 PM



PLAN

1"=100'



PLAN

1"=100'

10%- NOT FOR CONSTRUCTION

100 50 0 100 200

HORIZONTAL SCALE 1"= 100'

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS
- E — EXISTING ELECTRIC LINE
- FO — EXISTING FIBER OPTIC LINE
- G — EXISTING GAS LINE
- S — EXISTING SEWER LINE
- SD — EXISTING STORM DRAIN LINE
- T — EXISTING TELECOM LINE
- W — EXISTING WATER LINE
- G — PROPOSED GAS LINE
- S — PROPOSED SEWER LINE
- SD — PROPOSED STORM DRAIN LINE
- PROPOSED CONCRETE CHANNEL

NO.	DATE	REVISIONS	BY	CHK	APRV

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		DATE
DESIGNED BY	PB	10/19
DRAWN BY	VE	10/19
CHECKED BY	MW	10/19
PRJ. ENG.	PB	10/19

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CARLSBAD VILLAGE RAILROAD TRENCH

LONG TRENCH ALTERNATIVE
UTILITY PLAN

STA 2265+00 TO 2315+00

SCALE: **AS SHOWN**

CONTRACT NO.

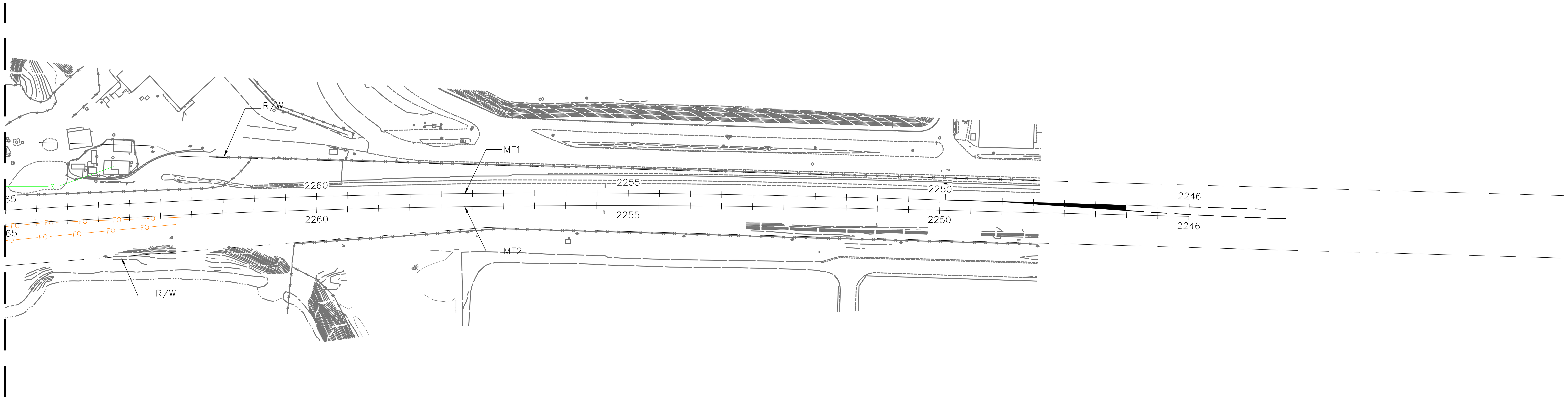
DRAWING NO. UT-03

SHEET NO. 20

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES
0 1 2 3

Revised: January 31, 2020
Path: T:\SanDiego\Projects\70129015\600_CADD\05_Official\70129015_UT-03 Long Printed: 3/4/2020 3:34 PM

MATCHLINE 2265+00.00 SEE SHEET UT-03



PLAN
1"=100'

10%- NOT FOR CONSTRUCTION

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

N

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS
- E — EXISTING ELECTRIC LINE
- FO — EXISTING FIBER OPTIC LINE
- G — EXISTING GAS LINE
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- T — EXISTING TELECOM LINE
- W — EXISTING WATER LINE
- G — PROPOSED GAS LINE
- S — PROPOSED SEWER LINE
- SD — PROPOSED STORM DRAIN LINE
- PROPOSED CONCRETE CHANNEL

NO.	DATE	REVISIONS	BY	CHK	APRV

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STATE OF CALIFORNIA

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CHECKED BY	MW	10/19
PRJ. ENG.	PB	10/19

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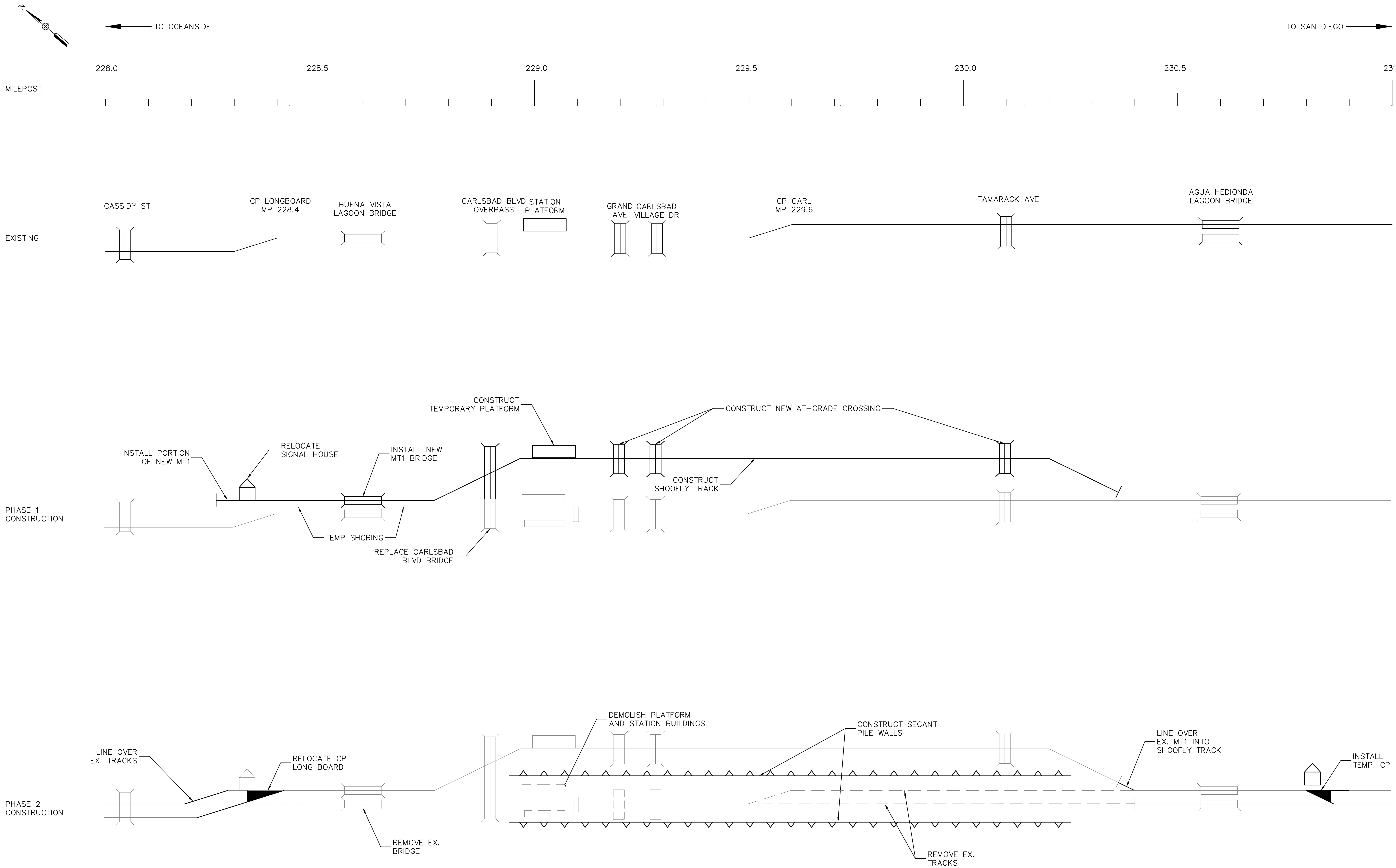
CARLSBAD VILLAGE RAILROAD TRENCH

LONG TRENCH ALTERNATIVE
UTILITY PLAN
STA 2246+00 TO 2265+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: UT-04
SHEET NO.: 21

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES
0 1 2 3

Revised: January 31, 2020
Path: T:\SanDiego\Projects\701290.15\600_CADD\05_Official\70129015_UT-04 Long Printed:3/4/2020 3:35 PM



10%- NOT FOR CONSTRUCTION

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STATE OF CALIFORNIA

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DESIGNED BY	PB	10/19
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CHECKED BY	MW	10/19
PRJ. ENG.	PB	10/19

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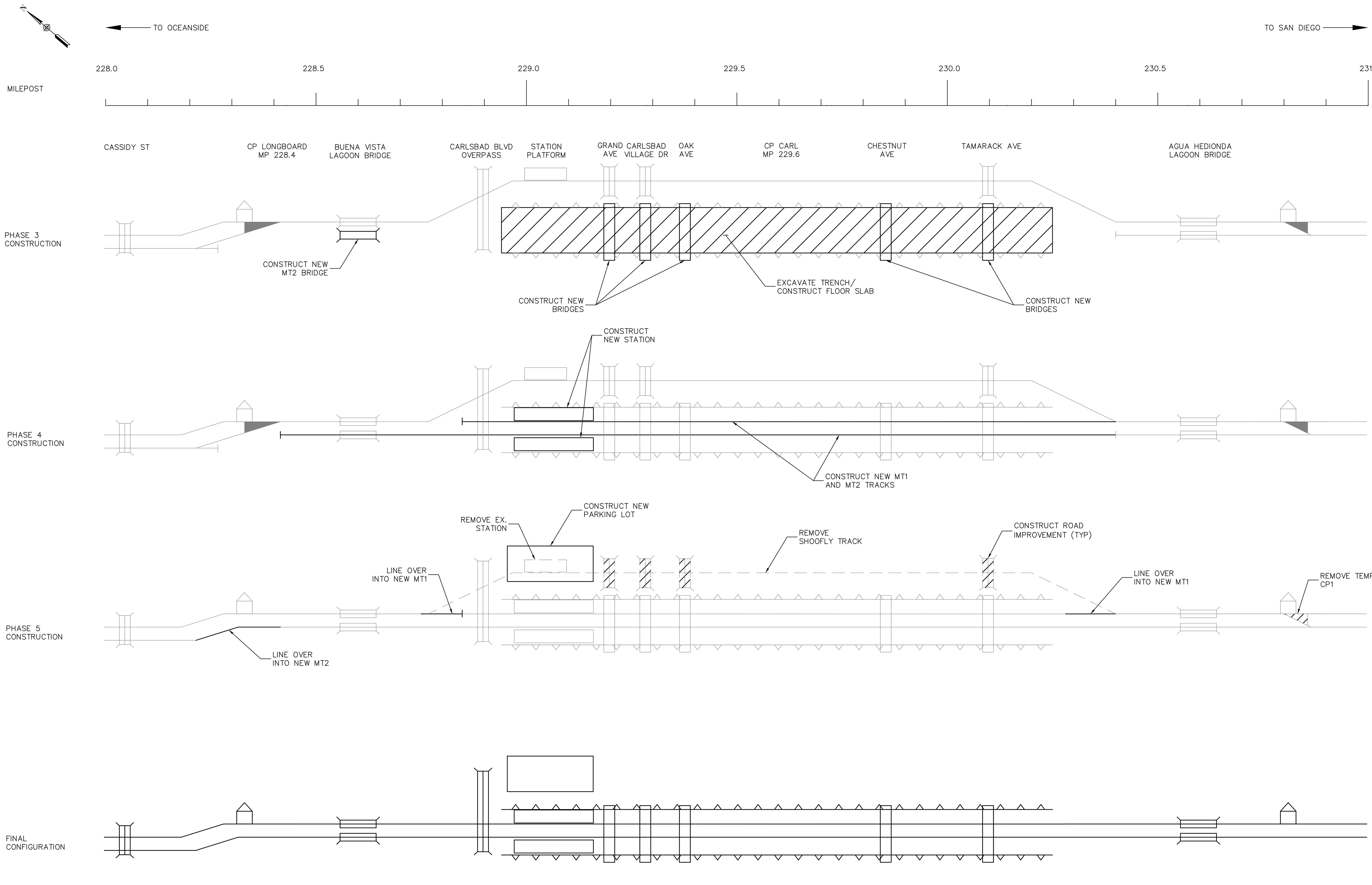
CARLSBAD VILLAGE RAILROAD TRENCH

LONG TRENCH
CONCEPTUAL PHASING PLAN

SCALE: NO SCALE
CONTRACT NO.
DRAWING NO. PP-01
SHEET NO. 22

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES
0 1 2 3

Revised: January 31, 2020
Path: T:\SanDiego\Projects\701290.15\600_CADD\05_Official\70129015_PP-01 Long - Construction Staging Printed: 3/4/2020 3:35 PM



10%- NOT FOR CONSTRUCTION

Revised: January 31, 2020
Path: T:\SanDiego\Projects\701290.15\600_CADD\05_Official\70129015_PP-02 Long – Construction Staging Printed: 3/4/2020 3:36 PM

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Exp. _____
CIVIL
STATE OF CALIFORNIA

		DATE
DESIGNED BY	PB	10/19
DRAWN BY	VE	10/19
CHECKED BY	MW	10/19
PRJ. ENG.	PB	10/19

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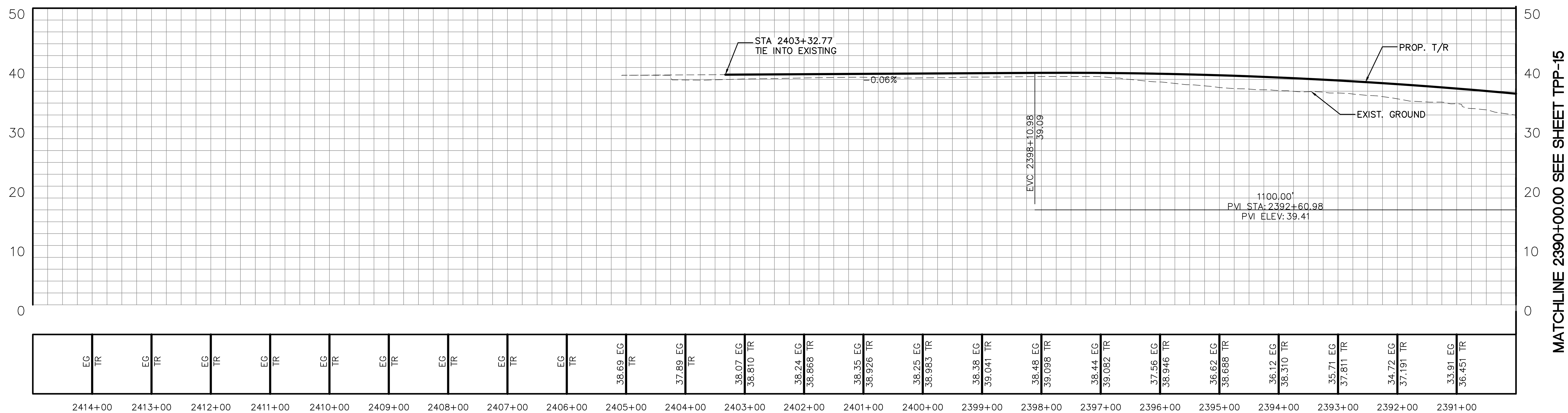
CARLSBAD VILLAGE RAILROAD TRENCH

LONG TRENCH
CONCEPTUAL PHASING PLAN

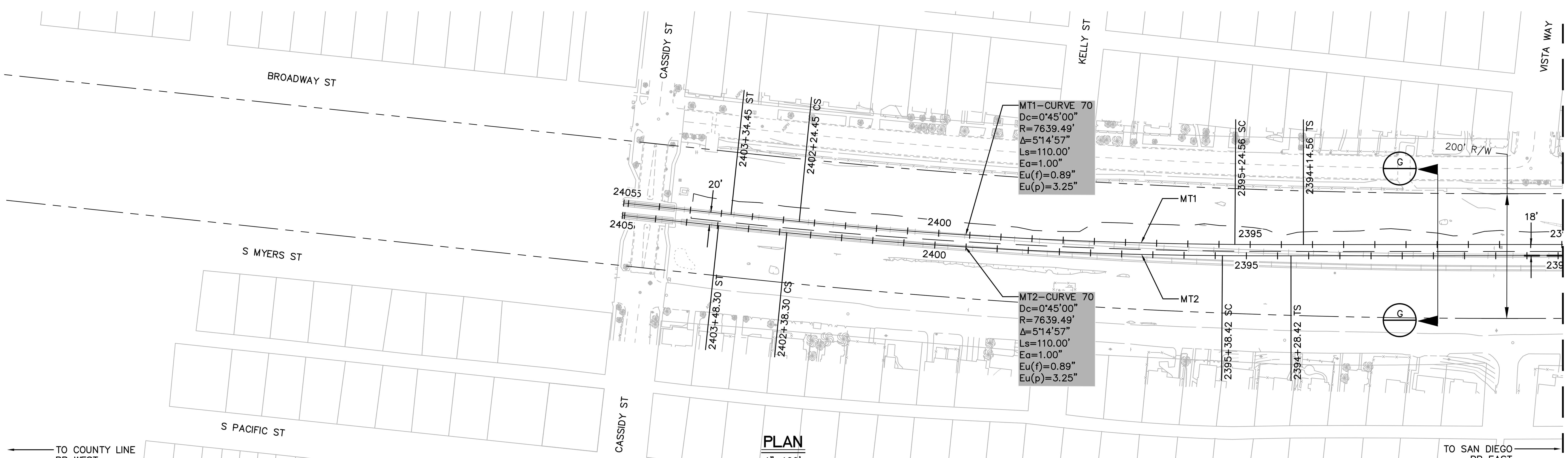
SCALE: NO SCALE
CONTRACT NO.
DRAWING NO.: PP-02
SHEET NO.: 23

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES
0 1 2 3



PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

HORIZONTAL SCALE 1"= 100'

VERTICAL SCALE 1"= 10'

10%- NOT FOR CONSTRUCTION

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

NO.	DATE	REVISIONS	BY	CHK	APRV

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CIVIL
STATE OF CALIFORNIA

		DATE
DESIGNED BY	PB	10/19
DRAWN BY	VE	10/19
CHECKED BY	MW	10/19
PRJ. ENG.	PB	10/19

SANDAG
San Diego's Regional Planning Agency

CARLSBAD VILLAGE RAILROAD TRENCH

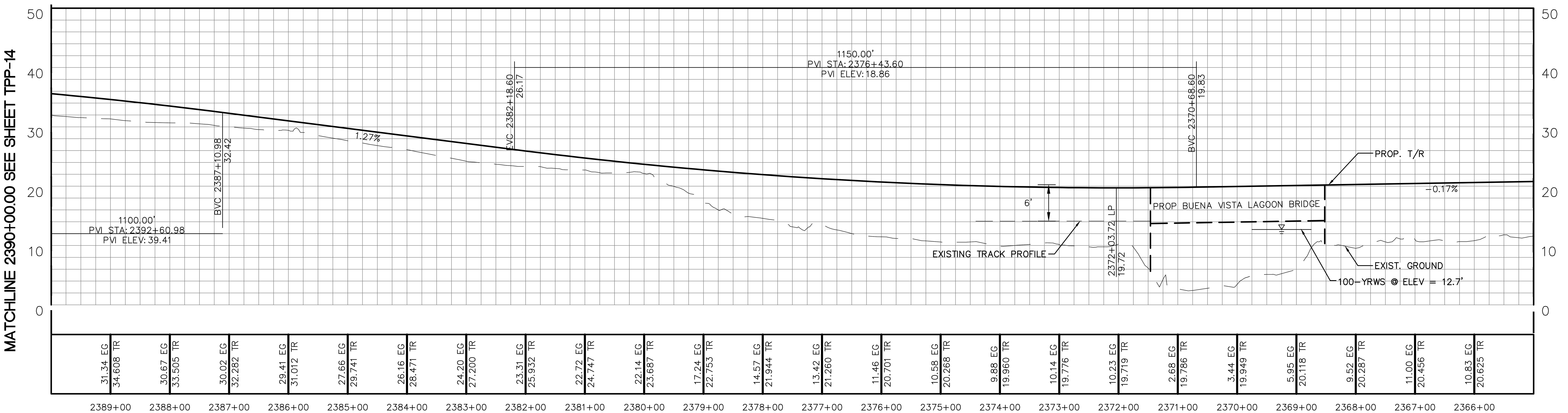
SHORT TRENCH ALTERNATIVE
TRACK PLAN AND PROFILE

STA 2390+00 TO STA 2415+00

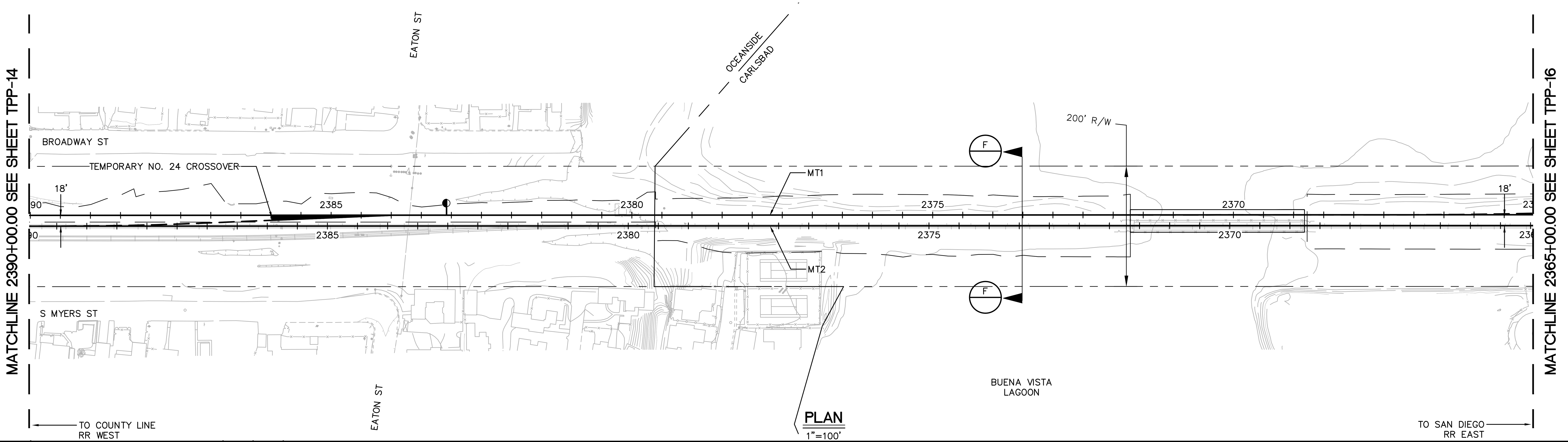
SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-14
SHEET NO.: 24

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES

Revised: February 5, 2020
Path: T:\SanDiego\Projects\70129015\600_CADD\05_Official\70129015_TPP-01 Short Printed: 3/4/2020 3:37 PM



PROFILE
HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN
1"=100'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10 5 0 10 20
VERTICAL SCALE 1"= 10'

LEGEND:
- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

NOT FOR CONSTRUCTION

NO.	DATE	REVISIONS	BY	CHK	APRV

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STATE OF CALIFORNIA

	DATE
DESIGNED BY PB	10/19
DRAWN BY VE	10/19
CHECKED BY MW	10/19
PRJ. ENG. PB	10/19

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San Diego's Regional Planning Agency

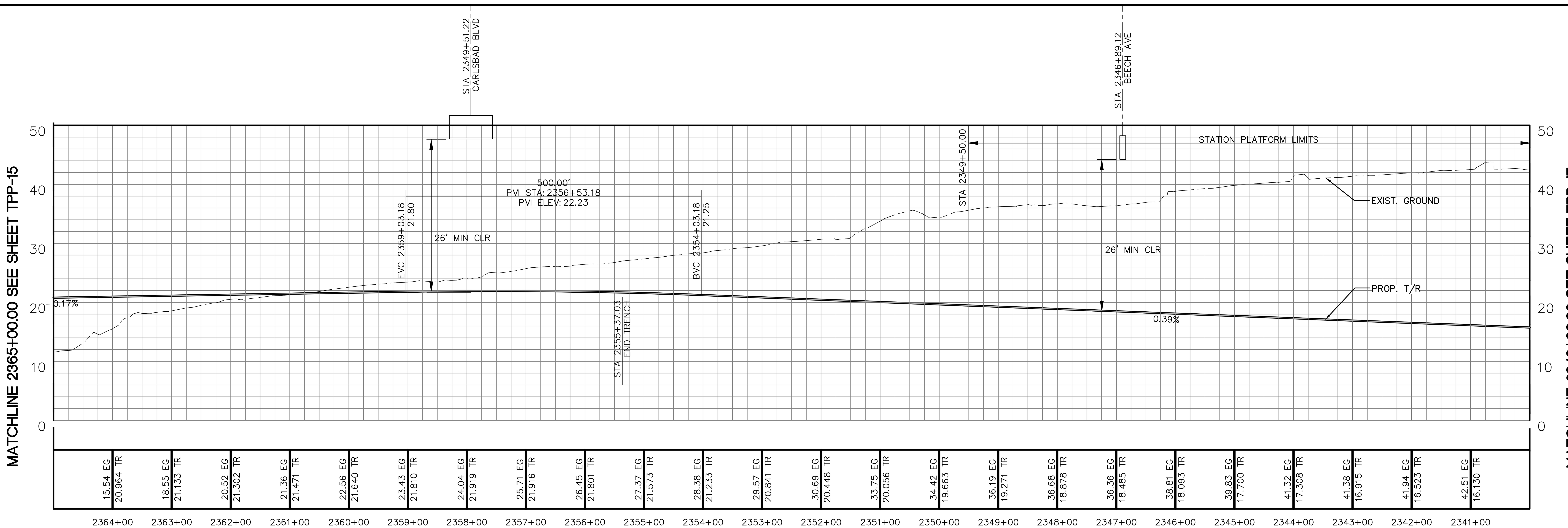
CARLSBAD VILLAGE RAILROAD TRENCH

SHORT TRENCH ALTERNATIVE
TRACK PLAN AND PROFILE
STA 2365+00 TO STA 2390+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-15
SHEET NO.: 25

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES
0 1 2 3

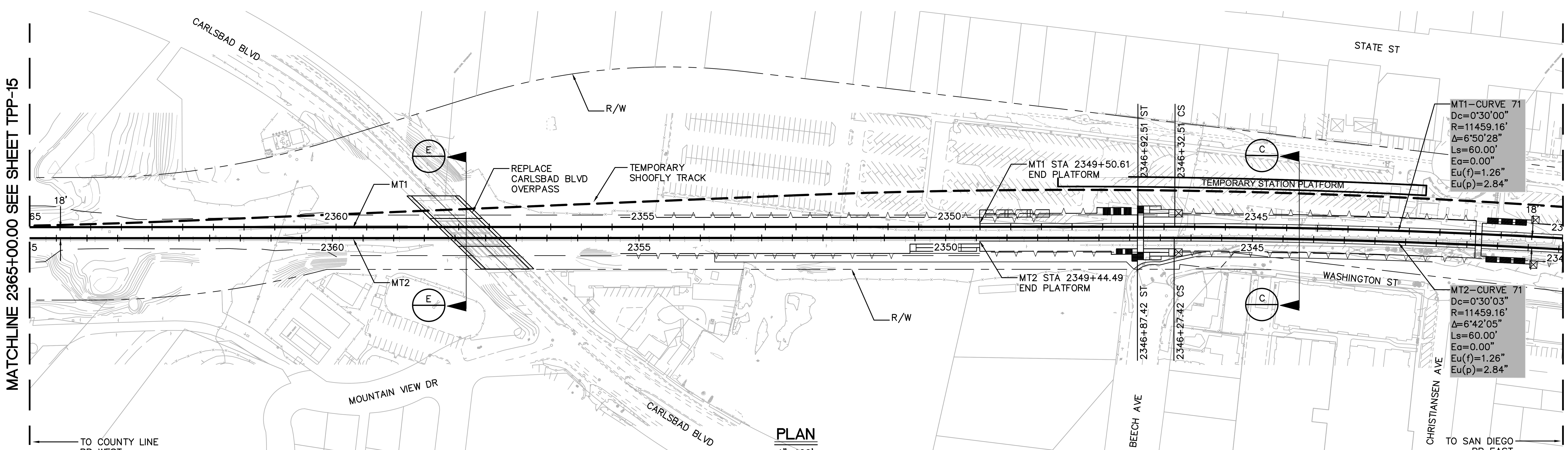
Revised: March 4, 2020
Path: T:\SanDiego\Projects\701290.15\600_CADD\05_Official\70129015_TPP-02 Short Printed: 4/14/2020 3:43 PM



PROFILE
HORIZONTAL 1"=100'
VERTICAL 1"=10'

10%- NOT FOR CONSTRUCTION

HORIZONTAL SCALE 1"= 100'
VERTICAL SCALE 1"= 10'



PLAN
1"=100'

LEGEND:
- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

NO.	DATE	REVISIONS	BY	CHK	APRV

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DRAWN BY	VE	10/19
CHECKED BY	MW	10/19
PRJ. ENG.	PB	10/19

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San Diego's Regional Planning Agency

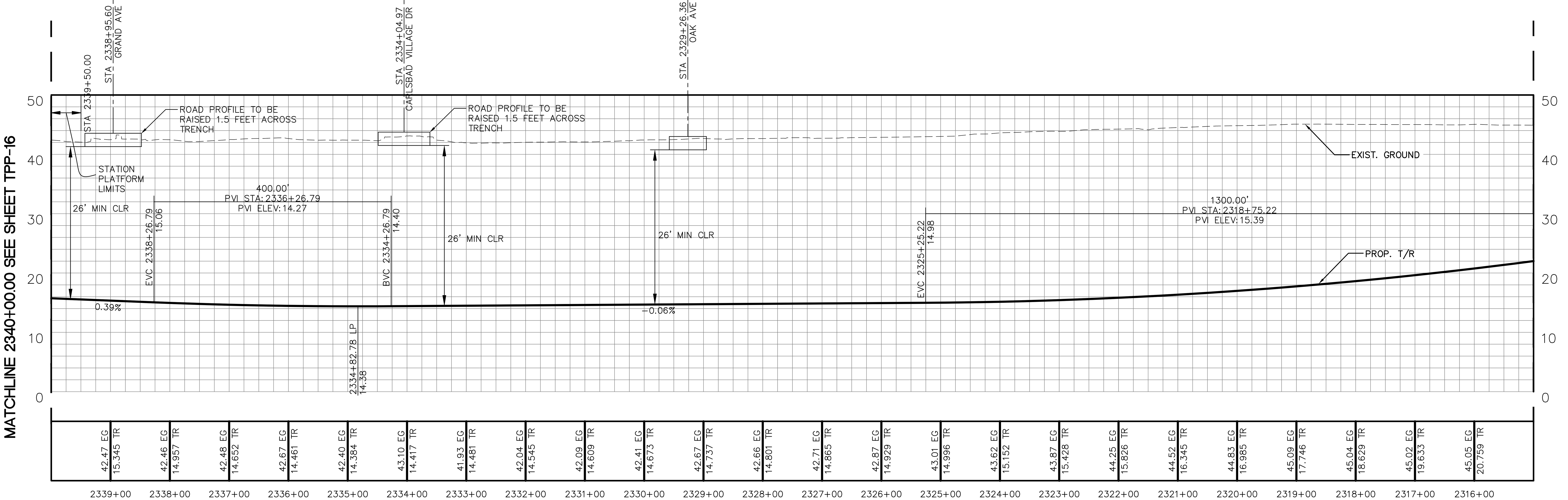
CARLSBAD VILLAGE RAILROAD TRENCH

SHORT TRENCH ALTERNATIVE
TRACK PLAN AND PROFILE
STA 2340+00 TO 2365+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO. TPP-16
SHEET NO. 26

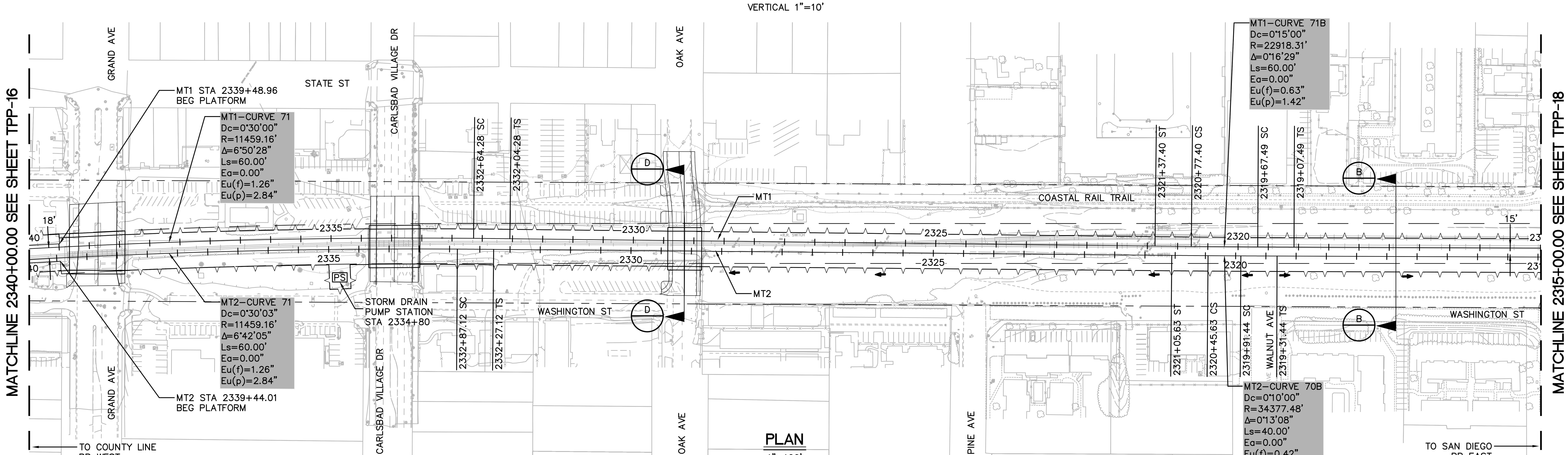
FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES
0 1 2 3

Revised: February 5, 2020
Path: T:\SanDiego\Projects\701290.15\600_CADD\05_Official\70129015_TPP-03 Short Printed: 3/4/2020 3:38 PM



PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10 5 0 10 20
VERTICAL SCALE 1"= 10'

10%- NOT FOR CONSTRUCTION

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

NO.	DATE	REVISIONS	BY	CHK	APRV

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No. ______
Exp. ______
CIVIL
STATE OF CALIFORNIA

		DATE
DESIGNED BY	PB	10/19
DRAWN BY	VE	10/19
CHECKED BY	MW	10/19
PRJ. ENG.	PB	10/19

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CARLSBAD VILLAGE RAILROAD TRENCH

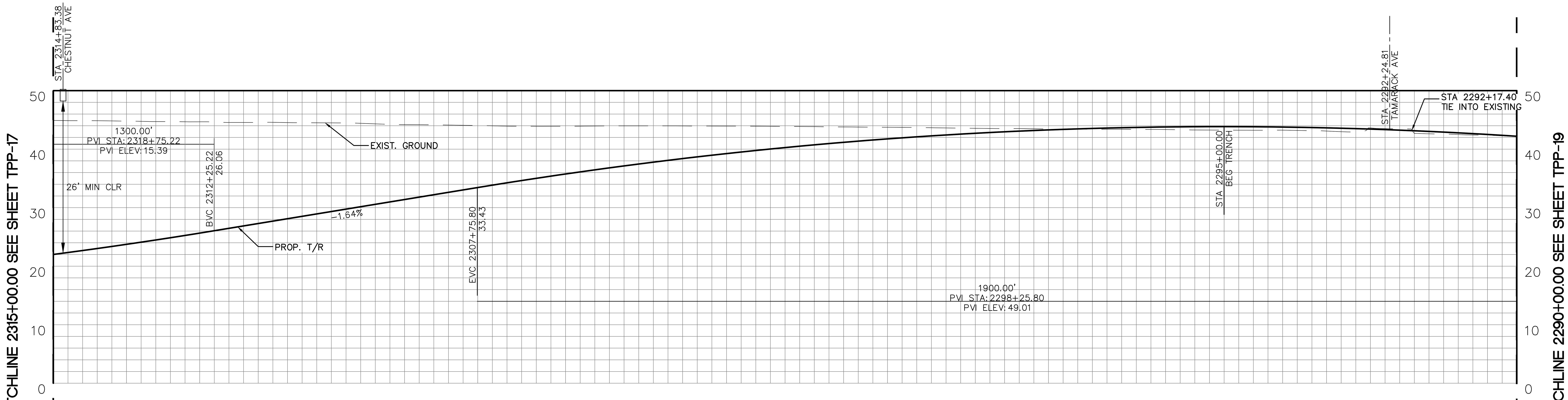
SHORT TRENCH ALTERNATIVE TRACK PLAN AND PROFILE

STA 2315+00 TO 2340+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-17
SHEET NO.: 27

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES
0 1 2 3

Revised: February 5, 2020
Path: T:\SanDiego\Projects\701290.15\600_CADD\05_Official\70129015_TPP-04 Short Printed: 3/4/2020 3:40 PM

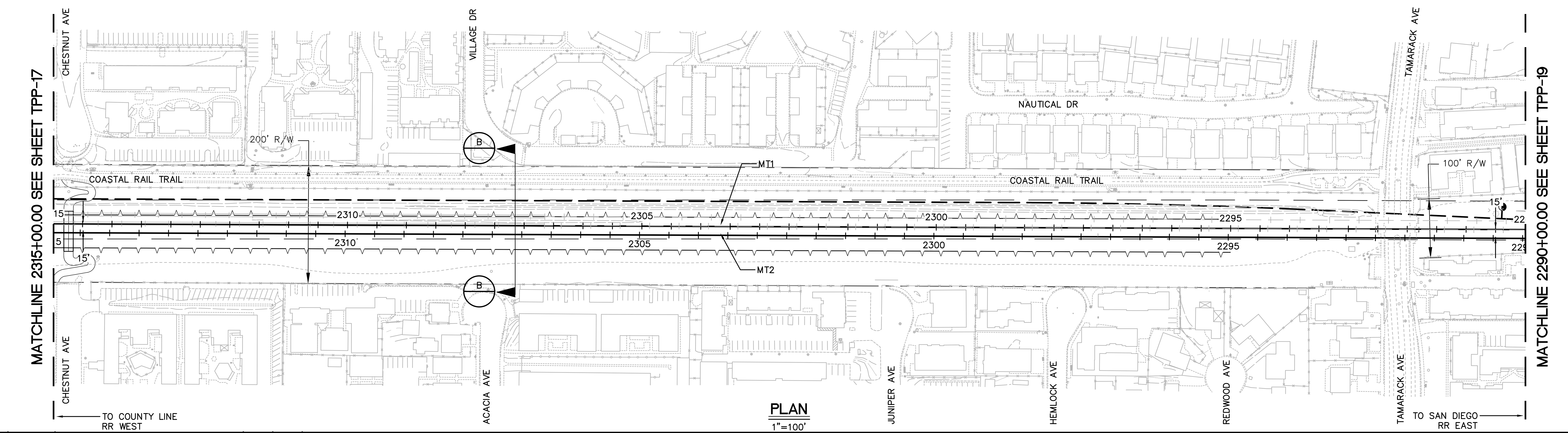


Station	EG	TR
2314+00	44.83	23.373
2313+00	44.71	24.863
2312+00	44.56	26.469
2311+00	44.54	28.110
2310+00	44.47	29.751
2309+00	44.19	31.391
2308+00	44.08	33.032
2307+00	43.92	34.635
2306+00	43.93	36.113
2305+00	43.98	37.462
2304+00	43.96	38.682
2303+00	43.92	39.773
2302+00	43.85	40.735
2301+00	43.75	41.567
2300+00	43.66	42.270
2299+00	43.53	42.844
2298+00	43.45	43.289
2297+00	43.40	43.605
2296+00	43.35	43.792
2295+00	43.25	43.850
2294+00	43.25	43.778
2293+00	42.98	43.577
2292+00	43.45	43.247
2291+00	42.50	42.788

PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'

10%- NOT FOR CONSTRUCTION



PLAN

1"=100'

HORIZONTAL SCALE 1"= 100'

VERTICAL SCALE 1"= 10'

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

NO.	DATE	REVISIONS	BY	CHK	APRV

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CHECKED BY	MW	10/19
PRJ. ENG.	PB	10/19

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CARLSBAD VILLAGE RAILROAD TRENCH

SHORT TRENCH ALTERNATIVE
TRACK PLAN AND PROFILE

STA 2290+00 TO 2315+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO. TPP-18
SHEET NO. 28

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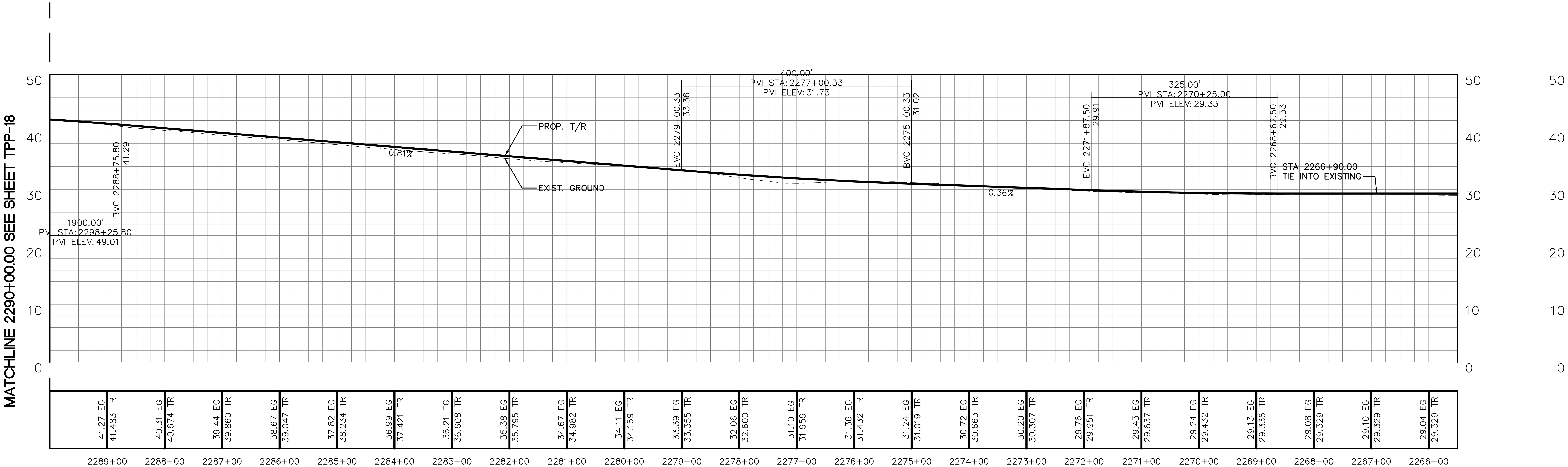

PROFILE

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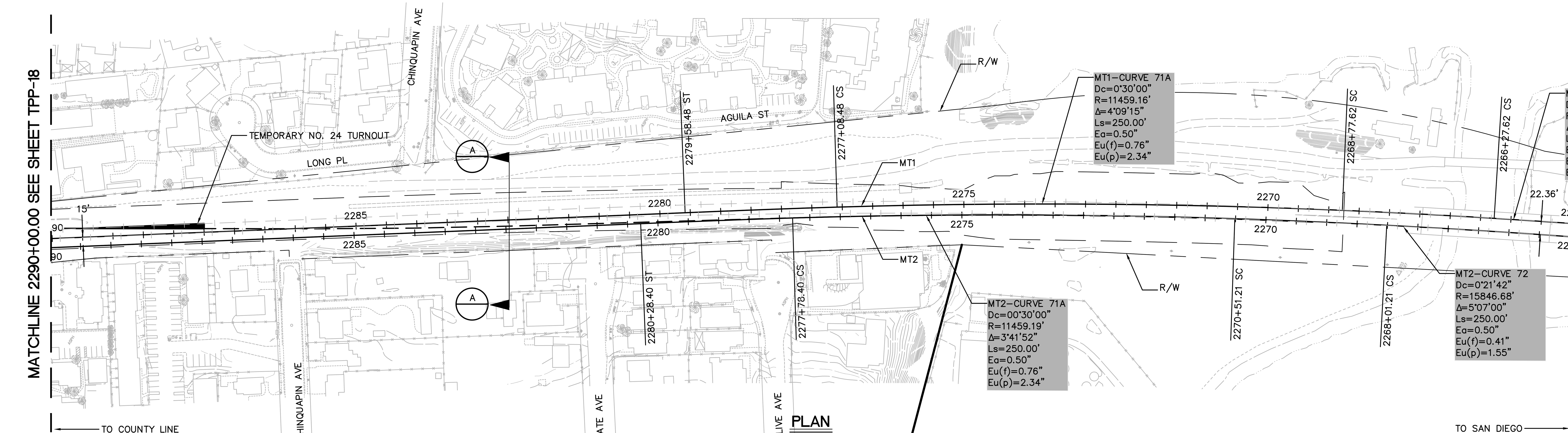
VERTICAL 1"=10'



PLAN

1"=100'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10 5 0 10 20
VERTICAL SCALE 1"= 10'

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT–OF–WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

10%- NOT FOR CONSTRUCTION

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CARLSBAD VILLAGE RAILROAD TRENCH

SHORT TRENCH ALTERNATIVE
TRACK PLAN AND PROFILE

STA 2265+00 TO 2290+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO. TPP-19
SHEET NO. 29

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES
0 1 2 3

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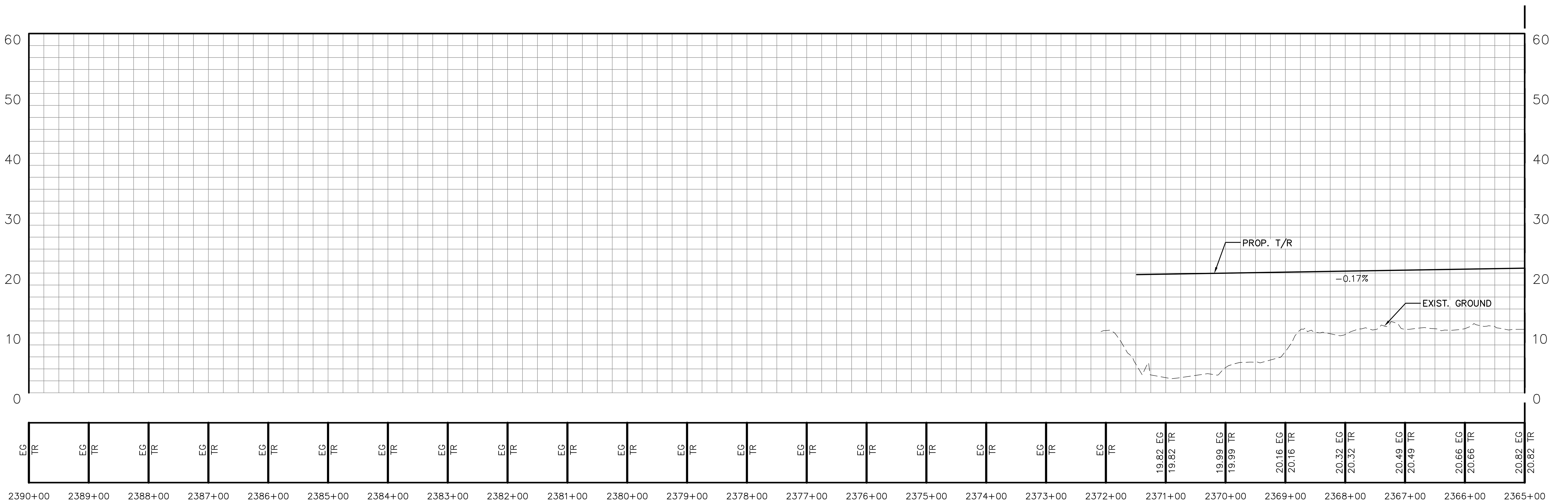
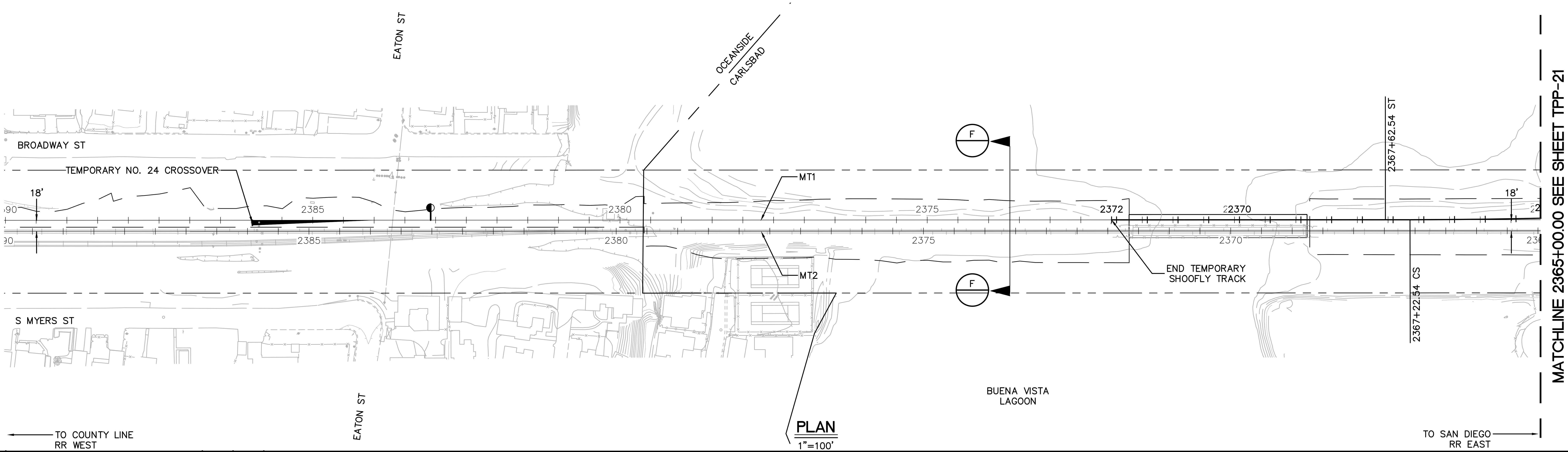


PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10 5 0 10 20
VERTICAL SCALE 1"= 10'

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

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CARLSBAD VILLAGE RAILROAD TRENCH

SHORT TRENCH SHOOFLY TRACK PLAN AND PROFILE

STA 2365+00 TO STA 2390+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-20
SHEET NO.: 30

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0 1 2 3

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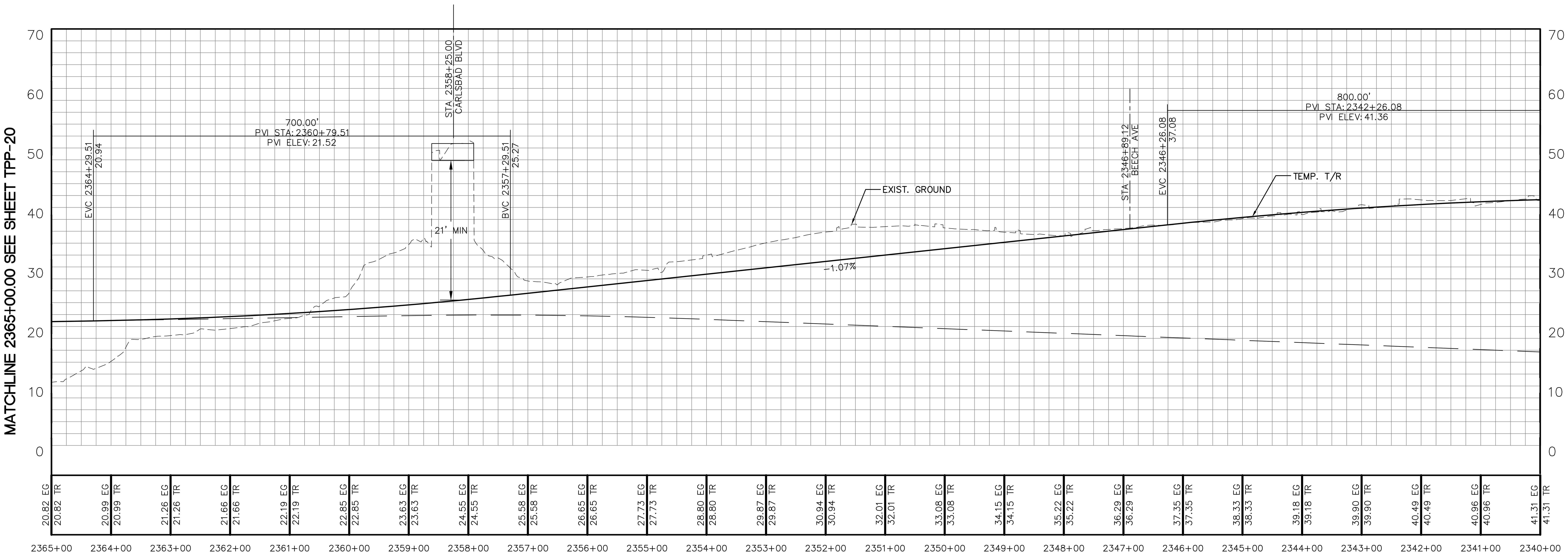
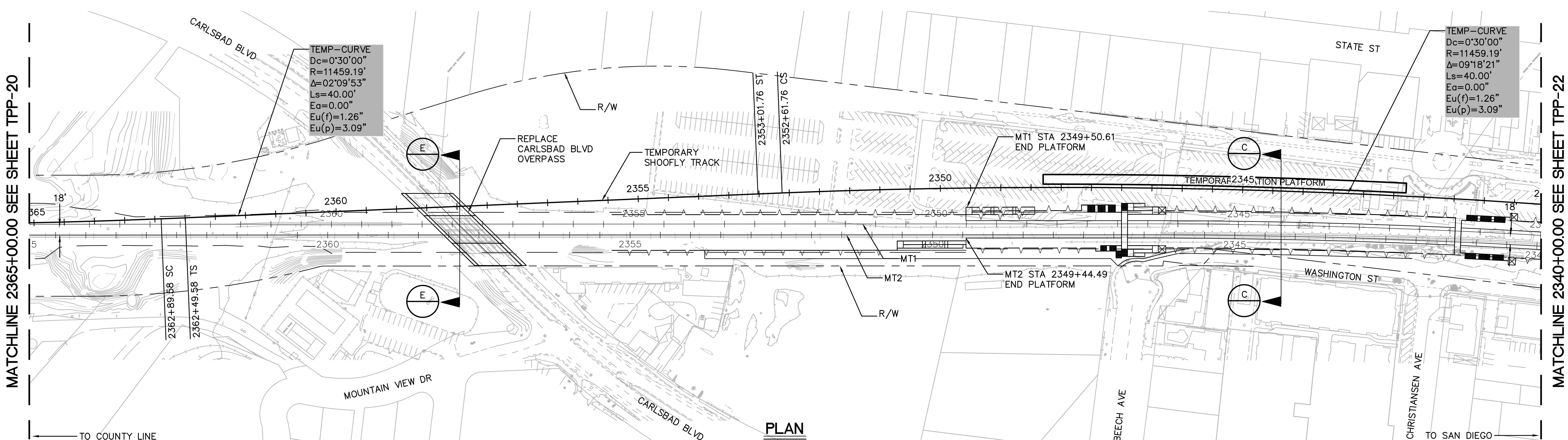


PROFILE
HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN
1"=100'

HORIZONTAL SCALE 1"= 100'
VERTICAL SCALE 1"= 10'

NOT FOR CONSTRUCTION

LEGEND:
- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

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CARLSBAD VILLAGE RAILROAD TRENCH

SHORT TRENCH SHOOFLY
TRACK PLAN AND PROFILE
STA 2340+00 TO 2365+00

SCALE AS SHOWN
CONTRACT NO.
DRAWING NO. TPP-21
SHEET NO. 31

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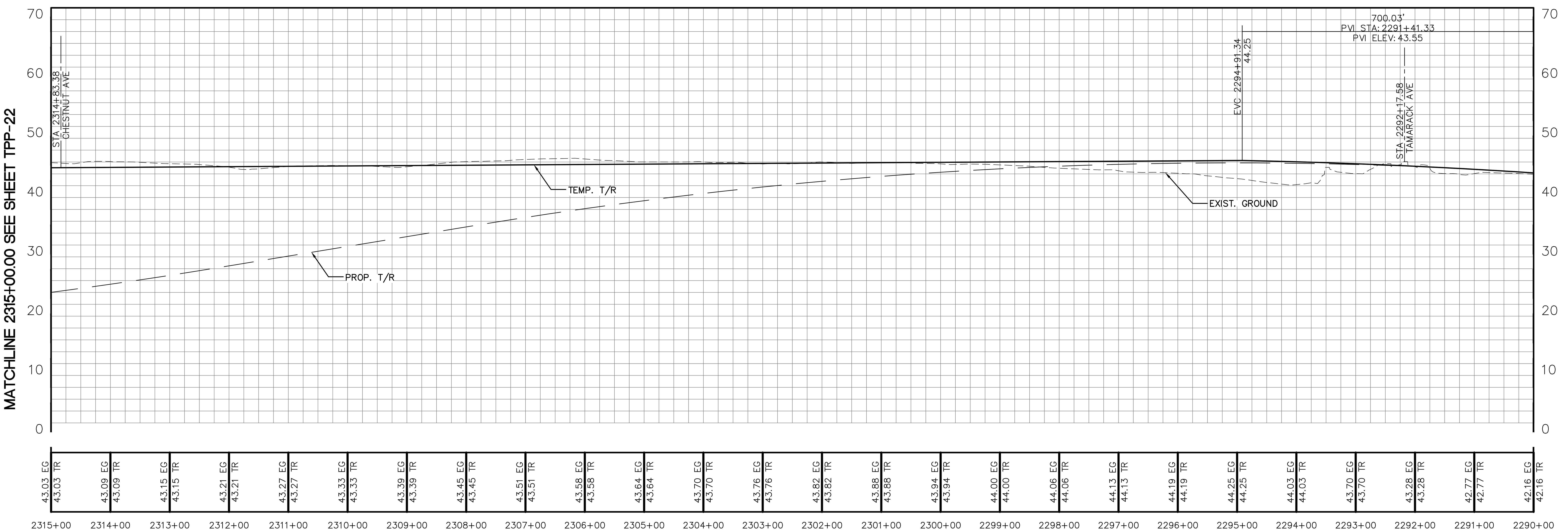
CARLSBAD VILLAGE RAILROAD TRENCH

SHORT TRENCH SHOOFLY TRACK PLAN AND PROFILE

STA 2315+00 TO 2340+00

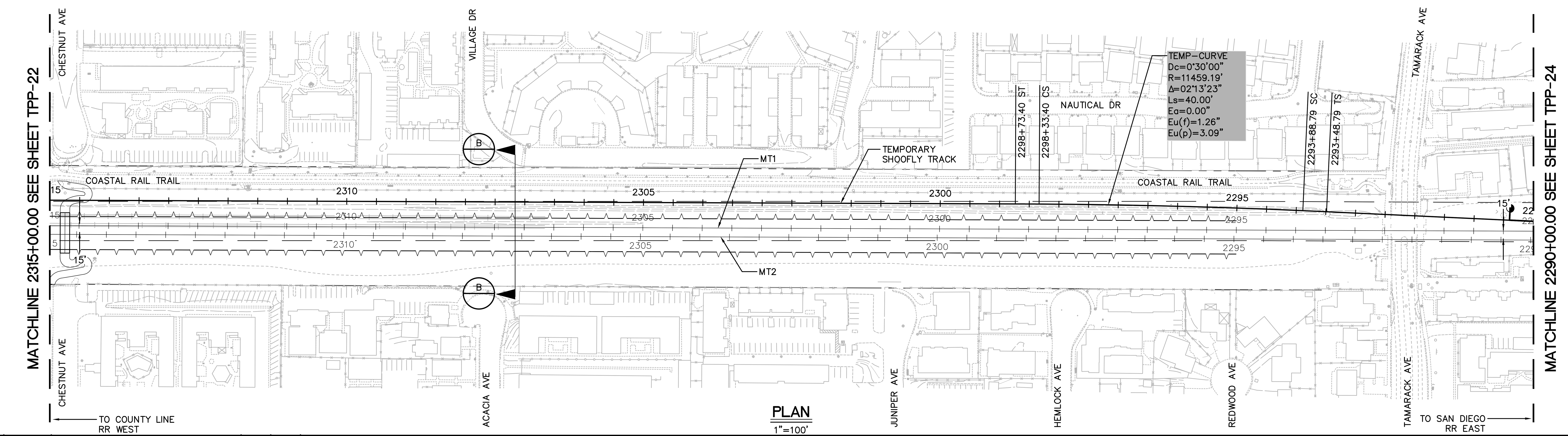
SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-22
SHEET NO.: 32

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES



PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

HORIZONTAL SCALE 1"= 100'

VERTICAL SCALE 1"= 10'

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

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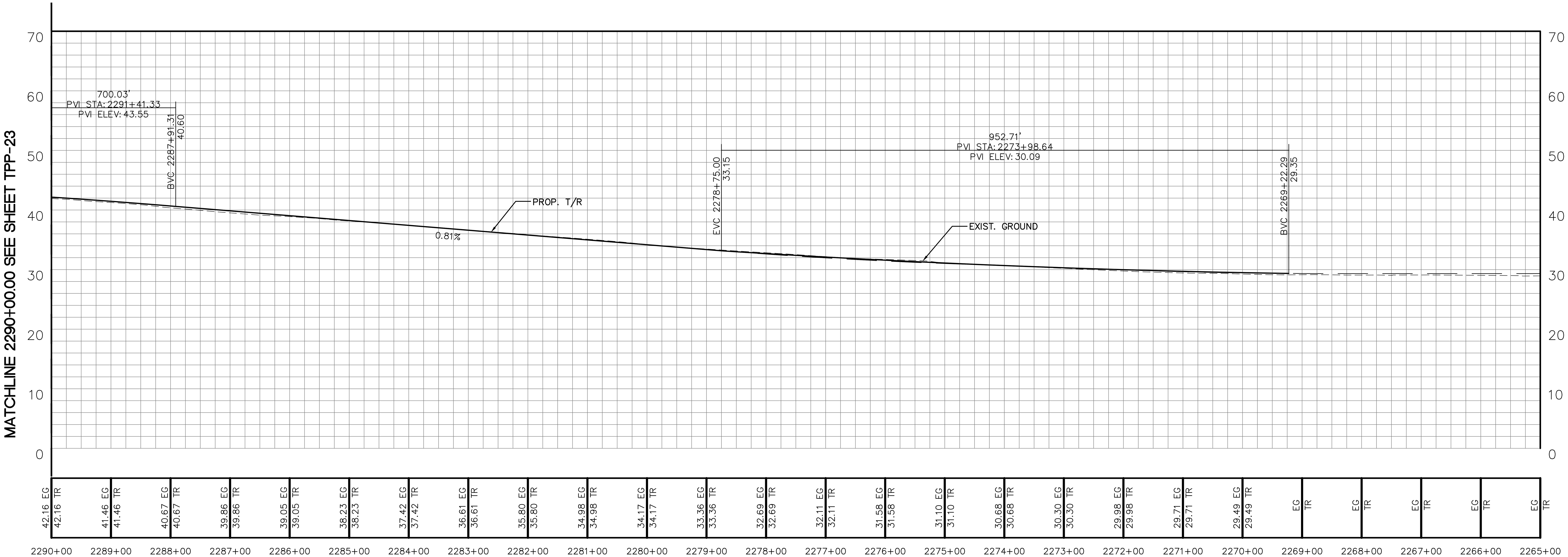
CARLSBAD VILLAGE RAILROAD TRENCH

SHORT TRENCH SHOOFLY
TRACK PLAN AND PROFILE

STA 2290+00 TO 2315+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO. TPP-23
SHEET NO. 33

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES

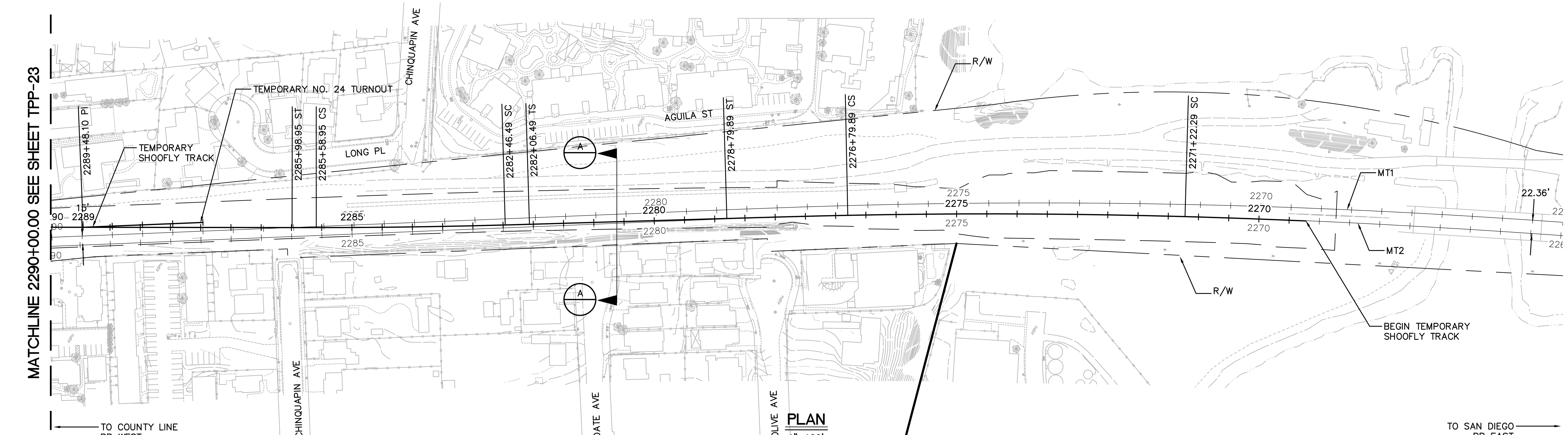


PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10 5 0 10 20
VERTICAL SCALE 1"= 10'



PLAN

1"=100'

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS

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CARLSBAD VILLAGE RAILROAD TRENCH

SHORT TRENCH SHOOFLY
TRACK PLAN AND PROFILE

STA 2265+00 TO 2290+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-24
SHEET NO.: 34

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES
0 1 2 3

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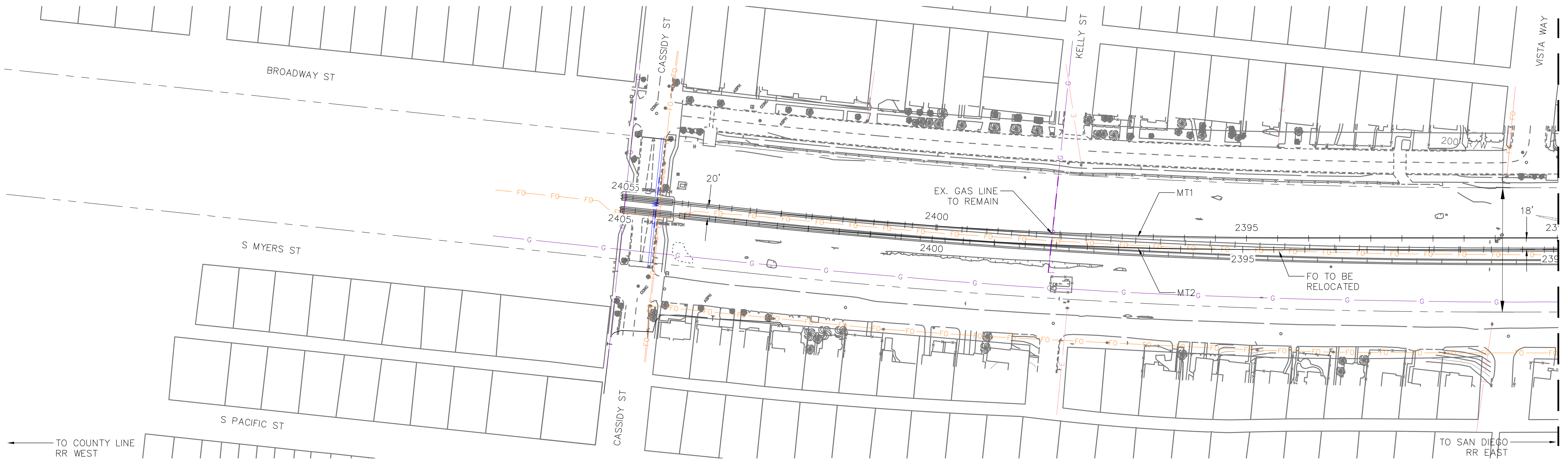

PLAN
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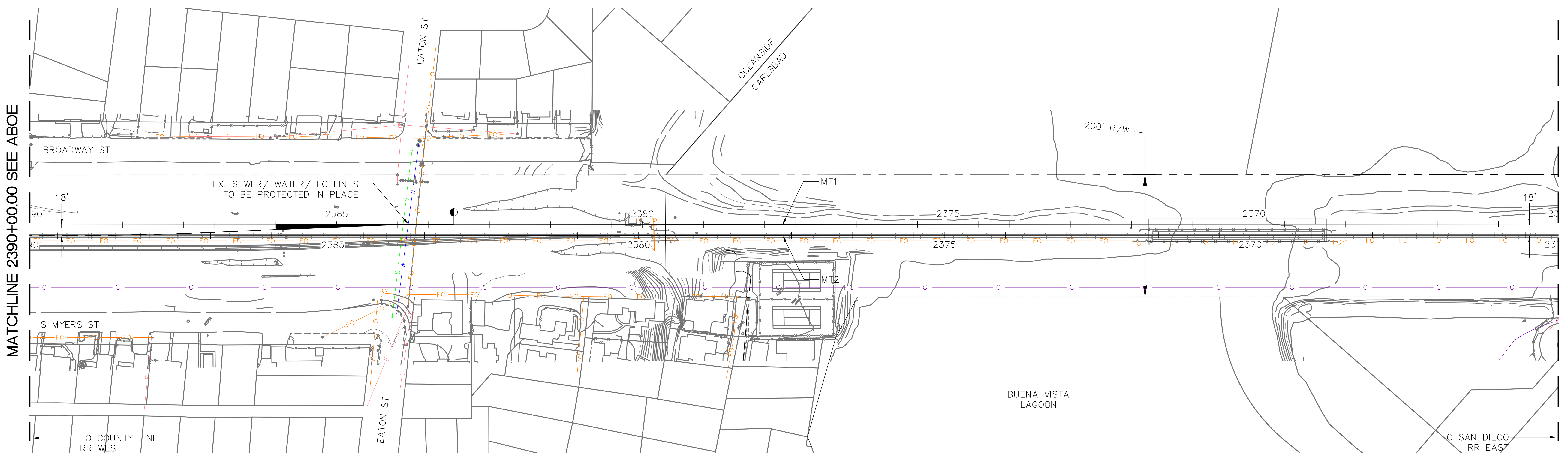

PLAN
1"=100'

10%- NOT FOR CONSTRUCTION

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS
- E EXISTING ELECTRIC LINE
- FO EXISTING FIBER OPTIC LINE
- G EXISTING GAS LINE
- S EXISTING SEWER LINE
- SD EXISTING STORM DRAIN LINE
- T EXISTING TELECOM LINE
- W EXISTING WATER LINE
- G PROPOSED GAS LINE
- S PROPOSED SEWER LINE
- SD PROPOSED STORM DRAIN LINE
- PROPOSED CONCRETE CHANNEL

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CARLSBAD VILLAGE RAILROAD TRENCH

SHORT TRENCH ALTERNATIVE
UTILITY PLAN
STA 2365+00 TO STA 2405+00

SCALE: **AS SHOWN**
CONTRACT NO.
DRAWING NO. UT-05
SHEET NO. 35

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES
0 1 2 3

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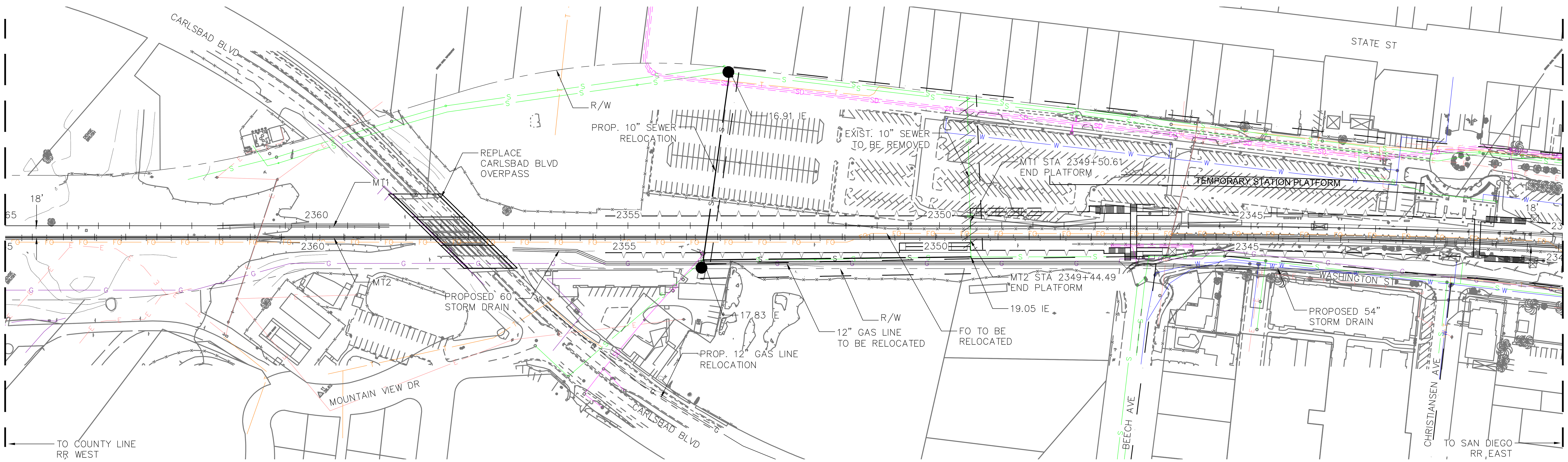

PLAN

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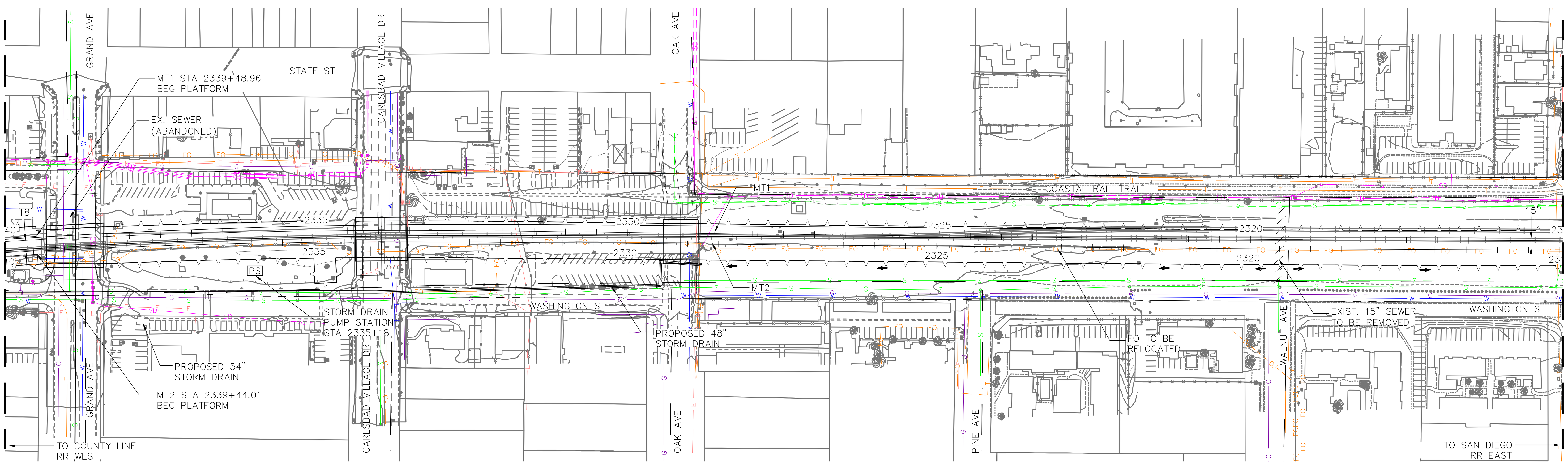

PLAN

1"=100'

100 50 0 100 200

HORIZONTAL SCALE 1"= 100'

NOT FOR CONSTRUCTION

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS
- E — EXISTING ELECTRIC LINE
- FO — EXISTING FIBER OPTIC LINE
- G — EXISTING GAS LINE
- S — EXISTING SEWER LINE
- SD — EXISTING STORM DRAIN LINE
- T — EXISTING TELECOM LINE
- W — EXISTING WATER LINE
- G — PROPOSED GAS LINE
- S — PROPOSED SEWER LINE
- SD — PROPOSED STORM DRAIN LINE
- PROPOSED CONCRETE CHANNEL

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CARLSBAD VILLAGE RAILROAD TRENCH

SHORT TRENCH ALTERNATIVE
TRACK PLAN AND PROFILE
STA 2315+00 TO 2365+00

SCALE: AS SHOWN

CONTRACT NO.

DRAWING NO. UT-06

SHEET NO. 36

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES
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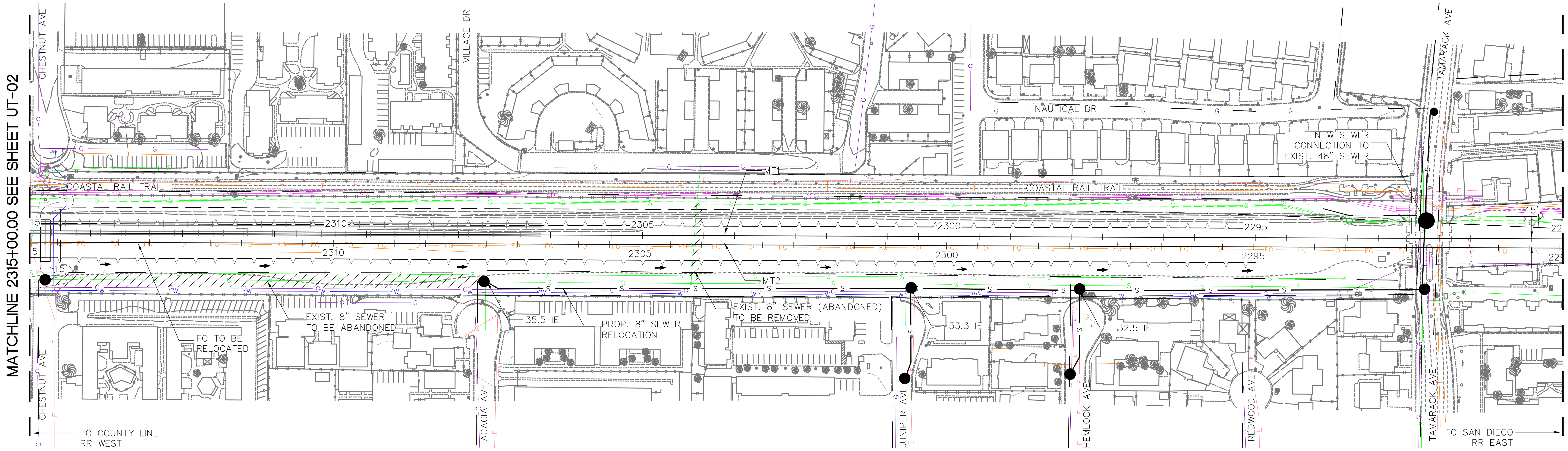

PLAN
1"=100'

PLAN
1"=100'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10%- NOT FOR CONSTRUCTION

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS
- E — EXISTING ELECTRIC LINE
- FO — EXISTING FIBER OPTIC LINE
- G — EXISTING GAS LINE
- S — EXISTING SEWER LINE
- SD — EXISTING STORM DRAIN LINE
- T — EXISTING TELECOM LINE
- W — EXISTING WATER LINE
- G — PROPOSED GAS LINE
- S — PROPOSED SEWER LINE
- SD — PROPOSED STORM DRAIN LINE
- PROPOSED CONCRETE CHANNEL

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CARLSBAD VILLAGE RAILROAD TRENCH

SHORT TRENCH ALTERNATIVE
UTILITY PLAN
STA 2265+00 TO 2315+00

SCALE
AS SHOWN
CONTRACT NO.
DRAWING NO. UT-07
SHEET NO. 37

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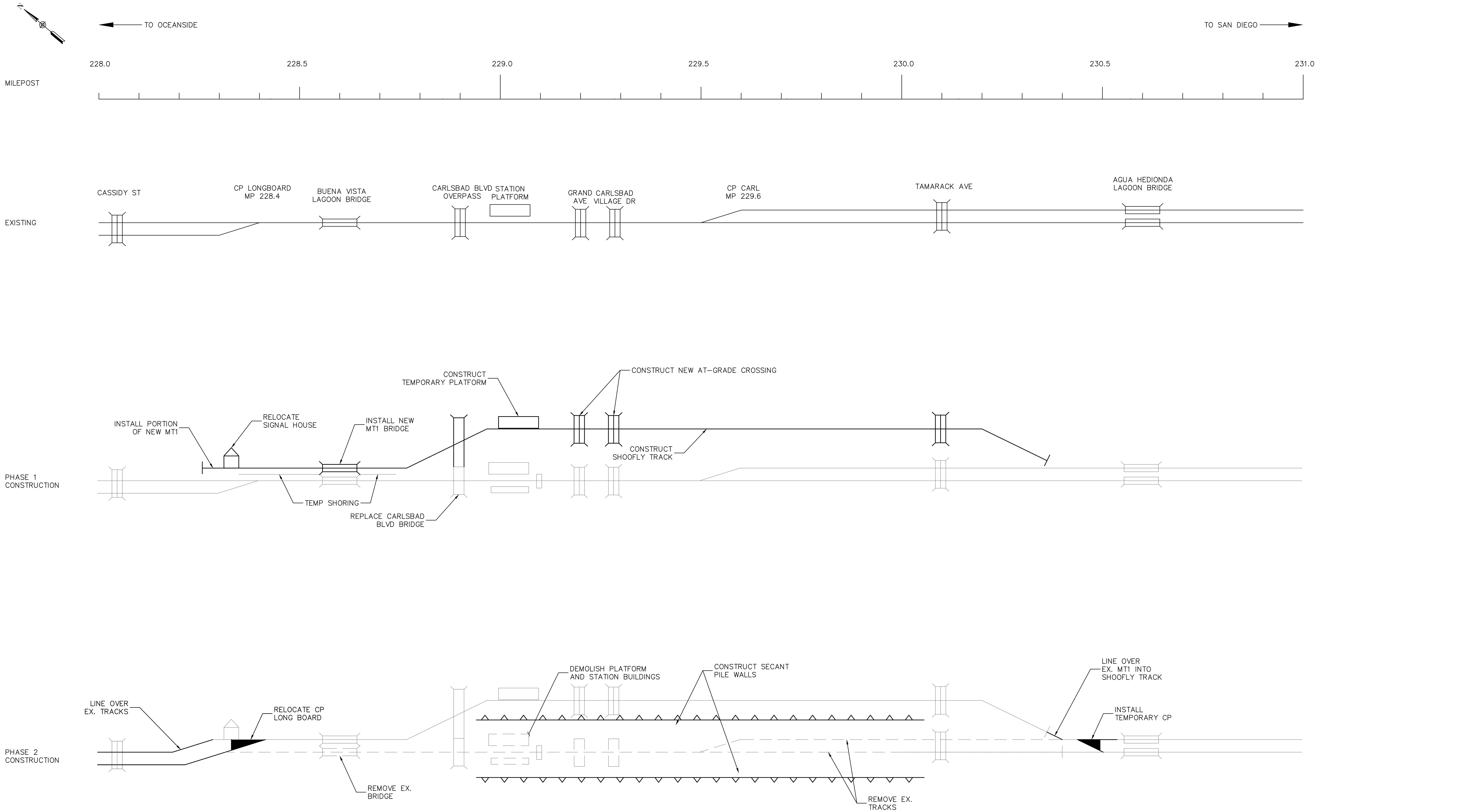

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CHECKED BY	MW	10/19
PRJ. ENG.	PB	10/19

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CARLSBAD VILLAGE RAILROAD TRENCH

SHORT TRENCH CONCEPTUAL PHASING PLAN

SCALE: NO SCALE
CONTRACT NO.
DRAWING NO. PP-03
SHEET NO. 38

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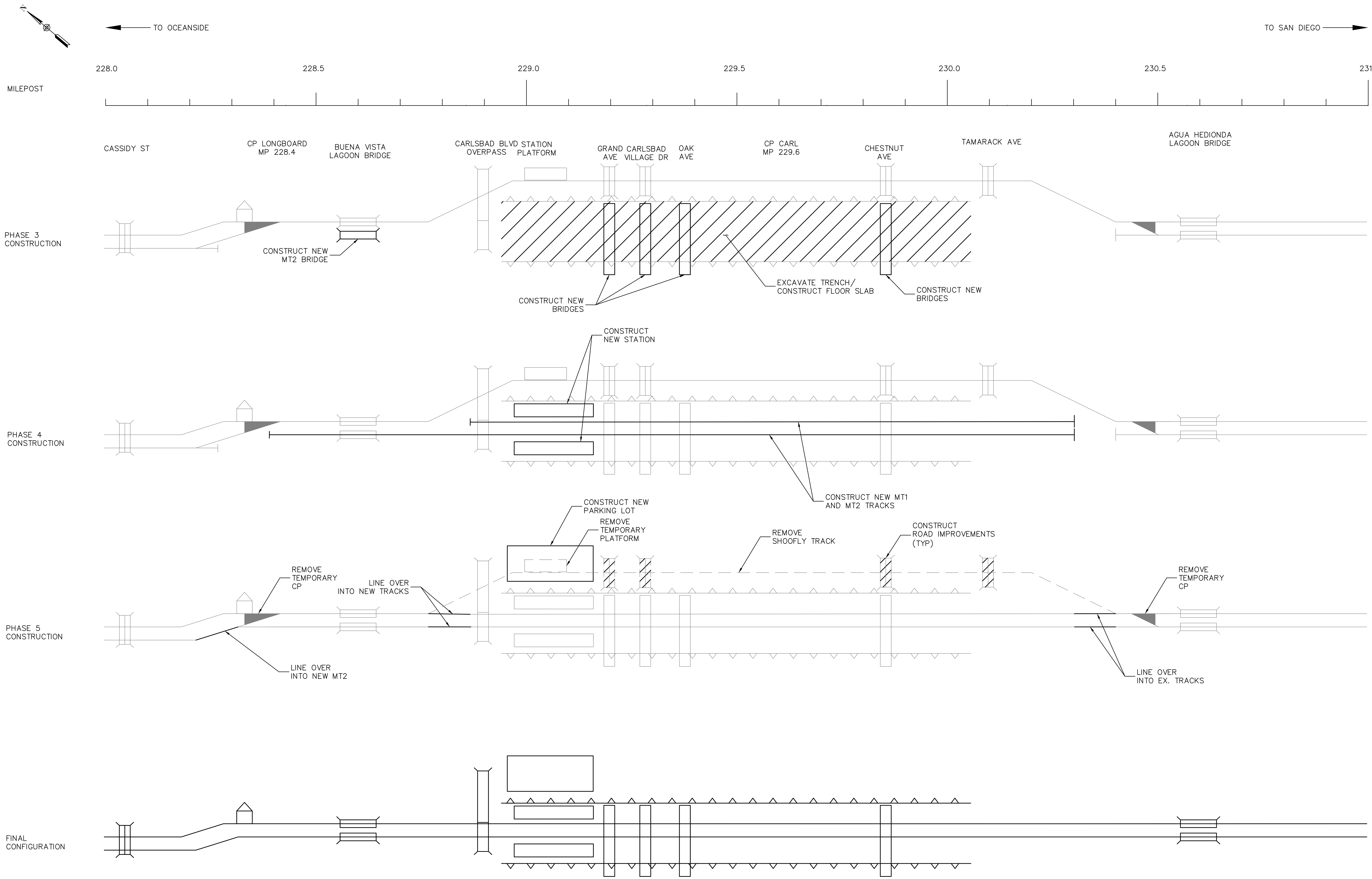

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DATE

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CARLSBAD VILLAGE RAILROAD TRENCH

SHORT TRENCH
CONCEPTUAL PHASING PLAN

SCALE
NO SCALE

CONTRACT NO.

DRAWING NO. PP-04

SHEET NO. 39

FOR REDUCED PLANS
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ATTACHMENT C:

WHITE PAPER ON ENVIRONMENTAL COMPLIANCE

Carlsbad Village and Barrio Railroad Trench Alternatives
Environmental White Paper

A. Summary

The Carlsbad Village Double Track project would construct a second railroad main track at grade from Cassidy Street in Oceanside south to approximately Walnut Avenue in Carlsbad (See Figure 1, Regional Location Map and Figure 2, Project Location Map). The At-Grade Alternative would construct a second track at the existing ground level, modify the at-grade street crossings, and construct a double-track bridge over Buena Vista Lagoon. The Carlsbad Village and Barrio Railroad Trench Alternatives would include grade separation of the railroad tracks by constructing the tracks in a trench, beneath the existing street elevations. The first alternative, known as the Short Trench Alternative (See Figure 3), would construct the double track railroad in a trench passing under vehicular overpasses at Grand Avenue, Carlsbad Village Drive, and Oak Avenue, with pedestrian overpasses at Beech Ave/Carlsbad Village Station and Chestnut Avenue. The second alternative is the Long Trench Alternative (See Figure 4), which would construct a railroad trench passing under vehicular overpasses at Grand Avenue, Carlsbad Village Drive, Oak Avenue, Chestnut Avenue, and Tamarack Avenue, with a pedestrian overpass at Beech Ave/Carlsbad Village Station. Both trench alternatives would require replacement of the Carlsbad Boulevard Overcrossing with a new bridge spanning the tracks.

Several legal and legislative considerations affecting the trench alternatives are discussed in this white paper. These include:

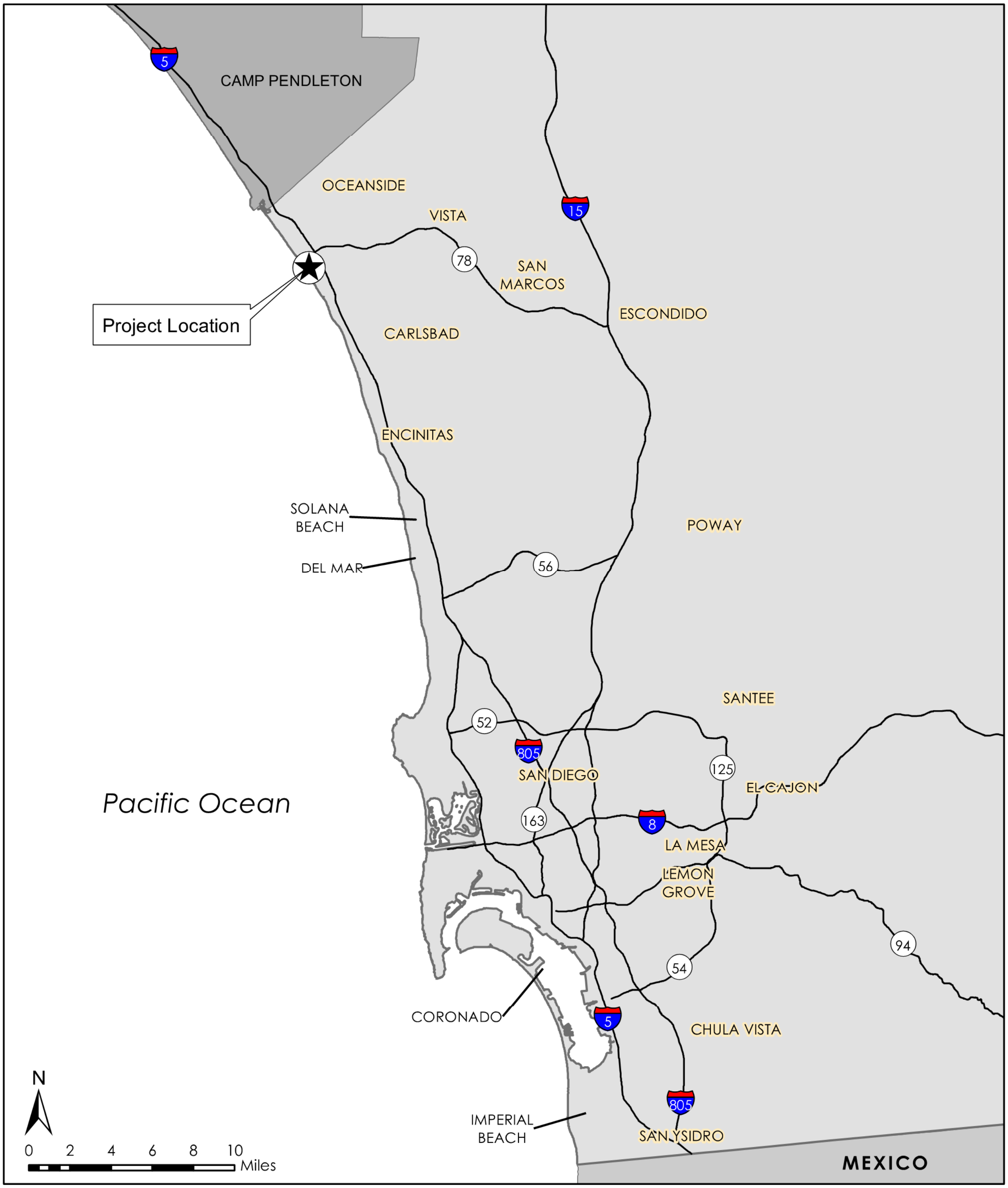
- The Interstate Commerce Commission Termination Act (ICCTA);
- City of Encinitas v. North County Transit District;
- Surface Transportation Board’s Decision on the North County Transit Development Board Petition for Declaratory Order;
- North County Transit District (NCTD) Outside Council Applicability of State and Local Permitting and Environmental Requirements to San Diego Associations of Governments (SANDAG) Projects;
- California Supreme Court Opinion, Friends of the Eel River v. North Coast Railroad Authority;
- Federal Supreme Court Denial of Petition for Writ of Certiorari, Friends of the Eel River v. North Coast Railroad Authority;
- the National Environmental Policy Act (NEPA); and,
- the California Environmental Quality Act (CEQA).

For NEPA compliance, assuming a federal action is associated with the Carlsbad Village and Barrio Railroad Trench (CBT) project, BRG recommends SANDAG consider preparation of Categorical Exclusion (CE) from NEPA (23 CFR Part 771.116 (c) (12)) supported by technical reports to document that no impacts are significant with project features incorporated to reduce impacts. Alternatively, BRG recommends SANDAG work with Federal Railroad Administration (FRA) toward preparation of an Environmental Assessment/Finding of No Significant Impact (EA/FONSI).

For CEQA Compliance, assuming NCTD is indistinguishable from the North Coast Railroad Authority and ICCTA preemption of CEQA does not apply, BRG recommends the project is likely eligible under the Statutory Exemption at Public Resources Code Section 21080.13, Railroad Grade Separation Projects.

BRG recommends the following technical reports prepared for the 2019 at-grade Carlsbad Village Double Track Project and *Carlsbad Village Double Track Trench Alternatives Economic Analysis and Feasibility Study* would need to be updated for the Trench project:

Carlsbad Village At-Grade Alternative Status of Environmental Technical Studies	
Study	**Recommended Action**
Community Impact Assessment	Update
Noise and Vibration Impact Assessment	Update
Section 4f Evaluation	Update
Preliminary Stormwater Management Plan	Update
Visual Impact Assessment	Update
Air Quality and GHG Impact Analysis	Update
Preliminary Drainage Study	Update
Land Use Technical Report	Update
Utility Impacts Report	Update
Biological Technical Report	Update
Cultural and Historical Resources Report	Update
Phase 1 Environmental Site Assessment	Update
Traffic Study	Update



SOURCE: FRA, 2019.

10/2/19

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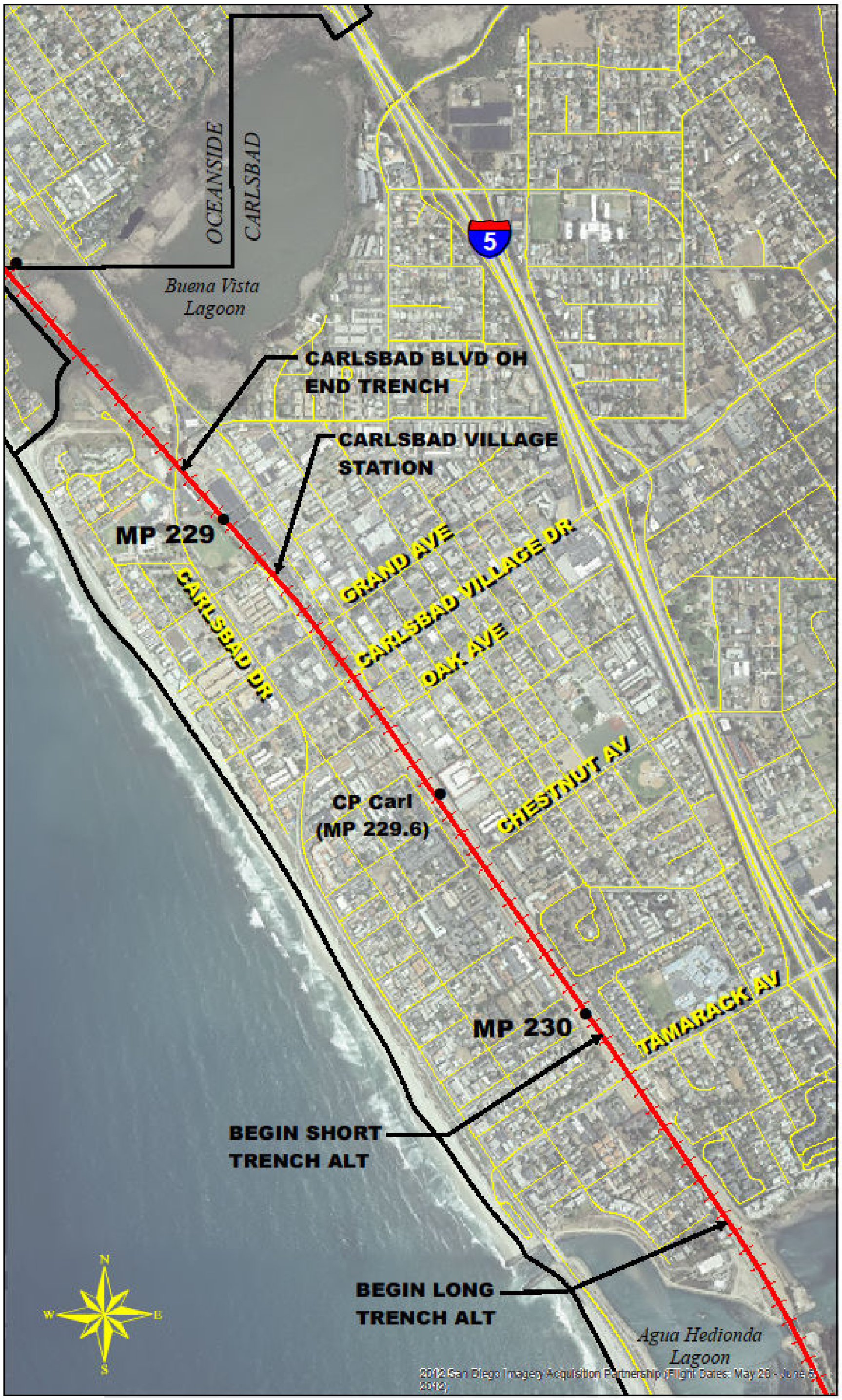
Carlsbad Village and Barrio Railroad Trench Alternatives

Regional Location

FIGURE 1



SOURCE: Source: T.Y. Lin International, 2017.

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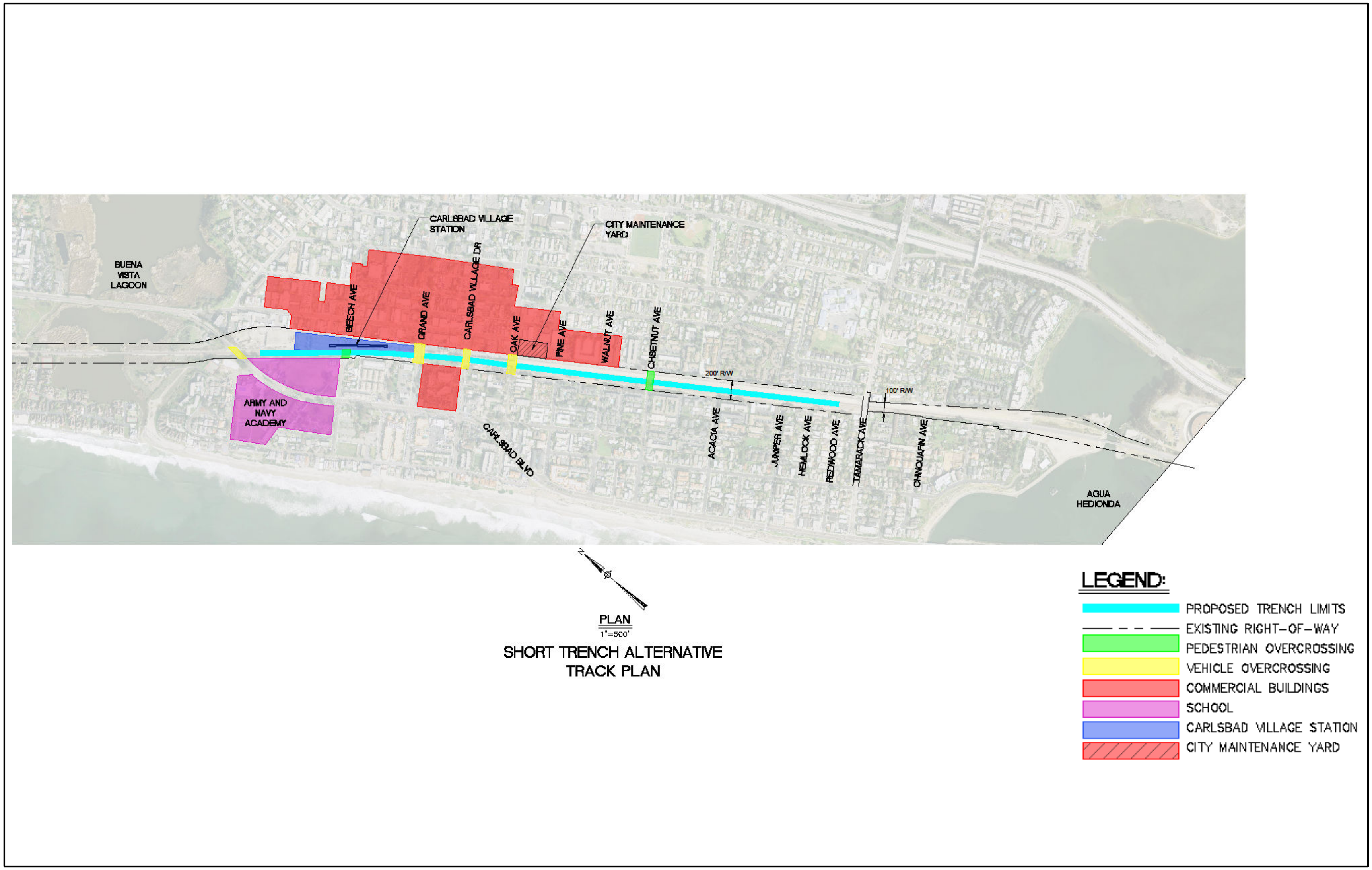
Carlsbad Village and Barrio Railroad Trench Alternatives

Project Location

FIGURE 2



SOURCE: Source: T.Y. Lin International, 2019.

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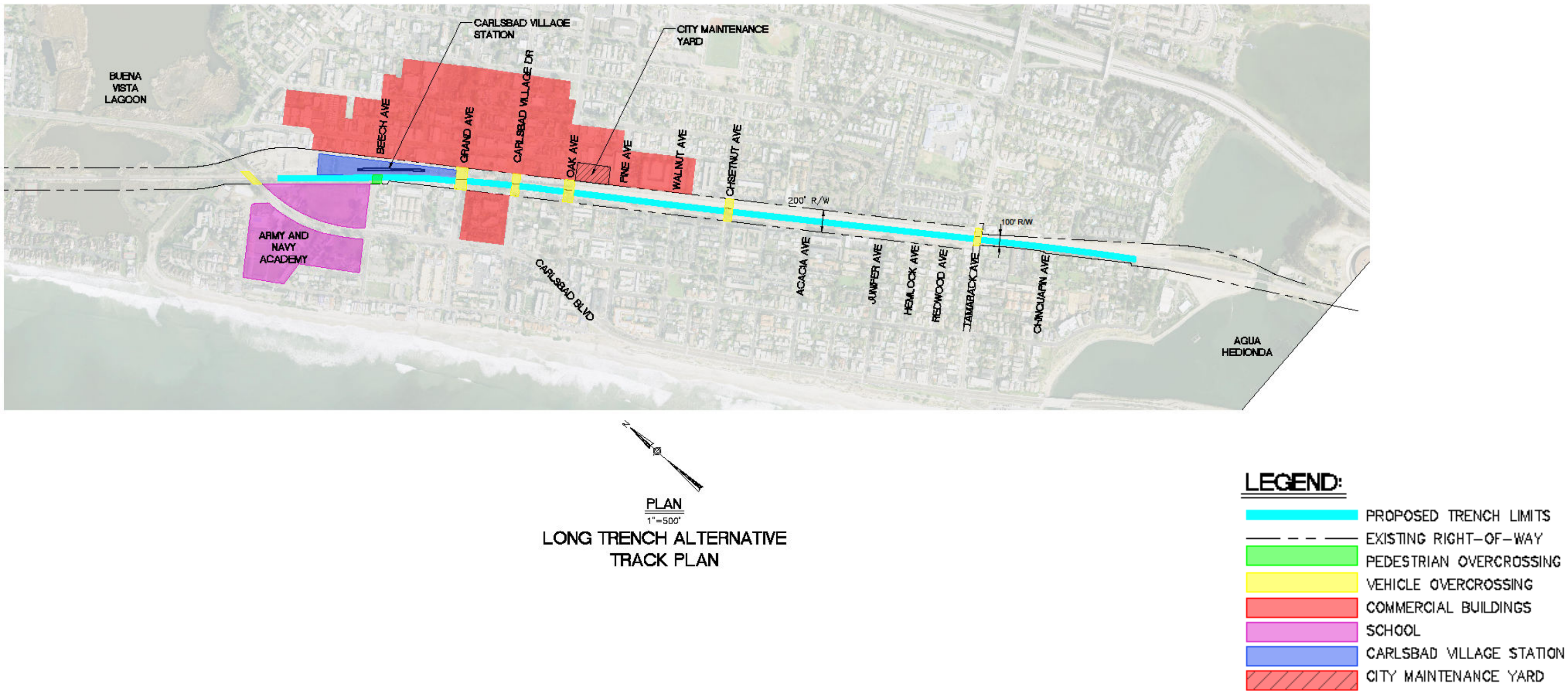
BRG CONSULTING, INC.

Carlsbad Village and Barrio Railroad Trench Alternatives

Short Trench Alternative

FIGURE 3



SOURCE: Source: T.Y. Lin International, 2019.

10/2/19

BRG CONSULTING, INC.

Carlsbad Village and Barrio Railroad Trench Alternatives

Long Trench Alternative

FIGURE 4

B. Project History and Description

Project History

Previous studies of the Carlsbad Village and Barrio Railroad Trench Alternatives project area have focused primarily on at-grade alternatives for double-tracking across Buena Vista Lagoon and through Downtown Carlsbad.

The California Department of Transportation (Caltrans) and the FRA considered a second main track with at-grade and trenching alternatives in the City of Carlsbad as part of the Tier 1 Los Angeles – San Diego – San Luis Obispo Rail Corridor (LOSSAN) Preliminary Environmental Impact Report and Preliminary Environmental Impacts Statement (PEIR/PEIS). The FRA issued the Record of Decision for the PEIS in 2009.

A Project Study Report prepared by RailPros, Inc. in August 2011 recommended that an at-grade second track alignment be constructed to the east of the existing track maintaining 18-foot track centers through the station area, Grand Ave, and Carlsbad Village Drive.

An Alternatives Analysis Report was prepared for the Pacific Surfliner Carlsbad Village Double Track Preliminary Engineering/National Environmental Policy Act Project by T.Y. Lin International in April 2014 that studied various alternatives for at-grade double-tracking. This report recommended a preferred alternative that shifted the existing track 3 feet west and constructed a new track 15 feet east of the existing track. Subsequent to this work, T.Y. Lin International completed preliminary engineering for the project.

SANDAG and Caltrans prepared the North Coast Corridor Public Works Plan and Transportation and Resource Enhancement Program (PWP/TREP) that addressed transportation improvements from Oceanside to San Diego (Approved by California Coastal Commission in August 2014). Double tracking through downtown Carlsbad and a new replacement railroad bridge over Buena Vista Lagoon are included in the PWP/TREP. A trench alternative in the project area is not listed as a project in the PWP/TREP

In a letter addressed to the California Coastal Commission on July 17, 2014, the City of Carlsbad provided comments on the draft North Coast Corridor PWP/TREP. The comment letter included a request that SANDAG evaluate both an at-grade railroad option and a trench alternative. The City of Carlsbad, in cooperation with SANDAG, initiated preparation of a Feasibility Study for the grade separation of the railroad tracks and construction of the second track (Carlsbad Village Double Track – Railroad Trench Alternative Economic Analysis and Feasibility Study, January 2017).

BRG Consulting, Inc. completed preparation of the Tier 2 EA/FONSI, which was signed by the FRA in 2019. The EA/FONSI addressed the environmental impacts associated with adding a second main track and replacing the existing single-track bridge over Buena Vista Lagoon with a new double-track bridge. The project limits are from approximately Cassidy Street in Oceanside to Walnut Avenue in Carlsbad.

Project Description

Currently, two railroad trench alternatives are being considered by the City of Carlsbad and SANDAG, a Short Trench and a Long Trench. Both alternatives start in the north at Cassidy Street and would construct a double track replacement railroad bridge over Buena Vista Lagoon and there is no difference in this northern section of the project. The improvements in the northern section are also the same as those addressed in the 2019 EA/FONSI. The long and short trench would begin at approximately the Carlsbad Boulevard bridge over the railroad. The different trench alternatives would provide the following improvements:

Short Trench Alternative

- Lower the railroad in a trench to pass under an overpass at Carlsbad Boulevard, Beech Avenue (pedestrian Only), Grand Avenue, Carlsbad Village Drive, Oak Avenue, and Chestnut Avenue (pedestrian only).
- Maintain Tamarack Avenue as an at-grade crossing.
- Minimize impacts to on-street traffic during construction.
- Minimize impacts to railroad operations during construction.
- Provide double-tracking from Cassidy Street in Oceanside to the Agua Hedionda Lagoon Bridge.

Long Trench Alternative

- Lower the railroad in a trench to pass under an overpass at Carlsbad Boulevard, Beech Avenue (pedestrian only), Grand Avenue, Carlsbad Village Drive, Oak Avenue, Chestnut Avenue, and Tamarack Avenue.
- Minimize impacts to on-street traffic during construction.
- Minimize impacts to railroad operations during construction.
- Provide double-tracking from Cassidy Street in Oceanside to the Agua Hedionda Lagoon Bridge.

The existing station and platforms would be demolished and rebuilt with the platforms in the trench and the station at ground level. It is anticipated the station/platforms arrangement would be somewhat similar to the station/platform's arrangement at the Solana Beach Coaster Station.

The trench would be lower in the middle than at either end; therefore, it is proposed that accumulated stormwater be pumped from the trench and into swales at either end of the trench. These swales would carry the stormwater to Buena Vista and/or Aqua Hedionda Lagoons.

C. Discussion of Relevant Legislative and Legal Considerations

Interstate Commerce Commission Termination Act

Under the ICCTA, 49 U.S.C. section 10101, et seq., the federal Surface Transportation Board (STB) has exclusive jurisdiction over regulation of the construction and operation of rail facilities

(49 U.S.C., Section 10501(b)). NCTD is considered a rail carrier within ICCTA's definition and is therefore subject to STB Jurisdiction (City of Encinitas v. North San Diego County Transit Development Board (S.D. Cal., Jan. 14, 2002, Case No. 01-CV-1734-J (AJB)) ("City of Encinitas").

City of Encinitas V. North County Transit District

In the mid 1990s, NCTD proposed to construct an approximately 1.7 mile passing track within the City of Encinitas. On or about June 26, 1996, NCTD filed for a Coastal Development Permit for the project in accordance with the California Coastal Act, a state law. The City of Encinitas determined that an Environmental Impact Report prepared per the requirements of CEQA was necessary. On July 19, 2001, stating that it feared the loss of state funding for the project, NCTD's board voted to proceed with construction of the passing track without the permit.

In August 2001, prior to NCTD's filing of this request for declaratory order, the City filed an action with the San Diego County Superior Court seeking declaratory and injunctive relief preventing NCTD from building the passing track until it fulfilled the state permitting requirement. On September 26, 2001, NCTD had the state court action removed to the United States District Court for the Southern District of California. On January 14, 2002, the District Court issued a decision finding that the City's permitting process is preempted by 49 U.S. C. 1050I(b), as broadened by the ICCTA, and dismissed the action with prejudice for lack of subject matter jurisdiction. See City of Encinitas v. North, San Diego County Transit Development Board, et al., Case No. 0I-CV-1734-J (AJB) (City of Encinitas).

Surface Transportation Board Decision on the North County Transit Development Board Petition for Declaratory Order

By petition filed on October 11, 2001, NCTD requested the STB institute a declaratory order proceeding and determine that the City of Encinitas, CA (the City), is prohibited from requiring NCTD to obtain a permit or other prior approval in order to construct the Encinitas Passing Track on NCTD' s San Diego Subdivision main line.

STB ruled as follows:

- Under 49 U.S.C. 1050I(b), the City of Encinitas, CA, is prohibited from requiring NCTD to obtain a permit or other pre-approvals prior to constructing the Encinitas Passing Track on NCTD' s San Diego Subdivision main track.
- This action will not significantly affect either the quality of the human environment or the conservation of energy resources.

The STB Ruling is included in Appendix A to this White Paper.

North County Transit District (NCTD) Legal Analysis

On July 13, 2012, NCTD's outside council, Best Best and Krieger, LLP, prepared a memorandum titled *Applicability of State and Local Permitting and Environmental Requirements to SANDAG Projects*. The memorandum arrived at the following three conclusions:

- Federal law preempts state and local permitting requirements.
- Preemption extends to rail related facilities located outside right-ow-way.
- Preemption also applies to improvements constructed by SANDAG.

This Memorandum is included in Appendix B to this White Paper.

California Supreme Court Opinion, Friends of the Eel River v. North Coast Railroad Authority

On December 10, 2014, the California Supreme Court agreed to review an appeal of a lower court's decision that would exempt publicly owned railroads from having to comply with CEQA.

An appellate court had found that the federal Interstate Commerce Commission Termination Act pre-empted all state laws managing or governing railroads, including CEQA. But the North Coast Railroad Authority (NCRA) case—brought by Friends of the Eel River (FOER) and Californians for Alternatives to Toxics (CATs)—concerns California's state-owned railroad, the NCRA, which meant California would be forbidden to control the railroad it had bought and paid for with public funds.

A different court of appeals reached the opposite conclusion in a case involving California's High Speed Rail Authority (HSRA). That court found that where the state is acting as an owner, not a regulator, federal preemption does not shield the state-owned rail line from having to comply with CEQA as a condition of its state funding.

The NCRA case presents substantially identical facts to the HSRA case. The plaintiff environmental groups had argued that the split between the courts of appeals should move the Supreme Court (Court) to take the case.

The Court focused on two specific areas in deciding the matter before it, 1) principles derived from deregulation and 2) the market participant doctrine.

The deregulation principle means that once general ICCTA compliance obligations are met, the railroad owner has a protected domain that is subject neither to federal nor to state regulation, a freedom to plan, develop, and restore rail service on market principles but within the framework of modest federal regulation. The Court presumed that a private conglomerate that owns a subsidiary that is a railroad company is not required to decide when it is prudent to go forward with the development of a railroad project by, for example, tossing a coin. Rather, it can make its decisions based on its own internal guidelines, so long as there is no conflict with federal law. The Court questioned how is the freedom accorded to the private owner by the ICCTA to be given effect when the state is the owner of a rail line? If a private owner has the freedom to adopt guidelines to make decisions in a deregulated field, the Court found no indication the ICCTA preemption clause was intended to deny the same freedom to the state as owner. Furthermore, the Court presumed that Congress, in adopting a preemption provision, did not intend to deprive a state of its sovereign authority over its internal governance — at least not without a particularly clear statement of intent. The Court found no such clear statement of intent in ICCTA.

The market participant doctrine acknowledges that in some circumstances, states may be acting not as regulators of others, but as participants in a marketplace who themselves need to deal with private parties to obtain services or products. In this proprietary capacity they generally should have the same freedom as private actors in the market, just as they must ordinarily carry the same burdens. The court noted that application of CEQA is not solely a matter of self-governance by the state. CEQA can be seen as an expression of how the state, as proprietor, directs that a state enterprise will be run — an expression that can be analogized to private corporate bylaws and guidelines governing corporate subsidiaries. To the extent a private corporate parent would have a zone of freedom under the ICCTA to govern how its subsidiaries will engage in the railroad business — including the freedom to direct them to undertake environmental fact finding as a condition of approving or going forward with their projects — the state presumably has the same sphere of freedom of action.

Finally, the Court noted that the STB has currently rendered an opinion that the ICCTA preempts CEQA as related to the California High Speed Rail project. "But these decisions on the part of the STB did not consider the deregulatory aspect of the ICCTA and the different way in which deregulation affects public and private rail lines. The Court stated in its opinion that the Court is not bound to follow them."

The Court did acknowledge the following in its opinion:

> We acknowledge that, at least as to privately owned railroads, state environmental permitting or preclearance regulation that would have the effect of preventing a private railroad from operating pending CEQA compliance would be categorically preempted.
>
> We acknowledge that CEQA actions might cross the line into preempted regulation if the review process imposes unreasonable burdens outside the particular market in which the state is the owner and developer of a railroad enterprise. But in the context of addressing the competing federal and state interests in governing state-owned rail lines that are before us in this case, such a line is not crossed by recognizing CEQA causes of action brought against NCRA to enforce environmental rules of decision that the state has imposed on itself for its own development projects.

On July 27, 2017, the California Supreme Court concluded as follows:

> The ICCTA preempts state regulation of rail transportation. In this case, the application of CEQA to NCRA would not be inconsistent with the ICCTA and its preemption clause. This is both because we presume Congress does not intend to disrupt state self-governance without clear language to that effect, and because the ICCTA leaves a relevant zone of freedom of

action for owners that the state, as owner, can elect to act in through CEQA. We conclude that the judgment of the Court of Appeal should be reversed and the matter remanded for further proceedings consistent with this opinion.

Federal Supreme Court Denial of Petition for Writ of Certiorari, Friends of the Eel River v. North Coast Railroad Authority

On April 30, 2018, the United States Supreme Court denied the petition for writ of certiorari filed in North Coast Railroad Authority v. Friends of the Eel River, U.S. Supreme Ct. Case No. 17-915, which presented this issue: "Whether citizen suits that seek to enforce state environmental approval requirements against a state-owned railroad by enjoining activities subject to the [Surface Transportation Board]'s exclusive jurisdiction are categorically preempted by [the Interstate Commerce Commission Termination Act of 1995]."

The high court's denial of review left undisturbed the California Supreme Court's decision holding state public entity NCRA's railroad project on its own line was subject to CEQA as an act of "self-governance," whereas private rail carriers are exempt from these "regulatory" burdens by virtue of federal preemption under ICCTA.

National Environmental Policy Act

The National Environmental Policy Act (42 U.S.C. §4321 et seq.) was enacted in 1969 as one of the first laws ever written that establishes the broad national framework for protecting our environment. NEPA's basic policy is to assure that all branches of government give proper consideration to the environment prior to undertaking any major federal action that significantly affects the environment. NEPA requirements are invoked when airports, buildings, military complexes, highways, parkland purchases, and other federal activities are proposed. EAs and Environmental Impact Statements (EISs), which are assessments of the likelihood of impacts from alternative courses of action, are required from all Federal agencies and are the most visible NEPA requirements.

California Environmental Quality Act

The California Environmental Quality Act (Pubic Resources Code Section 21000 et seq.) was enacted in 1970 as a system of checks and balances for land-use development and management decisions in California. The basic purposes of CEQA are to:

1. Inform governmental decision makers and the public about the potential, significant environmental effects of proposed activities;
2. Identify the ways that environmental damage can be avoided or significantly reduced;
3. Prevent significant, avoidable damage to the environment by requiring changes in projects through the use of alternatives or mitigation measures when the governmental agency finds the changes to be feasible; and,
4. Disclose to the public the reasons why a governmental agency approved the project in the manner the agency chose if significant environmental effects are involved.

CEQA applies to governmental action. This action may involve:

1. Activities directly undertaken by a governmental agency;
2. Activities financed in whole or in part by a governmental agency; or,
3. Private activities which require approval from a governmental agency.

Environmental Impact Reports (EIRs) and Negative Declarations (NDs) are the most visible CEQA requirements.

D. Approaches to National Environmental Policy Act and California Environmental Quality Act Compliance

As stated above, the Caltrans and FRA considered a second main track with at-grade and trenching alternatives in the City of Carlsbad as part of the Tier 1 LOSSAN PEIR/PEIS. The FRA issued the Record of Decision for the PEIS in 2009. The PEIR/PEIS anticipated Tier 2, site-specific environmental review prior to construction.

National Environmental Policy Act

This discussion assumes FRA would be the federal lead agency for NEPA compliance for the project. As stated above, the FRA completed a Tier 2 EA/FONSI for compliance with NEPA in 2019 for a new double track railroad bridge and an at-grade second main track within the project area. Trenching was dismissed as a project alternative in the EA/FONSI. The Proposed Action of at-grade double tracking would not preclude trenching in the future as discussed in the EA:

> "SANDAG considers projects on a regional basis and prioritizes them in the San Diego Forward: The Regional Plan. Trenching through downtown Carlsbad is not consistent with The Regional Plan, as it was not identified as a high-priority project because of the associated high cost. The Railroad Trench Alternative Economic Analysis and Feasibility Study identified that the Short Trench would have an estimated cost of between $215 million and $235 million, while the Long Trench would have an estimated cost of between $320 million and $350 million. For Comparison, the Proposed Action is estimated to cost approximately $53.6 million. SANDAG would continue to study the possibility of trenching in the future; however, the trenching alternative was eliminated from further review in this EA."

As of November 28, 2018, FRA conducts environmental reviews according to its revised NEPA legislation and regulations contained in 23 CFR Part 771 Environmental Impact and Related Procedures, and 23 CFR Part 774, Parks, Recreation Areas, Wildlife and Waterfowl Refuges, and Historic Sites (Section 4(f)) for transportation projects.

FRA recognizes a CE from NEPA for minor rail line additions, including construction of side tracks, passing tracks, crossovers, short connections between existing rail lines, and new tracks within existing rail yards or right-of-way, provided that such additions are not inconsistent with existing zoning, do not involve acquisition of a significant amount of right-of-way, and do not significantly alter the traffic density characteristics of the existing rail lines or rail facilities (23 CFR Part 771.116 (c) (12)). Any action that normally would be classified as a CE but could involve unusual circumstances would require FRA, in cooperation with the applicant, to conduct appropriate environmental studies to determine if the CE classification is proper. Such unusual circumstances include:

- Significant environmental impacts;
- Substantial controversy on environmental grounds;
- Significant impact on properties protected by Section 4(f) requirements or Section 106 of the National Historic Preservation Act; or,
- Inconsistencies with any Federal, State, or local law, requirement or administrative determination relating to the environmental aspects of the action.

In this case, we know we will have to move a National Register Listed historic train station and could trigger other potentially significant impacts related to stormwater management, construction impacts, and vibration. Reliance on this CE would require technical reports to identify any significant impacts and design measures that would be incorporated into the project to reduce such impacts to insignificance.

In the event FRA does not agree the project falls under a CE, an EA would have to be prepared. FRA's NEPA guidelines do not recognize supplemental EAs, only supplemental EISs (23 CFR Part 771.130). A draft EIS must be prepared when the Administration determines that the action is likely to cause significant impacts on the environment (23 CFR Part 771.123 (a)).

BRG recommends that SANDAG request FRA consider a CE with technical reports for the proposed trench project; however, SANDAG should be ready to prepare an EA, given that an EA was prepared for the at-grade double track alternative. We do not believe an EIS will be required, because we believe impacts likely can be mitigated. Also, we do not believe trench-related relocation of the historic train station to another location on the current parcel will be considered an adverse effect to historic properties or to a 4(f) resource, assuming such relocation likely is feasible.

California Environmental Quality Act

CEQA requires that a lead agency determine if a project is subject to CEQA (CCR Section 15060 (c)), and if subject to CEQA, is the project exempt from CEQA (CCR Section 15061). Assuming that the Eel River decision applies because NCTD is an agency of the State of California, the provision of a railroad double track project within a trench would be an activity subject to CEQA. There are two Statutory Exemptions that appear to apply to the proposed project alternatives:

PRC Section 21080. DIVISION APPLICATION TO DISCRETIONARY PROJECTS; NONAPPLICATION; NEGATIVE DECLARATIONS; ENVIRONMENTAL IMPACT REPORT PREPARATION:

(b) This division does not apply to any of the following activities:

(10) A project for the institution or increase of passenger or commuter services on rail or highway rights-of-way already in use, including modernization of existing stations and parking facilities. For purposes of this paragraph, “highway” shall have the same meaning as defined in Section 360 of the Vehicle Code.

PRC Section 21080.13. RAILROAD GRADE SEPARATION PROJECTS; APPLICATION OF DIVISION:

(a) This division shall not apply to any railroad grade separation project that eliminates an existing grade crossing or that reconstructs an existing grade separation.

(b) (1) Whenever a state agency determines that a project is not subject to this division pursuant to this section, and it approves or determines to carry out the project, the state agency shall file a notice with the Office of Planning and Research in the manner specified in subdivisions (b) and (c) of Section 21108.

(2) Whenever a local agency determines that a project is not subject to this division pursuant to this section, and it approves or determines to carry out the project, the local agency shall file a notice with the Office of Planning and Research and with the county clerk in each county in which the project will be located in the manner specified in subdivisions (b) and (c) of Section 21152.

The Statutory Exemption found at PRC Section 21080 (b) (10), may not be applicable because it appears use of private property, outside of public rights-of-way, is required for at least one of the trench alternatives. For this reason, it is recommended that the Statutory Exemption found at PRC Section 21080.13 be relied on for CEQA Compliance. Current at-grade railroad crossing in the project area include vehicular crossings at Grand Avenue, Carlsbad Village Drive, and Tamarack Avenue. The Long Trench alternative replaces all three of these at-grade crossings with grade-separated crossings and adds 3 additional grade-separated crossings. The Short Trench alternative is similar, except it leaves the at-grade crossing at Tamarack Avenue. For this reason, the project appears to qualify for the aforementioned Statutory Exemption.

We recommend SANDAG review the purchase agreement between Burlington Northern and Santa Fe Railroad (BNSF) and NCTD for any language giving BNSF rights over railroad operations. Any such language may distinguish NCTD from NCRA, maintaining the ICCTA pre-emption over the LOSSAN Corridor in the project area despite the California Supreme Court’s ruling in the Eel River Case.

E. Validity of Prior Technical Studies

BRG scope of work included the following table, which includes an initial assessment of which technical studies may remain valid for use with the CBT project:

Carlsbad Village At-Grade Alternative - Status of Environmental Technical Studies	
Study	**Potential Action**
Community Impact Assessment	Use
Environmental Justice Technical Report	Use
Carlsbad Village Station Underpass Preliminary Foundation Report	Use
Buena Vista Lagoon Bridge Preliminary Foundation Report	Use
Noise and Vibration Impact Assessment	Use
Section 4f Evaluation	Use
Preliminary Stormwater Management Plan	Use
Visual Impact Assessment	Update
Air Quality and GHG Impact Analysis	Update
Fluvial Hydraulics Analysis	Update
Preliminary Drainage Study	Update
Land Use Technical Report	Update
Utility Impacts Report	Update
Biological Technical Report	Update
Cultural and Historical Resources Report	Update
Phase 1 Environmental Site Assessment	Update

BRG has reviewed the table and offers the following modifications (**bolded and numbered**) as explained further below:

Carlsbad Village At-Grade Alternative - Status of Environmental Technical Studies	
Study	**Potential Action**
Community Impact Assessment	**Update (1)**
Environmental Justice Technical Report	Use
Carlsbad Village Station Underpass Preliminary Foundation Report	Use
Buena Vista Lagoon Bridge Preliminary Foundation Report	Use
Noise and Vibration Impact Assessment	**Update (2)**
Section 4f Evaluation	**Update (3)**
Preliminary Stormwater Management Plan	**Update (4)**
Visual Impact Assessment	Update
Air Quality and GHG Impact Analysis	Update
Fluvial Hydraulics Analysis	**Use (5)**
Preliminary Drainage Study	Update
Land Use Technical Report	Update
Utility Impacts Report	Update
Biological Technical Report	Update
Cultural and Historical Resources Report	Update
Phase 1 Environmental Site Assessment	Update

(1) Community Impact Assessment. Construction of the trench has the potential to isolate various neighborhoods. This should be analyzed in an updated Community Impact Analysis.
(2) Noise and Vibration Impact Assessment. We understand two reports have been prepared, one by BRG's subcontractor and another by the City. Nether BRG's report nor the City's report consider the noise and vibration associated with construction of a trench in close proximity to residential and commercial uses or noise and vibration associated with hauling excavated material from the trench off-site. Also, BRG's report does not address noise and vibration levels that would be experienced from trains operating in a trench. The City's report does identify a reduction in noise levels associated with operational impacts but does not address vibration effects at a project level. For these reasons, an updated noise and vibration report should be prepared.
(3) Section 4(f) resources include historic resources on the National Register of Historic Places. We understand the historic station building will have to be relocated as part of the trench project. This would need to be analyzed as a potential impact to a Section 4(f) resource. BRG understands that the impacts to the lagoon and parks and recreation identified in the EA/FONSI would not change under either trench alternative. There is no need to update the 4(f) analysis as it related to wildlife and waterfowl refuges or parks and recreation resources.
(4) Preliminary Stormwater Management Plan. This plan does not address the trench alternatives, which will increase impervious surfaces and require pumping to remove stormwater both during construction and operations. This would need to be analyzed in an updated plan.
(5) BRG understands that the Fluvial Hydraulics Analysis is related to the new railroad bridge over Buena Vista Lagoon. We further understand that the trench would not alter the current railroad bridge design. No update of the Fluvial Hydraulics Analysis would be required.

In addition, BRG recommends a traffic study be prepared to address traffic impacts associated with construction of the trench alternatives. Substantial traffic delay may result from closures, detours, and trucking of excavated material off-site. Also, the Kimley Horn traffic study included in the RSG, Inc. January 17, 2017 *Economic Study Assessing LOSSAN Corridor Improvement Options – City of Carlsbad* failed to analyze proposed new signal pre-emption strategies being implemented by NCTD and SANDAG at the Old Town station. Rather, the Kimley Horn study assumed the same signal/gate operations through the year 2035. This assumption overstated the railroad-related delay at grade crossing analyzed.

ATTACHMENT D:

UTILITY MATRIX

ITEM	UTILITY DESCRIPTION	UTILITY OWNER	AGREEMENT NO.	LOCATION	STATION	DATA SOURCE	POTENTIAL CONFLICT	DISPOSITION	
								PIP/RELOCATE/ ENCASE	BY
1	48-INCH PLRCP SEWER	CITY OF CARLSBAD	TO BE DETERMINED	NORTH AND SOUTH OF TAMARACK, EAST SIDE	2285+00 TO 2295+00	AS-BUILT 360-5 AND MANHOLE LIDS	TRENCH	RELOCATE	PROJECT
2	84-INCH RCP STORM DRAIN	CITY OF CARLSBAD	TO BE DETERMINED	NORTH AND SOUTH OF TAMARACK, EAST SIDE	2285+00 TO 2295+00	AS-BUILT 360-5 AND MANHOLE LIDS	TRENCH, SEWER RELOCATION	RELOCATE	PROJECT
3	OH TELECOM	AT&T	TO BE DETERMINED	NORTH OF TAMARACK, EAST SIDE	2283+00 TO 2315+00	UTILITY MAP AND TOPO	STORM DRAIN RELOCATION	RELOCATE	AT&T
4	12-INCH GAS	SC GAS	TO BE DETERMINED	SOUTH OF TAMARACK	2285+00 TO 2289+75	AS-BUILT 360-5/UTILITY MAPS	TRENCH WALLS AND SHOOFLY TRACK	RELOCATE	SC GAS
5	FIBER OPTIC DUCT BANK (4~2-INCH CONDUITS)	VERIZON/NCTD	TO BE DETERMINED	SOUTH OF TRENCH TO NORTH OF LAGOON	2275+00 TO 2376+00	AS-BUILTS AND UTILITY MARKERS	TRENCH	RELOCATE	VERIZON/ PROJECT
6	3-INCH WATER	CMWD	TO BE DETERMINED	SOUTH OF TAMARACK	2283+00 TO 2285+00	AS-BUILT 360-5	TRENCH	RELOCATE	CMWD
7	36-INCH RCP SEWER (ABANDONED)	CITY OF CARLSBAD	TO BE DETERMINED	NORTH AND SOUTH OF TAMARACK	2283+00 TO 2290+00	AS-BUILT 360-5	TRENCH	REMOVE	PROJECT
8	8-INCH PVC SEWER	CITY OF CARLSBAD	TO BE DETERMINED	SOUTH OF TAMARACK	2286+10	AS-BUILT 360-5	TRENCH	RELOCATE	PROJECT
9	OH ELECTRIC	SDG&E	TO BE DETERMINED	SOUTH OF TAMARACK	2286+15	SURVEY, VISUAL, UTILITY MAP	CONSTRUCTION EQUIPMENT	PIP	PROJECT
10	OH TELECOM	AT&T	TO BE DETERMINED	SOUTH OF TAMARACK	2286+15	SURVEY, VISUAL, UTILITY MAP	CONSTRUCTION EQUIPMENT	PIP	PROJECT
11	UG TELECOM	AT&T	TO BE DETERMINED	TAMARACK AVE	2292+00	UTILITY MAP	TRENCH, TAMARACK BRIDGE	RELOCATE	AT&T
12	UG TELECOM	TWC	TO BE DETERMINED	TAMARACK AVE	2292+00	UTILITY MAP	TRENCH, TAMARACK BRIDGE	RELOCATE	TWC
13	10" VCP SEWER	CITY OF CARLSBAD	TO BE DETERMINED	TAMARACK AVE	2292+30	AS-BUILT 360-5	TRENCH, TAMARACK BRIDGE	RELOCATE	PROJECT
14	4" GAS	SDG&E	TO BE DETERMINED	TAMARACK AVE	2292+40	UTILITY MAP	TRENCH, TAMARACK BRIDGE	RELOCATE	SDG&E

ITEM	UTILITY DESCRIPTION	UTILITY OWNER	AGREEMENT NO.	LOCATION	STATION	DATA SOURCE	POTENTIAL CONFLICT	DISPOSITION	
								PIP/RELOCATE/ ENCASE	BY
15	10" VCP SEWER	CITY OF CARLSBAD	TO BE DETERMINED	TAMARACK AVE	2293+50	AS-BUILT 360-5	TRENCH	RELOCATE	PROJECT
16	10" PVC SEWER	CITY OF CARLSBAD	TO BE DETERMINED	SOUTH OF ACACIA	2304+00	AS-BUILT 360-5	TRENCH	RELOCATE	PROJECT
17	24" RCP STORM DRAIN	CITY OF CARLSBAD	TO BE DETERMINED	CHESTNUT AVE	2314+10	AS-BUILT 360-6	TRENCH	RELOCATE	PROJECT
18	10" ACP WATER	CMWD	TO BE DETERMINED	CHESTNUT AVE	2314+50	AS-BUILT 360-5	TRENCH, CHESTNUT BRIDGE	RELOCATE	CMWD
19	8" VCP SEWER	CITY OF CARLSBAD	TO BE DETERMINED	CHESTNUT AVE	2315+00	AS-BUILT 360-5	TRENCH, CHESTNUT BRIDGE	RELOCATE	PROJECT
20	OH ELECTRIC	SDG&E	TO BE DETERMINED	CHESTNUT AVE	2315+00	UTILITY MAP, VISUAL, TOPO	TRENCH	RELOCATE	SDG&E
21	UG TELECOM	AT&T	TO BE DETERMINED	CHESTNUT AVE	2315+00	UTILITY MAP	TRENCH, CHESTNUT BRIDGE	RELOCATE	AT&T
22	UG TELECOM	AT&T	TO BE DETERMINED	CHESTNUT AVE	2308+00 TO 2311+00	UTILITY MAP	TRENCH	RELOCATE	AT&T
23	8' x 3' RCB	CITY OF CARLSBAD	TO BE DETERMINED	CHESTNUT AVE	2315+00	AS-BUILT 360-5	CHESTNUT ROAD WORK, SHOOFLY TRACK	PIP	PROJECT
24	24" PVC SD	CITY OF CARLSBAD	TO BE DETERMINED	CHESTNUT AVE	2315+00	AS-BUILT 360-5	TRENCH	RELOCATE	PROJECT
25	15" PVC SEWER IN STL CASING	CITY OF CARLSBAD	TO BE DETERMINED	NORTH OF CHESTNUT	2319+50	AS-BUILT 360-5	TRENCH	RELOCATE	PROJECT
26	OH TELECOM	TWC	TO BE DETERMINED	OAK AVE	2329+00	UTILITY MAP, VISUAL, TOPO	TRENCH	PIP	PROJECT
27	OH ELECTRIC	SDG&E	TO BE DETERMINED	OAK AVE	2329+00	UTILITY MAP, VISUAL, TOPO	TRENCH	PIP	PROJECT
28	12" ACP WATER	CITY OF CARLSBAD	59408-A	OAK AVE	2329+00	AS-BUILT 319-7	TRENCH	RELOCATE	PROJECT
29	36" CSP SD	CITY OF CARLSBAD	TO BE DETERMINED	OAK AVE	2329+00	AS-BUILT 360-5	TRENCH	RELOCATE	PROJECT
30	OH ELECTRIC	SDG&E	TO BE DETERMINED	OAK AVE	2331+80	UTILITY MAP, VISUAL, TOPO	TRENCH	PIP	PROJECT
31	UG ELECTRIC, TRANSFORMER	SDG&E	TO BE DETERMINED	CARLSBAD VILLAGE DR	2333+50	UTILITY MAP, VISUAL, TOPO	TRENCH, CARLSBAD VILLAGE DR BRIDGE	RELOCATE	SDG&E

ITEM	UTILITY DESCRIPTION	UTILITY OWNER	AGREEMENT NO.	LOCATION	STATION	DATA SOURCE	POTENTIAL CONFLICT	DISPOSITION	
								PIP/RELOCATE/ ENCASE	BY
32	OH ELECTRIC	SDG&E	TO BE DETERMINED	CARLSBAD VILLAGE DR	2333+50	UTILITY MAP, VISUAL, TOPO	TRENCH, CARLSBAD VILLAGE DR BRIDGE	RELOCATE	SDG&E
33	1" HP Gas	SDG&E	TO BE DETERMINED	CARLSBAD VILLAGE DR	2333+55	15330-120370	TRENCH, CARLSBAD VILLAGE DR BRIDGE	RELOCATE	PROJECT
34	4" HP Gas	SDG&E	TO BE DETERMINED	CARLSBAD VILLAGE DR	2334+00	15330-120370	ROAD WORK	PIP	PROJECT
35	6" ACP Water	CMWD	TO BE DETERMINED	CARLSBAD VILLAGE DR	2333+90	AS-BUILT 291-2D	TRENCH, CARLSBAD VILLAGE DR BRIDGE	RELOCATE	PROJECT
36	Street Light and Pull Box	City of Carlsbad	TO BE DETERMINED	CARLSBAD VILLAGE DR	2334+15	AS-BUILT 291-2D	TRENCH, CARLSBAD VILLAGE DR BRIDGE	RELOCATE	PROJECT
37	OH Electric	SDG&E	TO BE DETERMINED	GRAND AVE	2338+50	15330-120375	TRENCH, GRAND AV BRIDGE	RELOCATE	SDG&E
38	24" RCP STORM DRAIN	CITY OF CARLSBAD	TO BE DETERMINED	GRAND AVE	2338+60	333-6	TRENCH, GRAND AV BRIDGE	RELOCATE	PROJECT
39	36" SEWER (ABANDONED)	CITY OF CARLSBAD	69287	GRAND AVE	2339+00	133-9, 333-6	TRENCH, GRAND AV BRIDGE	RELOCATE	PROJECT
40	4" GAS	SDG&E	TO BE DETERMINED	GRAND AVE	2339+10	333-6	TRENCH, GRAND AV BRIDGE	RELOCATE	SDG&E
41	2" IRRIGATION SERVICE	CMWD	TO BE DETERMINED	GRAND AVE	2339+15	AS-BUILT 333-6	TRENCH, GRAND AV BRIDGE	RELOCATE	PROJECT
42	10" WATER	CMWD	TO BE DETERMINED	GRAND AVE	2338+75	AS-BUILT 118-6	TRENCH, GRAND AV BRIDGE	RELOCATE	PROJECT
43	18" RCP SD & TYPE B INLET	CITY OF CARLSBAD	TO BE DETERMINED	CARLSBAD VILLAGE STATION	2347	AS-BUILT 333-6	TRENCH, STATION	RELOCATE	PROJECT
44	10" VCP SEWER	CITY OF CARLSBAD	33144	CARLSBAD VILLAGE STATION	2347	AS-BUILT 120-2	TRENCH, STATION	RELOCATE	PROJECT

ITEM	UTILITY DESCRIPTION	UTILITY OWNER	AGREEMENT NO.	LOCATION	STATION	DATA SOURCE	POTENTIAL CONFLICT	DISPOSITION	
								PIP/RELOCATE/ ENCASE	BY
45	12" HP GAS	SC GAS	34570-11	CARLSBAD VILLAGE STATION	2354+00 to 2345+00	1026-75	TRENCH, STATION	RELOCATE	SC GAS
46	10" VCP SEWER	CITY OF CARLSBAD	33144	CARLSBAD VILLAGE STATION	2354+90 to 2345+00	AS-BUILT 120-2	TRENCH, STATION	RELOCATE	PROJECT
47	OH ELECTRIC	SDG&E	123036	CARLSBAD VILLAGE STATION	2346+00	15322-120380	TRENCH, STATION	RELOCATE	SDG&E
48	18" RCP STORM DRAIN	CITY OF CARLSBAD	TO BE DETERMINED	CARLSBAD VILLAGE STATION	2347+00 to 2346+00	AS-BUILT 333-6	TRENCH, STATION	RELOCATE	PROJECT
49	STREET LIGHT AND PULL BOX	CITY OF CARLSBAD	TO BE DETERMINED	CARLSBAD VILLAGE STATION	2347+00 to 2346+00	AS-BUILT 333-6	TRENCH, STATION	RELOCATE	PROJECT
50	OH ELECTRIC	SDG&E	32413	NORTH OF CARLSBAD BLVD	2361+00	UTILITY MAP, VISUAL, TOPO	Trench	PIP	SDG&E
51	OH TELECOM	COX	33945	EATON ST	2384+00	Oceanside Passing Track MP226.66 to MP228.42	Trench	PIP	PROJECT
52	8-inch Water in 16-inch Casing	CITY OF OCEANSIDE	183295	EATON ST	2384+00	Oceanside Passing Track MP226.66 to MP228.42	Trench	ENCASE	PROJECT
53	12-inch VCP Sewer	CITY OF OCEANSIDE	Custodian No 284	EATON ST	2384+00	Oceanside Passing Track MP226.66 to MP228.42	Trench	ENCASE	PROJECT
54	8-inch HP Gas in 12-inch Casing	SDG&E	137975	KELLY ST	2398+00	15292-120420	Trench	PIP	SDG&E

ITEM	UTILITY DESCRIPTION	UTILITY OWNER	AGREEMENT NO.	LOCATION	STATION	DATA SOURCE	POTENTIAL CONFLICT	DISPOSITION	
								PIP/RELOCATE/ ENCASE	BY
1	48-INCH PLRCP SEWER	CITY OF CARLSBAD	TO BE DETERMINED	NORTH AND SOUTH OF TAMARACK, EAST SIDE	2285+00 TO 2295+00	AS-BUILT 360-5 AND MANHOLE LIDS	TRENCH	PIP	PROJECT
2	84-INCH RCP STORM DRAIN	CITY OF CARLSBAD	TO BE DETERMINED	NORTH AND SOUTH OF TAMARACK, EAST SIDE	2285+00 TO 2295+00	AS-BUILT 360-5 AND MANHOLE LIDS	TRENCH, SEWER RELOCATION	PIP	PROJECT
3	OH TELECOM	AT&T	TO BE DETERMINED	NORTH OF TAMARACK, EAST SIDE	2283+00 TO 2315+00	UTILITY MAP AND TOPO	SHOOFLY	PIP	AT&T
4	12-INCH GAS	SC GAS	TO BE DETERMINED	SOUTH OF TAMARACK	2285+00 TO 2289+75	AS-BUILT 360-5/UTILITY MAPS	TRENCH WALLS AND SHOOFLY TRACK	PIP	SC GAS
5	FIBER OPTIC DUCT BANK (4~2-INCH CONDUITS)	VERIZON/NCTD	TO BE DETERMINED	SOUTH OF TRENCH TO NORTH OF LAGOON	2293+00 TO 2376+00	AS-BUILTS AND UTILITY MARKERS	TRENCH	RELOCATE	VERIZON /PROJECT
6	3-INCH WATER	CMWD	TO BE DETERMINED	SOUTH OF TAMARACK	2283+00 TO 2285+00	AS-BUILT 360-5	TRENCH	PIP	CMWD
7	36-INCH RCP SEWER (ABANDONED)	CITY OF CARLSBAD	TO BE DETERMINED	NORTH AND SOUTH OF TAMARACK	2283+00 TO 2290+00	AS-BUILT 360-5	TRENCH	PIP	PROJECT
8	8-INCH PVC SEWER	CITY OF CARLSBAD	TO BE DETERMINED	SOUTH OF TAMARACK	2286+10	AS-BUILT 360-5	TRENCH	PIP	PROJECT
9	OH ELECTRIC	SDG&E	TO BE DETERMINED	SOUTH OF TAMARACK	2286+15	SURVEY, VISUAL, UTILITY MAP	CONSTRUCTION EQUIPMENT	PIP	PROJECT
10	OH TELECOM	AT&T	TO BE DETERMINED	SOUTH OF TAMARACK	2286+15	SURVEY, VISUAL, UTILITY MAP	CONSTRUCTION EQUIPMENT	PIP	PROJECT
11	UG TELECOM	AT&T	TO BE DETERMINED	TAMARACK AVE	2292+00	UTILITY MAP	TRENCH, TAMARACK BRIDGE	PIP	AT&T
12	UG TELECOM	TWC	TO BE DETERMINED	TAMARACK AVE	2292+00	UTILITY MAP	TRENCH, TAMARACK BRIDGE	PIP	TWC
13	10" VCP SEWER	CITY OF CARLSBAD	TO BE DETERMINED	TAMARACK AVE	2292+30	AS-BUILT 360-5	TRENCH, TAMARACK BRIDGE	PIP	PROJECT

ITEM	UTILITY DESCRIPTION	UTILITY OWNER	AGREEMENT NO.	LOCATION	STATION	DATA SOURCE	POTENTIAL CONFLICT	DISPOSITION	
								PIP/RELOCATE/ ENCASE	BY
14	4" GAS	SDG&E	TO BE DETERMINED	TAMARACK AVE	2292+40	UTILITY MAP	TRENCH, TAMARACK BRIDGE	PIP	SDG&E
15	10" VCP SEWER	CITY OF CARLSBAD	TO BE DETERMINED	TAMARACK AVE	2293+50	AS-BUILT 360-5	TRENCH	PIP	PROJECT
16	10" PVC SEWER	CITY OF CARLSBAD	TO BE DETERMINED	SOUTH OF ACACIA	2304+00	AS-BUILT 360-5	TRENCH	RELOCATE	PROJECT
17	24" RCP STORM DRAIN	CITY OF CARLSBAD	TO BE DETERMINED	CHESTNUT AVE	2314+10	AS-BUILT 360-6	TRENCH	RELOCATE	PROJECT
18	10" ACP WATER	CMWD	TO BE DETERMINED	CHESTNUT AVE	2314+50	AS-BUILT 360-5	TRENCH, CHESTNUT BRIDGE	RELOCATE	CMWD
19	8" VCP SEWER	CITY OF CARLSBAD	TO BE DETERMINED	CHESTNUT AVE	2315+00	AS-BUILT 360-5	TRENCH, CHESTNUT BRIDGE	RELOCATE	PROJECT
20	OH ELECTRIC	SDG&E	TO BE DETERMINED	CHESTNUT AVE	2315+00	UTILITY MAP, VISUAL, TOPO	TRENCH	RELOCATE	SDG&E
21	UG TELECOM	AT&T	TO BE DETERMINED	CHESTNUT AVE	2315+00	UTILITY MAP	TRENCH, CHESTNUT BRIDGE	RELOCATE	AT&T
22	UG TELECOM	AT&T	TO BE DETERMINED	CHESTNUT AVE	2308+00 TO 2311+00	UTILITY MAP	TRENCH	RELOCATE	AT&T
23	8' x 3' RCB	CITY OF CARLSBAD	TO BE DETERMINED	CHESTNUT AVE	2315+00	AS-BUILT 360-5	CHESTNUT ROAD WORK, SHOOFLY TRACK	PIP	PROJECT
24	24" PVC SD	CITY OF CARLSBAD	TO BE DETERMINED	CHESTNUT AVE	2315+00	AS-BUILT 360-5	TRENCH	RELOCATE	PROJECT
25	15" PVC SEWER IN STL CASING	CITY OF CARLSBAD	TO BE DETERMINED	NORTH OF CHESTNUT	2319+50	AS-BUILT 360-5	TRENCH	RELOCATE	PROJECT
26	OH TELECOM	TWC	TO BE DETERMINED	OAK AVE	2329+00	UTILITY MAP, VISUAL, TOPO	TRENCH	PIP	PROJECT
27	OH ELECTRIC	SDG&E	TO BE DETERMINED	OAK AVE	2329+00	UTILITY MAP, VISUAL, TOPO	TRENCH	PIP	PROJECT
28	12" ACP WATER	CITY OF CARLSBAD	59408-A	OAK AVE	2329+00	AS-BUILT 319-7	TRENCH	RELOCATE	PROJECT
29	36" CSP SD	CITY OF CARLSBAD	TO BE DETERMINED	OAK AVE	2329+00	AS-BUILT 360-5	TRENCH	RELOCATE	PROJECT
30	OH ELECTRIC	SDG&E	TO BE DETERMINED	OAK AVE	2331+80	UTILITY MAP, VISUAL, TOPO	TRENCH	PIP	PROJECT

ITEM	UTILITY DESCRIPTION	UTILITY OWNER	AGREEMENT NO.	LOCATION	STATION	DATA SOURCE	POTENTIAL CONFLICT	DISPOSITION	
								PIP/RELOCATE/ ENCASE	BY
31	UG ELECTRIC, TRANSFORMER	SDG&E	TO BE DETERMINED	CARLSBAD VILLAGE DR	2333+50	UTILITY MAP, VISUAL, TOPO	TRENCH, CARLSBAD VILLAGE DR BRIDGE	RELOCATE	SDG&E
32	OH ELECTRIC	SDG&E	TO BE DETERMINED	CARLSBAD VILLAGE DR	2333+50	UTILITY MAP, VISUAL, TOPO	TRENCH, CARLSBAD VILLAGE DR BRIDGE	RELOCATE	SDG&E
33	1" HP Gas	SDG&E	TO BE DETERMINED	CARLSBAD VILLAGE DR	2333+55	15330-120370	TRENCH, CARLSBAD VILLAGE DR BRIDGE	RELOCATE	PROJECT
34	4" HP Gas	SDG&E	TO BE DETERMINED	CARLSBAD VILLAGE DR	2334+00	15330-120370	ROAD WORK	PIP	PROJECT
35	6" ACP Water	CMWD	TO BE DETERMINED	CARLSBAD VILLAGE DR	2333+90	AS-BUILT 291-2D	TRENCH, CARLSBAD VILLAGE DR BRIDGE	RELOCATE	PROJECT
36	Street Light and Pull Box	City of Carlsbad	TO BE DETERMINED	CARLSBAD VILLAGE DR	2334+15	AS-BUILT 291-2D	TRENCH, CARLSBAD VILLAGE DR BRIDGE	RELOCATE	PROJECT
37	OH Electric	SDG&E	TO BE DETERMINED	GRAND AVE	2338+50	15330-120375	TRENCH, GRAND AV BRIDGE	RELOCATE	SDG&E
38	24" RCP STORM DRAIN	CITY OF CARLSBAD	TO BE DETERMINED	GRAND AVE	2338+60	333-6	TRENCH, GRAND AV BRIDGE	RELOCATE	PROJECT
39	36" SEWER (ABANDONED)	CITY OF CARLSBAD	69287	GRAND AVE	2339+00	133-9, 333-6	TRENCH, GRAND AV BRIDGE	RELOCATE	PROJECT
40	4" GAS	SDG&E	TO BE DETERMINED	GRAND AVE	2339+10	333-6	TRENCH, GRAND AV BRIDGE	RELOCATE	SDG&E
41	2" IRRIGATION SERVICE	CMWD	TO BE DETERMINED	GRAND AVE	2339+15	AS-BUILT 333-6	TRENCH, GRAND AV BRIDGE	RELOCATE	PROJECT
42	10" WATER	CMWD	TO BE DETERMINED	GRAND AVE	2338+75	AS-BUILT 118-6	TRENCH, GRAND AV BRIDGE	RELOCATE	PROJECT

ITEM	UTILITY DESCRIPTION	UTILITY OWNER	AGREEMENT NO.	LOCATION	STATION	DATA SOURCE	POTENTIAL CONFLICT	DISPOSITION	
								PIP/RELOCATE/ ENCASE	BY
43	18" RCP SD & TYPE B INLET	CITY OF CARLSBAD	TO BE DETERMINED	CARLSBAD VILLAGE STATION	2347	AS-BUILT 333-6	TRENCH, STATION	RELOCATE	PROJECT
44	10" VCP SEWER	CITY OF CARLSBAD	33144	CARLSBAD VILLAGE STATION	2347	AS-BUILT 120-2	TRENCH, STATION	RELOCATE	PROJECT
45	12" HP GAS	SC GAS	34570-11	CARLSBAD VILLAGE STATION	2354+00 to 2345+00	1026-75	TRENCH, STATION	RELOCATE	SC GAS
46	10" VCP SEWER	CITY OF CARLSBAD	33144	CARLSBAD VILLAGE STATION	2354+90 to 2345+00	AS-BUILT 120-2	TRENCH, STATION	RELOCATE	PROJECT
47	OH ELECTRIC	SDG&E	123036	CARLSBAD VILLAGE STATION	2346+00	15322-120380	TRENCH, STATION	RELOCATE	SDG&E
48	18" RCP STORM DRAIN	CITY OF CARLSBAD	TO BE DETERMINED	CARLSBAD VILLAGE STATION	2347+00 to 2346+00	AS-BUILT 333-6	TRENCH, STATION	RELOCATE	PROJECT
49	STREET LIGHT AND PULL BOX	CITY OF CARLSBAD	TO BE DETERMINED	CARLSBAD VILLAGE STATION	2347+00 to 2346+00	AS-BUILT 333-6	TRENCH, STATION	RELOCATE	PROJECT
50	OH ELECTRIC	SDG&E	32413	NORTH OF CARLSBAD BLVD	2361+00	UTILITY MAP, VISUAL, TOPO	Trench	PIP	SDG&E
51	OH TELECOM	COX	33945	EATON ST	2384+00	Oceanside Passing Track MP226.66 to MP228.42	Trench	PIP	PROJECT
52	8-inch Water in 16-inch Casing	CITY OF OCEANSIDE	183295	EATON ST	2384+00	Oceanside Passing Track MP226.66 to MP228.42	Trench	ENCASE	PROJECT
53	12-inch VCP Sewer	CITY OF OCEANSIDE	Custodian No 284	EATON ST	2384+00	Oceanside Passing Track MP226.66 to MP228.42	Trench	ENCASE	PROJECT
54	8-inch HP Gas in 12-inch Casing	SDG&E	137975	KELLY ST	2398+00	15292-120420	Trench	PIP	SDG&E

ATTACHMENT E:

GROUNDWATER INVESTIGATION REPORT

GROUNDWATER INVESTIGATION REPORT
CARLSBAD VILLAGE DOUBLE TRACK TRENCH PROJECT
NORTH COUNTY, SAN DIEGO, CALIFORNIA
KLEINFELDER PROJECT NO. 20200172.001A

APRIL 13, 2020

Prepared For:

Prepared By:

A Report Prepared for:

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GROUNDWATER INVESTIGATION REPORT
CARLSBAD VILLAGE DOUBLE TRACK TRENCH PROJECT
NORTH COUNTY, CALIFORNIA

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April 13, 2020
Kleinfelder Project No. 20200172.001A

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FIGURES

APPENDICES

1 INTRODUCTION

On behalf of TY Lin International, Kleinfelder has prepared this Kleinfelder has prepared this *Groundwater Investigation Report* (Report) as part of the Carlsbad Village Trench Alternatives Analysis (Project). The purpose of the Report is to present an assessment of local groundwater conditions to support decision makers regarding design and eventually construction activities related to the Project. This Report also describes the field activities and results associated with the installation, development, aquifer testing and abandonment of groundwater monitoring wells. The Report also presents groundwater modeling results using aquifer test and geotechnical data. These activities were performed at the Project according to the project Work Plan (Kleinfelder 2019). A site map showing the location of four investigation areas is included as Figure 1.

2 SITE BACKGROUND AND DESCRIPTION

This Project proposes to construct railroad tracks below the water table. The data collected and analyzed for this project can be used for a better understanding of groundwater conditions. Three groundwater monitoring wells were installed as part of this project. Soil samples from the borings were used for geotechnical analysis and the wells were monitored for depth to groundwater and for aquifer testing.

A previous consultant installed one groundwater monitoring well in 2016. The locations of the three new groundwater monitoring wells (MW1 to MW3) and one existing monitoring well (MW4) are presented in Table 1 and on Figures 2A through 2D. These locations include State Street, Juniper Avenue, Chinquapin Avenue, and Washington Street in Carlsbad, California. The survey coordinates of these wells were collected by Kleinfelder on October 2 and 3, 2019 using a global positioning system (GPS) unit (i.e., Trimble) as noted on the table.

Table 1
Location of Groundwater Monitoring Wells

MW No.	Site Name	Latitude	Longitude
1	State Street	33.163984	-117.353391
2	Juniper Avenue	33.151489	-117.343544
3	Chinquapin Avenue	33.148028	-117.339783
4	Washington Street	33.156291	-117.347461

Carlsbad is located within the coastal portion of the Peninsular Ranges Geomorphic Province, a region characterized by northwest-trending structural blocks and intervening fault zones. Typical lithologies in the Peninsular Ranges include a variety of igneous, intrusive rocks associated with the Cretaceous-age Southern California Batholith. In western San Diego County, batholithic rocks are often intruded into Jurassic-age metavolcanic and/or metasedimentary units, with these basement rocks locally overlain by Tertiary-age (between approximately 2 and 65 million years old) marine and non-marine sedimentary strata. Tertiary rocks in the western portion of the county are associated primarily with several sea level advance and retreat cycles over approximately the last 55 million years, including sedimentary units in Carlsbad and vicinity. A review of Geological Map of the Oceanside Quadrangle (California Department of Conservation, 2007) indicates that surface geology in vicinity of the railway and immediately downgradient of it consists of late to middle Pleistocene old Paralic deposits (i.e., interfingering marine and continental sediments). The lithology immediate upgradient of the Project is middle to early Pleistocene very old Paralic deposits. These sediments consist of both cemented and non-cemented fine grain sand, silt and clay observed during borehole drilling (Section 4).

3 SITE PREPARATIONS AND PERMITTING

Well permit applications were prepared and submitted to the County of San Diego Department of Environmental Health (DEH) for each of the three proposed groundwater monitoring wells. Approved well permits are included in Appendix A. Well permits for abandonment were not required per County guidelines because the wells were installed, tested and destroyed in less than 60 days.

On September 3, 2019, Kleinfelder met with the City of Carlsbad representative. Each proposed groundwater monitoring well was located with a GPS unit (i.e., Trimble) and marked in the field. After locations were marked, Underground Service Alert (also known as Dig Alert) was contacted to inform public utility companies of the proposed excavation. Dig Alert Ticket numbers for well installation include: A192540892, A192540907, and A192540912 for the State Street, Juniper Avenue, and Chinquapin Avenue, respectively.

On September 10, 2019, underground utility clearance activities were performed by a private geophysical company, Subsurface Surveys of Carlsbad, California. Subsurface Surveys identified and marked underground utilities in the vicinity of the proposed well borings.

4 BOREHOLE DRILLING AND MONITORING WELL INSTALLATION

One groundwater monitoring well was installed at each of the three locations. A previous consultant installed the fourth well identified as MW4 in 2016. Borehole drilling and well installation were completed using hollow stem auger drilling techniques. Wells were installed by Pacific Drilling Co., of San Diego, California. Soil cuttings were stored in Department of Transportation (DOT)-approved 55-gallon drums. The first occurrence of groundwater (i.e., saturated sediments) was recorded on a boring log form. Well installation was performed on September 25 through 30, 2019. Soil boring field logs are presented in Appendix B.

Soil samples for geotechnical analysis were collected during well drilling. Geotechnical samples were analyzed for grain size distribution using ASTM D6913 and are presented in Table 2. Laboratory logs for individual grain sized distribution tests are presented in Appendix C. Soil was classified according to the Unified Soil Classification System (USCS). Results show that soil at MW1 primarily consists for clayey sand (SC) and lean clay (CL). The soil from 24 feet to 53 feet was very dense; this is shown on boring logs where 50 sampler blow counts only penetrated 3 to 5 inches of material. Auger drilling was slow and this material acts as a confining layer to groundwater beneath it. Soil at MW2 primarily consists of silty sand (SM) and clayey sand (SC). Soil at MW3 primarily consists for poorly graded sand (SP) and silty dense to very dense cemented sandstone. The lateral extent of the dense confining layer in MW-1 is not known, but does not extend far to the south of MW1 across the project site since these conditions were not encountered in MW2 and MW3.

Table 2
Grain Size Distribution Data

Well	Depth (bgs)	Passing 200%	USCS Classification	Sample Description
MW1	5	43.3	SC	Dark Grayish Brown Clayey Sand
MW1	10	5.6	SP-SM	Light Brownish Gray Poorly Graded Sand with Silt
MW1	15	25	SC	Pale Yellow Clayey Sand
MW1	20	26.7	SC	Pale Yellow Clayey Sand
MW1	24	54.4	CL	Light Gray Sandy Lean Clay
MW1	26	50.9	CL	Pale Yellow Sandy lean Clay

Table 2 (continued)

Grain Size Distribution Data

Well	Depth (bgs)	Passing 200%	USCS Classification	Sample Description
MW1	28	25.3	SC	Pale Yellow Clayey Sand
MW1	32	40.3	SC	Pale Yellow Clayey Sand
MW1	34	37.9	SC	Pale Yellow Clayey Sand
MW1	36	46.3	SC	Dark Yellowish-Brown Clayey Sand
MW1	38	27.6	SC	Pale Yellow Clayey Sand
MW1	40	38.6	SC	Pale Yellow Clayey Sand
MW1	42	26.2	SC	Light Yellowish-Brown Clayey Sand
MW1	44	24.4	SC	Pale Yellow Clayey Sand
MW1	46	19.5	SC	Pale Yellow Clayey Sand
MW1	48	23.4	SC	Pale Yellow Clayey Sand
MW1	52	30.3	SC	Light Yellowish-Brown Clayey Sand
MW1	54	23.6	SC	Pale Yellow Clayey Sand
MW2	5	22.6	SM	Dark Reddish-Brown Silty Sand
MW2	10	18.5	SM	Dark Yellowish-Brown Silty Sand
MW2	15	23.0	SM	Dark Yellowish-Brown Silty Sand
MW2	17	31.1	SM	Light Olive Brown Silty Sand
MW2	19	30.3	SM	Light Olive Brown Silty Sand
MW2	21	15.3	SM	Light Olive Brown Silty Sand
MW2	23	31.4	SC	Light Olive Brown Clayey Sand
MW2	25	42.3	SC	Light Olive Brown Clayey Sand
MW2	27	23.6	SC	Grayish Brown Clayey Sand
MW3	1	24.2	SM	Dark Reddish-Brown Silty Sand

Table 2 (continued)

Grain Size Distribution Data

Well	Depth (bgs)	Passing 200%	USCS Classification	Sample Description
MW3	5	26.7	SM	Reddish-Brown Silty Sand
MW3	10	23.7	SM	Dark Reddish-Brown Silty Sand
MW3	15	13.8	SM	Dark Yellowish-Brown Silty Sand
MW3	20	4.8	SP	Pale Yellow Poorly Graded Sand
MW3	25	14.0	SM	Light Olive Brown Silty Sand With Gravel
MW3	27	6.5	SP-SM	Pale Yellow Poorly Graded Sand With Silt
MW3	29	3.2	SP	Pale Yellow Poorly Graded Sand
MW3	31	4.3	SP	Pale Yellow Poorly Graded Sand
MW3	33	5.3	SP-SM	Light Olive Brown Poorly Graded Sand with Silt
MW3	35	11.0	SP-SM	Light Olive Brown Poorly Graded Sand with Silt
MW3	37	4.9	SP	Light Olive Brown Poorly Graded Sand
MW3	39	6.7	SP-SM	Light Olive Brown Poorly Graded Sand with Silt
MW3	41	4.7	SP	Light Olive Brown Poorly Graded Sand
MW3	43	4.9	SP	Light Olive Brown Poorly Graded Sand

Note: Sample depth in feet below ground surface (bgs)

Grain size data was used to estimate of hydraulic conductivity (K) values using the Hazen Method (Fetter 1988). The Hazen approximation is:

$K = C(D_{10})^2$

Where:

- K is the hydraulic conductivity in cm/sec
- D_{10} is the effective grain size in cm (taken from grain sized distribution curves)
- C is a coefficient based on grain size and sorting

The criteria for using this method only applied to samples with sand in the saturated zone at MW3. K-values for MW1 and MW2 cannot be calculated via the Hazen Method because the effective grain size distribution (D_{10}) is less than 0.1 and 3.0 millimeters. MW1 and MW2 samples are generally finer grained sediments than that in MW3. Five samples were applicable for MW3 at depths of 35, 37, 39, 41, and 43 feet below ground surface (bgs) that had Hazen calculated K-values of 3.38E-05, 5.42E-05, 4.86E-05, 1.06E-04, and 6.00E-05 meters per second (m/sec), respectively. The arithmetic mean of these five K-values is 6.05E-05 m/sec. These results are similar to K-values calculated for MW3 during aquifer testing (Section 6) and used to support groundwater modeling efforts (Section 9).

Soil samples were collected in the saturated zone for laboratory analysis of hydraulic conductivity. Two samples were tested for hydraulic conductivity using ASTM D5084, Method C. One sample from MW2 was collected at a depth of 22 feet bgs and has a K-value of 1.1E-09 m/sec. One sample from MW3 was collected at a depth of 38 feet bgs and has a hydraulic conductivity of 3.2E-06 m/sec. A sample for hydraulic conductivity analysis could not be collected from MW1 due to poor sample recovery. Laboratory logs for individual hydraulic conductivity tests are presented in Appendix C.

Groundwater monitoring wells were installed and constructed consistent with *Water Well Standards* (DWR, 1981 and 1990). Monitoring wells were completed in an 8-inch diameter borehole. The total well depth for each of the three new wells ranged from 30 to 54 feet bgs.

Each monitoring well was constructed of 2-inch diameter, Schedule 40, flush-jointed polyvinyl chloride (PVC) casing and factory-slotted well screen. A 10-foot long well screen was used with 0.020-inch slotted openings. A filter pack of clean No. 3 silica sand was poured from ground surface into the annular space between the screen and the borehole wall as the augers were slowly raised. The filter pack extended approximately 2 feet above the top of the screen. A 3- foot-thick layer of bentonite clay (i.e., bentonite chips) was placed on top of the filter pack and allowed to fully hydrate before filling the remaining annular space with mixture of bentonite grout (5%) and concrete (95%) to ground surface.

Flush-mounted steel well boxes with watertight gaskets were anchored in aggregate concrete approximately 1-foot bgs. The boxes were positioned at 1 inch above grade. All wells were secured with locking caps. Well construction details are provided in Table 3 and also shown on soil boring field logs presented in Appendix B.

Table 3

Well Construction Details

Monitoring well number	MW1	MW2	MW3
Surface Completion	Traffic Box	Traffic Box	Traffic Box
Surface Seal (Concrete)	0-3	0-3	0-3
Grout (Bentonite-Cement)	3-38	3-14	3-31
Annual Seal (Bentonite Chips)	38-41	14-17	31-34
Filter Pack (No. 2 Sand)	41-53	17-29	34-46
Screen Interval (0.020 slots)	43-53	19-29	36-46
Bottom of Hole	54	30	46.5

Note: All measurements are feet below ground surface (bgs)

5 WELL DEVELOPMENT AND SAMPLING

Groundwater monitoring well development was performed by Pacific Drilling, Co., consistent with *Water Well Standards* (DWR, 1981 and 1990). Well development was performed on September 30, 2019 and on October 2, 2019.

Groundwater monitoring wells were developed by the surge-and-bail and pump method to remove fine materials from the well and improve hydraulic communication between the geologic formation and the well. For each well, the development procedure included measuring the depth to groundwater in the well and calculating the volume of water within the well casing and filter pack (i.e., borehole volume). Subsequently, each of the wells was surged using a surge block within 5-foot intervals of the saturated portion of the screened interval for approximately 10 minutes for each 5-foot interval. Next, the wells were bailed and then pumped to remove a minimum of three borehole volumes of groundwater. Indicator parameters for pH, temperature, turbidity, electrical conductivity, oxidation reduction potential (ORP), and dissolved oxygen (DO) were monitored until they stabilized and extracted groundwater became visually clear (less than 5 nephelometric turbidity units [NTUs]), at which time development was considered complete. The water levels, purge volumes, indicator parameters, and quantity of water removed was recorded on a well development record field form. Field forms are included in Appendix B.

Development water was transferred to DOT-approved 55-gallon drums. The drums were sealed, labeled, and stored at the storage site located on Buena Vista Way in Carlsbad. Details of waste management is presented in Section 8, Investigation Derived Waste Management.

6 AQUIFER TESTING

Aquifer testing, consisting of slug testing, was performed on the three new groundwater monitoring well and the existing monitoring well to assess hydraulic conductivity. Darcy's Law defines the hydraulic conductivity (K) as the ratio of the average velocity of a fluid through a cross-sectional area to the applied hydraulic gradient. Slug testing provides an estimate of hydraulic conductivity and has an advantage over pumping tests in that it can be completed quickly, does not require additional observation wells and does not require the disposal of large quantities of water that are produced during pumping tests. It does however provide a hydraulic conductivity value for only a small volume of in-situ material in close proximity to the well. Evaluation of hydraulic conductivity representative of a larger volume or area would require longer duration multiple well aquifer pumping tests.

Slug testing was performed by Kleinfelder personnel on October 2 and 3, 2019. One injection and one withdrawal slug test was performed on the following wells; MW1 and MW4. Two injections and two withdrawal slug tests were performed on the following wells; MW2 and MW 3. Water levels were gauged prior to the beginning of the tests to evaluate baseline conditions. A water-level pressure transducer was installed near the bottom of the well. The water level was allowed to equilibrate to pre-test conditions prior to beginning the test. The pressure transducer used was the 15-pounds per square inch (psi) vented-Level TROLL 700 data logger made by In-situ, Inc., of Fort Collins, Colorado. The 15-psi transducer was used for all monitoring wells (i.e., MW1 through MW4).

Two slugs constructed of PVC were used for testing. A 0.11-foot diameter slug with a total length of 8.09 feet and a total volume of 0.0783 cubic feet was used for monitoring wells MW1, MW2, and MW4. A 0.11-foot diameter slug with a total length of 4.09 feet and a total volume of 0.0403 cubic feet was used for MW3. Both slugs were used for MW2 and results were comparable. For the slug injection tests, the slug was lowered into the well until the slug was submerged in the water column. The displacement and recovery of the water column was recorded by the transducer and periodically by manual measurements. The water level was monitored until a minimum of 95% recovery had been attained (relative to static conditions). For the slug withdrawal tests, the slug was rapidly removed from the water column and the change in water level was monitored as specified for the injection tests.

Field observations and measurement were recorded on the slug testing field form and the slug testing water level measurements form included in Appendix B. Slug testing pressure data from the data logger is included in Appendix D, Aquifer Test Results. This appendix also includes the

In-Situ program output information used to prepare graphs and to calculate hydraulic conductivity values.

The hydraulic conductivity values ranged from 3.24E-06 m/sec at MW1 to 4.93E-04 m/sec at MW3 for slug injection tests. The hydraulic conductivity values ranged from 2.92E-06 m/sec at MW1 to 2.63E-04 m/sec at MW3 for slug withdrawal tests. A summary of slug test results is presented in Table 4. These values were compared to textbook values for hydraulic conductivity (Freeze and Cherry 1979). Textbook description of these values indicates the soil type would be clayey sand/silty sands and clean sands which is consistent with field classifications of the aquifer during drilling activities.

Table 4
Aquifer Test Results

Well ID	Test Identification	K VALUE (feet/sec)	K VALUE (feet/sec)	K VALUE (m/sec)	K VALUE (m/sec)	Text Book Soil Classification
Slug Injection						
MW1	MW1 SLUG IN 1	0.00001061	1.06E-05	0.000003236	3.24E-06	Silty/Clayey Sand
MW2	MW2 SLUG IN 1	0.00001997	2.00E-05	0.000006091	6.09E-06	Silty/Clayey Sand
MW2	MW2 SLUG IN 2	0.00001332	1.33E-05	0.000004063	4.06E-06	Silty/Clayey Sand
MW3	MW3 SLUG IN 1	0.0007571	7.57E-04	0.000230916	2.31E-04	Clean Sand
MW3	MW3 SLUG IN 2	0.001615	1.62E-03	0.000492575	4.93E-04	Clean Sand
MW4	MW4 SLUG IN 1	0.0001183	1.18E-04	0.000036082	3.61E-05	Silty Sand, Clean Sand
Slug Withdrawal						
MW1	MW1 SLUG OUT 1	0.0000096	9.56E-06	0.000002916	2.92E-06	Silty/Clayey Sand
MW2	MW2 SLUG OUT 1	0.0000148	1.48E-05	0.000004514	4.51E-06	Silty/Clayey Sand
MW2	MW2 SLUG OUT 2	0.0000151	1.51E-05	0.000004599	4.60E-06	Silty/Clayey Sand
MW3	MW3 SLUG OUT 1	0.0008631	8.63E-04	0.000263246	2.63E-04	Clean Sand
MW3	MW3 SLUG OUT 2	0.0005047	5.05E-04	0.000153934	1.54E-04	Clean Sand
MW4	MW4 SLUG OUT 1	0.0001210	1.21E-04	0.000036905	3.69E-05	Silty Sand, Clean Sand

Notes: Text Book Classification, Freeze and Cherry, 1979

7 WELL DESTRUCTION

Groundwater well decommissioning was performed after aquifer testing was complete. Dig Alert Ticket numbers for well destruction included: A192540892, A192540907, and A192540912 for the State Street, Juniper Avenue, and Chinquapin Avenue, respectively.

Well decommissioning was performed by Pacific Drilling Co., on October 7 and 8, 2019. Decommissioning was performed by over drilling each monitoring well using hollow stem auger drilling methods. Boreholes were pressure grouted to the surface. The soil and well construction materials were contained in DOT-approved 55-gallon drums. A hot patch of asphalt was installed at the surface of each well location to match the existing road asphalt.

8 INVESTIGATION DERIVED WASTE MANAGEMENT

Investigation-derived waste (IDW) generated during this investigation included soil cuttings, well construction materials, monitoring well development and purge water, and equipment decontamination water. All solid materials and water were placed in DOT-approved 55-gallon drums. The drums were sealed, labeled, and stored offsite. Sampling and analysis of IDW was performed for waste disposal profiling. Samples were collected on September 25 and 26, 2019 and on October 2 and 15, 2019. Samples were submitted to Pace Analytical for analysis.

Laboratory reports for both soil and water IDW are included in Appendix E. Sample results indicate that all waste (soil and water) is profiled as nonhazardous. Waste manifests were signed by an authorized agent from the City of Carlsbad and are included in Appendix E. Waste transport and disposal was coordinated through Belshire Environmental Services Inc., of Foothill Ranch, California. Waste was removed from the drum storage site on December 2, 2019 and brought to an offsite treatment and recycling facility.

9 GROUNDWATER MODELING PROCEDURES AND RESULTS

This section presents the methods and procedures that were followed to produce a simplified numerical groundwater flow model.

The model grid was created using the United States Geological Survey (USGS) three-dimensional, finite-difference, computer code MODFLOW. The grids were constructed with 50-foot by 50-foot cells defined by a series of rows, columns, and layers (Appendix F). Along the railroad trench, the grids were refined to 6-foot by 6-foot cells. The flow model was constructed using the Groundwater Vistas® (v.7.24) modeling platform developed by Environmental Simulations, Inc. (2020). The program consists of a series of pre- and post-processors that transfer information to a groundwater modeling computer code. Groundwater flow modeling was performed using the USGS unstructured Grid (USG) computer code, MODFLOW-USG (Panday et al., 2013). MODFLOW-USG consists of a main program that directs the execution of the simulation. It contains a series of user selectable packages or modules that simulate groundwater flow, control the solution of the finite-difference equations, and simulate boundary conditions. Length and time units of feet and days, respectively, were specified in the model, and the assigned parameter values were in consistent units.

The software used to simulate flow was selected because of its numerically stable codes and ability to adopt unstructured grids. Unstructured grids, such as quadtree, allow an efficient model discretization by creating areas with high level of refinement only in places of interest, such as in the vicinity of the proposed railroad trench, without sacrificing model run times and stability. Quadtree refinement is similar to finite-element modeling but the mesh is a lot easier to generate and maintain. In the quadtree mesh type, each parent cell is divided into smaller cells by a power of two; such subdivisions include 2, 4, 8, 16, 32, 64, and 128. Within Groundwater Vistas®, the refinements are smoothed such that each cell connects to no more than two other cells on each face of the cell.

9.1 MODEL GRID

A plan view of the model grid and domain is shown in Appendix F. The grid consists of 250 rows, 201 columns, and five layers. The model includes 516,485 active cells representing an area of approximately 2.25 square miles.

The Project is represented by five layers to provide flexibility in future model development, if needed, such as to represent different hydraulic behavior at different depths. Layer 1 through 4 represent Project quaternary soil and Layer 5 represents the bedrock (Santiago Formation). The aquifer system in the model area has been identified as unconfined system. Areas of the model domain that were not included in the modeled flow system were made inactive (no-flow).

9.2 BOUNDARY CONDITIONS

Constant head boundary (CHB) conditions were assigned to represent groundwater flux into and out of the model. One of the challenges of the Project groundwater model is establishing head boundary conditions. Accurate definition of head boundary conditions is an essential part of conceptualizing and modeling groundwater flow systems. In groundwater investigations, a system under study ideally should be enclosed by a boundary surface that corresponds to some kind of identifiable hydrogeologic features at which some characteristic of groundwater flow is easily described (for example a body of surface water, an impermeable surface, and a water table). The position of a three-dimensional boundary surface in nature (regardless of the extent to which it has been arbitrarily specified) defines the geometry of the groundwater flow system.

Spatially and temporally, insufficient groundwater data are available from monitoring wells upgradient of the Project to create and to be as head boundary conditions. At the Project, the northeast boundary conditions (i.e., constant head boundary) were chosen arbitrarily in a way that reflects the observed groundwater levels at the Project. The selection of the head boundary conditions for the numerical model involved considerable simplification of the actual hydrogeologic conditions.

The ocean and the two water bodies on northwest (Buena Vista Lagoon) and southeast (Agua Hedionda Lagoon) were assigned as a constant head boundary with a value set at mean sea level (Appendix F).

9.3 HYDRAULIC PARAMETERS

Hydraulic conductivities were assigned based on slug tests conducted at the Project and hydraulic conductivity calculated using grain size distribution. Values of storage parameters (specific yield for unconfined layers) and effective porosity were adopted from the literature for similar types of soils (Domenico, 1987; and Domenico and Schwartz, 1990). The distributions of hydraulic parameters, outside of the trench wall and its vicinity, were assumed to be constant throughout the model domain in each layer (Appendix F).

9.4 SOLVER

The Sparse Matrix Solver (SMS) package of MODFLOW-USG uses a Pre-Conditioned Conjugate Gradient Unstructured (PCGU) solver (White and Hughes, 2011) for the symmetric flow equations and the χMD solver (Ibaraki, 2005; Ibaraki et al., 2011) for asymmetric matrices used to solve the groundwater flow equations for hydraulic head produced by MODFLOW. The Delta-Bar-Delta/Newton Raphson method was used to solve nonlinear equations and the χMD solver was used to solve linear equations. The solvers calculate the hydraulic head distribution by iteratively solving the flow equations until convergence is achieved. An iterative matrix solver is assumed to have converged when some measure of the residual and/or the difference in results between successive iterations is less than user-specified convergence criteria value (which in this case was 0.01 foot). The specified convergence criteria are too large if the global groundwater flow budget errors calculated by the model are unacceptably large. For most groundwater flow problems, global budget errors greater than 1 percent are unacceptable.

9.5 PARTICLE TRACKING

Particle tracking is a widely applied tool to assess and evaluate water movement patterns and travel times in groundwater flow models. The particle tracking program mod-PATH3DU (Muffels et al., 2016) was used to perform particle tracking to evaluate potential groundwater flow paths along and across the proposed trench wall. The mod-PATH3DU program was used for calculating the three-dimensional pathlines of purely advective flow.

After running a MODFLOW-USG simulation, the user can designate the starting location of particles. The particles are then tracked through the model domain as they are transported by advection through the flow field computed by MODFLOW-USG. Particles can be tracked either forward or backward in time.

9.6 MODEL CALIBRATION

The numerical modeling process typically includes performing calibration and sensitivity analyses of the computer model. An attempt was made to calibrate the model, meaning the results of simulations should match measured head values as closely as possible while maintaining hydraulic parameter values that are reasonable and consistent with the conceptual model (i.e., not significantly different than calculated/measured or literature values). Calibration is thus an iterative process, whereby the model is run multiple times to find the optimum values and distribution of parameters.

9.7 NUMERICAL MODELING INPUT SUMMARY

The numerical groundwater flow model input parameters and model assumptions are summarized below.

- The model domain includes areas beyond the Project boundaries to help reduce the effects of the boundaries on the area of interest. To provide flexibility, CHBs were assigned on the northwest, southwest, southeast, and northeast sides of the model domain in all layers.
- The website, https://www.nws.noaa.gov was consulted to obtain precipitation data and to estimate the recharge value. The average annual precipitation at the Project and its vicinity is approximately 12 inches. The final recharge value was selected based on calibration results. Based on the final calibration results, a 15 percent of the rainfall was assigned as areal recharge to the model. The assigned recharge value was uniform across the Project.
- Hydraulic conductivity values were obtained from Project slug testing results, geotechnical testing, and published literatures. A summary of Project hydraulic conductivity values consider for the model is presented in Table 5, *Hydraulic Conductivity Value Summary*. Based on slug tests and calculations using grain size distribution, the range of the estimated horizontal hydraulic conductivities are 0.83 to 139.54 feet per day (feet/day). Initially, a range of values from the available calculated hydraulic conductivities were used to calibrate the model. Through the process of calibration, hydraulic conductivity values were selected (within the range of reported values) that simulate the distribution of measured groundwater elevation to an acceptable statistical result. During the simulation and calibration, geometric mean horizontal hydraulic conductivities were used as final value for Layer 1 through 4 and, based on slug tests results from wells MW1 through MW4, arithmetic mean values were used as final value along the trench wall and its vicinity (Table 5). Literature based value of 0.1 feet/day was used for the bedrock (Layer 5) as shown on Appendix F.
- Storage parameter values were obtained from published literatures. Uniform storage parameters (porosity 0.25 and specific yield 0.15) were used across the model domain in Layer 1 through 4. The bedrock (Layer 5) was assigned a porosity of 0.15 and a specific yield of 0.1.
- The model is a simplified version of the heterogeneous nature of the aquifer, and each layer was represented spatially by uniform aquifer parameters within each layer outside of the proposed trench wall and its vicinity (Appendix F). Within the vicinity of the trench

wall, four zones of hydraulic conductivities ranged from 1.4 to 80.8 feet/day were used in Layer 1 and 2.

- Groundwater elevations from October 2019 (MW1 through MW4) were used as calibration targets for the groundwater flow model. In addition, groundwater elevation values obtained from the California Geotracker website were used for calibrating the model. These groundwater elevation values are not contemporaneous data. To reflect this, the data were assigned a weight factor of 50 percent
- Model was calibrated under steady-state and unconfined aquifer conditions.
- Discharge from the steady-state model is primarily through CHBs.

Table 5

Hydraulic Conductivity Value Summary[1]

Well ID	Slug Withdrawal Arithmetic Mean[2]	Hazen Method[3]	Geotechnical Lab Analysis[4]	Modeling K-Value Selected[5]
MW1	8.27E-01	NA	NA	8.72E-01
MW2	1.29E+00	NA	3.12E-04	1.36E+00
MW3	5.92E+01	1.71E+01	9.06E-01	8.08 E+01
MW4	1.05E+01	NA	NA	1.03 E+01

Notes:
1 - All measurements are in feet/day
2 - Values for slug testing include the arithmetic mean of slug withdraw results
3 - Hazen Method was calculated from Project grain size distribution data using ASTM D6913
4 - Laboratory geotechnical analysis for hydraulic conductivity used ASTM D5084, Method C. Laboratory permeability values are generally considered to represent vertical hydraulic conductivity.
5 – Arithmetic mean values calculated using results from slug-in and slug-out testing.

9.8 NUMERICAL MODELING RESULTS

Numerical model calibration was performed as an iterative process to evaluate and compare simulated with observed groundwater potentiometric surface elevations. Calibration targets were distributed throughout the active model domain. Targets were selected based on the availability of measurements during the calibration period and on distribution within the model domain to provide reasonable coverage of the modeled area.

Model calibration was attempted by varying recharge, hydraulic conductivity (horizontal and vertical), and GHBs to produce a good match between simulated and measured groundwater elevations. Solver parameters and convergence criteria were also refined during model calibration to attain model convergence without excessive iterations. After model calibration was completed, the potential impact of the proposed trench wall on the groundwater flow at the Project was simulated.

9.8.1 Calibration Results

The quality of the calibration was evaluated first by comparison of observed and modeled heads at target wells and then by reviewing the incoming and outgoing fluxes (the mass balance) calculated by the model in comparison to the thickness of the saturated section and the hydraulic gradient. Residuals were calculated at each target location during calibration. Residuals are the difference between observed and simulated head values at calibration targets: positive values indicate lower simulated than observed hydraulic head while negative values indicate higher simulated than observed head.

Calibration was considered optimized when a statistically reasonable match between observed and model-calculated head values was obtained and the absolute residual mean (ARM, i.e., mean of the absolute value of target residuals) was within or less than 10% of the observed range in hydraulic head (Anderson and Woessner, 1992). The calculated scaled ARM of the calibrated model was 8.4 percent. The normalized Root Mean Square (RMS) is expressed as a percentage scaled to the observed head range, and is a more representative measure of the fit than the scaled ARM. The calculated scaled RMS of the calibrated model was 9.6 percent. The calibration statistics are plotted on a graph that shows the calculated head (groundwater elevation) compared with the observed head at monitoring wells in the project area (Appendix F).

The mass balance of the groundwater model is also generally considered to be acceptable when the difference between the incoming and outgoing fluxes is less than one percent and ideal when the difference is less than 0.1 percent (Anderson and Woessner, 1992). The mass balance error for the final calibrated model was calculated as -0.0026 percent (slightly more flux leaving than entering the model).

The hydrogeologic and boundary condition inputs were evaluated for sensitivity of the simulated head values to changes. A sensitivity analysis is the process of varying model input parameters over a reasonable range (e.g., range of uncertainty in values of model parameters) and observing the relative change in model response. The purpose of the sensitivity analysis is to demonstrate the sensitivity of the model simulations to uncertainty in model input values. The sensitivity of one model parameter relative to other parameters is also demonstrated.

The sensitivity of hydraulic head to changes in hydraulic conductivity, recharge, and CHBs was evaluated. In this type of analysis, the value of a selected parameter is increased and/or decreased according to a series of user specified multiplication factors, and the RMS error for each simulation is then compared to the RMS error of the base case. The model was considered sensitive to a parameter if changes to the value of that parameter resulted in a significant increase (i.e., more than 20 percent) in the RMS error.

Under steady-state conditions, the model appears to be sensitive to changes in aerial recharge, hydraulic conductivity, and CHBs.

9.8.2 Predictive Analysis

Based on data available from the Carlsbad Village Double Track project (TY Lin International, 2017), a uniform 50 feet deep non-permeable (assigned a zero hydraulic conductivity value) trench wall along the double track location was included in the numerical model to simulate its effect. As shown in Appendix F, and based on available data and assumptions, the numerical model indicated a mounding effect along the upgradient side of the trench wall. The potential groundwater mounding along the upgradient side of the proposed trench wall ranged from approximately 0.2 foot to approximately 4 feet. (Appendix F)

To evaluate and assess the flow path and behavior at the trench wall, forward particle tracking simulations were performed. Particles were released at the water table in Layer 1 upgradient of the trench wall (Appendix F). A forward particle tracking scheme was used to simulate and evaluate groundwater flow direction and flow paths within the vicinity of the proposed trench wall.

The particle tracking simulations without the trench wall indicated that the overall pathway of groundwater flow is from the northeast to southwest with uniform hydraulic gradient across the proposed trench wall. But, when a trench wall is considered, particles originating upgradient of the Project were deflected by the wall and forced to flow under and/or around the wall (Appendix F). The vertical movement of particles was controlled by the step hydraulic gradient created by the trench wall. As shown on Appendix F, strong vertical hydraulic gradients forced particles to move either downward or sideway near the proposed trench wall.

A groundwater system is a complex and open system, which is affected by natural conditions and human activities. A relatively simple flow governing equations are used to conceptualize natural hydrological processes. In addition, available observation data is always limited to fully assess the hydrogeological conditions of a given Project. With available limited data set and sets of simplified assumptions, the predictive results of groundwater simulation often deviate from true values, which is attribute to the uncertainty of groundwater numerical simulation. According to the process of system simulation, the uncertainty sources of groundwater numerical simulation can be attributed to model parameters, conceptual model, and observation data uncertainties.

The estimate of mounding from this calibrated model represent the one possible solution based on the assumptions used and the value of parameters selected to create the model. Equally valid solutions are possible that would provide different results, but we have incorporated the available data to provide a reasonable simulation of conditions. The model was run using different input parameters to arrive at a solution that met generally accepted groundwater flow model performance standards.

The model simulates steady state conditions, water level mounding in the short term may differ from steady state modeling results.

The calibrated model presents an optimized but non-unique solution. The model is a simplified version of real-world conditions but similar model performance metrics such as RMS and mass balance closure may be achieved with other combinations of hydrogeologic conditions.

The modeling results present our optimal simulation of potential future conditions with the available data, Improvements in precision of modeling results may be obtained with additional field data such as water levels from additional wells, long term monitoring of water levels, hydraulic testing at additional locations.

Limitations of the available data include field verification across the model domain of:

- Hydraulic conductivity
- Current groundwater level data,
- A record of the typical range of water levels on an annual and long-term basis.

10 CONCLUSIONS AND RECOMMENDATIONS

Kleinfelder installed, developed, performed aquifer slug tests and decommissioned three groundwater monitoring wells and slug tested one existing groundwater monitoring well, according to the project work plan (Kleinfelder 2019). Slug test and geotechnical sample results were used to assess hydraulic conductivity along the lineament of the proposed railway. Water level data from the wells and the hydraulic conductivity data were used in the development of a groundwater flow model. A steady-state MODFLOW-based groundwater model was developed and calibrated to simulate current groundwater level and flow in the study area. The model was used to simulate the effect of a groundwater barrier formed by a line trench for a potential future rail line modification on groundwater flow paths and water levels in the area of interest. The model was calibrated to within acceptable performance levels.

Conclusions drawn from the field investigation and groundwater modeling are as follows:

- The total well depth for each of the three new wells ranged from 30 to 54 feet bgs.
- The depth to groundwater ranged between 12.4 ft bgs and 34.82 ft bgs with the deepest water levels
- The soil at MW1 primarily consists for clayey sand (SC) and silty very dense cemented sandstone. Soil at MW2 primarily consists of silty sand (SM) and clayey sand (SC). Soil at MW3 primarily consists for poorly graded sand (SP). The dense sandstone layer at MW1 acts as a confining layer to groundwater beneath it. The lateral extent of the cemented sandstone is not known yet is likely limited and does not extend to the south of MW1 across the project site since these conditions were not encountered in MW2 and MW3.
- Hydraulic conductivity values from tests conducted in the four monitoring wells ranged between 2.92E-06 m/sec and 4.93E-04 m/sec.
- The steady-state groundwater modeling results indicate that a groundwater mound may develop on the upgradient side of the trench wall with a magnitude of up to approximately 4 feet depending on location.
- The modeling results present our optimal simulation of potential future conditions with the available data, Improvements in precision of modeling results may be obtained with additional field data such as water levels from additional wells, long term monitoring of water levels, hydraulic testing at additional locations.

11 LIMITATIONS

It should be recognized that definition and evaluation of geologic and environmental conditions are a difficult and inexact science. Judgments leading to conclusions and recommendations are generally made with incomplete knowledge of the subsurface conditions present due to the limitations of data from field studies. Although risk can never be eliminated, more detailed and extensive studies yield more information, which may help understand and manage the level of risk. Since detailed study and analysis involves greater expense, our clients participate in determining levels of service that provide adequate information for their purposes at acceptable levels of risk. The groundwater modeling reported here was performed for the purpose of the Alternatives Analysis report (which is the current phase of work). The results should not be used for engineering design purposes.

Our conclusions, opinions and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided. It should be recognized that definition and evaluation of subsurface conditions are difficult. Judgments leading to conclusions and recommendations are generally made with incomplete knowledge of the subsurface conditions present due to the limitations of data from field studies.

12 REFERENCES

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FIGURES

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PROJECT: 20200172	VICINITY MAP		FIGURE
DRAWN: JAN 2020			
DRAWN BY: KFH	CARLSBAD DOUBLE TRACK-TRENCH ALTERNATIVE PROJECT CARLSBAD, CALIFORNIA		1
CHECKED BY: EJ			
FILE NAME: Fig1_Vic.mxd			

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PROJECT:	20200172
DRAWN:	JAN 2020
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FILE NAME:	Fig2A_MW1.mxd

MW-1 GROUNDWATER MONITORING WELL LOCATION

CARLSBAD DOUBLE TRACK-TRENCH ALTERNATIVE PROJECT
CARLSBAD, CALIFORNIA

FIGURE

2A

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PROJECT:	20200172
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DRAWN BY:	KFH
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FILE NAME:	Fig2B_MW2.mxd

MW-2 GROUNDWATER MONITORING WELL LOCATION

CARLSBAD DOUBLE TRACK-TRENCH ALTERNATIVE PROJECT
CARLSBAD, CALIFORNIA

FIGURE

2B

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PROJECT:	20200172
DRAWN:	JAN 2020
DRAWN BY:	KFH
CHECKED BY:	JL
FILE NAME:	Fig2C_MW3.mxd

MW-3 GROUNDWATER MONITORING WELL LOCATION

CARLSBAD DOUBLE TRACK-TRENCH ALTERNATIVE PROJECT
CARLSBAD, CALIFORNIA

FIGURE
2C

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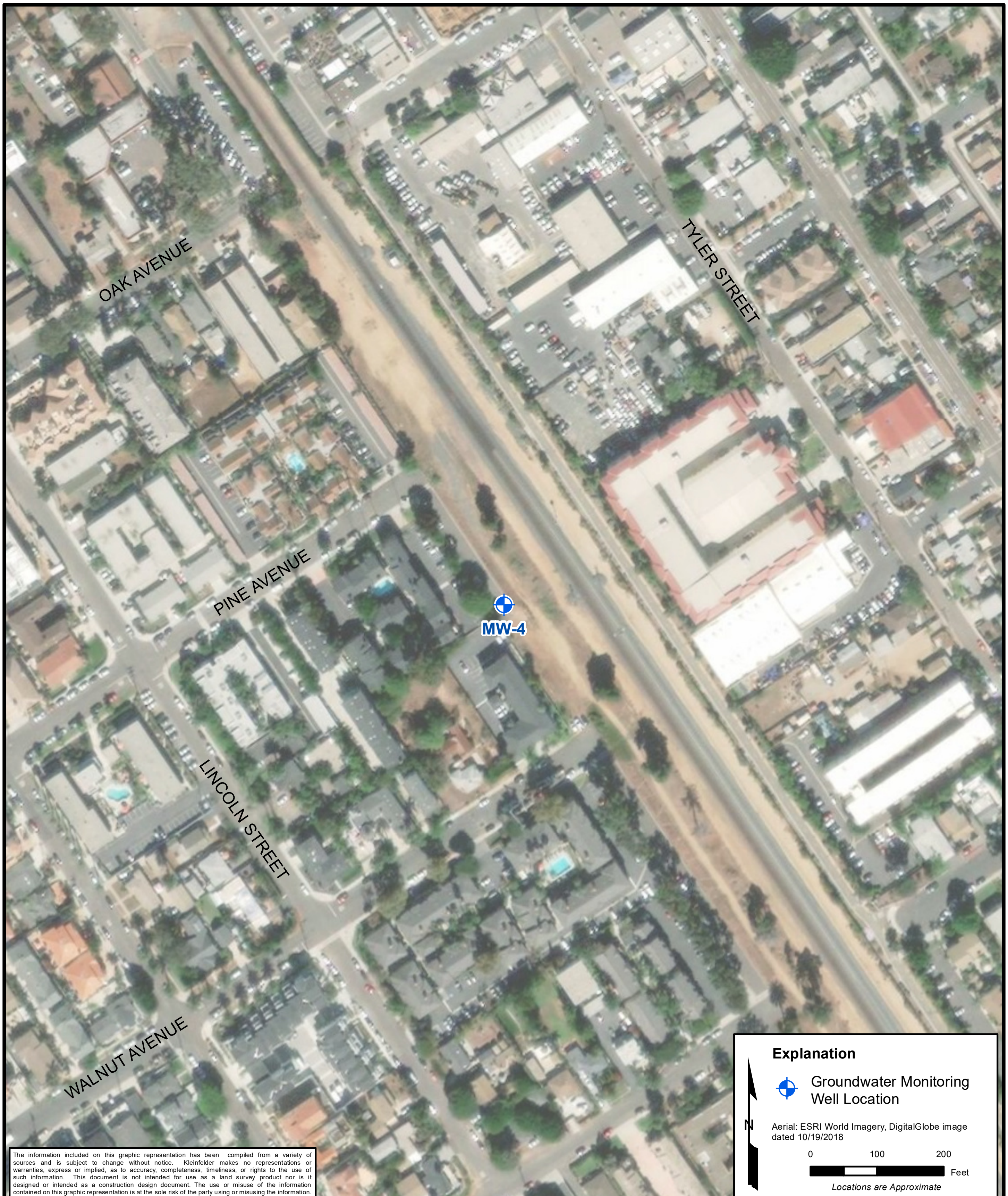

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PROJECT:	20200172	**MW-4 GROUNDWATER MONITORING WELL LOCATION**	FIGURE
DRAWN:	JAN 2020		
DRAWN BY:	KFH	CARLSBAD DOUBLE TRACK-TRENCH ALTERNATIVE PROJECT CARLSBAD, CALIFORNIA	**2D**
CHECKED BY:	EJ		
FILE NAME:	Fig2D_MW4.mxd		

SAN DIEGO, CA

APPENDIX A

Well Permits, Count of San Diego Department of Environmental Health

PERMIT # LMWP-004139
A.P.N. #: 203-054-28-00
+ 2 more APNs
EST #: NONE

COUNTY OF SAN DIEGO
DEPARTMENT OF ENVIRONMENTAL HEALTH
LAND AND WATER QUALITY DIVISION
MONITORING WELL PROGRAM

MONITORING WELL CONSTRUCTION PERMIT

SITE NAME: CITY OF CARLSBAD RIGHT OF WAY (ROW)

SITE ADDRESS: ADJACENT TO APNs: 203-054-28, 204-240-25, & 206-080-27-00

PERMIT FOR: CONSTRUCTION OF MONITORING WELLS (3)

PERMIT APPROVAL DATE: 9/05/2019

PERMIT EXPIRES ON: 1/07/2020

RESPONSIBLE PARTY: CITY OF CARLSBAD

PERMIT CONDITIONS:

1. Wells must have a **minimum 3-foot concrete surface seal**. The surface seal shall consist of concrete able to withstand the maximum anticipated load without cracking or deteriorating. The concrete should meet Class A specifications of a minimum 4000-pound compressive strength. **Bentonite slurries are not an acceptable annular sealing material in the unsaturated zone.**

2. All water and soil resulting from the activities covered by this permit must be managed, stored and disposed of as specified in the SAM Manual in Section 5, II, D-4. In addition, drill cuttings must be properly handled and disposed in compliance with the Stormwater Best Management Practices of the local jurisdiction.

3. Within 60 days of completing work, submit a well construction report, including all well and/or boring logs and laboratory data to the Well Permit Desk. This report must include all items required by the SAM Manual, Section 5, Pages 6 & 7.

4. This office must be given 24-hour notice of any drilling activity on this site and advanced notification of drilling cancellation. Please contact the Well Permit Desk at (858) 505-6688.

NOTE: **This permit does not constitute approval of a work plan as defined in Section 2722 of Article 11 of C.C.R., Title 23. Work plans are required for all unauthorized release investigations in San Diego County.**

APPROVED BY: *James Clay* DATE: 9/05/2019

James Clay

PERMIT APPLICATION
GROUNDWATER
AND VADOSE MONITORING WELLS
AND EXPLORATORY OR TEST BORINGS

OFFICE USE ONLY
PERMIT LMWP# 004139
SAM CASE Y/N # None
DATE RECEIVED: 8/29/2019
FEE PAID: $847.00
CHECK # Online

A. RESPONSIBLE PARTY City of Carlsbad E-mail transportation@carlsbadca.gov

(The person, persons, or company responsible for the construction, maintenance, and destruction of the proposed borings and/or wells.)

Mailing Address 1635 Faraday Avenue City Carlsbad State CA Zip 92008

Contact Person Brandon Miles Phone 760-602-2745 Ext.

B. SITE ASSESSMENT PROJECT NUMBER – IF APPLICABLE # _____

C. CONSULTING FIRM Kleinfelder Inc.

Mailing Address 550 West C Street Suite 1200 City San Diego State CA Zip 92101

Registered Professional Jake Lippman Phone 619-831-4677 Registration #9127(PG)

E-mail JLippman@kleinfelder.com

Contact Person Jake Lippman Phone 619-831-4677 Ext_____ Email JLippman@kleinfelder.com

D. DRILLING COMPANY Pacific Drilling Co C57# 681380

Contact Name Tod Clark E-mail Tod@pacdrill.com

Mailing Address 5220 Anna Avenue City San Diego State CA Zip 92110

Phone 619-294-3682 Ext._____

E. CONSTRUCTION INFORMATION

TYPE OF WELLS/ BORINGS TO BE CONSTRUCTED #

- ☒ Groundwater 3
- ☐ Vadose ___
- ☐ Boring ___
- ☐ Soil Vapor ___
- ☐ Other ___

NUMBER OF WELLS TO BE DESTROYED

☒ Destruction 3

MATERIALS TO BE USED

CASING

Not Applicable _____
Type PVC
Gauge Sch 40
Diameter 2"
Screen Size .020
Filter Pack #3 Sand

SEAL/BORING BACKFILL

- ☐ Neat Cement
- ☒ Cement & Bentonite
- ☐ Sand-Cement
- ☐ Bentonite
- ☐ Other

Borehole diameter 8"

Drilling Method

- ☒ Auger
- ☐ Direct Push
- ☐ Other _____
- ☐ Air Rotary
- ☐ Sonic
- ☐ Percussion

PROPOSED CONSTRUCTION

Estimated Groundwater Depth: 20 ft.
Estimated Depth of Boring: 35 ft.
Concrete Seal: 0 to 3
Annular Seal: 3 to 18
Filter Pack: 18 to 35
Perforation: 20 to 35

NOTE: Attach a well construction diagram

I agree to comply with the requirements of the current Site Assessment and Mitigation Manual, and with all ordinances and laws of the County of San Diego and the State of California pertaining to well/boring construction and destruction.

DRILLER'S SIGNATURE ______________ DATE 7/16/19

Within 60 days of completion, I will furnish the Monitoring Well Permit Desk (858) 505-6688 with a complete well/boring log. I will certify the design and construction or destruction of the well/borings in accordance with the permit application.

PG/RCE/CEG SIGNATURE Jake Lippman DATE 7/16/19

F. SITE INFORMATION - A Property Owner Consent agreement is required for all applications, except for onsite, open LOP/SAM site assessment cases, Caltrans properties and military properties. Submit a separate sheet for additional parcels.

1. **ASSESSOR'S PARCEL NUMBER** Adjacent to 203-054-2800

Site Address City of Carlsbad ROW, northern cul-de-sac of access road, southwest and parallel to State Street

City Carlsbad Zip 92008

PROPERTY OWNER City of Carlsbad

Phone 760-602-2745 Ext. _____ Fax _____

Mailing Address 1635 Faraday Avenue City Carlsbad State CA Zip 92008

NUMBER OF WELLS 1 **TYPE OF WELLS** Groundwater

2. **ASSESSOR'S PARCEL NUMBER** Adjacent to 204-240-2500

Site Address City of Carlsbad ROW, eastern end (cul-de-sac) of Juniper Avenue City Carlsbad Zip 92008

PROPERTY OWNER City of Carlsbad

Phone 760-602-2745 Ext. _____ Fax _____

Mailing Address 1635 Faraday Avenue City Carlsbad State CA Zip 92008

NUMBER OF WELLS 1 **TYPE OF WELLS** Groundwater

3. **ASSESSOR'S PARCEL NUMBER** Adjacent to 206-080-2700

Site Address City of Carlsbad ROW, western end of Chinquapin Avenue, south of Long Place City Carlsbad Zip 92008

PROPERTY OWNER City of Carlsbad

Phone 760-602-2745 Ext. _____ Fax _____

Mailing Address 1635 Faraday Avenue City Carlsbad State CA Zip 92008

NUMBER OF WELLS 1 **TYPE OF WELLS** Groundwater

G. QUESTIONNAIRE: Please answer all applicable questions completely *and submit any required supportive documentation*.

1. What is the purpose of the well/boring investigation?

☐ a. Part of an ongoing site assessment case in which a government regulator is the lead agency. If yes, indicate which government regulator is the lead agency and the case number.

☐ Regional Water Quality Control Board _____

☐ Department of Toxic Substances Control _____

☐ b. Part of a Phase I investigation for property ownership transfer.

☐ c. Geotechnical investigation for proposed construction or land stabilization.

☒ d. Other: Hydrogeologic investigation to assess groundwater conditions

2. If wells are to be destroyed, provide a description of method of destruction Removal of well box and overdrilling to remove well materials (casing, filter pack, etc.) Borehole will be backfilled with cement grout.

3. Are you proposing a variation from current SAM Manual Requirements for the construction or destruction of borings, Vadose and/or Groundwater Monitoring Wells? If yes, specify these variations and include a well construction diagram and all required supporting documentation. Refer to the SAM Manual Appendix B for monitoring well guidelines. Yes ☐ No ☒

   _____

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FILE NAME:	Fig1_Vic.mxd

VICINITY MAP

CARLSBAD DOUBLE TRACK-TRENCH
ALTERNATIVE PROJECT
CARLSBAD, CALIFORNIA

FIGURE

1

SAN DIEGO, CA

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PROJECT: 20200172	**PROPOSED MW-1 GROUNDWATER MONITORING WELL LOCATION**	FIGURE
DRAWN: JUL 2019		
DRAWN BY: KFH	CARLSBAD DOUBLE TRACK-TRENCH ALTERNATIVE PROJECT CARLSBAD, CALIFORNIA	**2**
CHECKED BY: JL		
FILE NAME: Fig2_MW1.mxd		

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PROJECT:	20200172
DRAWN:	JUL 2019
DRAWN BY:	KFH
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FILE NAME:	Fig3_MW2.mxd

PROPOSED MW-2 GROUNDWATER MONITORING WELL LOCATION

CARLSBAD DOUBLE TRACK-TRENCH
ALTERNATIVE PROJECT
CARLSBAD, CALIFORNIA

FIGURE

3

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PROJECT:	20200172
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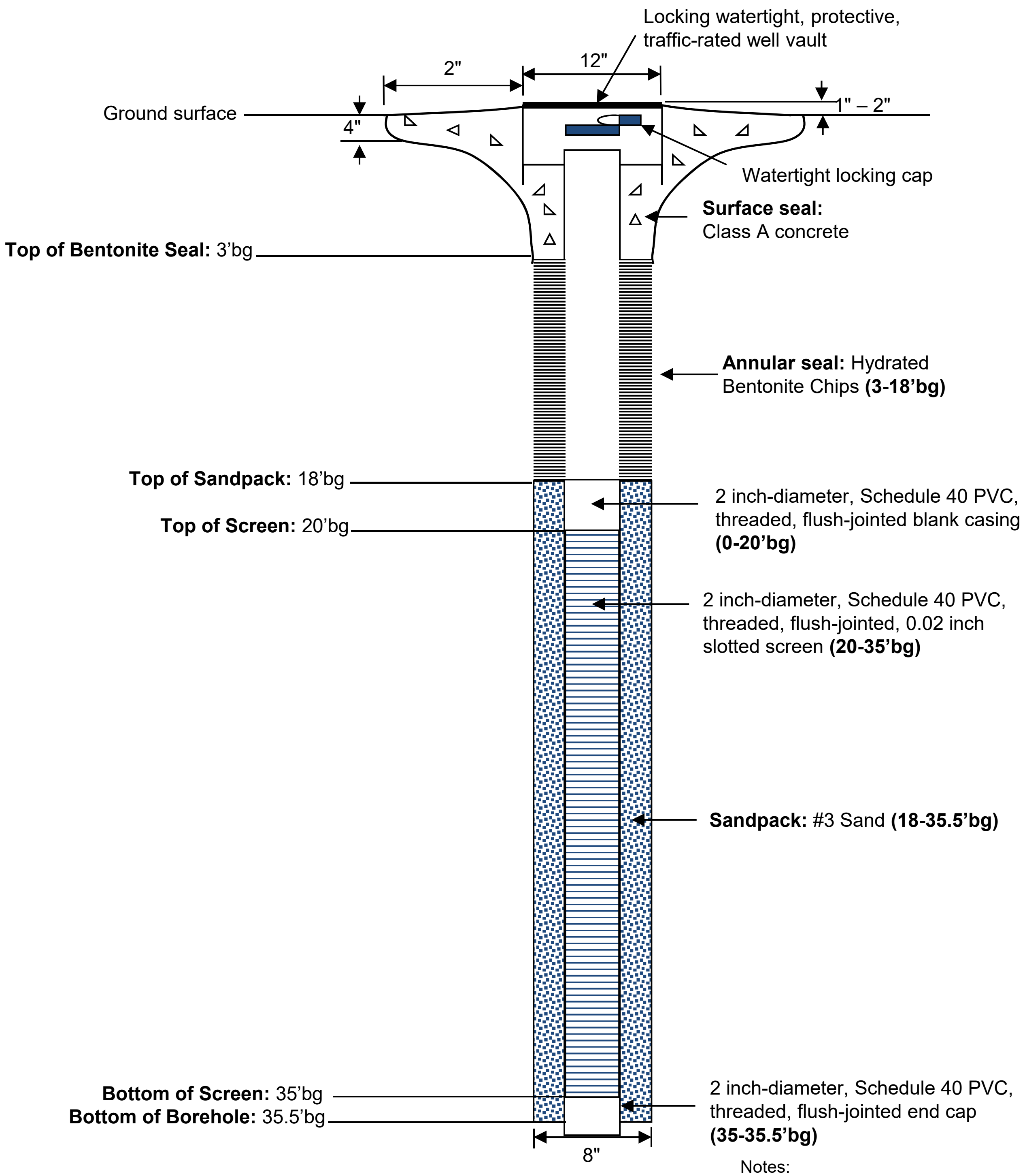
FILE NAME:	Fig4_MW3.mxd

PROPOSED MW-3 GROUNDWATER MONITORING WELL LOCATION

CARLSBAD DOUBLE TRACK-TRENCH ALTERNATIVE PROJECT
CARLSBAD, CALIFORNIA

FIGURE

4



Notes:
PVC – POLYVINYL CHLORIDE (WITH THREADED JOINTS, NO GLUED JOINTS).
Final well depth will be dependent on depths to groundwater.
bg = below grade

Not to Scale

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PROJECT NO. 20200172.001A		PROPOSED WELL CONSTRUCTION DIAGRAM	PLATE
DRAWN:	07/16/2019		1
DRAWN BY:	SB		
CHECKED BY:	JL	Carlsbad Village Double Track-Trench Alternative	
FILE NAME:		Carlsbad, California	

Right of Way Permit

Engineering Inspection Request Line (760) 438-3891

PERMIT #:	ROW2019-0744			**DATE:**	8/20/2019
PERMIT TYPE:	LDE-Right of Way	**SUB TYPE:**	Limited	**STATUS:**	Issued - Active
PARCEL #:		**ROW TYPE:**	Utility	**APPLIED:**	07/24/2019
LOT #:		**PROJECT #:**		**ISSUED:**	08/20/2019
JOB ADDRESS:		**DWG #:**		**EXPIRATION:**	02/28/2020
		PLAN #:		**INSPECTOR:**	DeLetto

LOCATION:

PROJECT:

DESCRIPTION: INSTALL (3) TEMPORARY MONITORING WELLS FOR C.I.P. PROJECT (P.M. = BRANDON MILES). WELLS TO BE REMOVED AFTER 3-4 MONTHS. ASPHALT TO BE RESTORED PER CITY STANDARDS. (20) 55 GALLON DRUMS OF EXCAVATED MATERIAL TO BE STORED AT 1605 BUENA VISTA WY FOR A 1-MONTH DURATION (SEE ATTACHED E-MAIL FOR PARKS' APPROVAL). STORED MATERIAL TO BE BACKFILLED AFTER WELLS ARE REMOVED. INS. EXP. 4/1/20

APPLICANT:
CO'S TRAFFIC CONTROL INC
COLLEEN BECHTEL
PO BOX 13459
SAN DIEGO, CA 92170
(619) 239-8200

CONTRACTOR:

PROPERTY OWNER:

FEE DESCRIPTION	TOTAL FEES	PAID AMOUNT	BALANCE DUE
RIGHT-OF-WAY PERMIT - Utility	$811.00	$811.00	$0.00
TOTAL PERMIT FEE	**$811.00**	**$811.00**	**$0.00**

This fee statement is subject to change as outlined in the Carlsbad Municipal Code.

This permit may be revoked by the City Engineer if it is deemed that inadequate progress is being made towards the completion of the work or if the work does not meet City Standards. The applicant may be billed for the cost of any of any corrective work that the City must perform.

Permit Release: ____________ **Date Released:** ____________ **Cash Deposit:** ____________

YOU MUST CALL UNDERGROUND SERVICE ALERT (1-800-422-4133) TWO WORKING DAYS PRIOR TO WORK.

UNDERGROUND SERVICE ALERT NO.________________________. THIS PERMIT IS INVALID WITHOUT THIS NUMBER IF ANY EXCAVATION OR BORING IS DONE.

1635 Faraday Avenue, Carlsbad, CA 92008-7314 | 760-602-2740 | 760-602-1052 f | www.carlsbadca.gov

APPENDIX B

Field Logs

SAMPLE/SAMPLER TYPE GRAPHICS

STANDARD PENETRATION SPLIT SPOON SAMPLER (2 in. (50.8 mm.) outer diameter and 1-3/8 in. (34.9 mm.) inner diameter)

GROUND WATER GRAPHICS

- WATER LEVEL (level where first observed)
- WATER LEVEL (level after exploration completion)
- WATER LEVEL (additional levels after exploration)
- OBSERVED SEEPAGE

NOTES

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual or differ from those shown.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, ie., GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.
- If sampler is not able to be driven at least 6 inches then 50/X indicates number of blows required to drive the identified sampler X inches with a 140 pound hammer falling 30 inches.

ABBREVIATIONS

WOH - Weight of Hammer
WOR - Weight of Rod

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVEL WITH <5% FINES	Cu≥4 and 1≤Cc≤3	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			Cu<4 and/ or 1>Cc>3	GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH 5% TO 12% FINES	Cu≥4 and 1≤Cc≤3	GW-GM	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				GW-GC	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
			Cu<4 and/ or 1>Cc>3	GP-GM	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				GP-GC	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
		GRAVELS WITH > 12% FINES		GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
				GC-GM	CLAYEY GRAVELS, GRAVEL-SAND-CLAY-SILT MIXTURES
	SANDS (Half or more of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH <5% FINES	Cu≥6 and 1≤Cc≤3	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			Cu<6 and/ or 1>Cc>3	SP	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH 5% TO 12% FINES	Cu≥6 and 1≤Cc≤3	SW-SM	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				SW-SC	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
			Cu<6 and/ or 1>Cc>3	SP-SM	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				SP-SC	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
		SANDS WITH > 12% FINES		SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
				SC-SM	CLAYEY SANDS, SAND-SILT-CLAY MIXTURES

FINE GRAINED SOILS (Half or more of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)	ML	INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, SILTS WITH SLIGHT PLASTICITY
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		CL-ML	INORGANIC CLAYS-SILTS OF LOW PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid Limit 50 or greater)	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
		OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20200172.001A	GRAPHICS KEY	APPENDIX
	DRAWN BY: TC	Carlsbad Double Track Trench Carlsbad, California	B-1
	CHECKED BY: EJ		
	DATE: 11/4/2019		PAGE: 1 of 2

PLOTTED: 01/30/2020 05:49 PM BY: TCisney
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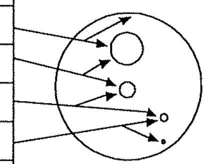
gINT FILE: Klf_gint_master_2020
gINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2020.GLB [_KLF_GEO-LEG1 (GRAPHICS KEY) WITH USCS]

GRAIN SIZE

DESCRIPTION		SIEVE SIZE	GRAIN SIZE	APPROXIMATE SIZE
Boulders		>12 in. (304.8 mm.)	>12 in. (304.8 mm.)	Larger than basketball-sized
Cobbles		3 - 12 in. (76.2 - 304.8 mm.)	3 - 12 in. (76.2 - 304.8 mm.)	Fist-sized to basketball-sized
Gravel	coarse	3/4 -3 in. (19 - 76.2 mm.)	3/4 -3 in. (19 - 76.2 mm.)	Thumb-sized to fist-sized
	fine	#4 - 3/4 in. (#4 - 19 mm.)	0.19 - 0.75 in. (4.8 - 19 mm.)	Pea-sized to thumb-sized
Sand	coarse	#10 - #4	0.079 - 0.19 in. (2 - 4.9 mm.)	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079 in. (0.43 - 2 mm.)	Sugar-sized to rock salt-sized
	fine	#200 - #40	0.0029 - 0.017 in. (0.07 - 0.43 mm.)	Flour-sized to sugar-sized
Fines		Passing #200	<0.0029 in. (<0.07 mm.)	Flour-sized and smaller



SECONDARY CONSTITUENT

Term of Use	AMOUNT: Secondary Constituent is Fine Grained	AMOUNT: Secondary Constituent is Coarse Grained
Trace	<5%	<15%
With	≥5 to <15%	≥15 to <30%
Modifier	≥15%	≥30%

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

CEMENTATION

DESCRIPTION	FIELD TEST
Weakly	Crumbles or breaks with handling or slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPT - N_{60} (# blows / ft)	Pocket Pen (tsf)	UNCONFINED COMPRESSIVE STRENGTH (Q_u)(psf)	VISUAL / MANUAL CRITERIA
Very Soft	<2	PP < 0.25	<500	Thumb will penetrate more than 1 inch (25 mm). Extrudes between fingers when squeezed.
Soft	2 - 4	0.25 ≤ PP <0.5	500 - 1000	Thumb will penetrate soil about 1 inch (25 mm). Remolded by light finger pressure.
Medium Stiff	4 - 8	0.5 ≤ PP <1	1000 - 2000	Thumb will penetrate soil about 1/4 inch (6 mm). Remolded by strong finger pressure.
Stiff	8 - 15	1 ≤ PP <2	2000 - 4000	Can be imprinted with considerable pressure from thumb.
Very Stiff	15 - 30	2 ≤ PP <4	4000 - 8000	Thumb will not indent soil but readily indented with thumbnail.
Hard	>30	4 ≤ PP	>8000	Thumbnail will not indent soil.

FROM TERZAGHI AND PECK, 1948; LAMBE AND WHITMAN, 1969; FHWA, 2002; AND ASTM D2488

REACTION WITH HYDROCHLORIC ACID

DESCRIPTION	FIELD TEST
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT-N_{60} (# blows/ft)	MODIFIED CA SAMPLER (# blows/ft)	CALIFORNIA SAMPLER (# blows/ft)	RELATIVE DENSITY (%)
Very Loose	<4	<4	<5	0 - 15
Loose	4 - 10	5 - 12	5 - 15	15 - 35
Medium Dense	10 - 30	12 - 35	15 - 40	35 - 65
Dense	30 - 50	35 - 60	40 - 70	65 - 85
Very Dense	>50	>60	>70	85 - 100

FROM TERZAGHI AND PECK, 1948

PLASTICITY

DESCRIPTION	LL	FIELD TEST
Non-plastic	NP	A 1/8-in. (3 mm.) thread cannot be rolled at any water content.
Low (L)	< 30	The thread can barely be rolled and the lump or thread cannot be formed when drier than the plastic limit.
Medium (M)	30 - 50	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump or thread crumbles when drier than the plastic limit.
High (H)	> 50	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump or thread can be formed without crumbling when drier than the plastic limit.

STRUCTURE

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 1/4-in. thick, note thickness.
Laminated	Alternating layers of varying material or color with the layer less than 1/4-in. thick, note thickness.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness.

ANGULARITY

DESCRIPTION	CRITERIA
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20200172.001A	SOIL DESCRIPTION KEY	APPENDIX
	DRAWN BY: TC	Carlsbad Double Track Trench Carlsbad, California	B-1
	CHECKED BY: EJ		
	DATE: 11/4/2019		PAGE: 2 of 2

Date Begin - End:	9/26/2019 - 9/30/2019	**Drilling Company:**	Pacific Drilling		**SOIL BORE LOG MW-1**
Logged By:	Lindsay Ellingson	**Drill Crew:**	NA		
Hor.-Vert. Datum:	NAVD88 - WGS84	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Not Available	**Exploration Diameter:**	8 in. O.D.		

Latitude: 33.16401°
Longitude: -117.35330°
Surface Condition: Asphalt

Depth (feet)	Graphical Log	Lithologic Description (FIELD EXPLORATION)	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol (LABORATORY RESULTS)	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	PIEZOMETER CONSTRUCTION*
		Lean CLAY (CL): medium plasticity, olive gray, moist, stiff, inorganic				CL							Concrete
5		**Clayey SAND (SC):** light brownish gray, moist, medium dense		BC=4 7 15		SC				43			
10		**Poorly Graded SAND with Silt (SP-SM):** light brownish gray, moist, medium dense		BC=9 11 12		SP-SM				5.6			
15		**Clayey SAND (SC):** light brownish gray, moist, medium dense		BC=18 43 50/4"		SC				25			2" SCH 40 Solid PVC Riser
20		becomes dense with gravel		BC=3 7 43		SC				27			Bentonite / Neat Cement Grout
		Sandy CLAY (CL): light brownish gray, moist, hard				CL				54			
25				BC=50/3"		CL				51			
		Clayey SAND (SC): light brownish gray, moist, very dense				SC				25			
30				BC=20 48 50/4"									
						SC				40			
						SC				38			

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PROJECT NO.: 20200172.001A		SOIL BORE LOG MW-1	APPENDIX
DRAWN BY:	TC	Carlsbad Double Track Trench Carlsbad, California	B-2
CHECKED BY:	EJ		
DATE:	11/4/2019		PAGE: 1 of 2

Date Begin - End:	9/26/2019 - 9/30/2019	Drilling Company:	Pacific Drilling	**SOIL BORE LOG MW-1**
Logged By:	Lindsay Ellingson	Drill Crew:	NA	
Hor.-Vert. Datum:	NAVD88 - WGS84	Drilling Equipment:	CME-75	Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge:	-90 degrees	Drilling Method:	Hollow Stem Auger	
Weather:	Not Available	Exploration Diameter:	8 in. O.D.	

FIELD EXPLORATION

Latitude: 33.16401°
Longitude: -117.35330°
Surface Condition: Asphalt

Depth (feet)	Graphical Log	Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	PIEZOMETER CONSTRUCTION*
		Clayey SAND (SC): light brownish gray, moist, very dense		BC=31 50/5"		SC				46			
						SC				28			Bentonite Chips
40				BC=9 47 50/4"		SC				39			
						SC				26			
						SC				24			
45				BC=21 50/5"		SC				20			2" SCH 40 Slotted 0.010 PVC Screen
						SC				23			
50		becomes olive gray		BC=14 50/5"									
						SC				30			
						SC				24			
55													
60													
65													

The soil boring was terminated at approximately 54 ft below ground surface. The monitoring well was over-drilled and back filled with cement/bentonite grout on October 7, 2019.

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 51 ft. below ground surface during drilling.
GENERAL NOTES:
A PID (ppmv) was used for environmental field screening.

PROFESSIONAL GEOLOGIST
ERIC A. JOHANSEN
No 6643
Exp. 10/31/2020
STATE OF CALIFORNIA

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PROJECT NO.: 20200172.001A	SOIL BORE LOG MW-1	APPENDIX
DRAWN BY: TC	Carlsbad Double Track Trench Carlsbad, California	B-2
CHECKED BY: EJ		
DATE: 11/4/2019		PAGE: 2 of 2

PLOTTED: 02/05/2020 07:47 AM BY: TCisney

Date Begin - End: 9/26/2019	**Drilling Company:** Pacific Drilling		**SOIL BORE LOG MW-2**
Logged By: Lindsay Ellingson	**Drill Crew:** NA		
Hor.-Vert. Datum: NAVD88 - WGS84	**Drilling Equipment:** CME-75	**Hammer Type - Drop:** 140 lb. Auto - 30 in.	
Plunge: -90 degrees	**Drilling Method:** Hollow Stem Auger		
Weather: Not Available	**Exploration Diameter:** 8 in. O.D.		

FIELD EXPLORATION — Latitude: 33.15151° Longitude: -117.34357° Surface Condition: Asphalt

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	PIEZOMETER CONSTRUCTION*
0		**Silty SAND (SM)**: reddish brown, moist, medium dense											Concrete
5				BC=6 8 8		SM				23			2" SCH 40 Solid PVC Riser
													Bentonite / Neat Cement Grout
10		becomes brown and dense		BC=8 15 25		SM				19			
15		becomes light brown		BC=12 26 34		SM				23			Bentonite Chips
∇ 17						SM				31			
19		**Clayey SAND (SC)**: light brownish gray, moist, very dense				SM				30			
20				BC=18 50/4"		SC				15			
				BC=28 50/3"		SC				31			2" SCH 40 Slotted 0.020 PVC Screen
25						SC				42			
						SC				24			
30													

PROFESSIONAL GEOLOGIST
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No 6643
Exp. 10/31/2020
STATE OF CALIFORNIA

The soil boring was terminated at approximately 30 ft below ground surface. The monitoring well was over-drilled and back filled with cement/bentonite grout on October 8, 2019.

GROUNDWATER LEVEL INFORMATION:
∇ Groundwater was observed at approximately 17 ft. below ground surface during drilling.
GENERAL NOTES:
A PID (ppmv) was used for environmental field screening.

OFFICE FILTER: SAN DIEGO
PROJECT NUMBER: 20200172.001A
gINT FILE: Klf_gint_master_2020
gINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2020.GLB [_KLF_BORING/TEST PIT SOIL LOG]

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20200172.001A	SOIL BORE LOG MW-2	APPENDIX
	DRAWN BY: TC	Carlsbad Double Track Trench Carlsbad, California	B-3
	CHECKED BY: EJ		
	DATE: 11/4/2019		PAGE: 1 of 1

SOIL BORE LOG MW-3

Date Begin - End: 9/25/2019
Logged By: Lindsay Ellingson
Hor.-Vert. Datum: NAVD88 - WGS84
Plunge: -90 degrees
Weather: Not Available

Drilling Company: Pacific Drilling
Drill Crew: NA
Drilling Equipment: CME-75
Drilling Method: Hollow Stem Auger
Exploration Diameter: 8 in. O.D.

Hammer Type - Drop: 140 lb. Auto - 30 in.

FIELD EXPLORATION

Latitude: 33.14807°
Longitude: -117.33986°
Surface Condition: Asphalt

Depth (feet)	Lithologic Description	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
0	**Silty SAND (SM)**: fine-grained, dark brown, moist, medium dense			SM				24		
5	becomes red brown	BC=21 20 16		SM				27		
10		BC=14 17 21		SM				24		
15	beconmes bluish gray	BC=21 15 26		SM				14		
20	**Poorly Graded SAND with minor Silt (SP)**: bluish gray, moist, very dense	BC=50/2"		SP				4.8		
25	**Silty SAND (SM)**: bluish gray, moist, very dense	BC=24 47 50/5"		SM				14		
	Poorly Graded SAND with Silt (SP-SM): bluish gray, moist, very dense			SP-SM				6.5		
	Poorly Graded SAND with minor Silt (SP): gray, moist, dense			SP				3.2		
30		BC=15 27 47		SP				4.3		
	Poorly Graded SAND with Silt (SP-SM): gray, moist, dense			SP-SM				5.3		

PIEZOMETER CONSTRUCTION*

- Concrete
- 2" SCH 40 Solid PVC Riser
- Bentonite / Neat Cement Grout
- Bentonite Chips

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PROJECT NO.: 20200172.001A
DRAWN BY: TC
CHECKED BY: EJ
DATE: 11/4/2019

SOIL BORE LOG MW-3

Carlsbad Double Track Trench
Carlsbad, California

APPENDIX
B-4

Date Begin - End:	9/25/2019	**Drilling Company:**	Pacific Drilling		**SOIL BORE LOG MW-3**
Logged By:	Lindsay Ellingson	**Drill Crew:**	NA		
Hor.-Vert. Datum:	NAVD88 - WGS84	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Not Available	**Exploration Diameter:**	8 in. O.D.		

Latitude: 33.14807°
Longitude: -117.33986°
Surface Condition: Asphalt

Depth (feet)	Graphical Log	Lithologic Description (FIELD EXPLORATION)	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol (LABORATORY RESULTS)	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	PIEZOMETER CONSTRUCTION*
				BC=13 18 23		SP-SM				11			
		Poorly Graded SAND (SP): olive gray, moist, dense				SP				4.9			
		Poorly Graded SAND with Silt (SP-SM): olive gray, moist, dense				SP-SM				6.7			
40				BC=8 15 34									2" SCH 40 Slotted 0.020 PVC Screen
		Poorly Graded SAND with minor Silt (SP): olive gray, moist, dense				SP				4.7			
						SP				4.9			
45													

The soil boring was terminated at approximately 46.5 ft below ground surface. The monitoring well was over-drilled and back filled with cement/bentonite grout on October 7, 2019.

GROUNDWATER LEVEL INFORMATION:
∇ Groundwater was observed at approximately 34 ft. below ground surface during drilling.
GENERAL NOTES:
A PID (ppmv) was used for environmental field screening.

PROFESSIONAL GEOLOGIST
ERIC A. JOHANSEN
No 6643
Exp. 10/31/2020
STATE OF CALIFORNIA

50
55
60
65

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PROJECT NO.: 20200172.001A	SOIL BORE LOG MW-3	APPENDIX
DRAWN BY: TC	Carlsbad Double Track Trench Carlsbad, California	B-4
CHECKED BY: EJ		
DATE: 11/4/2019		PAGE: 2 of 2

SLUG TESTING FIELD FORM

Site Information

Date	10/3/19	Site	MW-1
Personnel	S. Birardi / S. Treadway	Well ID	Carlsbad Village Trench

Baseline Monitoring Well Data

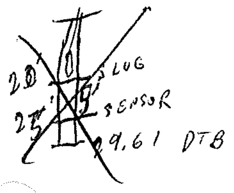
Depth to Water (ft)	12.70	Depth to Screen Top (ft)	
Depth to Bottom (ft)	53.92	Length of Screen (ft)	10'
Water Column Height (ft)		Well Diameter (inch)	2"

Transducer Information

Make and Model	Ins. tu Level Troll 700	Serial Number	345086
Pressure Rating (psi)	15	Recording Frequency	
Transducer Installation Time	0855	Cable Exposed to Sunlight?	Yes / No

Slug Testing Parameters

Required Data	***Slug Out Test 1***	***Slug Out Test 2***	***Slug Out Test 3***
Depth to Water Before Slug In (ft)	12.70		
Baseline Transducer Reading Before Slug In (ft)	15.217		
Slug In Time	0905		
Maximum Transducer Reading After Slug In (ft)	18.313		
Transducer Reading Prior to Slug Out (ft)	15.301		
Did Transducer Reading Return to Baseline Prior to Slug Out?	Yes / No	Yes / No	Yes / No
Slug Out Date	10/3/19		
Slug Out Time	10:46		
Minimum Transducer Reading After Slug Out (ft)	12.092		
Observed Displacement After Slug Out (ft)	-3.209		
Expected Displacement (ft)			
Slug Diameter (inch)	1"		
Number of Flush Joint Sections on Slug			
Slug Length (ft)	8'		
Did Transducer Reading Return to Baseline at End of Slug Out Test?	Yes / No	Yes / No	Yes / No
Comments: Transducer @ 28' Slug @ 23'			



SLUG TESTING FIELD FORM

Site Information

Date	10-3-19	Site	MW-2
Personnel	S. Birardi / S. Tradway	Well ID	Carlsbad Village Trench

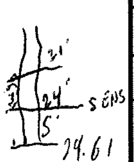
Baseline Monitoring Well Data

Depth to Water (ft)	15.44	Depth to Screen Top (ft)	
Depth to Bottom (ft)	29.61	Length of Screen (ft)	10'
Water Column Height (ft)	14.17	Well Diameter (inch)	2"

Transducer Information

Make and Model	INSITU LEVEL TROLL 700	Serial Number	345086
Pressure Rating (psi)	15	Recording Frequency	True Logrithmic
Transducer Installation Time	1540	Cable Exposed to Sunlight?	Yes / No (No circled)

Slug Testing Parameters



Required Data	*Slug Out Test 1*	*Slug Out Test 2*	*Slug Out Test 3*
Depth to Water Before Slug In (ft)	15.44	15.44	
Baseline Transducer Reading Before Slug In (ft)	11.345	11.333	
Slug In Time	1549	1655	
Maximum Transducer Reading After Slug In (ft)	13.607	14.014	
Transducer Reading Prior to Slug Out (ft)	11.345	11.416	
Did Transducer Reading Return to Baseline Prior to Slug Out?	Yes / No (Yes circled)	Yes / No (No circled)	Yes / No
Slug Out Date	10/3/19	10/3/19	
Slug Out Time	1620	1730	
Minimum Transducer Reading After Slug Out (ft)	9.927	8.491	
Observed Displacement After Slug Out (ft)	1.418	~~[illegible]~~	
Expected Displacement (ft)			
Slug Diameter (inch)	1"	1"	
Number of Flush Joint Sections on Slug			
Slug Length (ft)	4'	8'	
Did Transducer Reading Return to Baseline at End of Slug Out Test?	Yes / No (No circled)	Yes / No (Yes circled)	Yes / No
Comments: Transducer @ 27' Slug @ 25'	END - 11.335 END TEST - 1648 END DTW - 15.44	END TEST - 1807 END DTW - 15.48	

SLUG TESTING FIELD FORM

Site Information

Date	10/3/19	Site	MW-3
Personnel	STEFAN BIRARDI/STEVE TREADWAY	Well ID	Carlsbad Village Trench

Baseline Monitoring Well Data

Depth to Water (ft)	34.85	Depth to Screen Top (ft)	
Depth to Bottom (ft)	44.93	Length of Screen (ft)	10'
Water Column Height (ft)	10.08	Well Diameter (inch)	2"

Transducer Information

Make and Model	IN-SITU LEVEL TROLL 700	Serial Number	345086
Pressure Rating (psi)	15	Recording Frequency	
Transducer Installation Time	1317	Cable Exposed to Sunlight?	Yes / No

Slug Testing Parameters

Required Data	***Slug Out Test 1***	***Slug Out Test 2***	***Slug Out Test 3***
Depth to Water Before Slug In (ft)	34.85	34.85	
Baseline Transducer Reading Before Slug In (ft)	7.596	7.596	
Slug In Time	~~1330~~ 1330	14:10	
Maximum Transducer Reading After Slug In (ft)	7.862	8.310	
Transducer Reading Prior to Slug Out (ft)	7.596	7.599	
Did Transducer Reading Return to Baseline Prior to Slug Out?	Yes / No	Yes / No	Yes / No
Slug Out Date	10-3-19	10/3/19	
Slug Out Time	1345	1427	
Minimum Transducer Reading After Slug Out (ft)	6.845	6.954	
Observed Displacement After Slug Out (ft)	0.751	0.645	
Expected Displacement (ft)			
Slug Diameter (inch)	1"	1"	
Number of Flush Joint Sections on Slug			
Slug Length (ft)	4'	4'	
Did Transducer Reading Return to Baseline at End of Slug Out Test?	Yes / No END: 7.604	Yes / No END - 7.599	Yes / No
Comments: Transducer @ 43' Slug @ 40'	END TEST: 1406 END DTW: 34.85	END TEST: 1436 END DTW: 34.85	

6.954

SLUG TESTING FIELD FORM

Site Information

Date	10/2/19	Site	MW-4
Personnel	S. Birdi / S. Treadway	Well ID	Carlsbad Village Trench

Baseline Monitoring Well Data

Depth to Water (ft)	18.24	Depth to Screen Top (ft)	UNK
Depth to Bottom (ft)	39.87	Length of Screen (ft)	UNK
Water Column Height (ft)		Well Diameter (inch)	2"

Transducer Information

Make and Model	InSitu Level Troll 700	Serial Number	345086
Pressure Rating (psi)	15	Recording Frequency	
Transducer Installation Time	1527	Cable Exposed to Sunlight?	Yes / No

Slug Testing Parameters

Required Data	***Slug Out Test 1***	***Slug Out Test 2***	***Slug Out Test 3***
Depth to Water Before Slug In (ft)	18.24		
Baseline Transducer Reading Before Slug In (ft)	15.629		
Slug In Time	1533		
Maximum Transducer Reading After Slug In (ft)	15.862		
Transducer Reading Prior to Slug Out (ft)	15.670		
Did Transducer Reading Return to Baseline Prior to Slug Out?	Yes / No	Yes / No	Yes / No
Slug Out Date	10/2/19		
Slug Out Time	1629		
Minimum Transducer Reading After Slug Out (ft)	15.848		
Observed Displacement After Slug Out (ft)			
Expected Displacement (ft)			
Slug Diameter (inch)	1"		
Number of Flush Joint Sections on Slug			
Slug Length (ft)	8'		
Did Transducer Reading Return to Baseline at End of Slug Out Test?	Yes / No	Yes / No	Yes / No
Comments: Transducer @ 35' Slug @ 30'	Final DTW 18.26		

SLUG TESTING WATER LEVEL MEASUREMENTS

Date	10/3/19	Site	Carlsbad Village Train
Personnel	S. Biondi / S. Treadway	Well ID	MW-1 IN-1

Time	Depth to Water	Notes
0825	12.70	Initial DTW
0905	10.05	
0906	10.08	
0907	10.10	
0908	10.14	
0909	10.19	
0910	10.23	
0913	10.70	
0916	10.90	
0919	11.16	
0922	11.71	
0925	11.87	
0930	12.06	
0935	12.17	
0940	12.27	
0945	12.32	
0955	12.40	
~~0~~ 1005	12.41	
1015	12.43	
1025	12.45	
1035	12.45	
1045	12.45	
END	Test	

SLUG TESTING WATER LEVEL MEASUREMENTS

Date 10/3/19	Site Carlsbad Village Trench
Personnel S. Biondi / S. Treadwy	Well ID MW-1 OUT - 1

Time	Depth to Water	Notes
1050	14.39	Slug Out @ 1046
1051	14.27	
1052	14.17	
1053	14.06	
1054	13.98	
1057	13.85	
1100	13.73	
1103	13.62	
1106	13.30	
1109	13.10	
~~1119~~ 1114	12.99	
1119	12.89	
1124	12.83	
1129	12.75	
1134	12.70	
1144	12.62	
1154	12.62	
1204	12.61	
END Test		

SLUG TESTING WATER LEVEL MEASUREMENTS

Date	11/3/19	Site	MW-2 IN
Personnel	S. Brown / S. Trudum	Well ID	Carlsbad Village Trench

Time	Depth to Water	Notes
1551	14.44	Slug in @ 1549
1552	14.54	
1553	14.62	
1554	14.84	
1555	14.93	
1558	15.13	
1601	15.32	
1604	15.36	
1607	15.39	
1610	15.42	
1613	15.44	
END	TEST 1648	

SLUG TESTING WATER LEVEL MEASUREMENTS

Date 10/3/19 Site Carlsbad Village Trench

Personnel S. Birardi / S. Treadway Well ID MW-B In

Time	Depth to Water	Notes
1332	34.82	Slug in 1330
1333	34.84	
1334	34.85	
1375	34.85	
1336	34.85	
1337	34.85	
1342	34.85	
1343	END TEST	WELL REACHED STATIC LEVEL

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WELL DEVELOPMENT RECORD

PROJECT: Carlsbad Village Trench Project

WELL NO. MW-1

JOB NO. 20200172.001A | **SITE:** MW-1 | **PREPARED BY:** Stefan Birardi/Steve Treadway

PURGE METHOD	TOTAL VOL REMOVED	TOTAL HOURS
SURGING	Ø	10 min
BAILER	5 GAL	10 MIN
PUMP		
OTHER:		

PURGING CRITERIA

CHECKED BY

DATE STARTED: OCTOBER 2 2019 **DATE COMPLETED:**

WEATHER: CLEAR

TEMPERATURE: 61°F

SUBCONTRACTOR: PACIFIC DRILLING

BOREHOLE DIAM d_h = 8" ft.

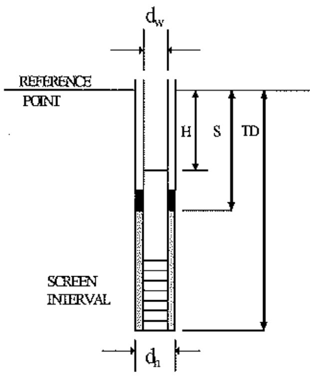
WELL CASING

INSIDE DIAM $d_w ID$ = ft.
OUTSIDE DIAM $d_w OD$ = 2" ft.

REFERENCE POINT: TOC

DEPTH TO:
WATER LEVEL H = 12.41 ft.
BASE OF SEAL S = ft.
TOP OF SCREEN = ft.
BASE OF SCREEN = ft.
BASE OF WELL TD = 53.90 ft.

ESTIMATED FILTER PACK POROSITY P = 30%



WELL VOLUME CALCULATION

CASING VOLUME (V_c)

$$V_c = \pi\left(\frac{d_w ID}{2}\right)^2 (TD-H) = \quad ft^3$$

FILTER PACK PORE VOLUME (V_F)

$$V_F = \pi\left[\left(\frac{d_h}{2}\right)^2 - \left(\frac{d_w OD}{2}\right)^2\right](TD - S \text{ or } H)(P) = \quad ft^3$$

(IF S > H, USE S. IF S < H, USE H.)

TOTAL WELL VOLUME (V_T)

$V_T = V_C + V_F =$ ft^3 x 7.48= gal

PURGING DATA				TOTAL WATER REMOVED		FIELD PARAMETERS				
Time Begin (hrs)	Time Finish (hrs)	Method	Water Removed (Gal)	Gal	Well Vols.	pH	Conduct. (µ mhos)	Temp (°C)	Turbidity (Visual/NTU)	COMMENTS ORP
0830	Ø84Ø	SURGE	Ø	Ø	Ø	—	—	—	—	
Ø850	Ø900	BAIL	5	5						
Ø904	Ø920	PUMP	10	15						
Ø92Ø	Ø930	PUMP	10	25		7.21	4.74	22.8	17 057.12	-74.8
Ø930	0940	PUMP	5	30		7.28	4.37	23.1	1455.71	-27.8
0940	Ø945	PUMP	1	31		7.2Ø	4.23	23.4	152.46	-32.1
0948	0950	PUMP	1	32		7.33	4.25	23.6	68.69	80.70
0950	0955	PUMP	2.5	34.5		7.39	4.25	23.7	38.74	-34.6
0955	1000	PUMP	1.5	36		7.14	4.27	24.0	44.87	-10.2
1000	1005	PUMP	2	38		7.24	4.24	23.9	44.72	-14.0
1005	1010	PUMP	2.5	40.5		7.03	4.23	24.2	199.62	-6.9
1010	1015	PUMP	1.5	42		7.13	4.25	23.7	52.67	-0.5
1015	1020	PUMP	1	43		7.03	4.25	24.Ø	144.15	-8.4
1020	1025	PUMP	1	44		7.58	4.25	23.6	~~22~~ 202.51	-13.6
1025	1030	PUMP	1	45		7.06	4.24	24.3	94.13	-7.1
1030	1035	PUMP	1	46		7.18	4.25	24.Ø	87.49	Ø.6
1035	1038	PUMP				7.23	4.25	24.0	124.64	4.9
1038	1041									

REMARKS:

1050 - 1100	Pump	1	47	7.05	4.32	25.6	133.16	-7.5
1100 - 1103	PUMP	1	48	7.02	4.24	24.7	30.64	-3.7
1103 - 1106	PUMP	1	49	7.08	4.26	24.5	50.42	-4.6
1106 - 1109	PUMP	0.5	49.5	7.03	4.22	24.4	42.26	-2.4
1109 - 1111	PUMP			7.00	4.24	24.3	37.63	1.8

DTW = 32.69

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PROJECT: Carlsbad Village Trench Project

WELL NO. MW-2

WELL DEVELOPMENT RECORD

JOB NO. 20200172.001A

SITE: MW-2

PREPARED BY: Stefan Birardi/Steve Treadway

PURGE METHOD	TOTAL VOL REMOVED	TOTAL HOURS
SURGING	0	10 min
BAILER	10 gal	20 min
PUMP	17.5 gal	80 min
OTHER:		

PURGING CRITERIA

CHECKED BY

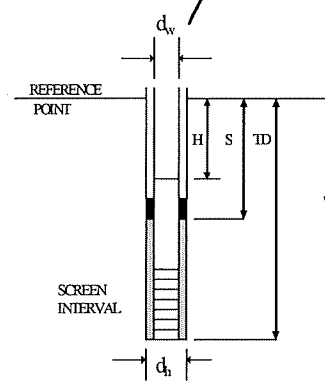
DATE STARTED: 9/30/19 **DATE COMPLETED:** 9/30/19

WEATHER: Sunny

TEMPERATURE: 74° F

SUBCONTRACTOR: Pacific Drilling

BOREHOLE DIAM	d_h	=	8''	ft.
WELL CASING				
INSIDE DIAM	d_wID	=	2''	ft.
OUTSIDE DIAM	d_wOD	=		ft.
REFERENCE POINT:	TOC			
DEPTH TO:				
WATER LEVEL	H	=	17.40	ft.
BASE OF SEAL	S	=		ft.
TOP OF SCREEN		=		ft.
BASE OF SCREEN		=		ft.
BASE OF WELL	TD	=	29.10	ft.
ESTIMATED FILTER PACK POROSITY	P	=	30%	



WELL VOLUME CALCULATION

CASING VOLUME (V_c)

$$V_c = \pi\left(\frac{d_wID}{2}\right)^2 (TD-H) = \qquad ft^3$$

FILTER PACK PORE VOLUME (V_F)

$$V_F = \pi\left[\left(\frac{d_h}{2}\right)^2 - \left(\frac{d_wOD}{2}\right)^2\right](TD - S \text{ or } H)(P) = \qquad ft^3$$

(IF S > H, USE S. IF S < H, USE H.)

TOTAL WELL VOLUME (V_T)

$V_T = V_C + V_F = \qquad ft^3 \times 7.48 = \qquad gal$

PURGING DATA				TOTAL WATER REMOVED		FIELD PARAMETERS				COMMENTS
Time Begin (hrs)	Time Finish (hrs)	Method	Water Removed (Gal)	Gal	Well Vols.	pH	Conduct. (μ mhos)	Temp (°C)	Turbidity (Visual/NTU)	
1330	1340	Surge	0	0	0	—	—	—	—	
1340	1400	Bail	10	10	2	—	—	—	—	
1400	1410	Pump	2.5	12.5	3	No Readings / heavy Silt, mud				
1430	1440	Pump	2.5	15		7.41	3.128	26.8	214.87	Heavy Silt / low Recharge
1500	1505	Bail	5	20		No Readings / too much Silt/Sand for pump				
1515	1520	Bail	5	25		No Readings / too much Silt/Sand for pump				
1520	1530	Pump	2.5	27.5	12.3	7.50	3.671	25.7	347.56	
										END DTW = 22.64

REMARKS: Very slow recovery. Field decision to discontinue purge after 2 hours & 27.5 gal of water removed.

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WELL DEVELOPMENT RECORD

PROJECT: Carlsbad Village Trench Project

WELL NO. MW-3

JOB NO. 20200172.001A

SITE: MW-3

PREPARED BY: Stefan Birardi/Steve Treadway

CHECKED BY

PURGE METHOD	TOTAL VOL REMOVED	TOTAL HOURS
SURGING	0	10 min
BAILER	10 gal	10 min
PUMP	45 gal	35 min
OTHER:		

PURGING CRITERIA

DATE STARTED: 9/30/19 **DATE COMPLETED:** 9/30/19

WEATHER: Sunny

TEMPERATURE: 72° F

SUBCONTRACTOR: Pacific Drilling

BOREHOLE DIAM d_h = 8" ft.

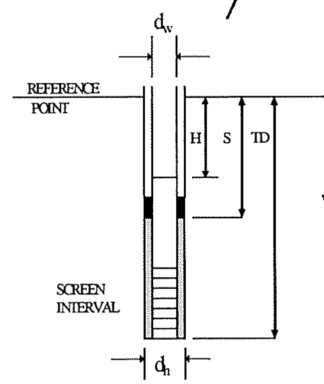
WELL CASING

INSIDE DIAM d_wID = ft.
OUTSIDE DIAM d_wOD = 2" ft.

REFERENCE POINT: TOC

DEPTH TO:
WATER LEVEL H = 34.85 ft.
BASE OF SEAL S = ft.
TOP OF SCREEN = ft.
BASE OF SCREEN = ft.
BASE OF WELL TD = 44.95 ft.

ESTIMATED FILTER PACK POROSITY P = 30%



WELL VOLUME CALCULATION

CASING VOLUME (V_c)

$$V_c = \pi\left(\frac{d_w ID}{2}\right)^2 (TD - H) = \qquad ft^3$$

FILTER PACK PORE VOLUME (V_F)

$$V_F = \pi\left[\left(\frac{d_h}{2}\right)^2 - \left(\frac{d_w OD}{2}\right)^2\right](TD - S \text{ or } H)(P) = \qquad ft^3$$

(IF S > H, USE S. IF S < H, USE H.)

TOTAL WELL VOLUME (V_T)

$V_T = V_C + V_F =$ ft^3 x 7.48= gal

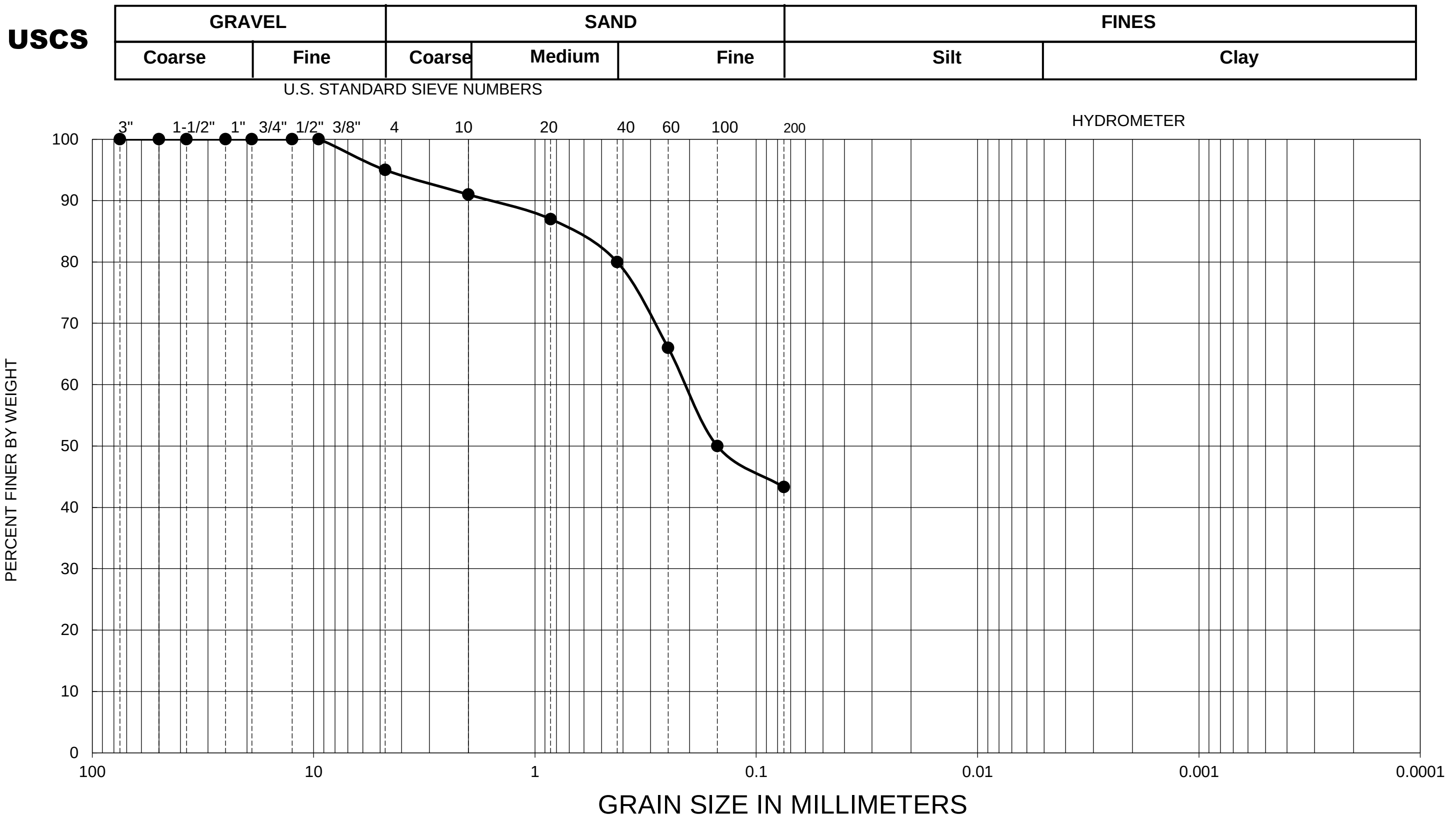
PURGING DATA				TOTAL WATER REMOVED		FIELD PARAMETERS				COMMENTS
Time Begin (hrs)	Time Finish (hrs)	Method	Water Removed (Gal)	Gal	Well Vols.	pH	Conduct. (µ mhos)	Temp (°C)	Turbidity (Visual/NTU)	ORP
1030	1040	Surge	0	0	0	—	—	—	—	
1040	1050	Bail	10	10	6	—	—	—	—	
1100	1114	pump	~ 10	20	12	No Readings / heavy silt, mud / Pump Issues				
1114	1117	pump	5	25	15	8.78	1.209	24.0	49.53	73.3
1117	1120	pump	5	30	18	7.92	1.284	22.5	10.22	85.7
1120	1123	pump	5	35	21	7.68	1.371	22.2	9.17	114.5
1123	1126	pump	5	40	24	7.58	1.443	22.4	5.95	134.2
1126	1129	pump	5	45	27	7.50	1.514	22.4	6.54	140.5
1129	1132	pump	5	50	30	7.46	1.532	22.3	5.29	142.0
1132	1135	pump	5	55	33	7.46	1.540	22.4	4.87	143.8
										END DTW = 36.91

REMARKS: 1 Well Vol = 1.65 gal based on 2" pvc
3 well vol = 4.95 gal

APPENDIX C

Geotechnical Laboratory Reports

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-1	1		43.3	SC

Sample Description	Dark Grayish Brown Clayey sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	95
	No. 10	2.0 mm	91
	No. 20	0.85 mm	87
	No. 40	0.425 mm	80
	No. 60	0.25 mm	66
	No 100	0.15 mm	50
	No 200	.075 mm	43.3

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

KLEINFELDER
Bright People. Right Solutions.

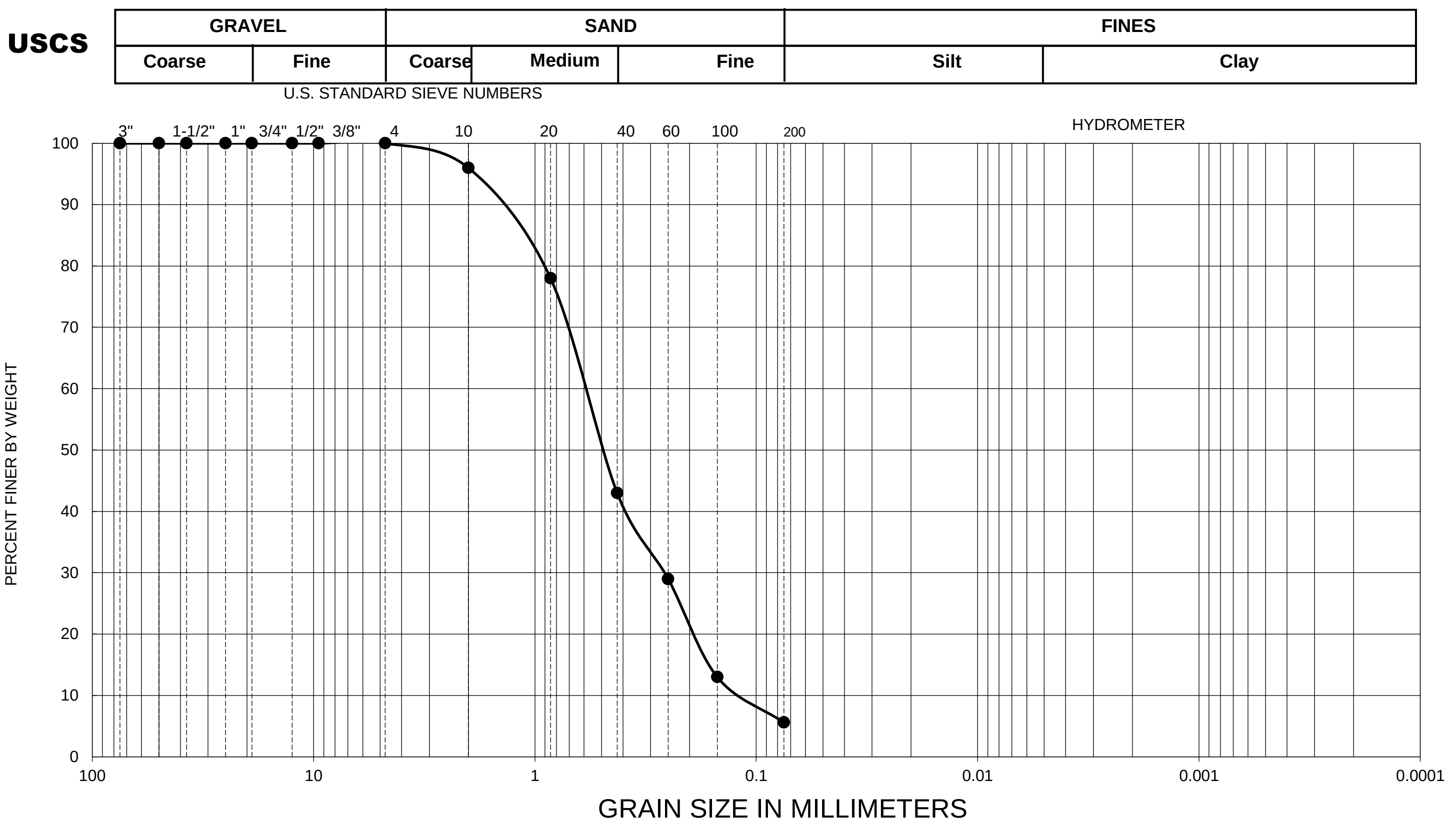
Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-1	10		5.6	SP-SM

Sample Description	Light brownish gray	Poorly graded sand with silt

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	96
	No. 20	0.85 mm	78
	No. 40	0.425 mm	43
	No. 60	0.25 mm	29
	No 100	0.15 mm	13
	No 200	.075 mm	5.6

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

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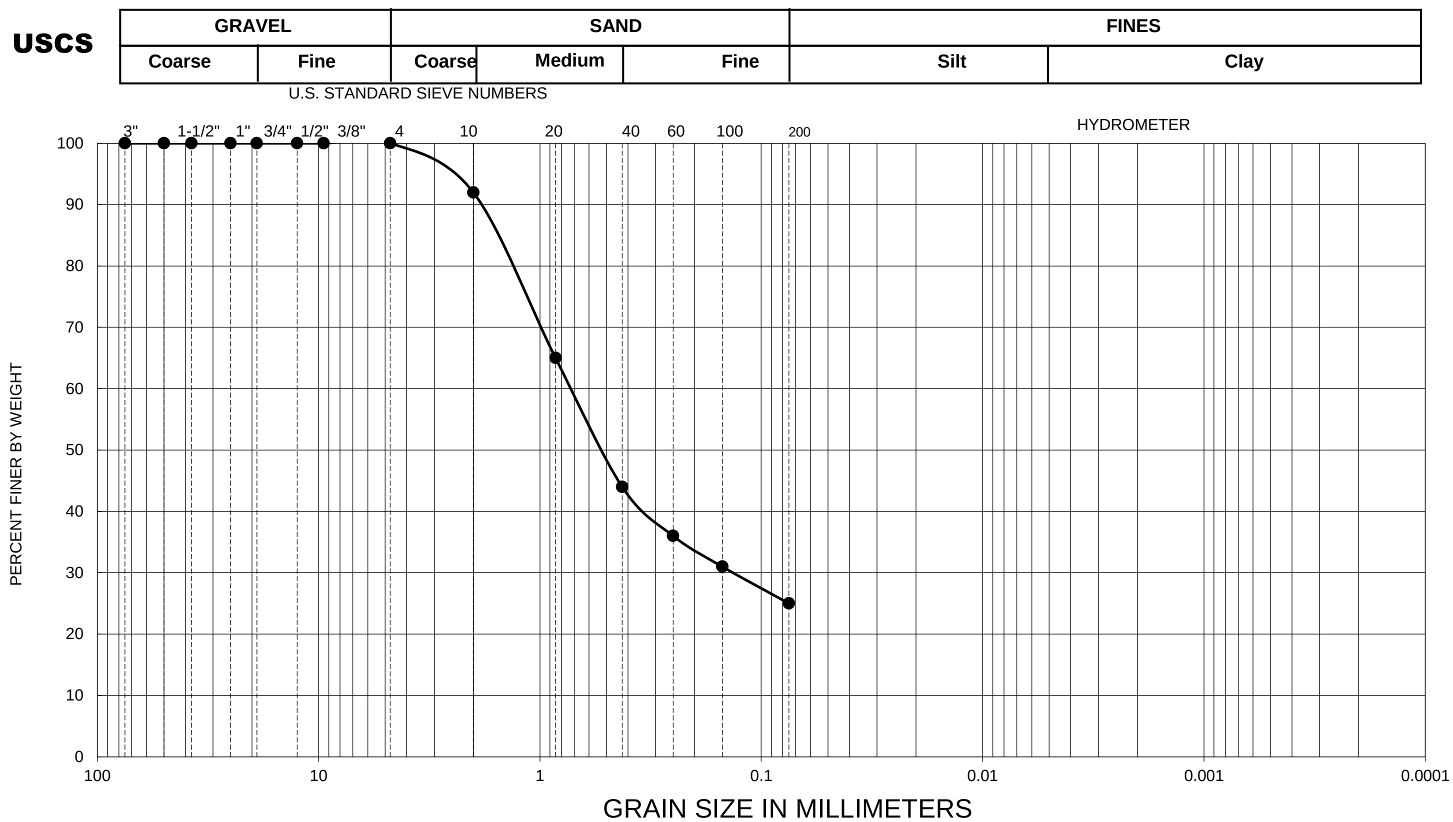
GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-1	15		25.0	SC

Sample Description	Pale yellow Clayey sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	92
	No. 20	0.85 mm	65
	No. 40	0.425 mm	44
	No. 60	0.25 mm	36
	No 100	0.15 mm	31
	No 200	.075 mm	25.0

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

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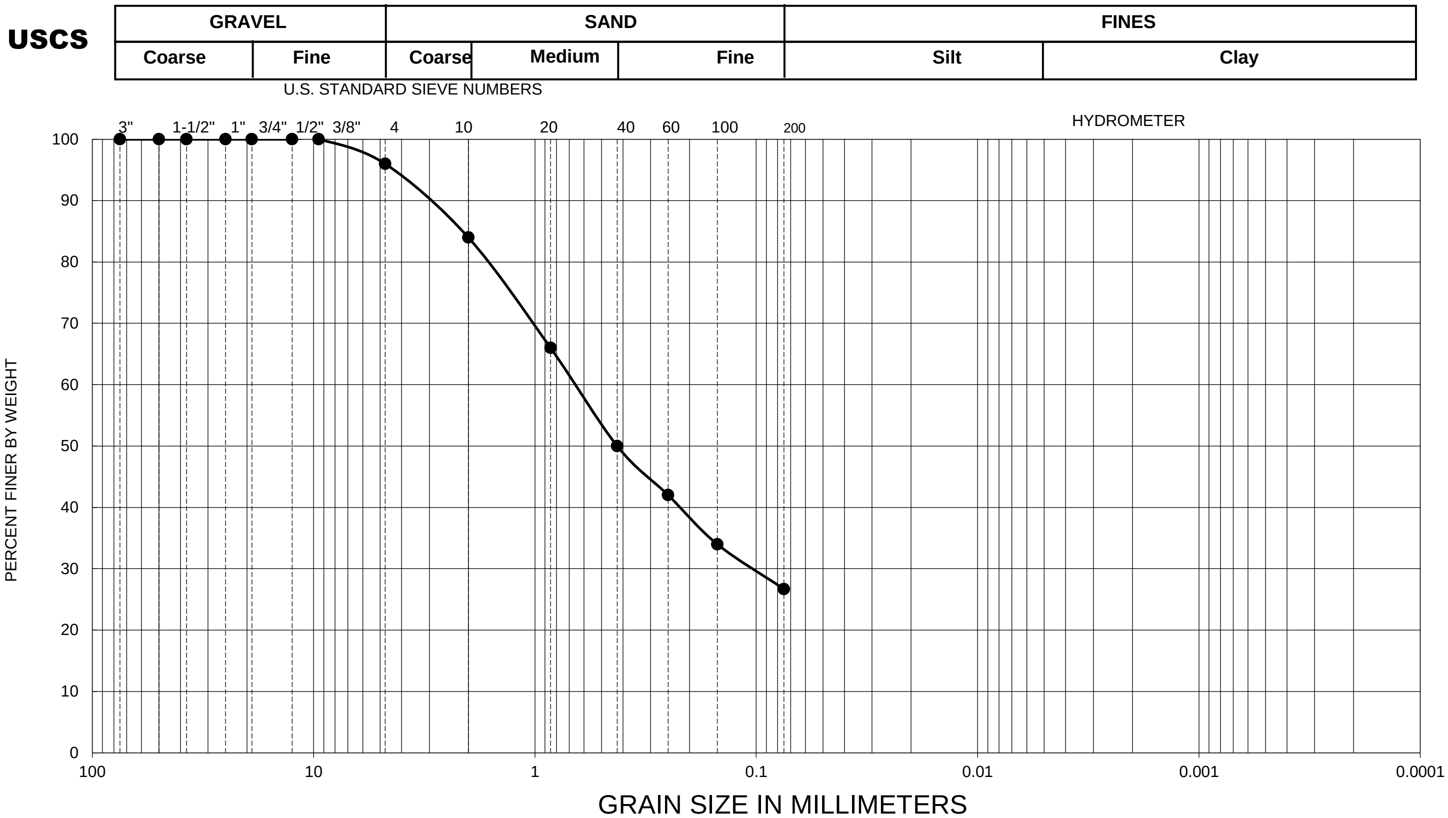
Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-1	20		26.7	SC

Sample Description	Pale yellow Clayey sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	96
	No. 10	2.0 mm	84
	No. 20	0.85 mm	66
	No. 40	0.425 mm	50
	No. 60	0.25 mm	42
	No 100	0.15 mm	34
	No 200	.075 mm	26.7

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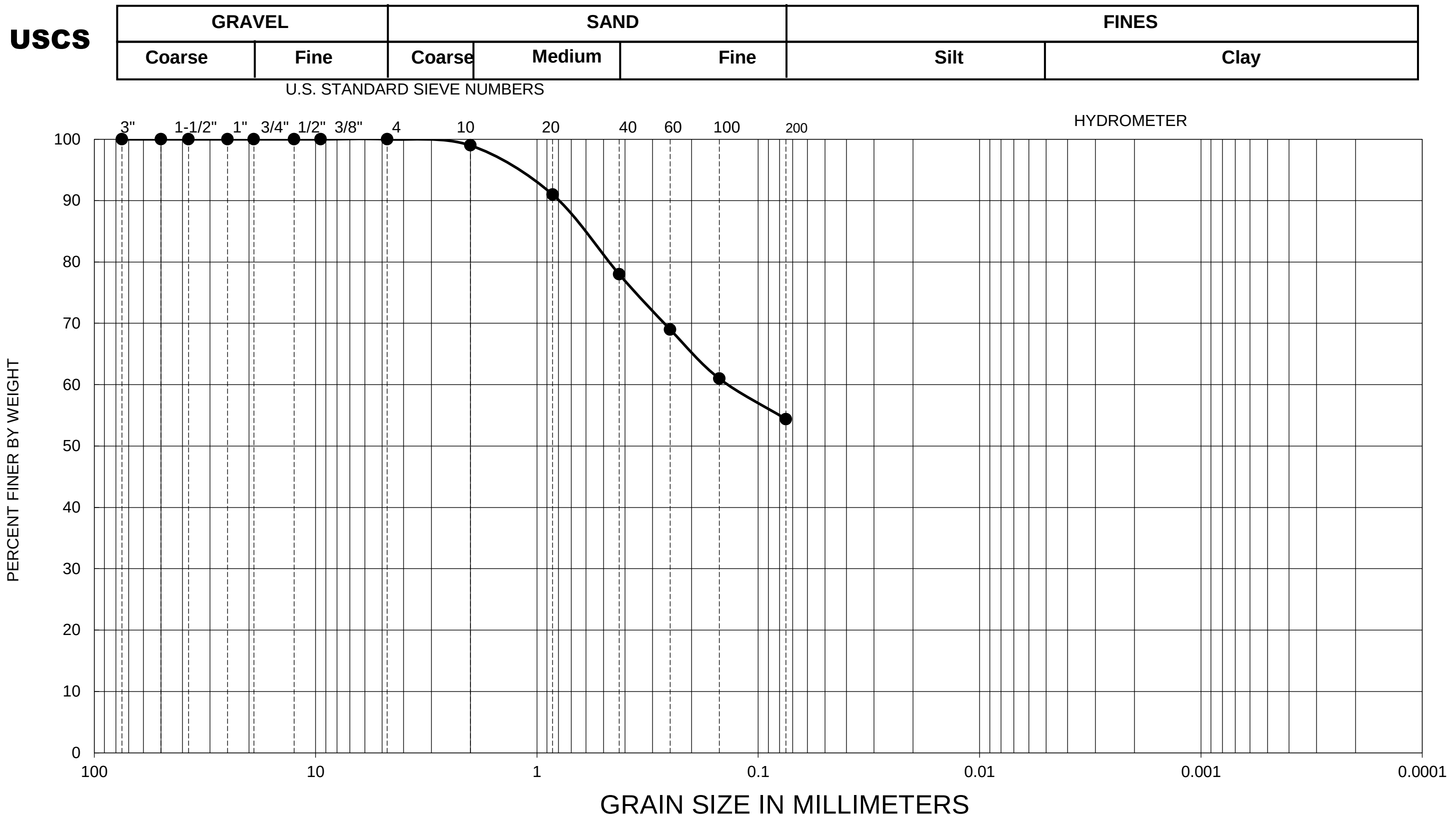
Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-1	24		54.4	CL

Sample Description	Light gray Sandy lean clay

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	99
	No. 20	0.85 mm	91
	No. 40	0.425 mm	78
	No. 60	0.25 mm	69
	No 100	0.15 mm	61
	No 200	.075 mm	54.4

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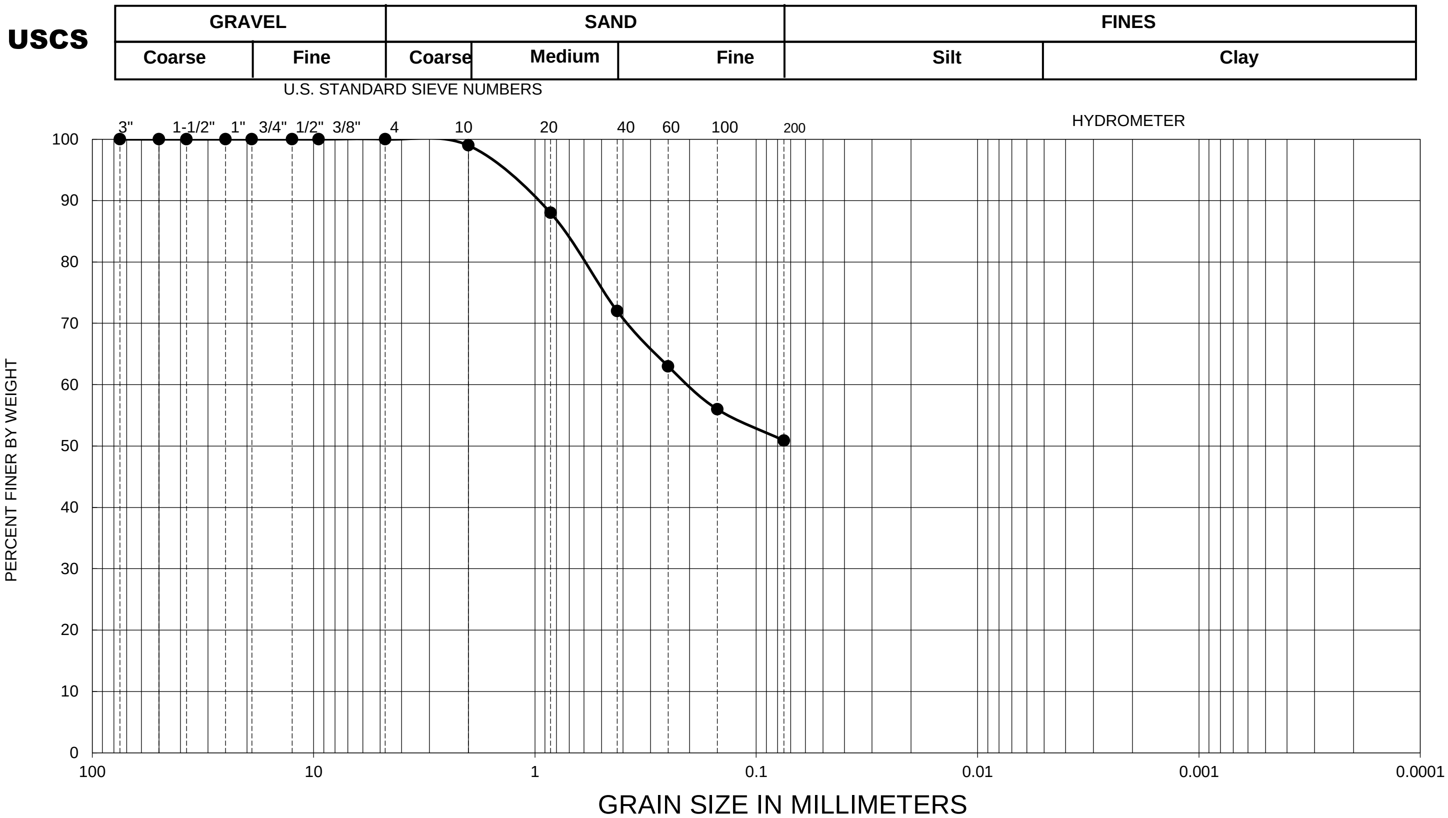
GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

Date Tested: **10/8/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-1	26		50.9	CL

Sample Description	Pale yellow Sandy lean clay

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	99
	No. 20	0.85 mm	88
	No. 40	0.425 mm	72
	No. 60	0.25 mm	63
	No 100	0.15 mm	56
	No 200	.075 mm	50.9

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

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GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

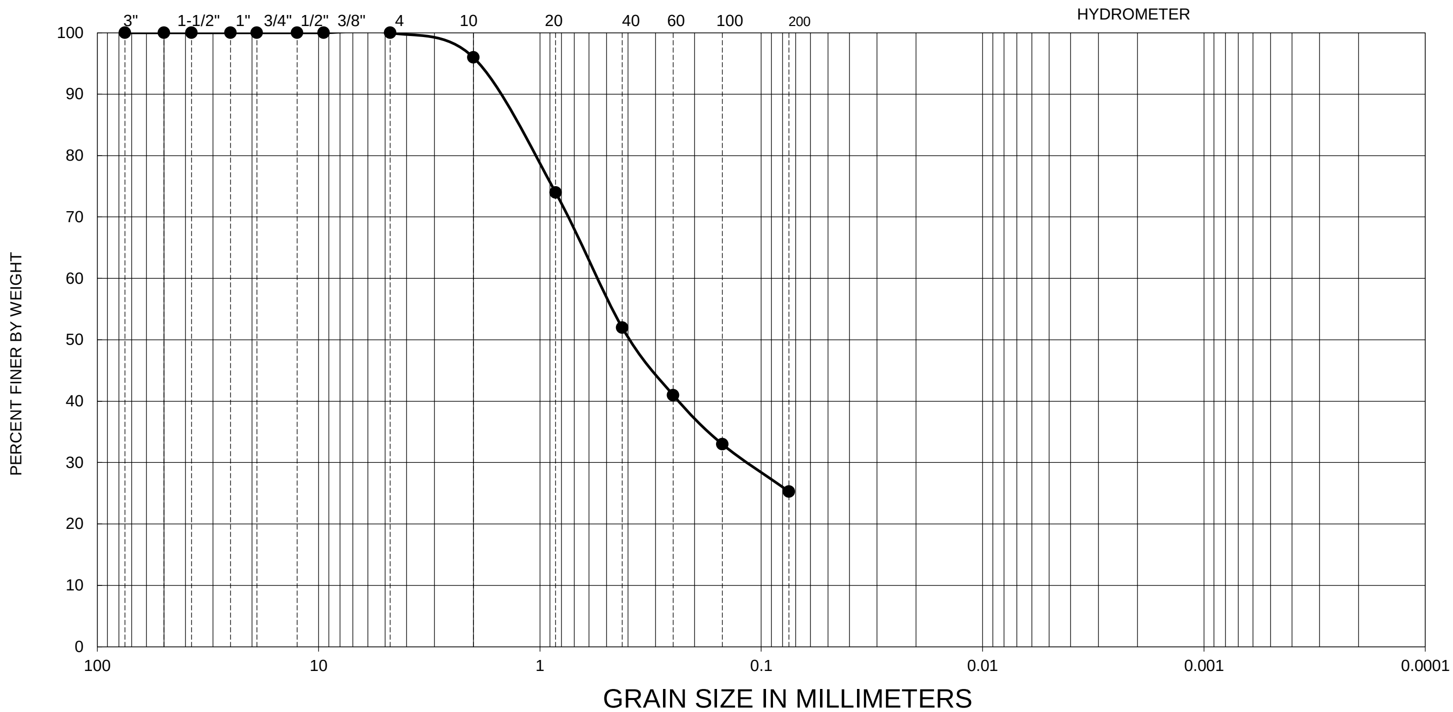
Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

Date Tested: **10/8/2019**

USCS

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

U.S. STANDARD SIEVE NUMBERS



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-1	28		25.3	SC

Sample Description	Pale yellow Clayey sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	96
	No. 20	0.85 mm	74
	No. 40	0.425 mm	52
	No. 60	0.25 mm	41
	No 100	0.15 mm	33
	No 200	.075 mm	25.3

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

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Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

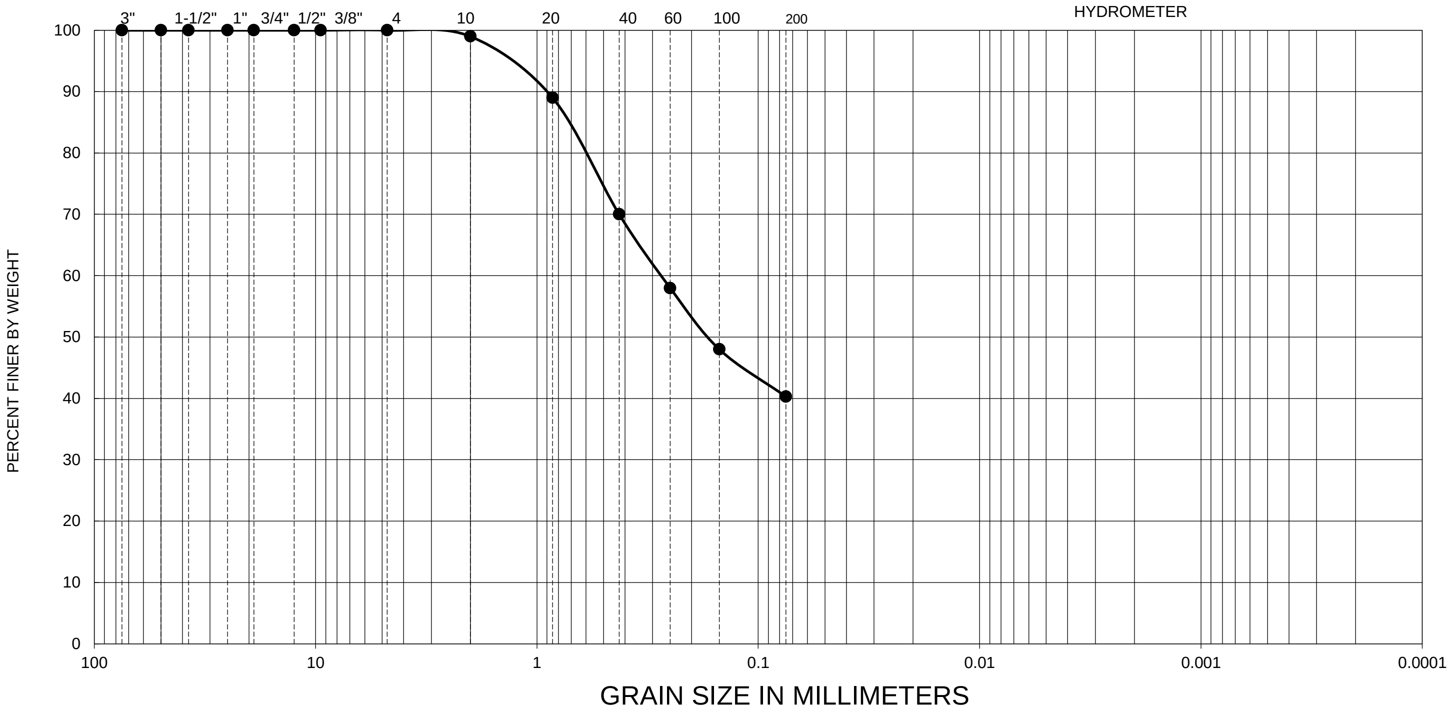
Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/4/2019**

USCS	**GRAVEL**		**SAND**			**FINES**	
	Coarse	**Fine**	**Coarse**	**Medium**	**Fine**	**Silt**	**Clay**

U.S. STANDARD SIEVE NUMBERS



Boring No.	**Sample No.**	**Depth (ft)**	**Passing 200 (%)**	**USCS Classification**
MW-1	32		40.3	SC

Sample Description	Pale yellow Clayey sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	99
	No. 20	0.85 mm	89
	No. 40	0.425 mm	70
	No. 60	0.25 mm	58
	No 100	0.15 mm	48
	No 200	.075 mm	40.3

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

KLEINFELDER
Bright People. Right Solutions.

Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

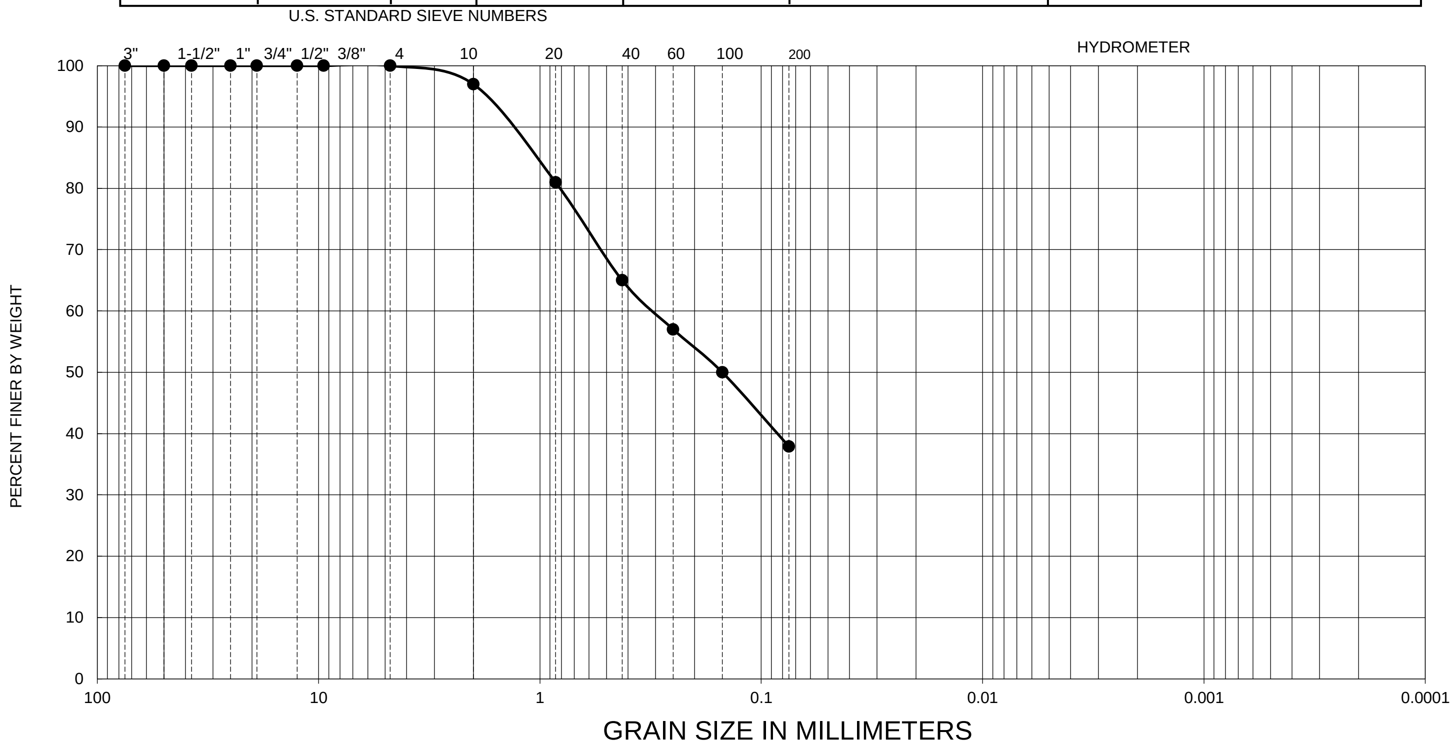
Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/8/2019**

USCS

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-1	34		37.9	SC

Sample Description	Pale yellow Clayey sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	97
	No. 20	0.85 mm	81
	No. 40	0.425 mm	65
	No. 60	0.25 mm	57
	No 100	0.15 mm	50
	No 200	.075 mm	37.9

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

KLEINFELDER
Bright People. Right Solutions.

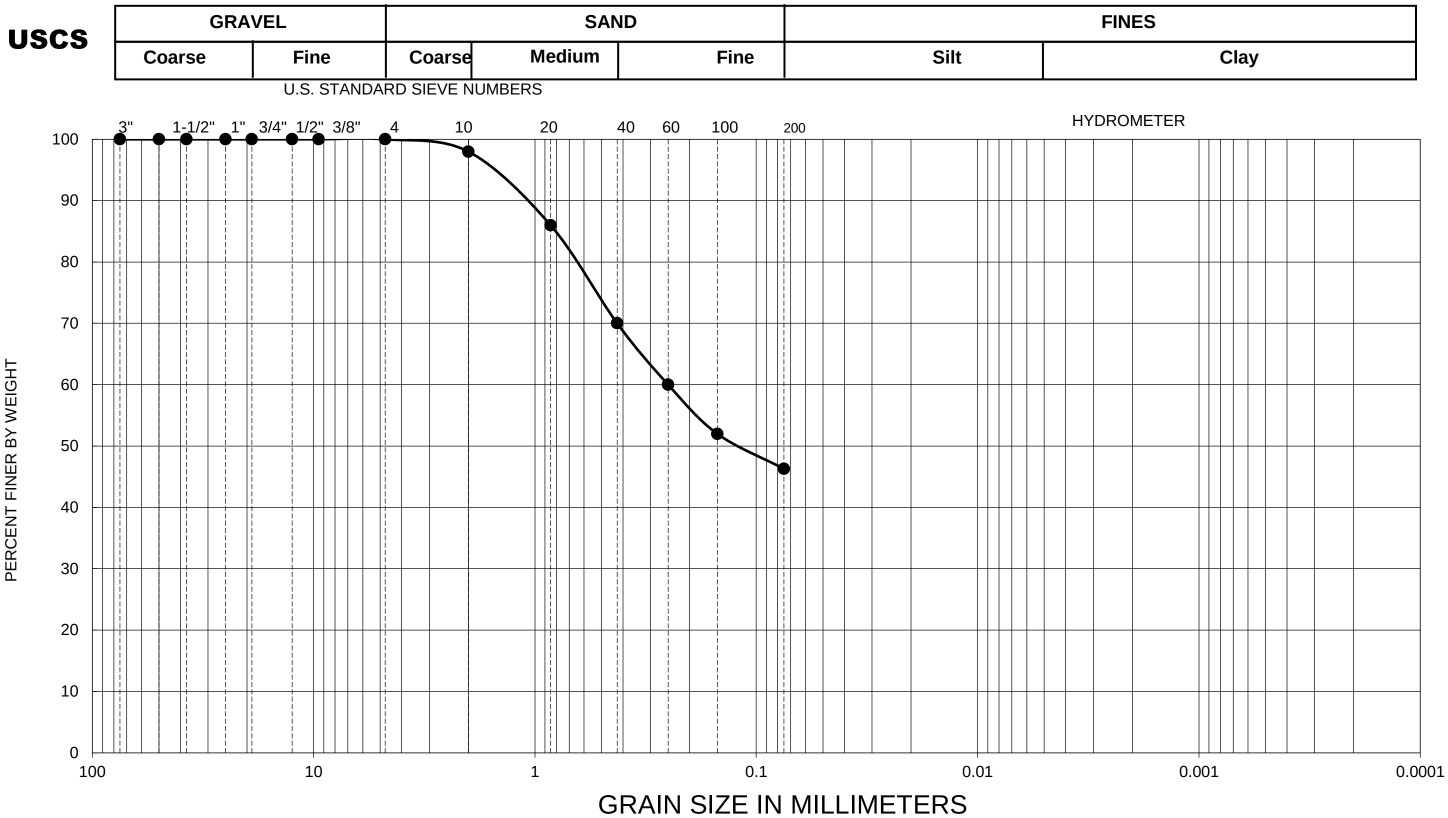
Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-1	36		46.3	SC

Sample Description	Dark yellowish brown Clayey sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	98
	No. 20	0.85 mm	86
	No. 40	0.425 mm	70
	No. 60	0.25 mm	60
	No 100	0.15 mm	52
	No 200	.075 mm	46.3

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

KLEINFELDER
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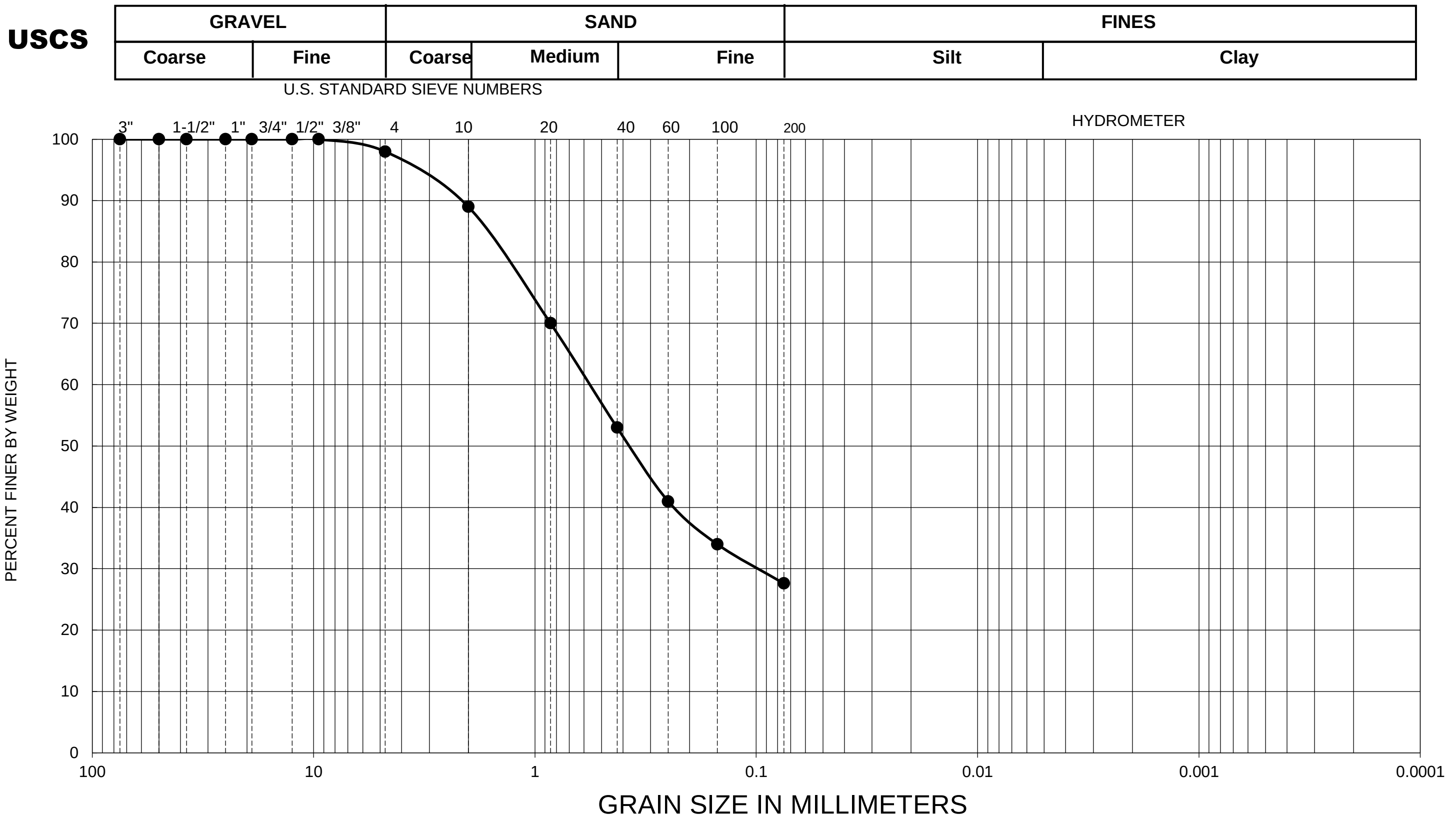
Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/8/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-1	38		27.6	SC

Sample Description	Pale yellow Clayey sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	98
	No. 10	2.0 mm	89
	No. 20	0.85 mm	70
	No. 40	0.425 mm	53
	No. 60	0.25 mm	41
	No 100	0.15 mm	34
	No 200	.075 mm	27.6

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GRADATION TEST RESULTS

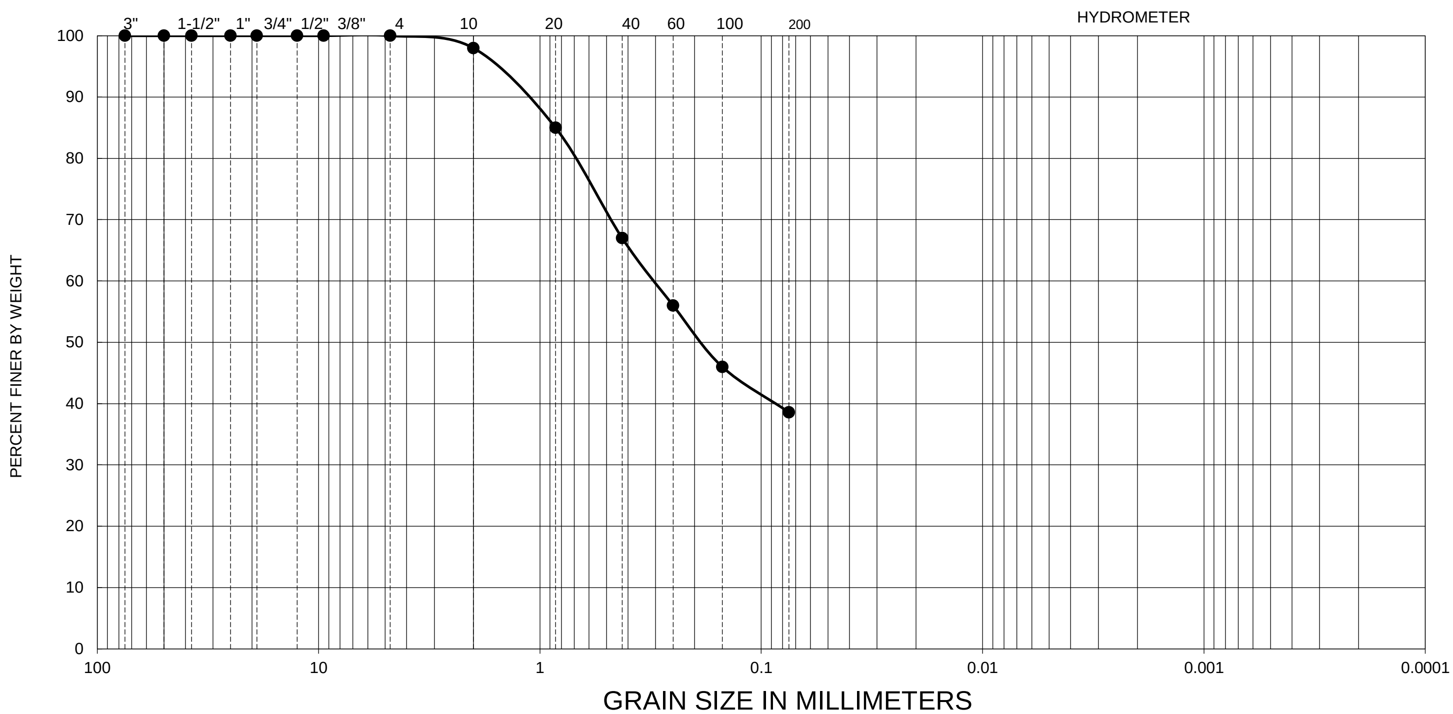
Carlsbad Double Track Trench alternative

FIGURE

Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

Date Tested: **10/7/2019**

USCS	**GRAVEL**		**SAND**			**FINES**	
	Coarse	**Fine**	**Coarse**	**Medium**	**Fine**	**Silt**	**Clay**



Boring No.	**Sample No.**	**Depth (ft)**	**Passing 200 (%)**	**USCS Classification**
MW-1	40		38.6	SC

Sample Description	Pale yellow Clayey sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	98
	No. 20	0.85 mm	85
	No. 40	0.425 mm	67
	No. 60	0.25 mm	56
	No 100	0.15 mm	46
	No 200	.075 mm	38.6

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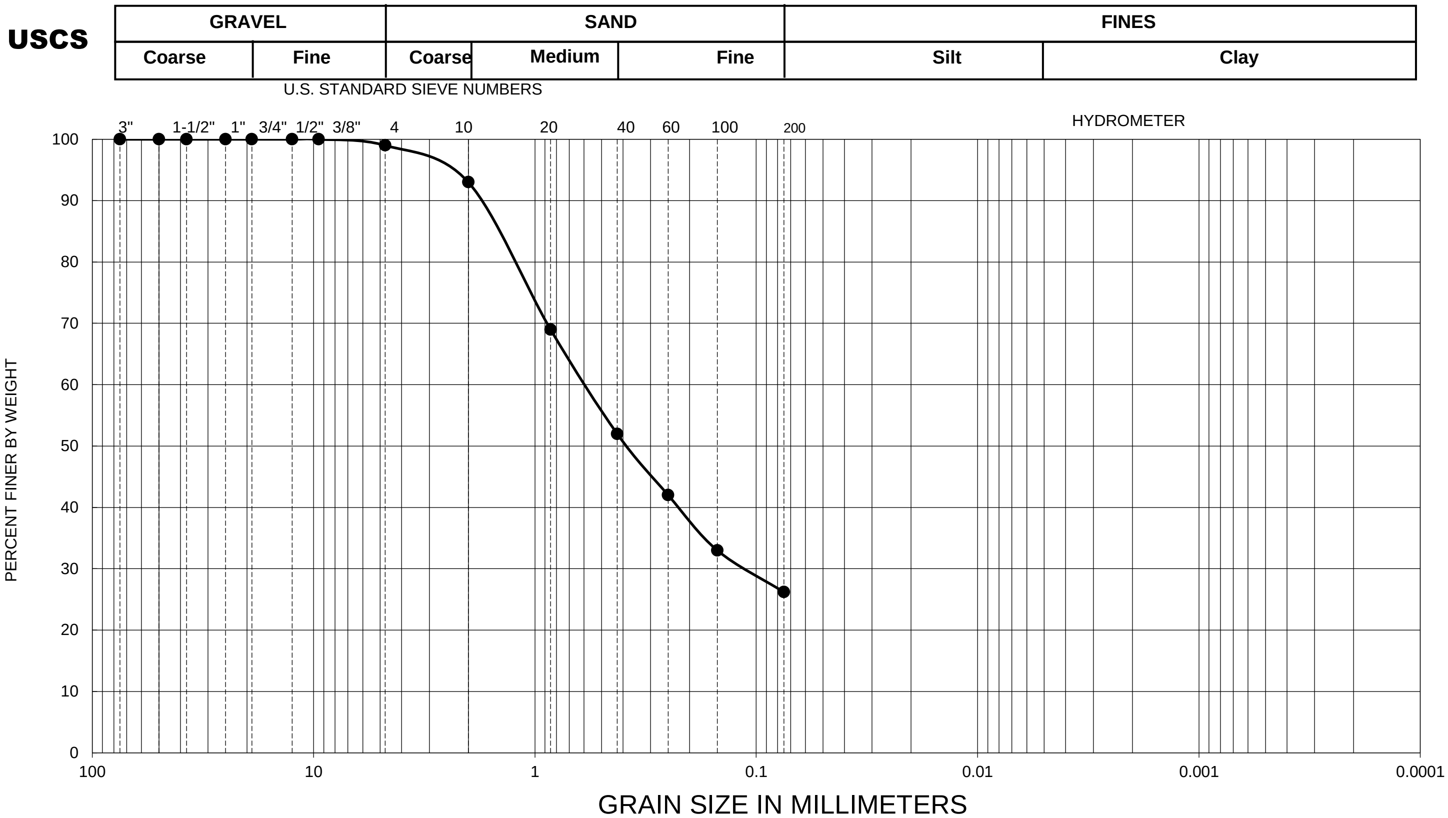
GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

Date Tested: **10/8/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-1	42		26.2	SC

Sample Description	Light yellowish brown Clayey sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	99
	No. 10	2.0 mm	93
	No. 20	0.85 mm	69
	No. 40	0.425 mm	52
	No. 60	0.25 mm	42
	No 100	0.15 mm	33
	No 200	.075 mm	26.2

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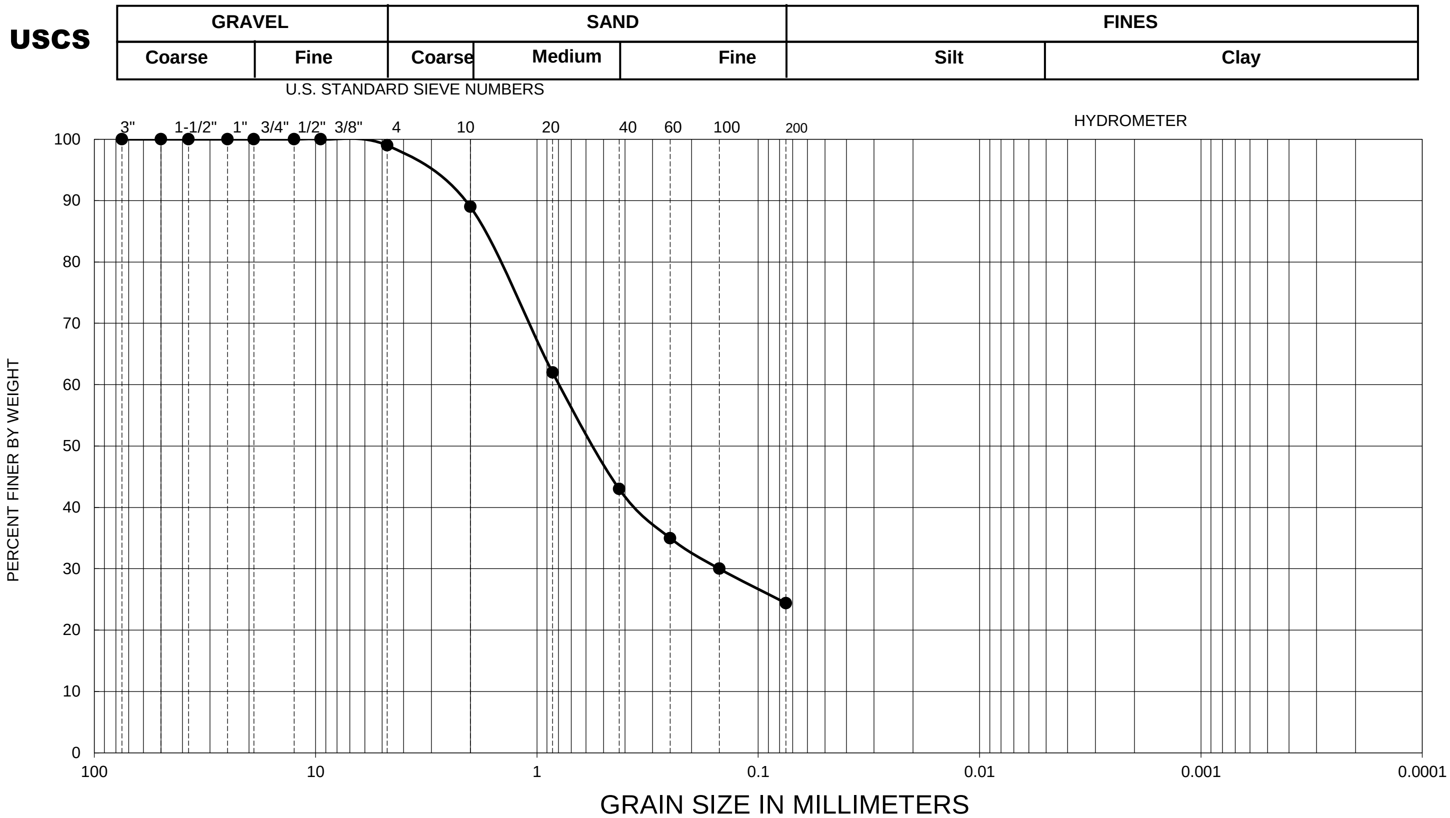
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-1	44		24.4	SC

Sample Description	Pale yellow Clayey sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	99
	No. 10	2.0 mm	89
	No. 20	0.85 mm	62
	No. 40	0.425 mm	43
	No. 60	0.25 mm	35
	No 100	0.15 mm	30
	No 200	.075 mm	24.4

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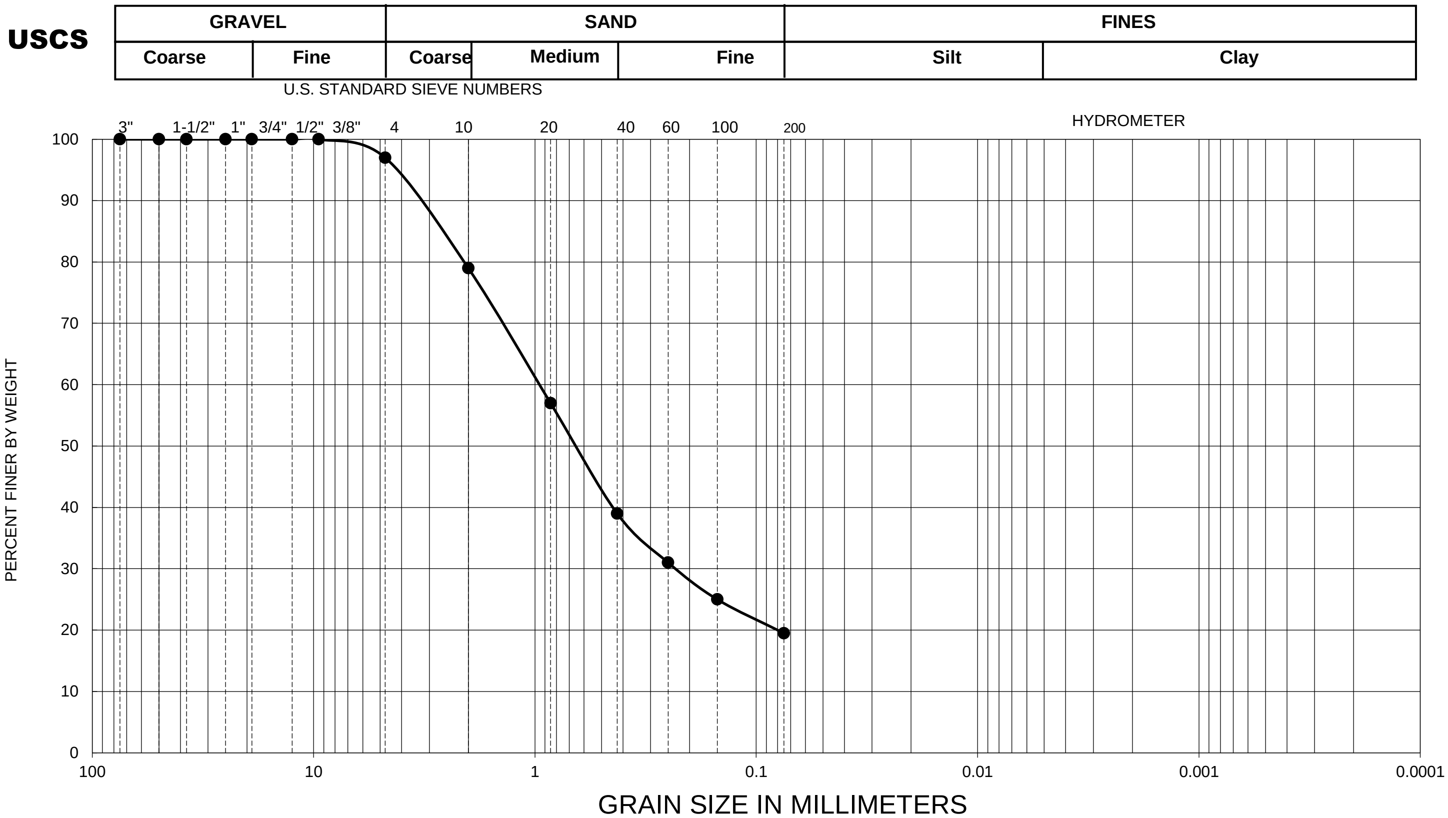
GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-1	46		19.5	SC

Sample Description	Pale yellow Clayey sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	97
	No. 10	2.0 mm	79
	No. 20	0.85 mm	57
	No. 40	0.425 mm	39
	No. 60	0.25 mm	31
	No 100	0.15 mm	25
	No 200	.075 mm	19.5

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Project No.	20200172	Date:	9-Oct-19

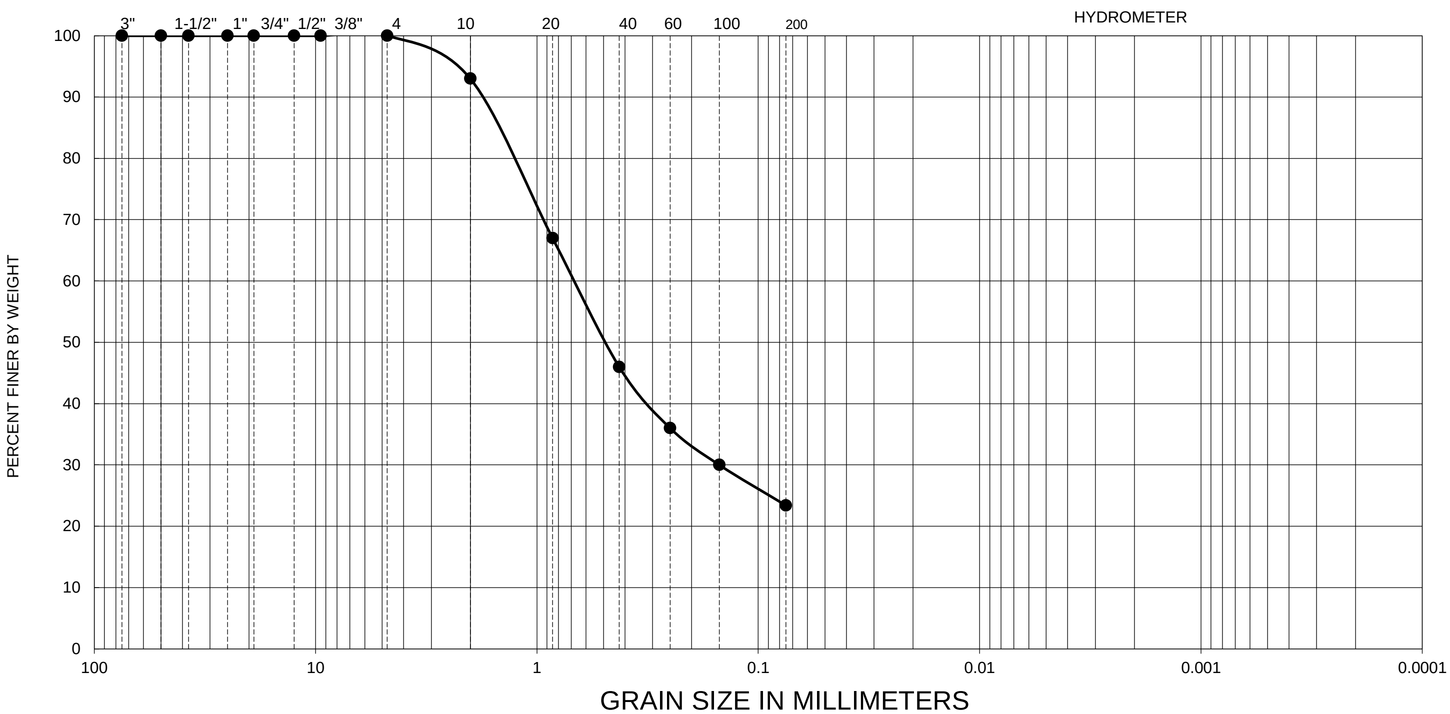
GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/8/2019**

USCS	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-1	48		23.4	SC

Sample Description	Pale yellow Clayey sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	93
	No. 20	0.85 mm	67
	No. 40	0.425 mm	46
	No. 60	0.25 mm	36
	No 100	0.15 mm	30
	No 200	.075 mm	23.4

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GRADATION TEST RESULTS

FIGURE

Carlsbad Double Track Trench alternative

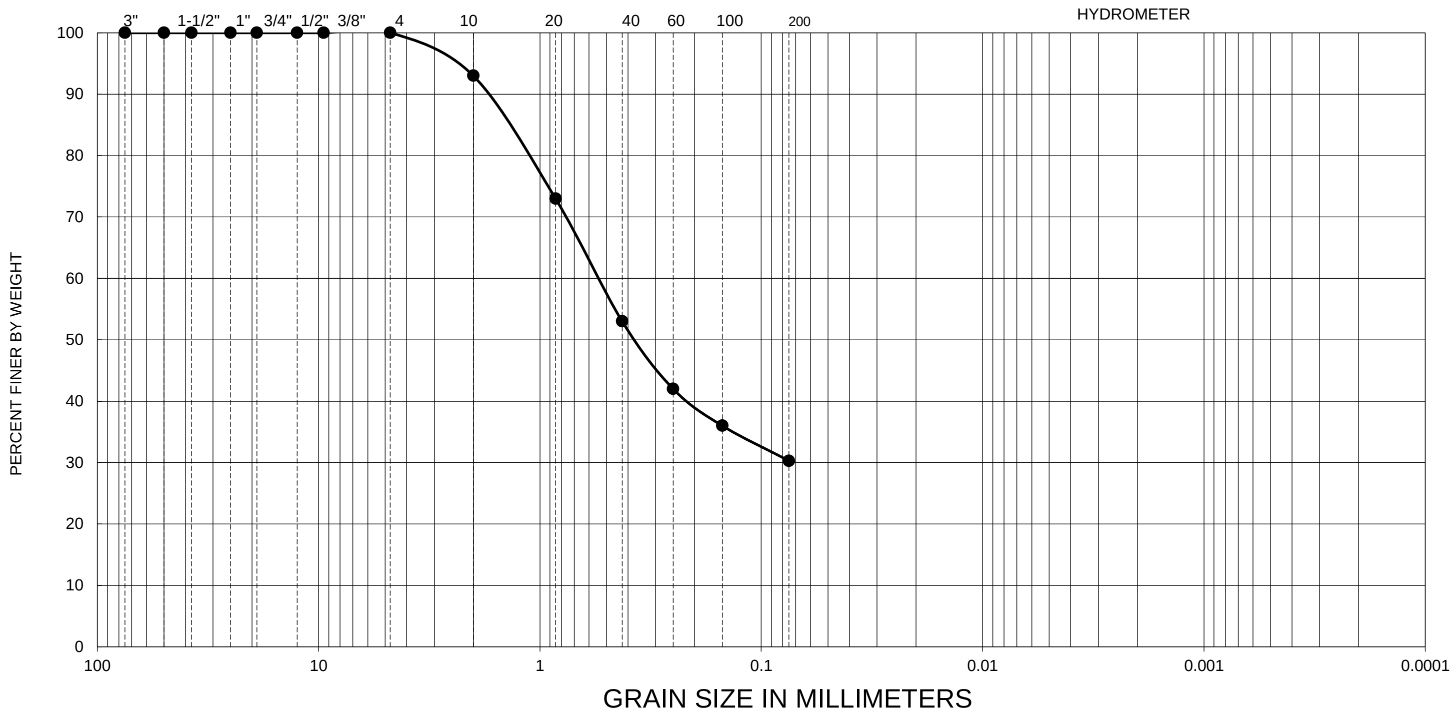
Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

Date Tested: **10/7/2019**

USCS

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

U.S. STANDARD SIEVE NUMBERS



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-1	52		30.3	SC

Sample Description	Light yellowish brown Clayey sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	93
	No. 20	0.85 mm	73
	No. 40	0.425 mm	53
	No. 60	0.25 mm	42
	No 100	0.15 mm	36
	No 200	.075 mm	30.3

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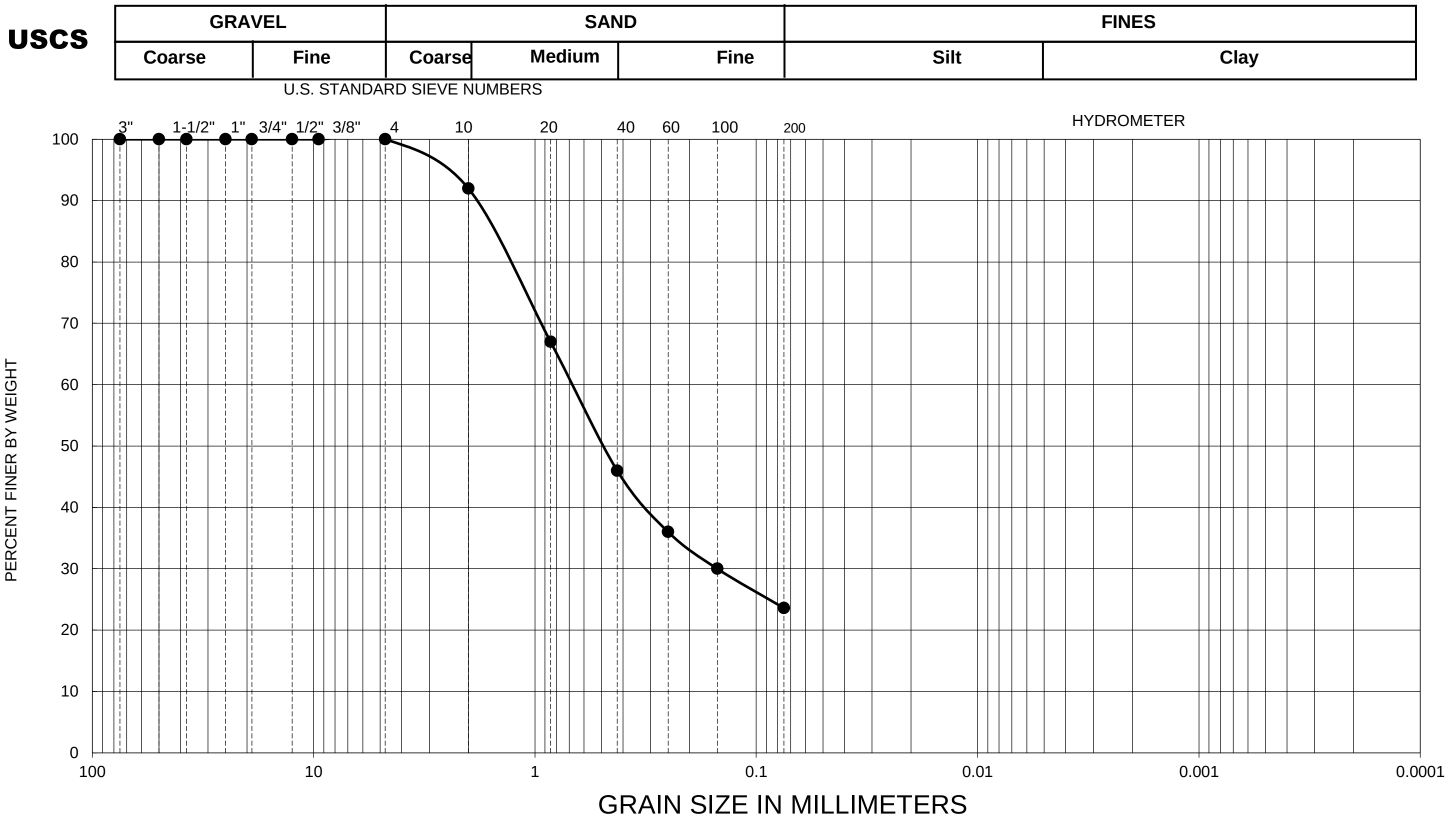
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-1	54		23.6	SC

Sample Description	Pale yellow Clayey sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	92
	No. 20	0.85 mm	67
	No. 40	0.425 mm	46
	No. 60	0.25 mm	36
	No 100	0.15 mm	30
	No 200	.075 mm	23.6

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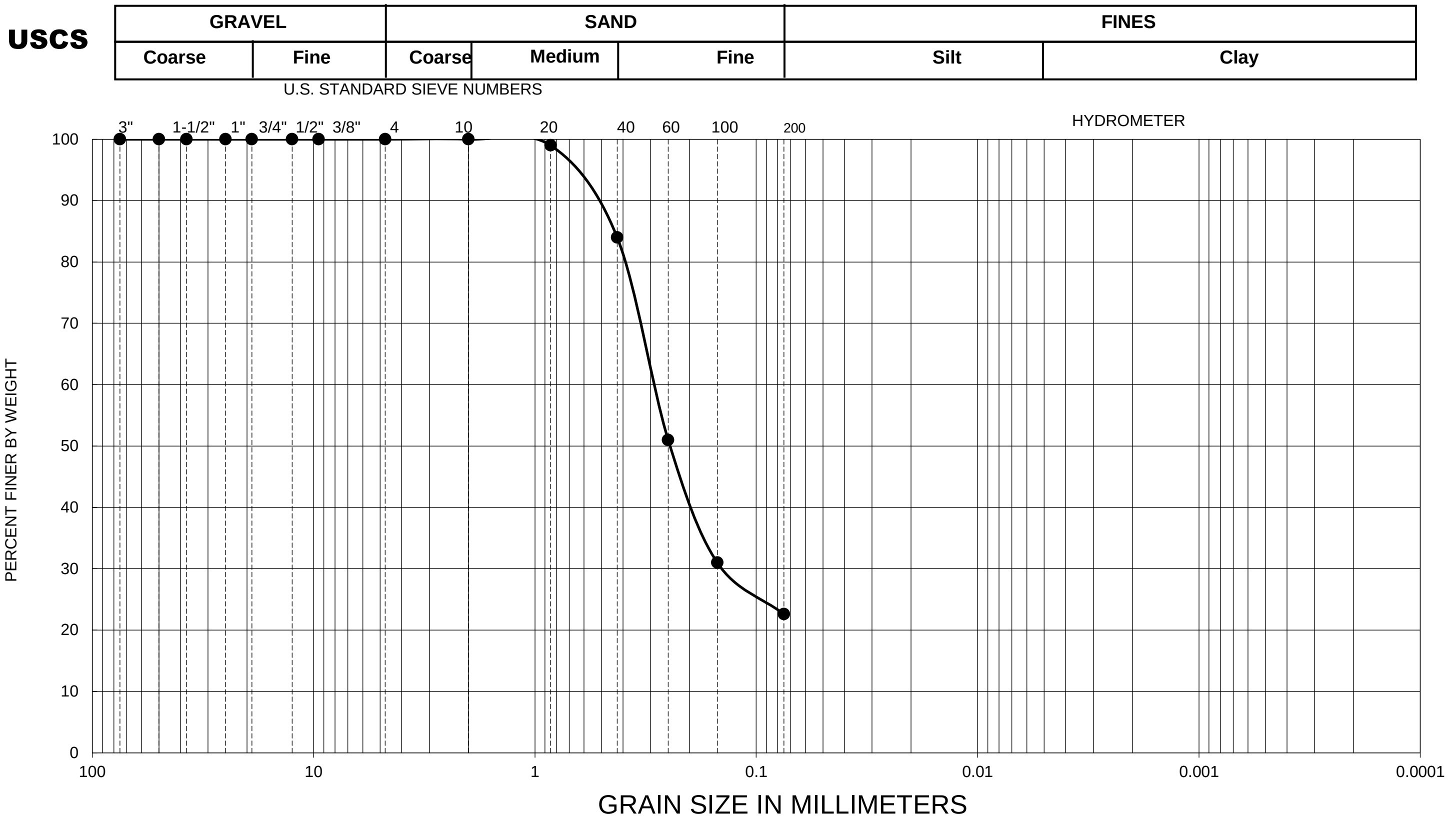
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-2	5		22.6	SM

Sample Description	Dark reddish brown	Silty sand

Sieve Analysis

Sieve Size		% Passing
3"	75 mm	100
2"	50 mm	100
1.5"	37.5 mm	100
1"	25 mm	100
3/4"	19 mm	100
1/2"	12.5 mm	100
3/8"	9.5 mm	100
No. 4	4.75 mm	100
No. 10	2.0 mm	100
No. 20	0.85 mm	99
No. 40	0.425 mm	84
No. 60	0.25 mm	51
No 100	0.15 mm	31
No 200	.075 mm	22.6

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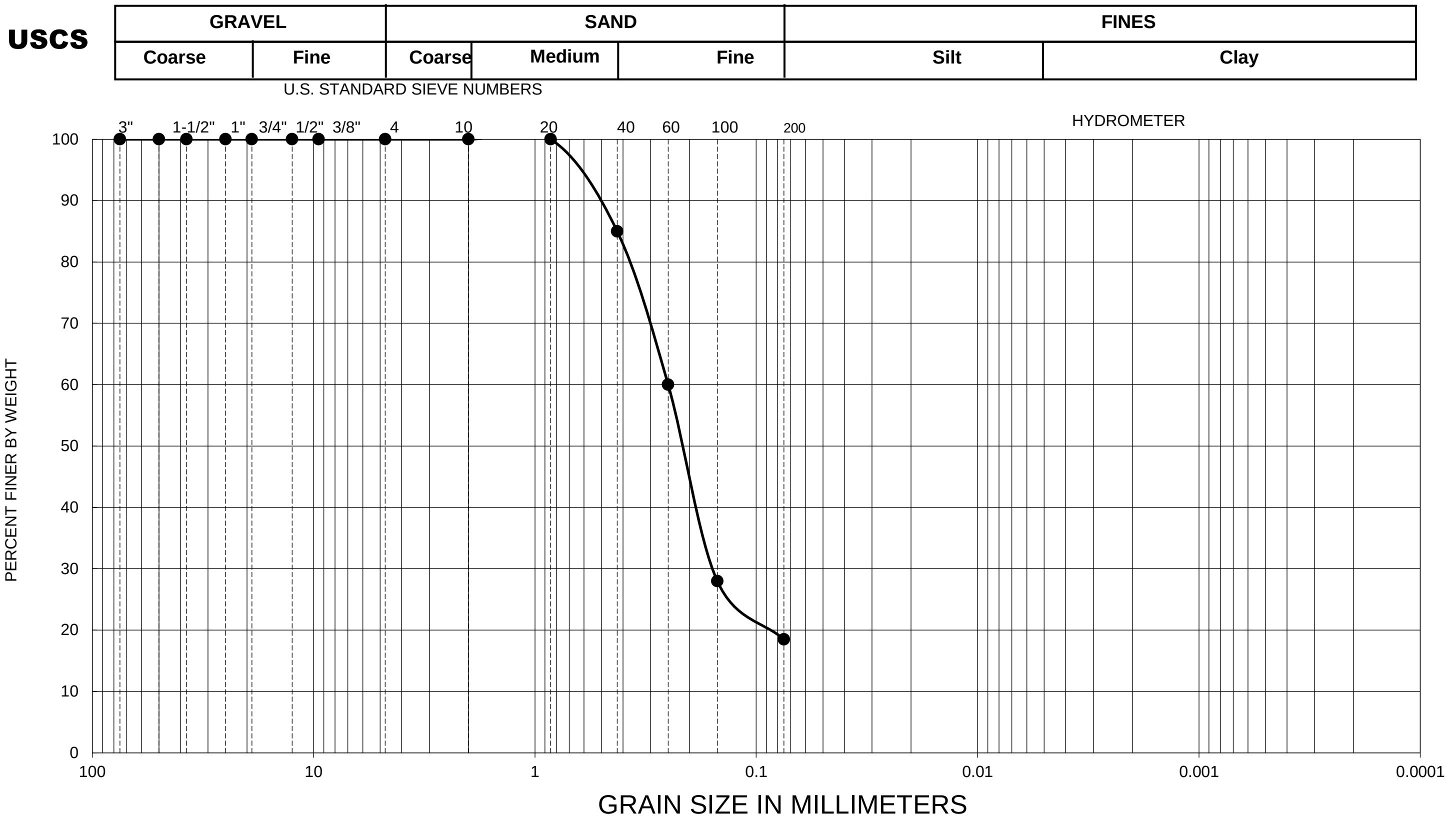
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-2	10		18.5	SM

Sample Description	Dark yellowish brown Silty sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	100
	No. 20	0.85 mm	100
	No. 40	0.425 mm	85
	No. 60	0.25 mm	60
	No 100	0.15 mm	28
	No 200	.075 mm	18.5

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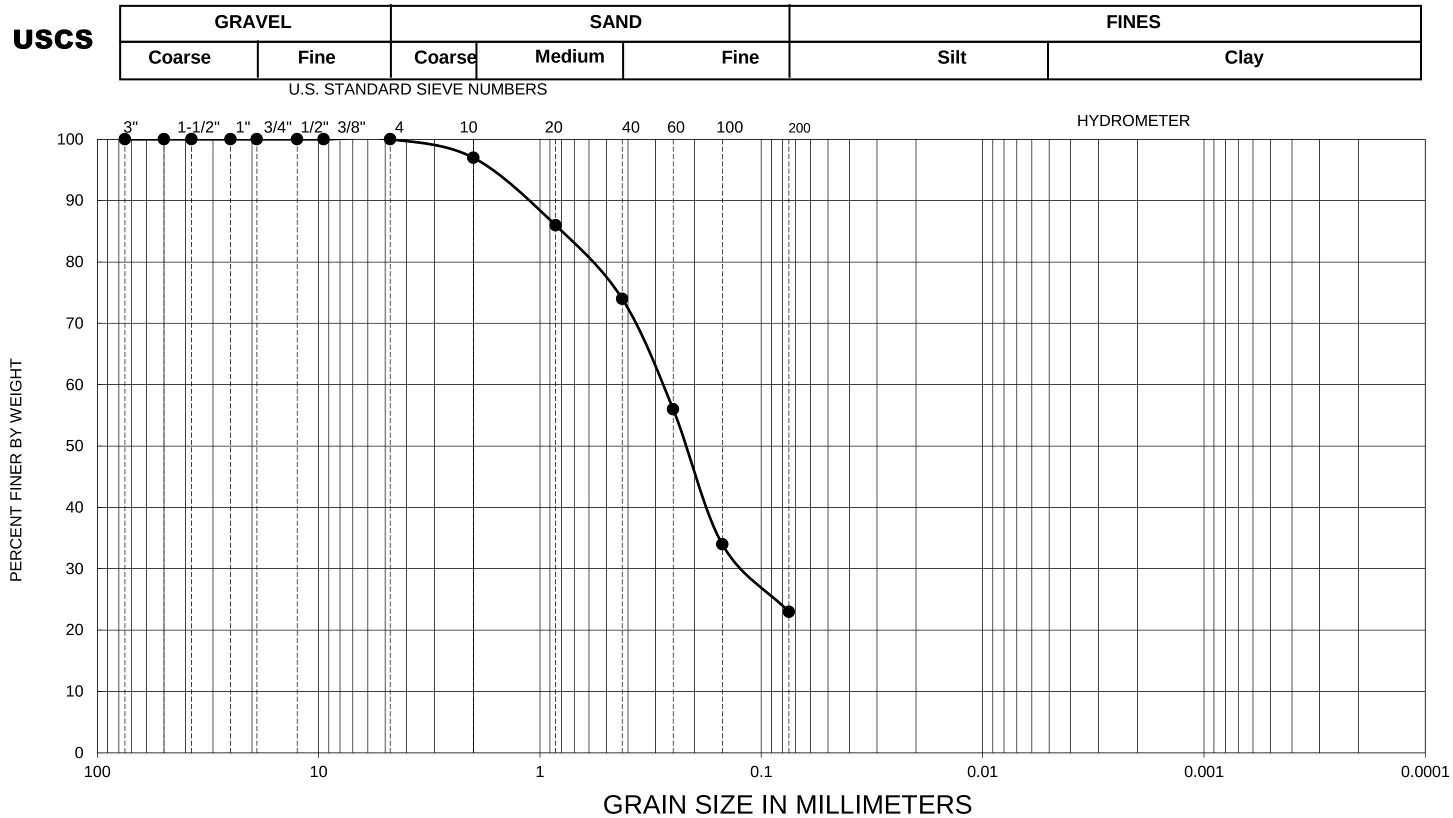
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/4/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-2	15		23.0	SM

Sample Description	Dark yellowish brown Silty sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	97
	No. 20	0.85 mm	86
	No. 40	0.425 mm	74
	No. 60	0.25 mm	56
	No 100	0.15 mm	34
	No 200	.075 mm	23.0

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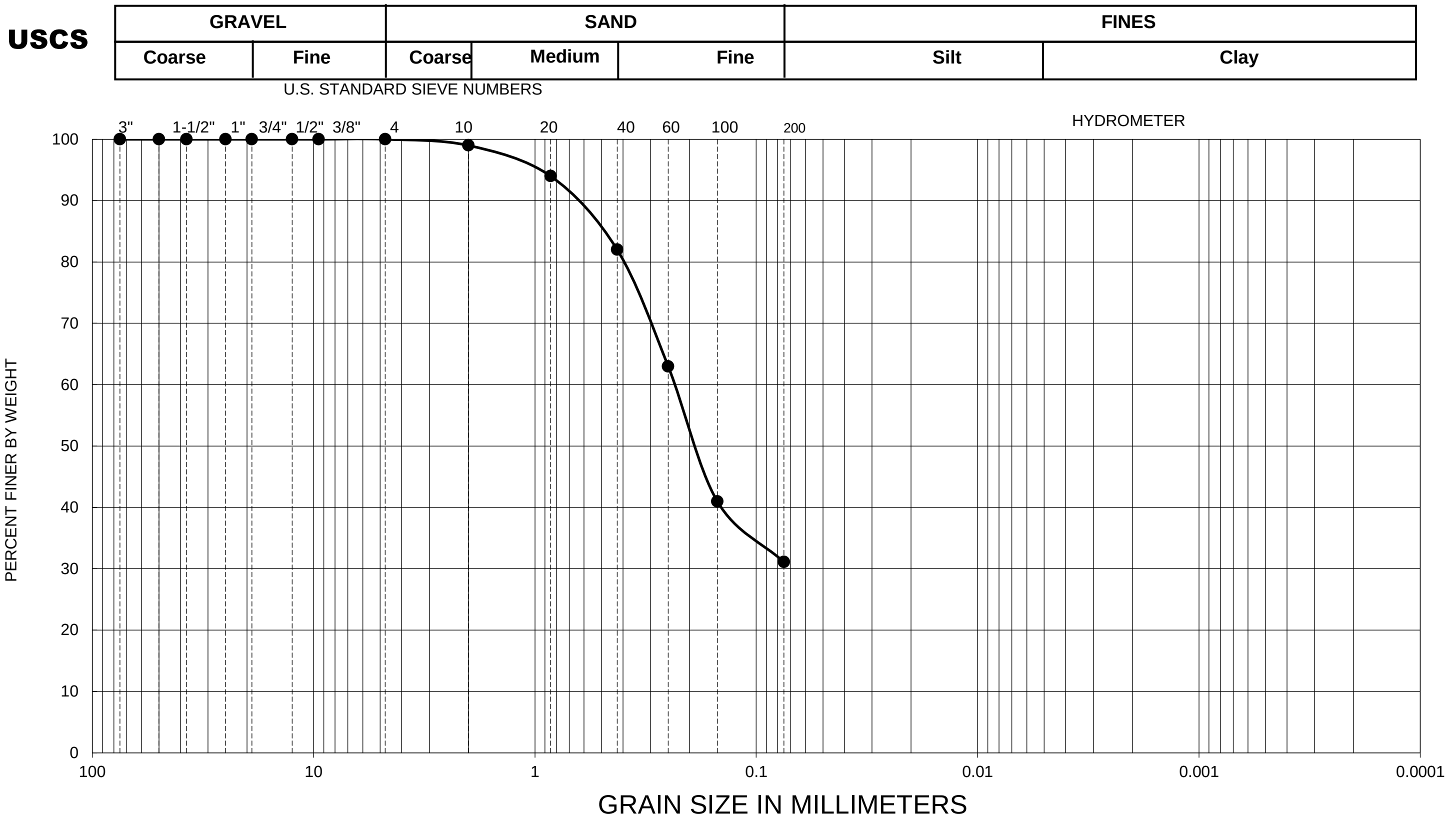
GRADATION TEST RESULTS

FIGURE

Carlsbad Double Track Trench alternative

Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-2	17		31.1	SM

Sample Description	Light olive brown Silty sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	99
	No. 20	0.85 mm	94
	No. 40	0.425 mm	82
	No. 60	0.25 mm	63
	No 100	0.15 mm	41
	No 200	.075 mm	31.1

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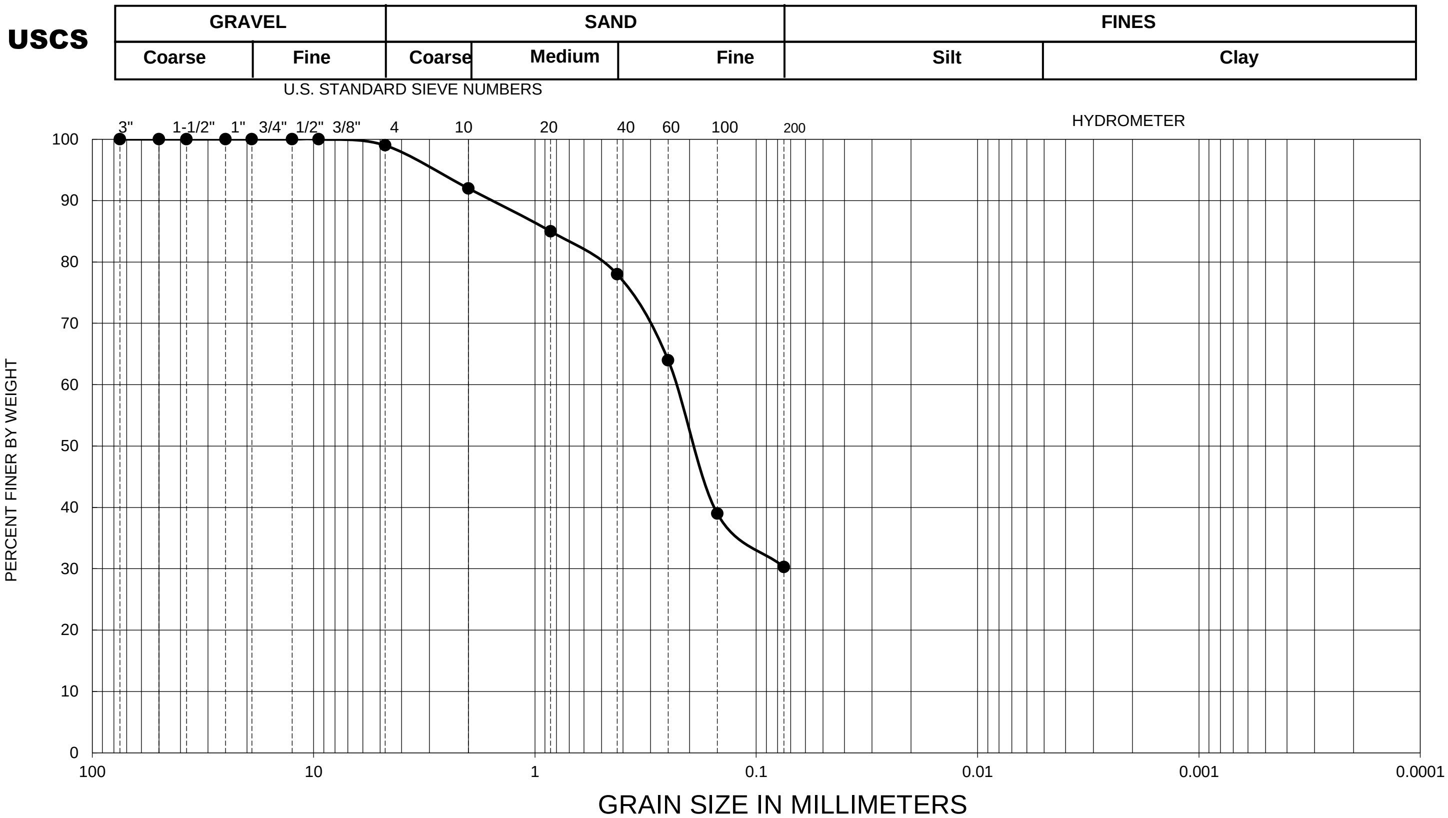
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-2	19		30.3	SM

Sample Description	Light olive brown Silty sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	99
	No. 10	2.0 mm	92
	No. 20	0.85 mm	85
	No. 40	0.425 mm	78
	No. 60	0.25 mm	64
	No 100	0.15 mm	39
	No 200	.075 mm	30.3

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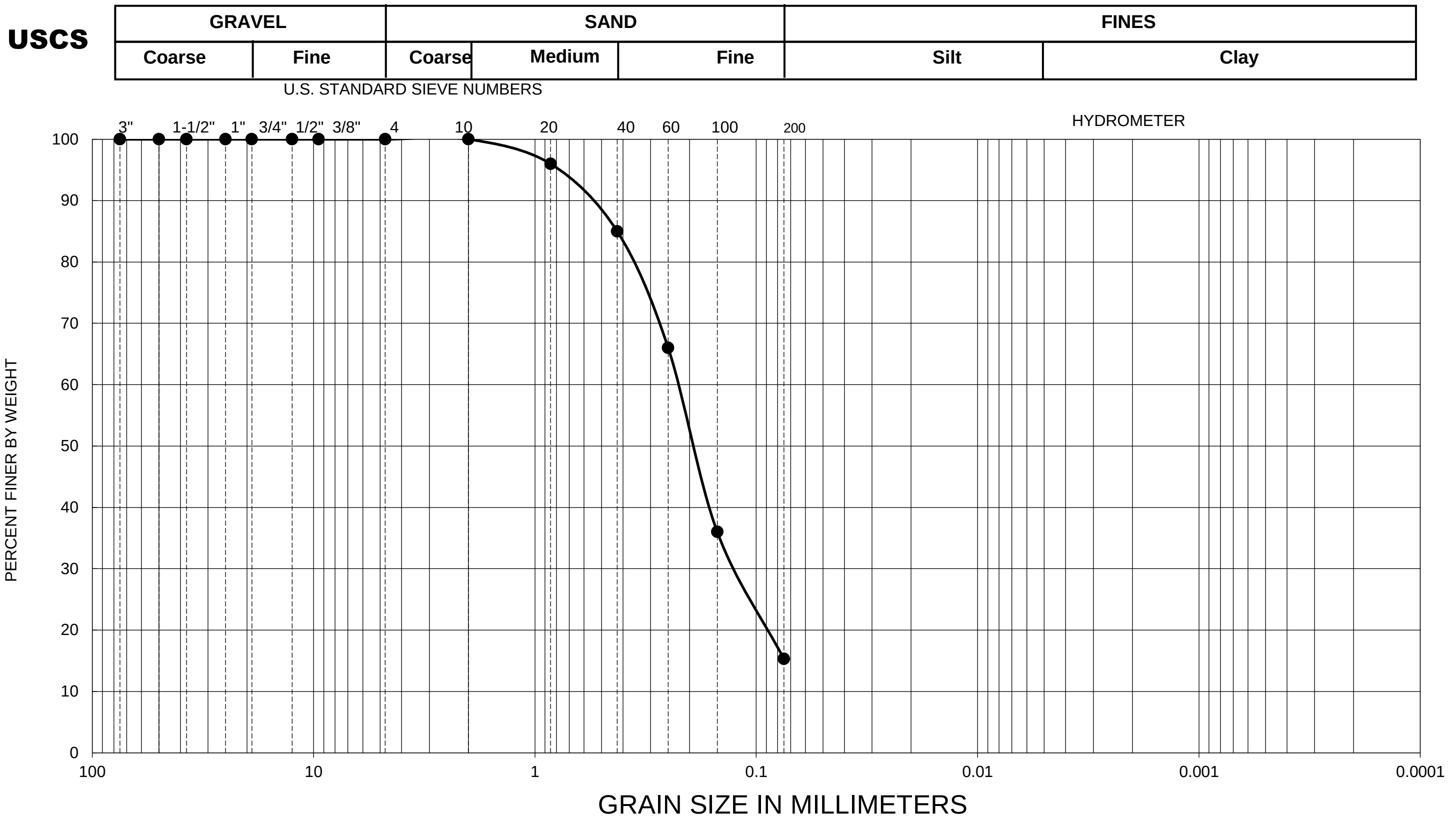
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-2	21		15.3	SM

Sample Description	Light olive brown Silty sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	100
	No. 20	0.85 mm	96
	No. 40	0.425 mm	85
	No. 60	0.25 mm	66
	No 100	0.15 mm	36
	No 200	.075 mm	15.3

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Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

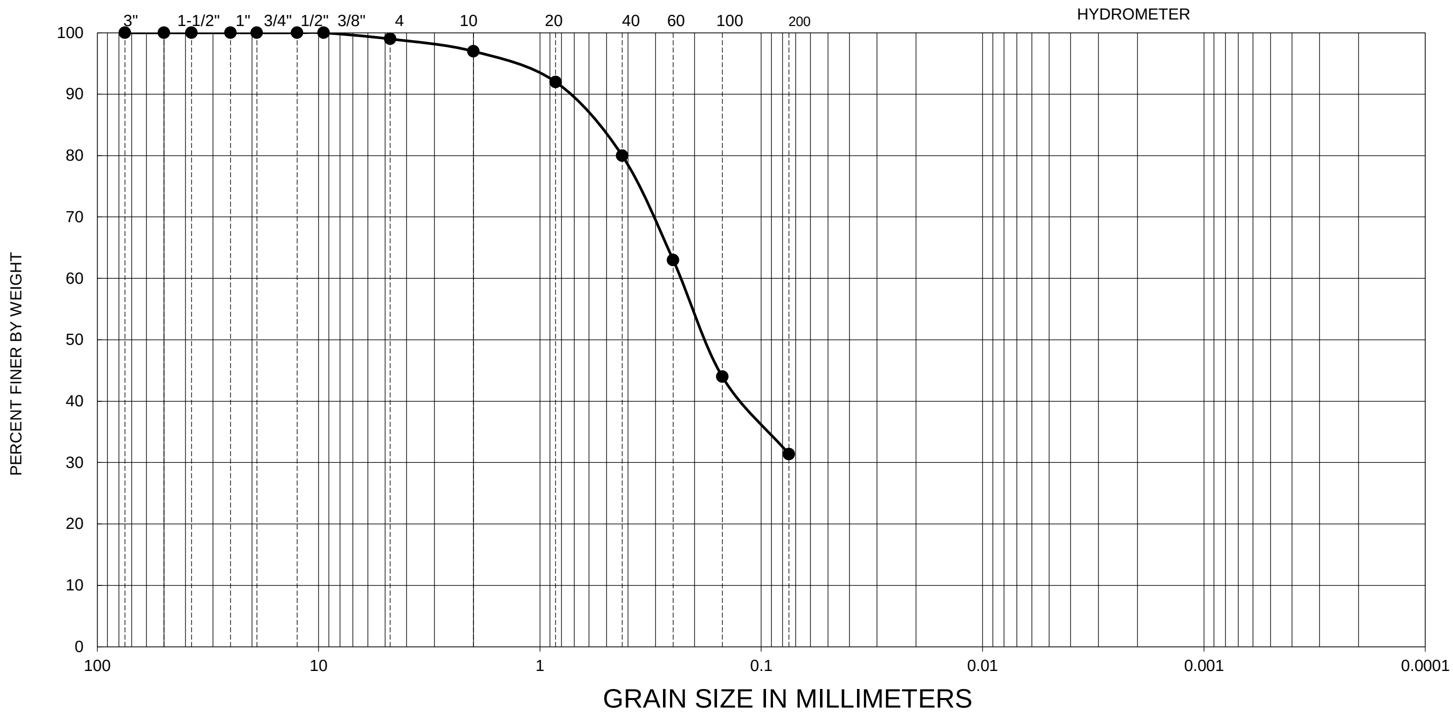
GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/7/2019**

USCS	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-2	23		31.4	SC

Sample Description	Light olive brown	Clayey sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	99
	No. 10	2.0 mm	97
	No. 20	0.85 mm	92
	No. 40	0.425 mm	80
	No. 60	0.25 mm	63
	No 100	0.15 mm	44
	No 200	.075 mm	31.4

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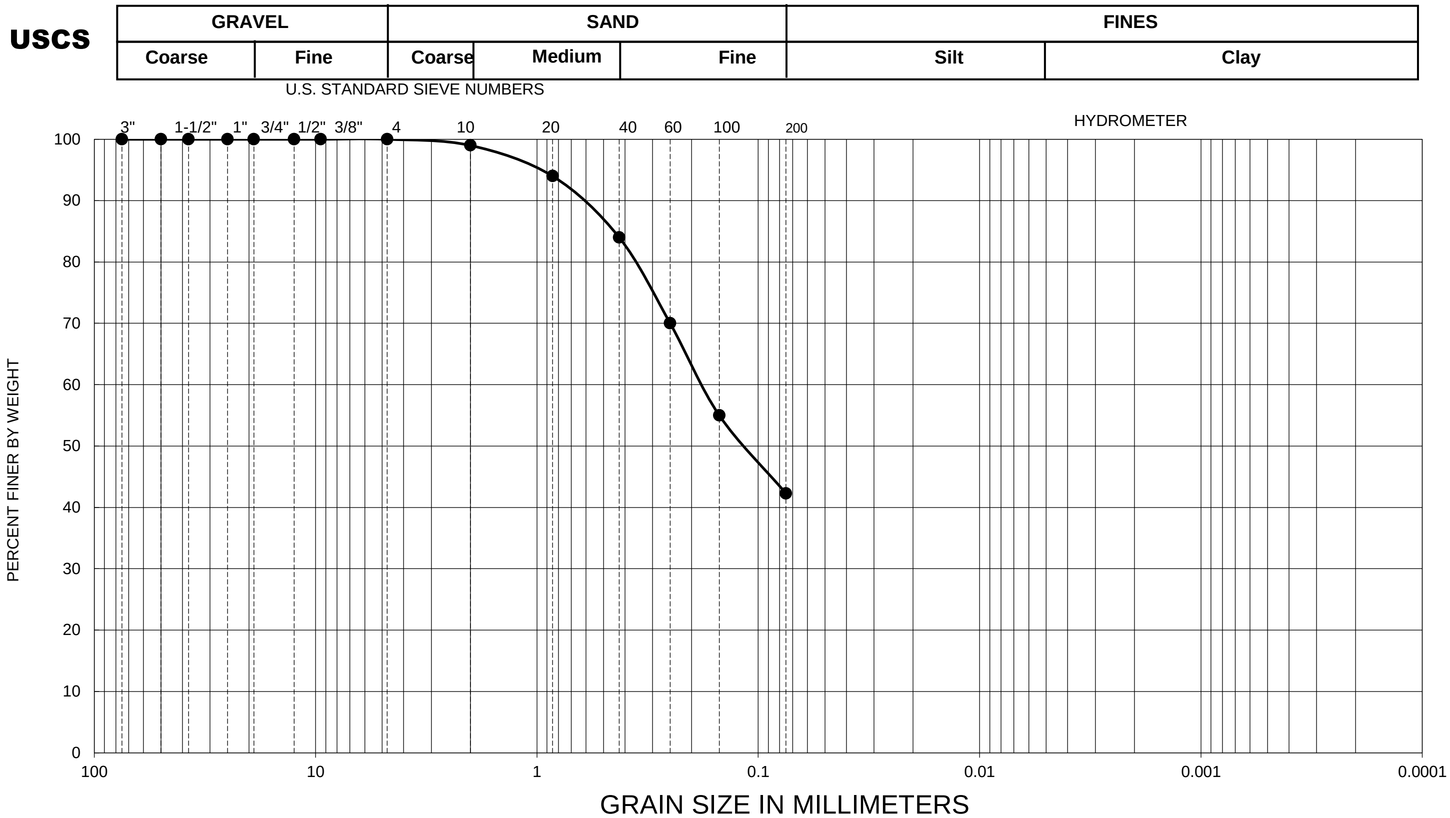
GRADATION TEST RESULTS

FIGURE

Carlsbad Double Track Trench alternative

Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-2	25		42.3	SC

Sample Description	Light olive brown Clayey sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	99
	No. 20	0.85 mm	94
	No. 40	0.425 mm	84
	No. 60	0.25 mm	70
	No 100	0.15 mm	55
	No 200	.075 mm	42.3

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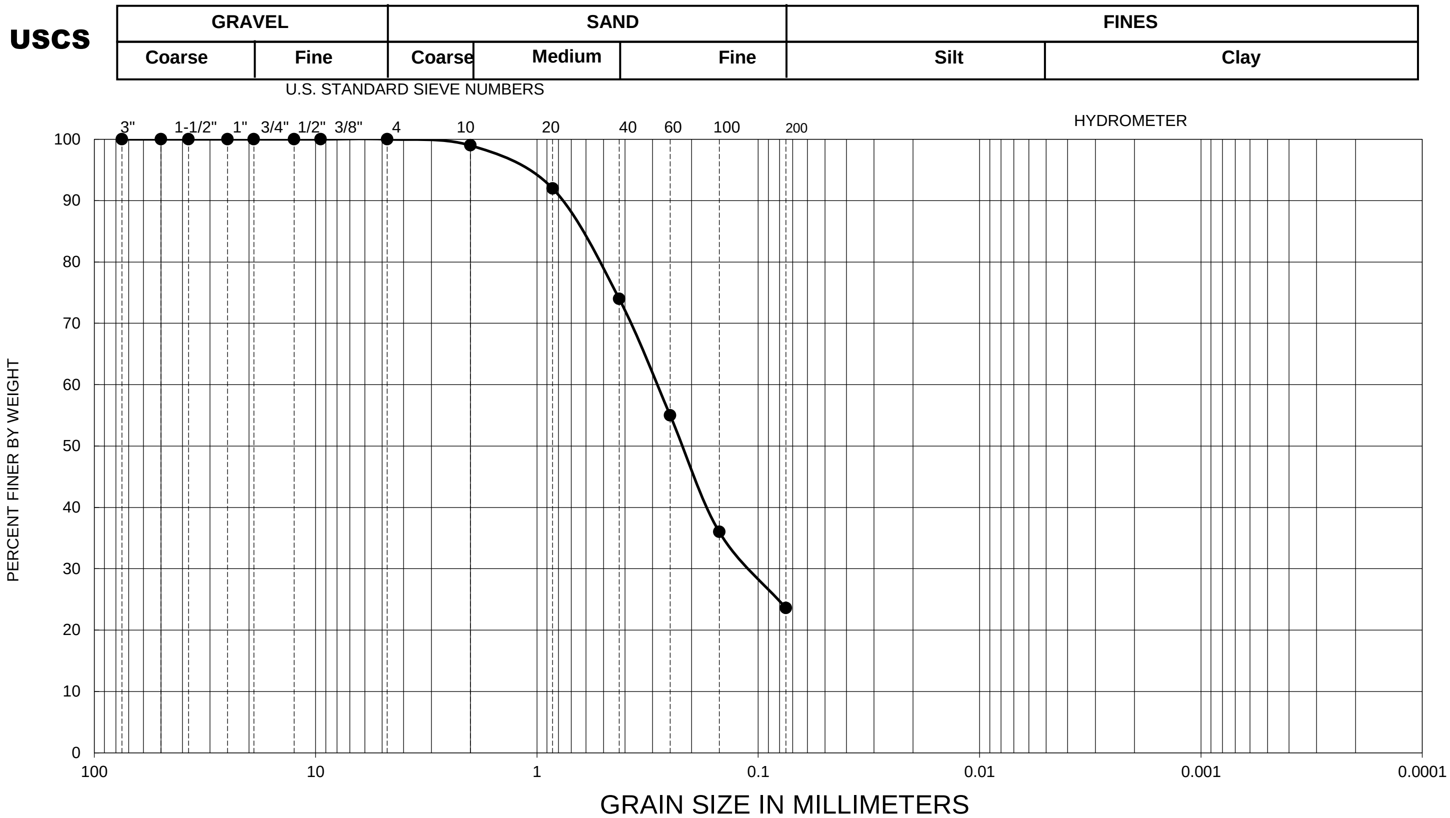
GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

Date Tested: **10/4/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-2	27		23.6	SC

Sample Description	Grayish brown Clayey sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	99
	No. 20	0.85 mm	92
	No. 40	0.425 mm	74
	No. 60	0.25 mm	55
	No 100	0.15 mm	36
	No 200	.075 mm	23.6

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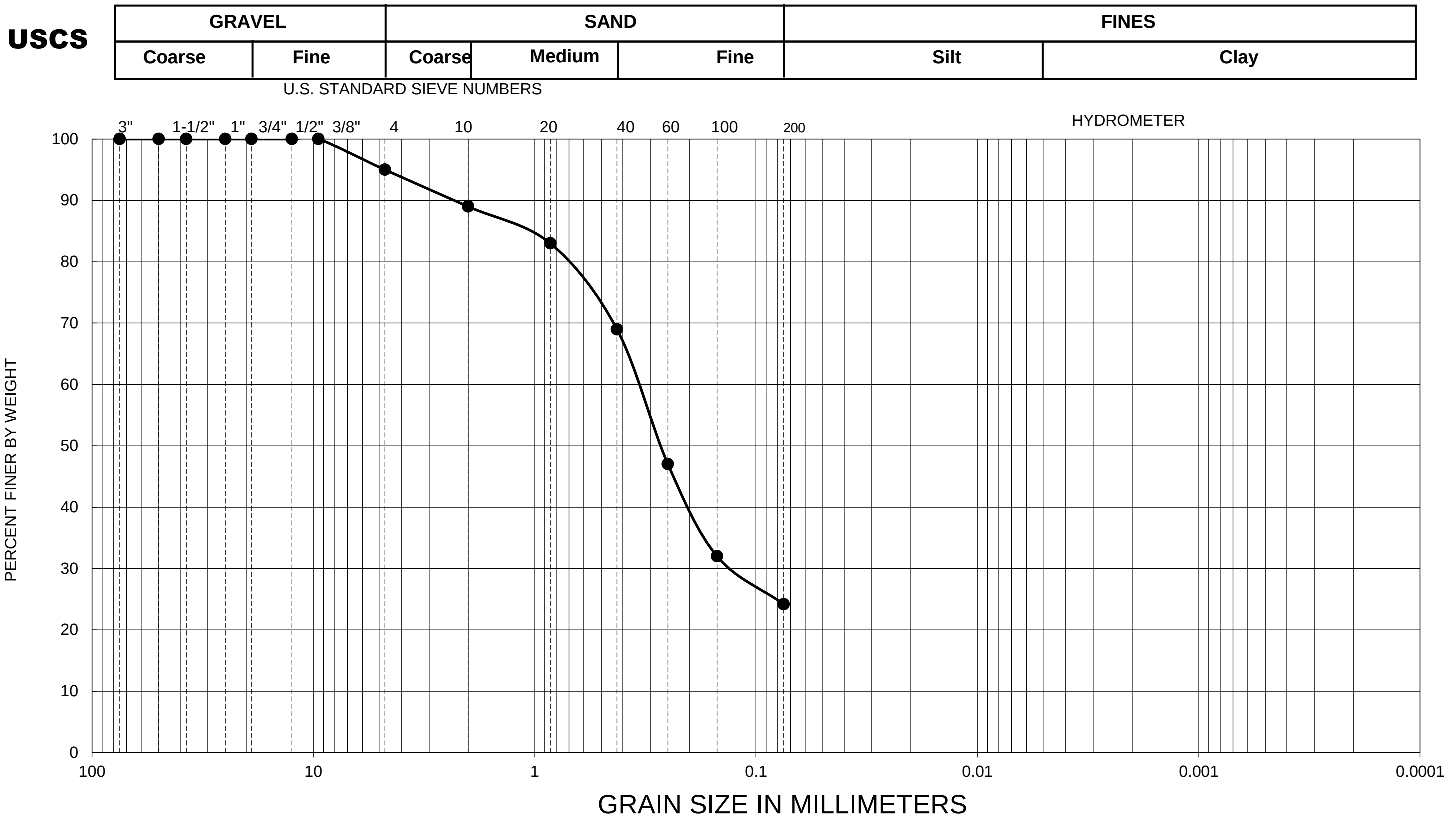
Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-3	1		24.2	SM

Sample Description	Dark reddish brown Silty sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	95
	No. 10	2.0 mm	89
	No. 20	0.85 mm	83
	No. 40	0.425 mm	69
	No. 60	0.25 mm	47
	No 100	0.15 mm	32
	No 200	.075 mm	24.2

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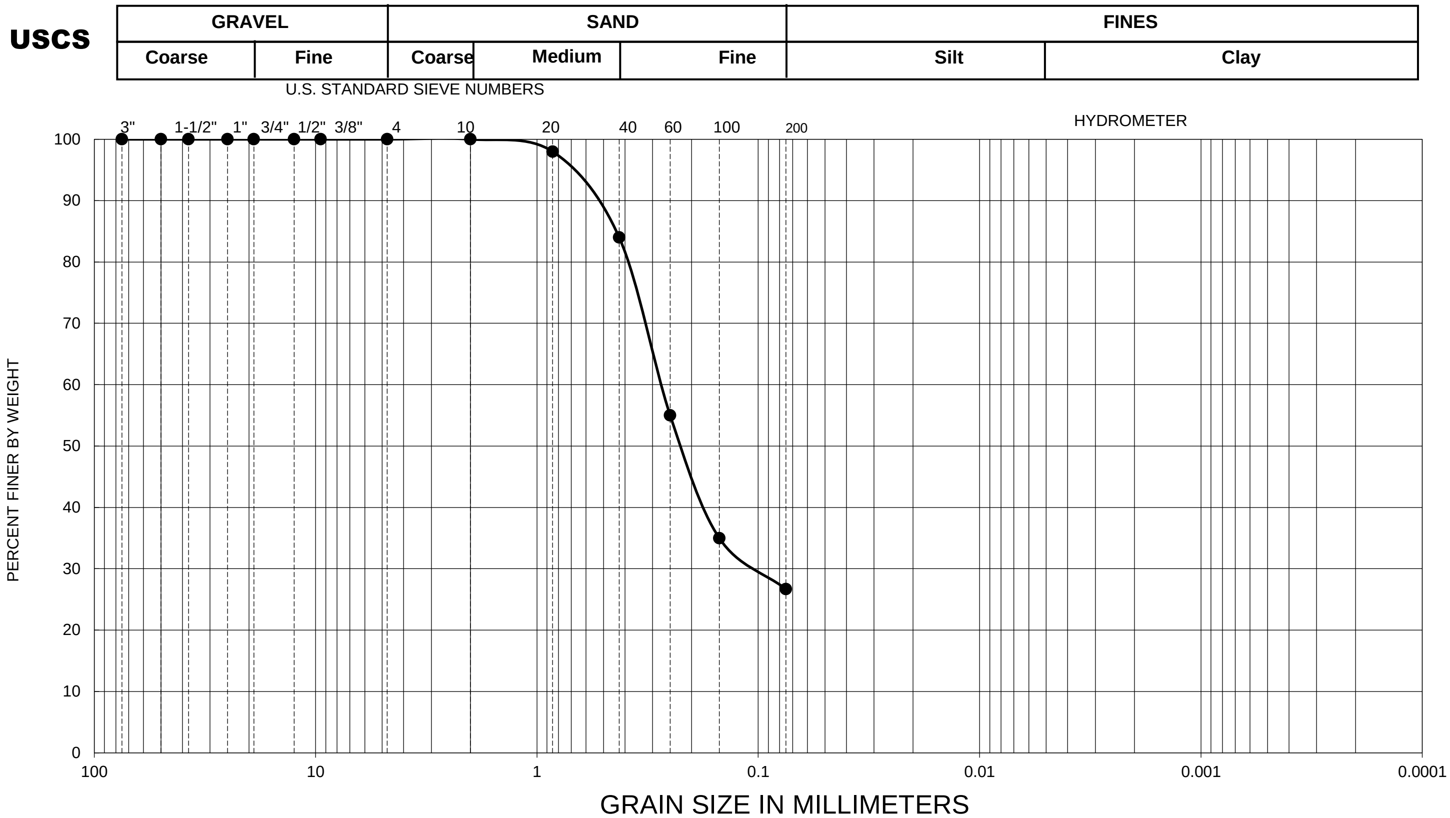
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-3	5		26.7	SM

Sample Description	Reddish brown Silty sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	100
	No. 20	0.85 mm	98
	No. 40	0.425 mm	84
	No. 60	0.25 mm	55
	No 100	0.15 mm	35
	No 200	.075 mm	26.7

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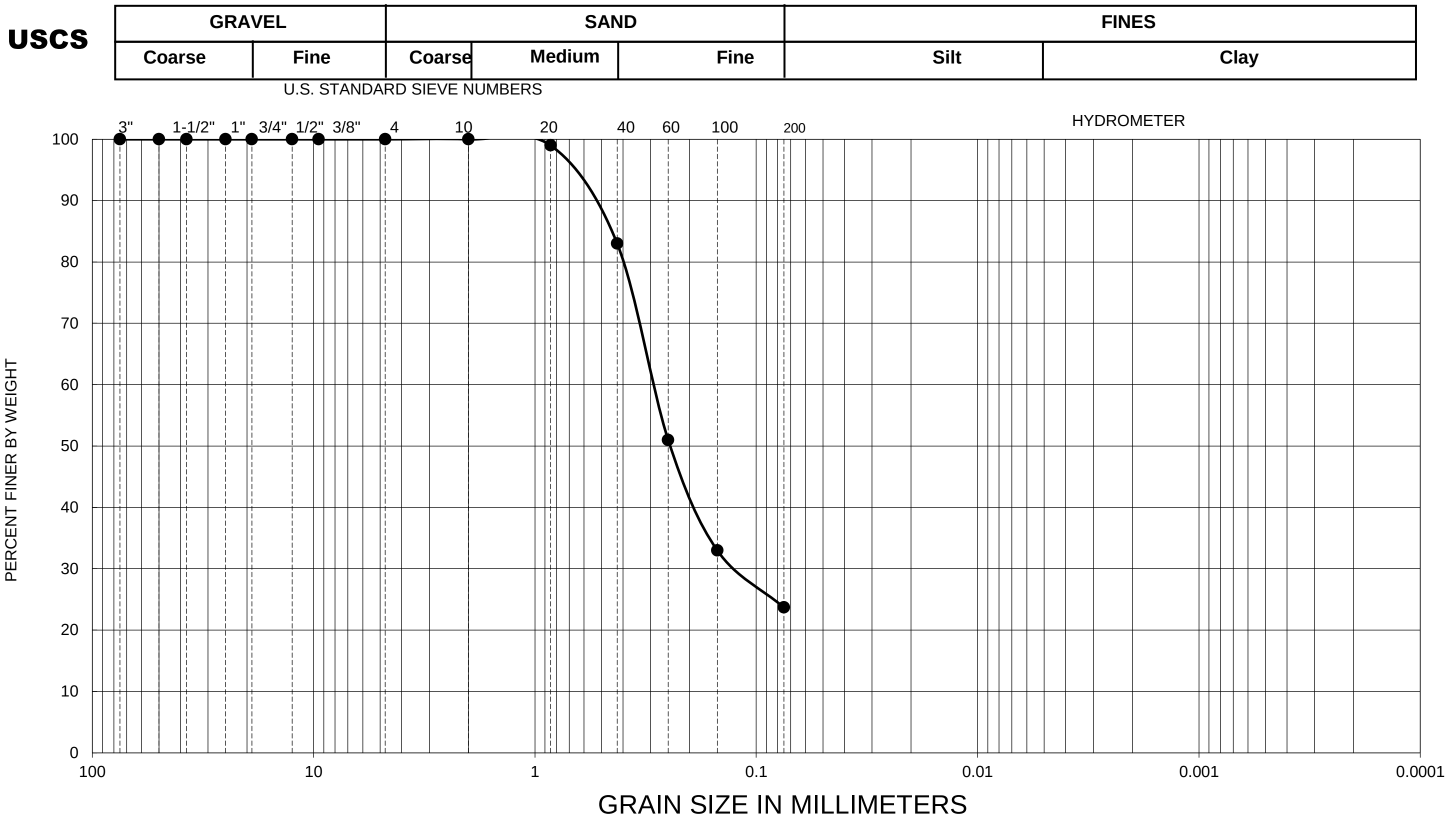
Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-3	10		23.7	SM

Sample Description	Dark reddish brown Silty sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	100
	No. 20	0.85 mm	99
	No. 40	0.425 mm	83
	No. 60	0.25 mm	51
	No 100	0.15 mm	33
	No 200	.075 mm	23.7

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Project No.	20200172	Date:	9-Oct-19

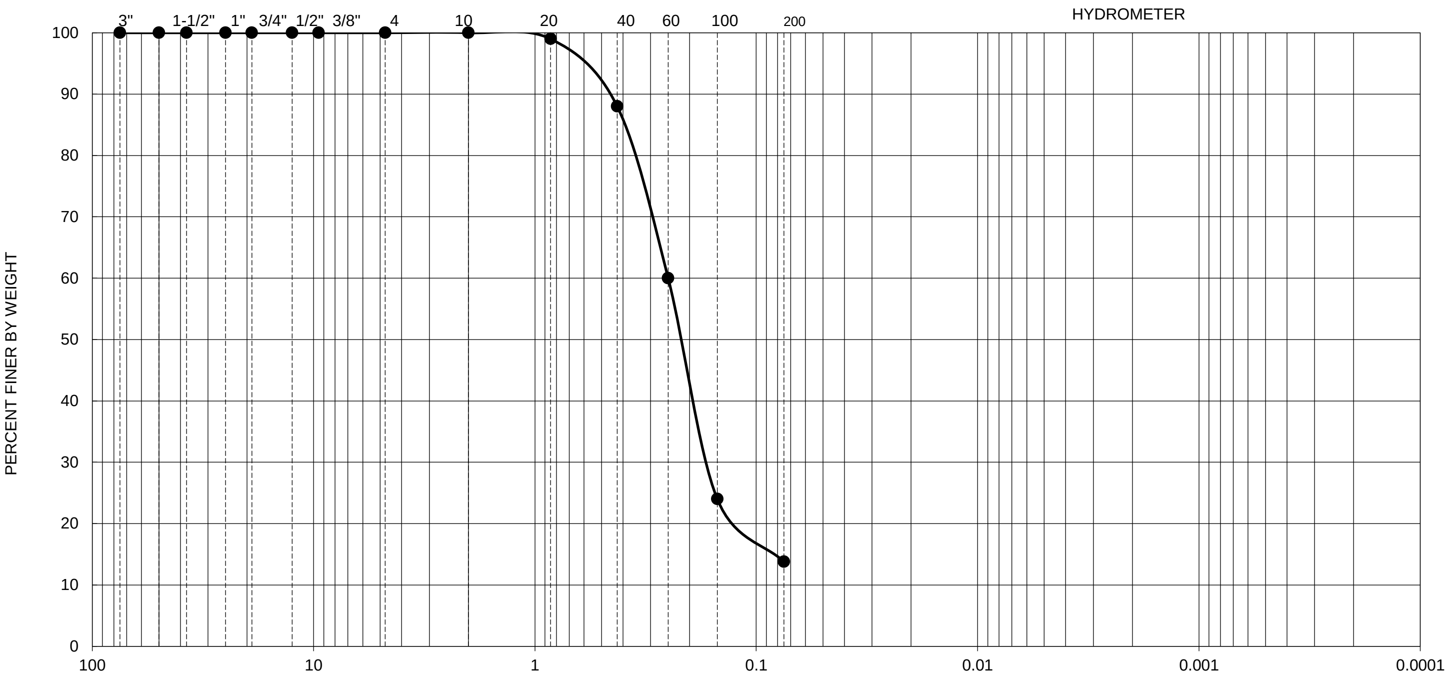
GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/7/2019**

USCS	**GRAVEL**		**SAND**			**FINES**	
	Coarse	**Fine**	**Coarse**	**Medium**	**Fine**	**Silt**	**Clay**



GRAIN SIZE IN MILLIMETERS

Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-3	15		13.8	SM

Sample Description	Dark yellowish brown Silty sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	100
	No. 20	0.85 mm	99
	No. 40	0.425 mm	88
	No. 60	0.25 mm	60
	No 100	0.15 mm	24
	No 200	.075 mm	13.8

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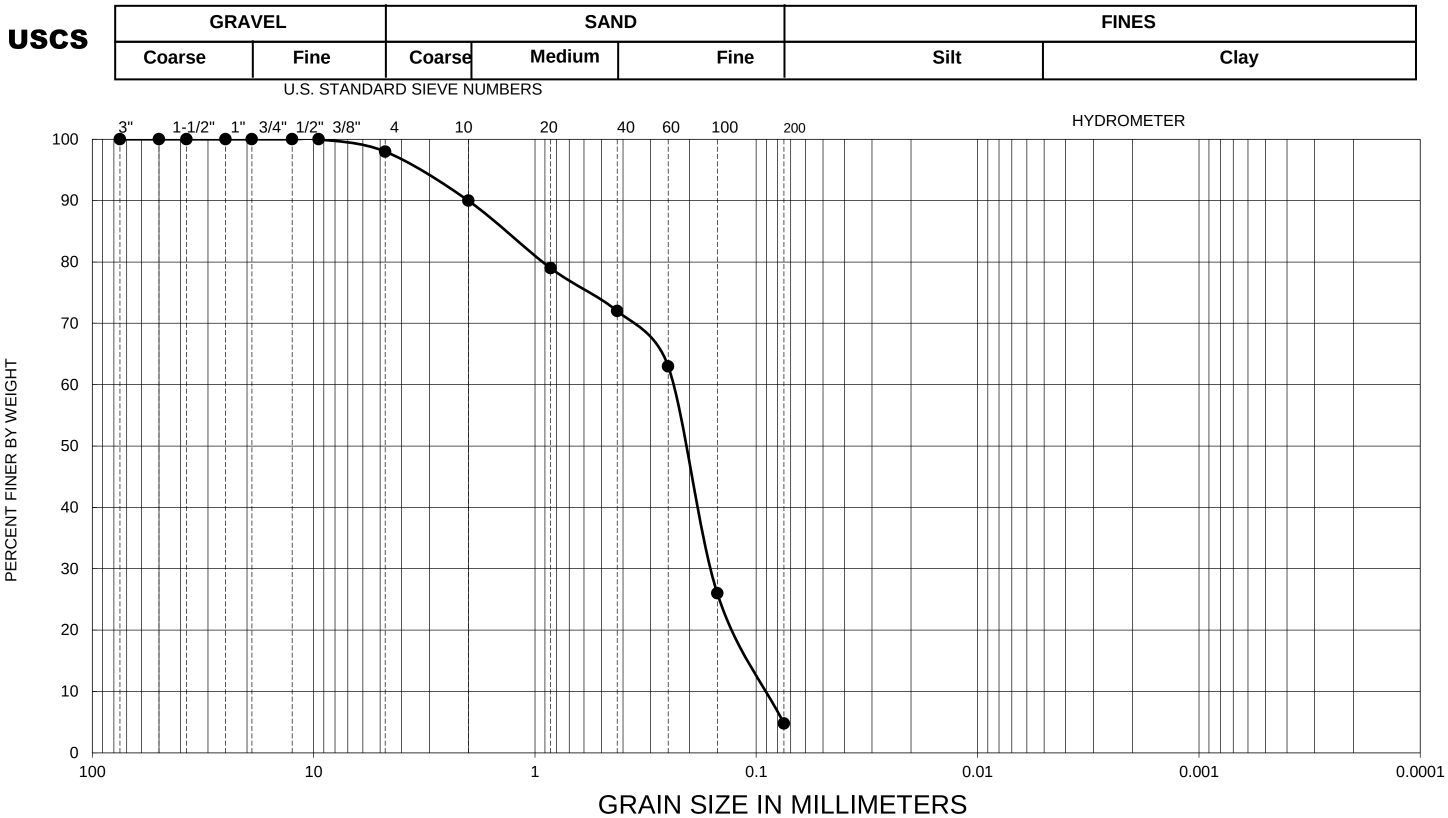
GRADATION TEST RESULTS

FIGURE

Carlsbad Double Track Trench alternative

Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

Date Tested: **10/8/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-3	20		4.8	SP

Sample Description	Pale yellow Poorly graded sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	98
	No. 10	2.0 mm	90
	No. 20	0.85 mm	79
	No. 40	0.425 mm	72
	No. 60	0.25 mm	63
	No 100	0.15 mm	26
	No 200	.075 mm	4.8

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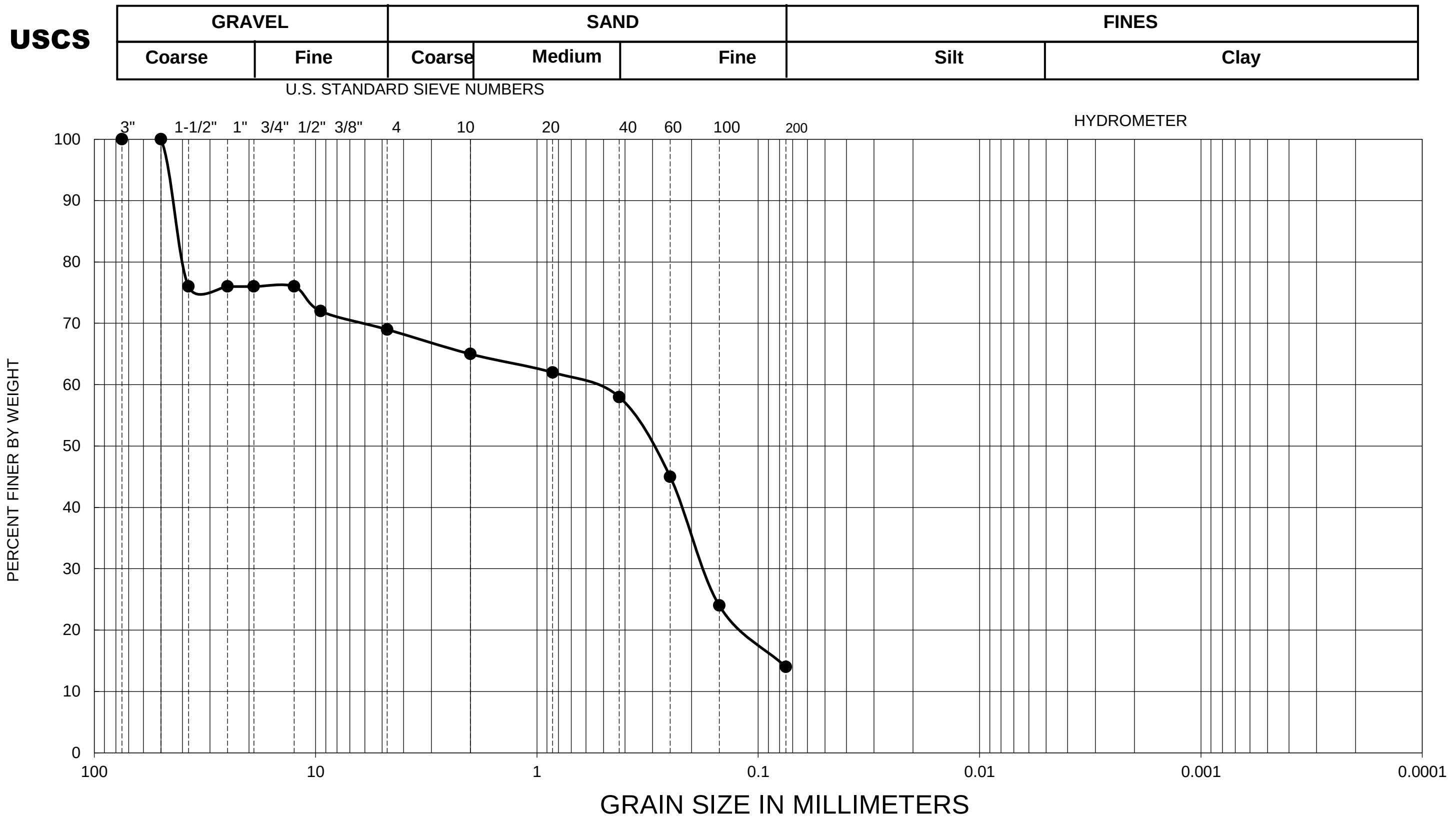
Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/8/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-3	25		14.0	SM

Sample Description	Light olive brown Silty sand with gravel

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	76
	1"	25 mm	76
	3/4"	19 mm	76
	1/2"	12.5 mm	76
	3/8"	9.5 mm	72
	No. 4	4.75 mm	69
	No. 10	2.0 mm	65
	No. 20	0.85 mm	62
	No. 40	0.425 mm	58
	No. 60	0.25 mm	45
	No 100	0.15 mm	24
	No 200	.075 mm	14.0

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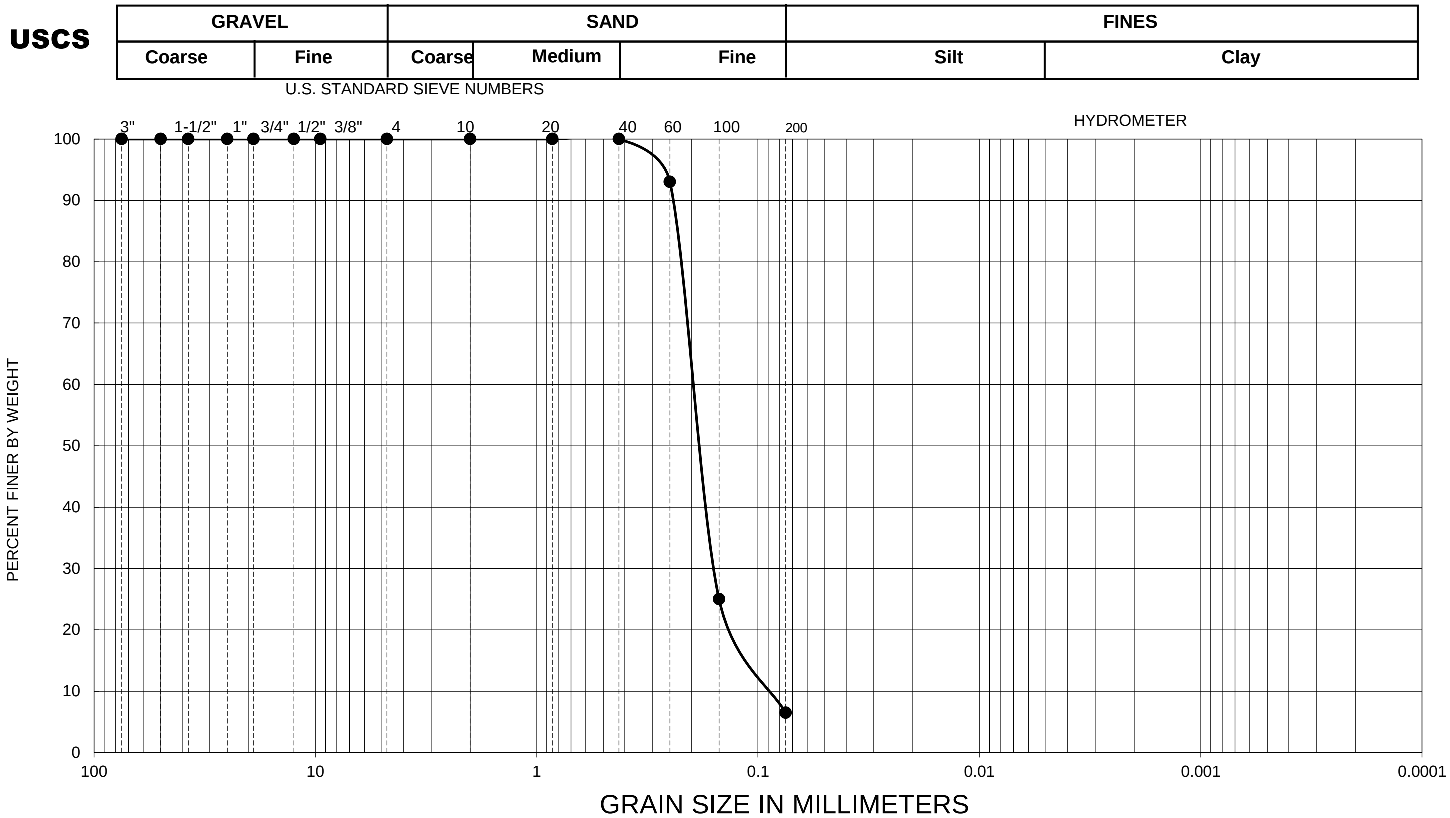
GRADATION TEST RESULTS

FIGURE

Carlsbad Double Track Trench alternative

Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

Date Tested: **10/8/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-3	27		6.5	SP-SM

Sample Description	Pale yellow Poorly graded sand with silt

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	100
	No. 20	0.85 mm	100
	No. 40	0.425 mm	100
	No. 60	0.25 mm	93
	No 100	0.15 mm	25
	No 200	.075 mm	6.5

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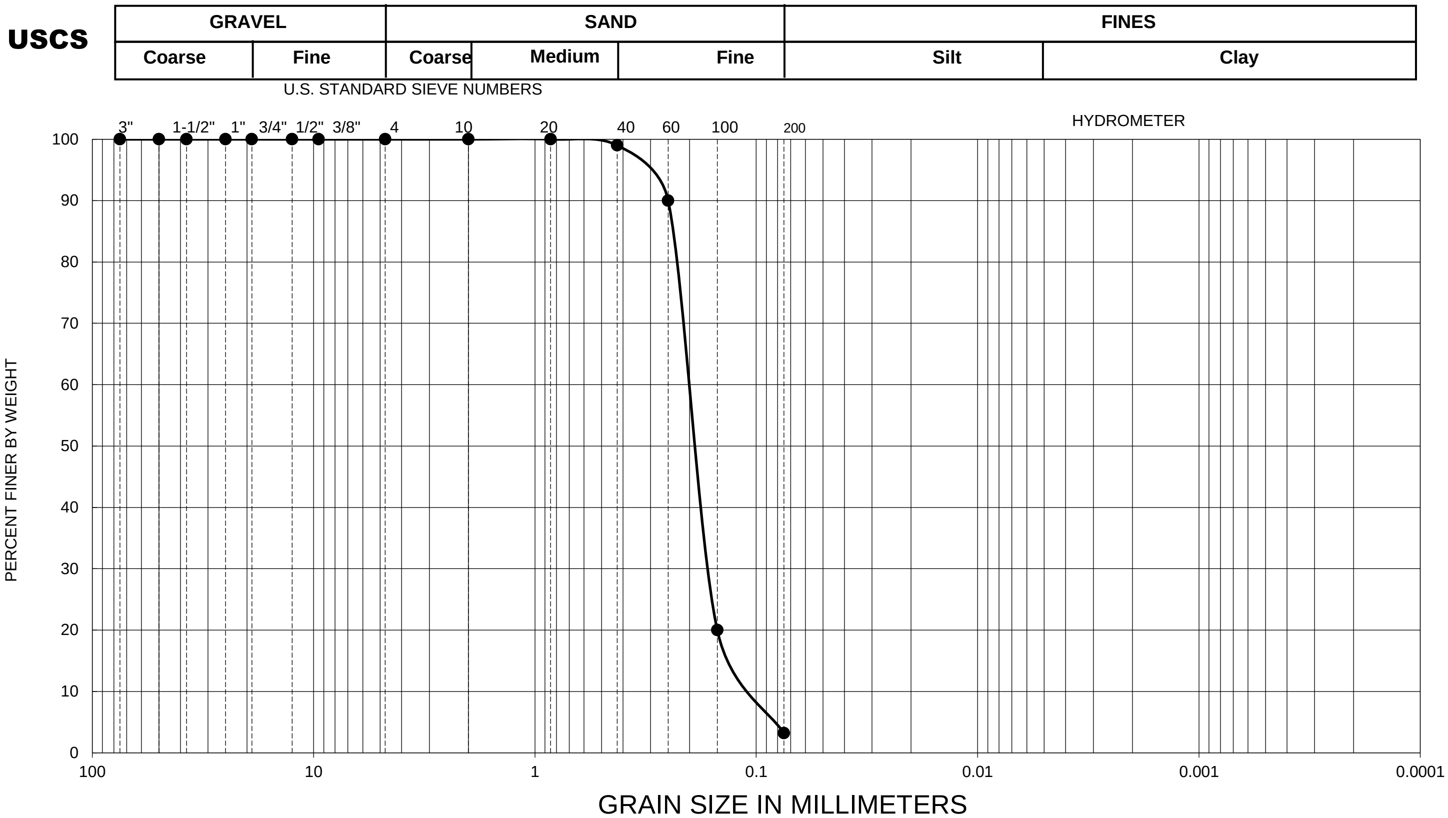
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-3	29		3.2	SP

Sample Description	Pale yellow Poorly graded sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	100
	No. 20	0.85 mm	100
	No. 40	0.425 mm	99
	No. 60	0.25 mm	90
	No 100	0.15 mm	20
	No 200	.075 mm	3.2

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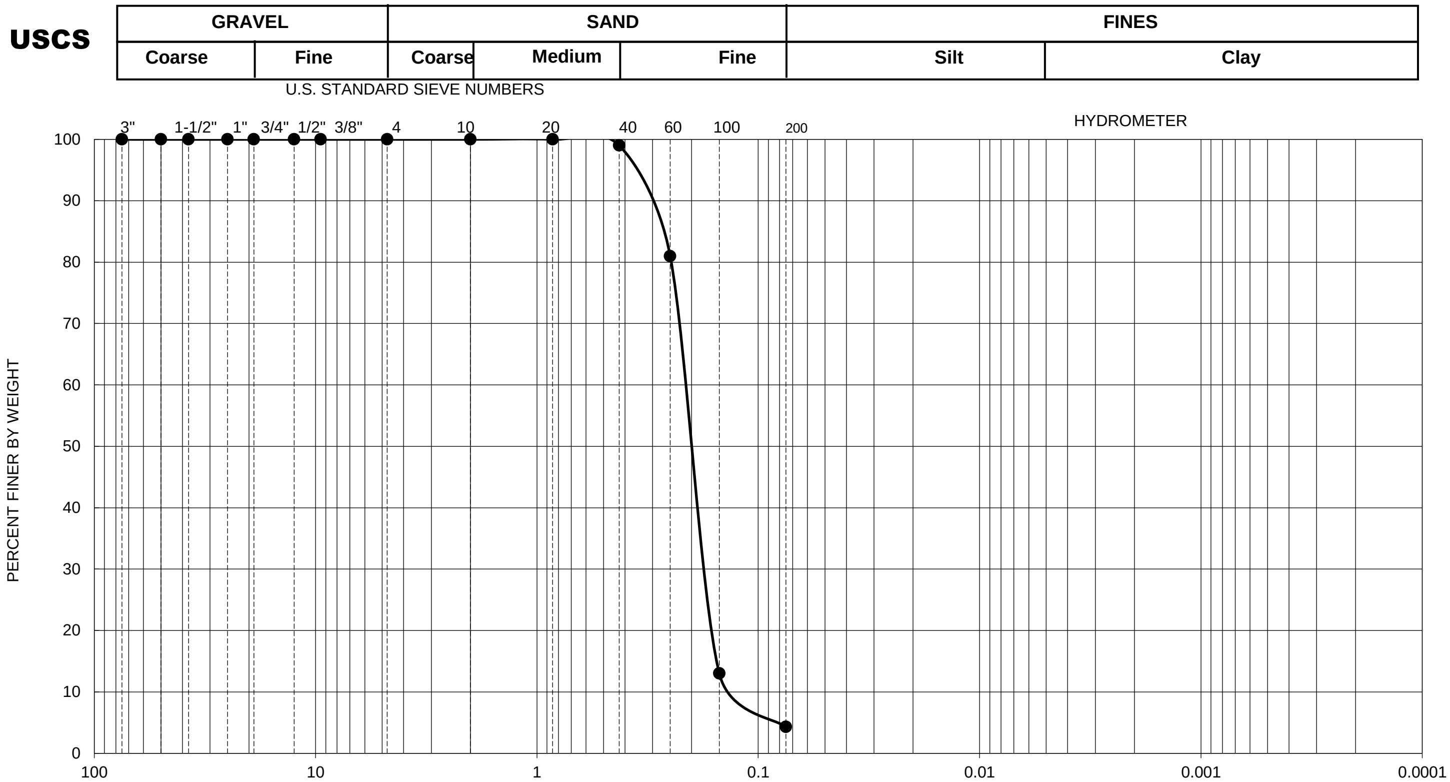
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-3	31		4.3	SP

Sample Description	Pale yellow Poorly graded sand

Sieve Analysis	Sieve Size		% Passing
	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	100
	No. 20	0.85 mm	100
	No. 40	0.425 mm	99
	No. 60	0.25 mm	81
	No 100	0.15 mm	13
	No 200	.075 mm	4.3

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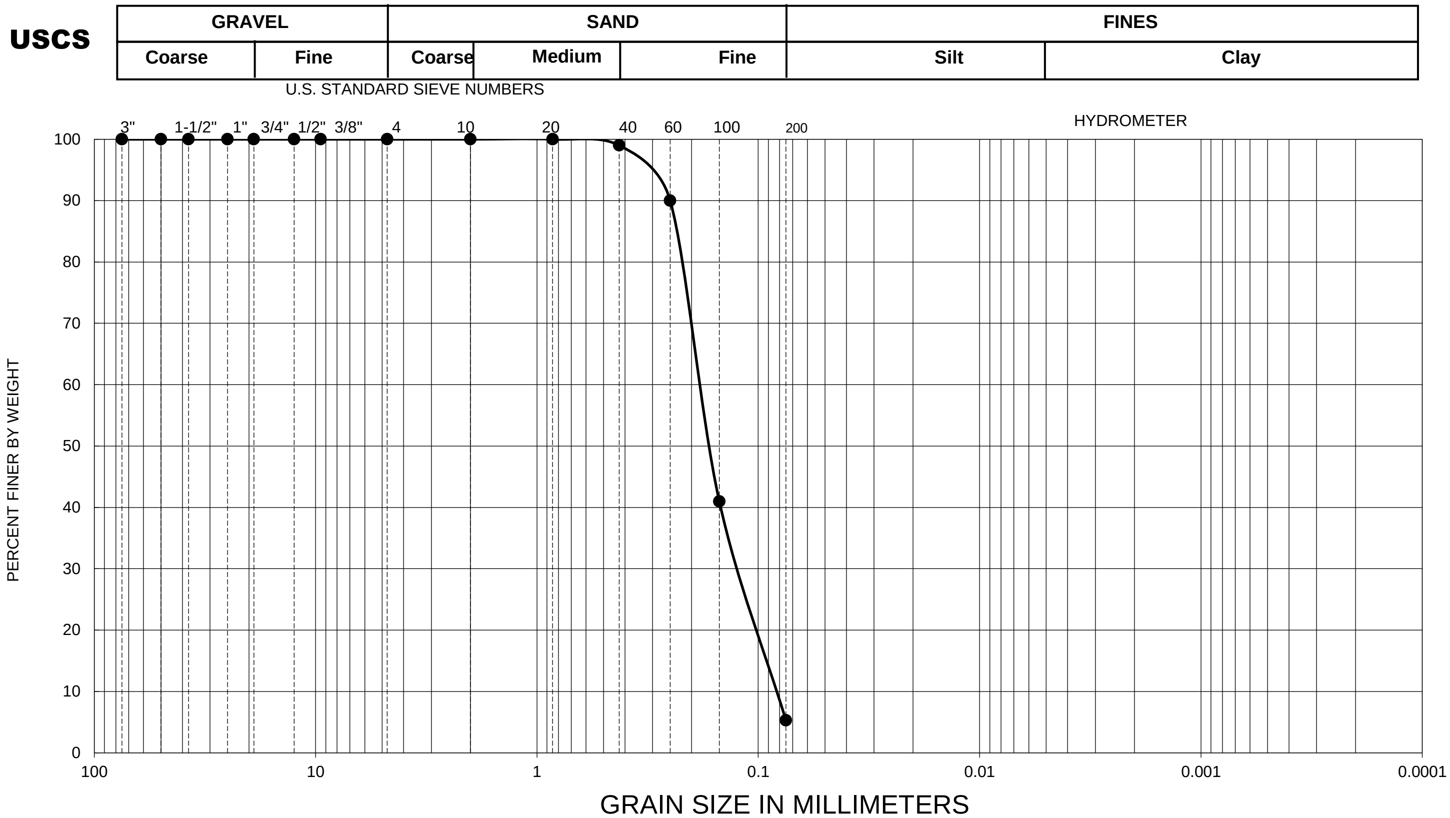
GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-3	33		5.3	SP-SM

Sample Description	Light olive brown Poorly graded sand with silt

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	100
	No. 20	0.85 mm	100
	No. 40	0.425 mm	99
	No. 60	0.25 mm	90
	No 100	0.15 mm	41
	No 200	.075 mm	5.3

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GRADATION TEST RESULTS

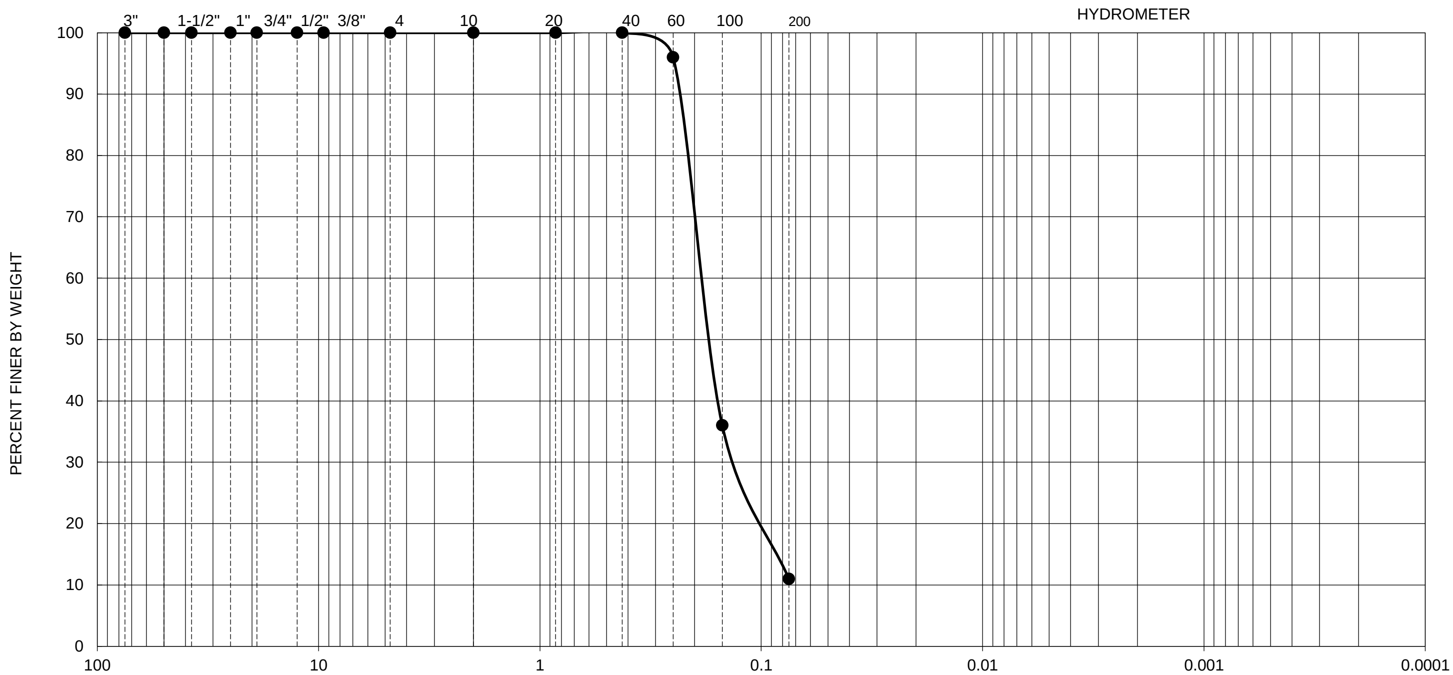
FIGURE

Carlsbad Double Track Trench alternative

Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

Date Tested: **10/4/2019**

USCS	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



GRAIN SIZE IN MILLIMETERS

Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-3	35		11.0	SP-SM

Sample Description	Light olive brown Poorly graded sand with silt

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	100
	No. 20	0.85 mm	100
	No. 40	0.425 mm	100
	No. 60	0.25 mm	96
	No 100	0.15 mm	36
	No 200	.075 mm	11.0

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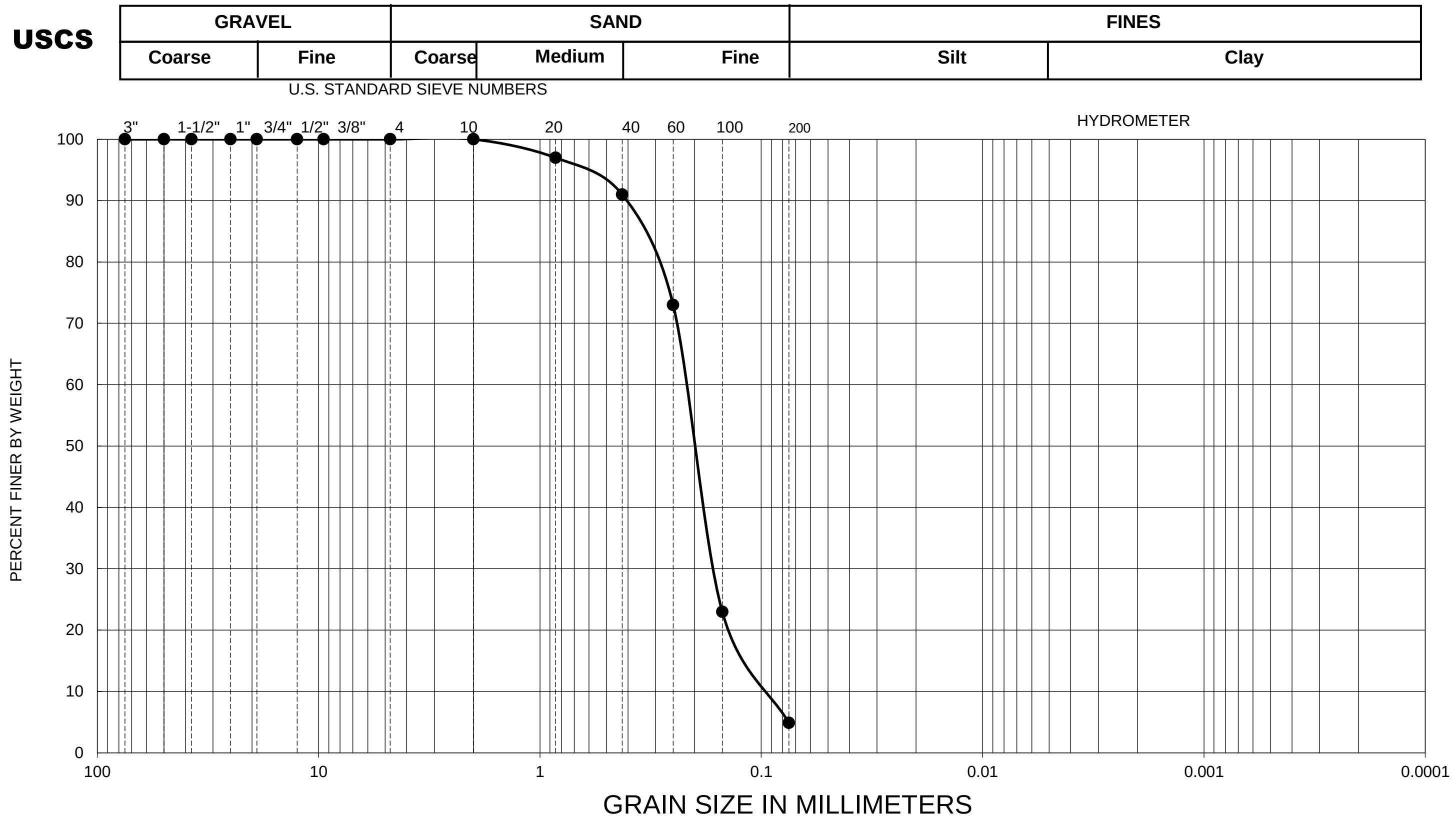
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/4/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-3	37		4.9	SP

Sample Description	Light olive brown Poorly graded sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	100
	No. 20	0.85 mm	97
	No. 40	0.425 mm	91
	No. 60	0.25 mm	73
	No 100	0.15 mm	23
	No 200	.075 mm	4.9

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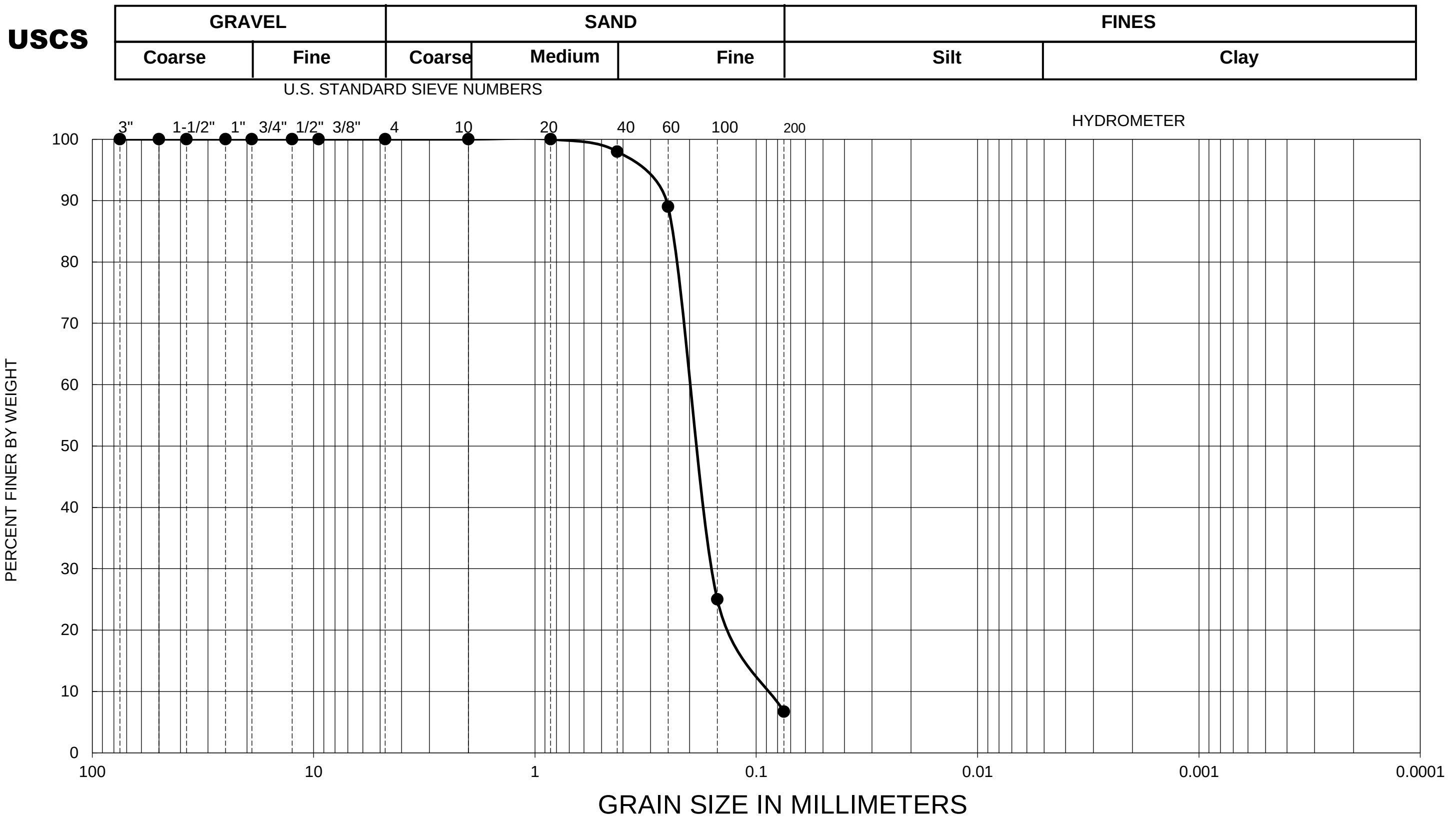
GRADATION TEST RESULTS

FIGURE

Carlsbad Double Track Trench alternative

Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-3	39		6.7	SP-SM

Sample Description	Light olive brown Poorly graded sand with silt

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	100
	No. 20	0.85 mm	100
	No. 40	0.425 mm	98
	No. 60	0.25 mm	89
	No 100	0.15 mm	25
	No 200	.075 mm	6.7

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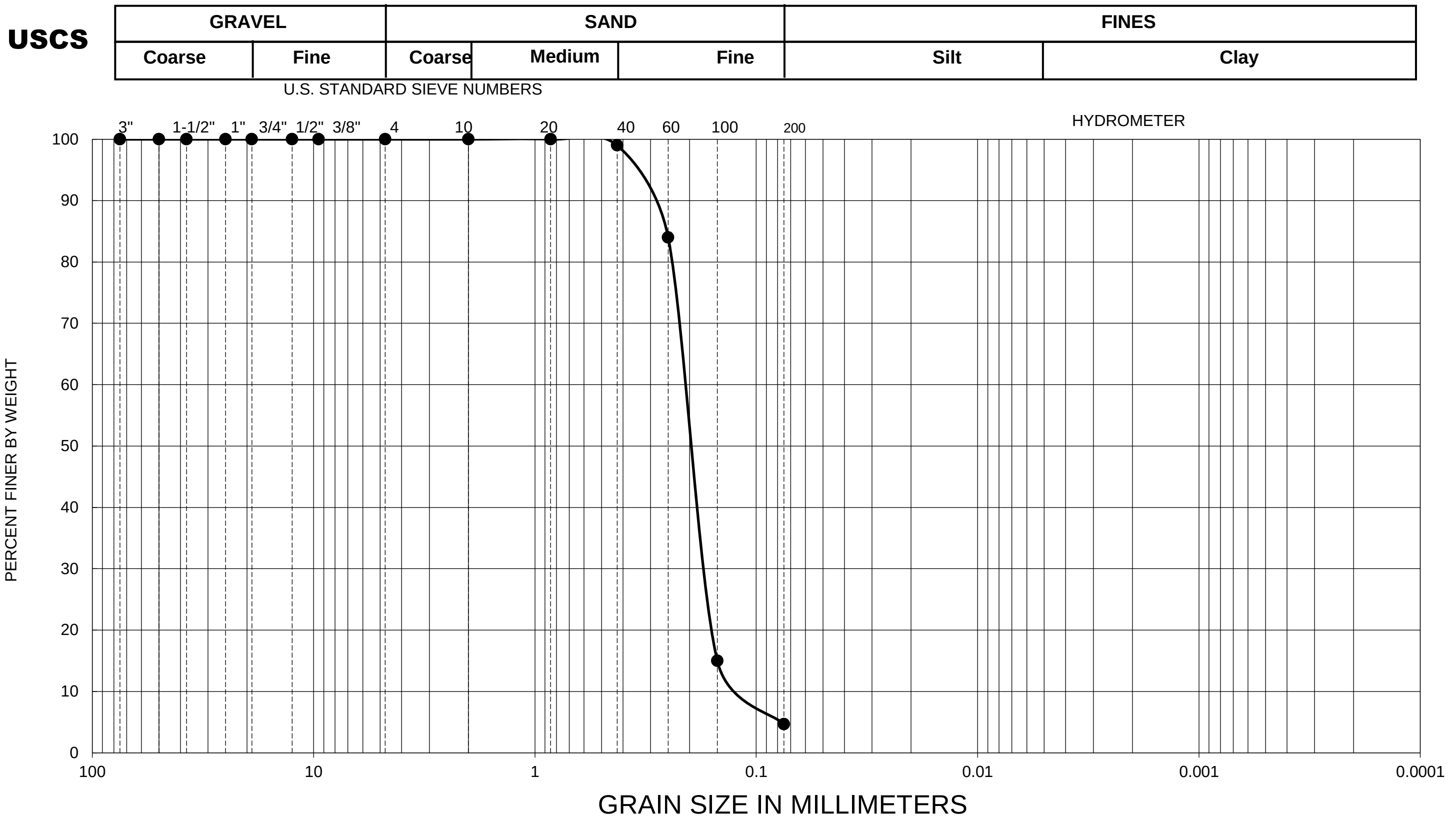
Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/4/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-3	41		4.7	SP

Sample Description	Light olive brown Poorly graded sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	100
	No. 20	0.85 mm	100
	No. 40	0.425 mm	99
	No. 60	0.25 mm	84
	No 100	0.15 mm	15
	No 200	.075 mm	4.7

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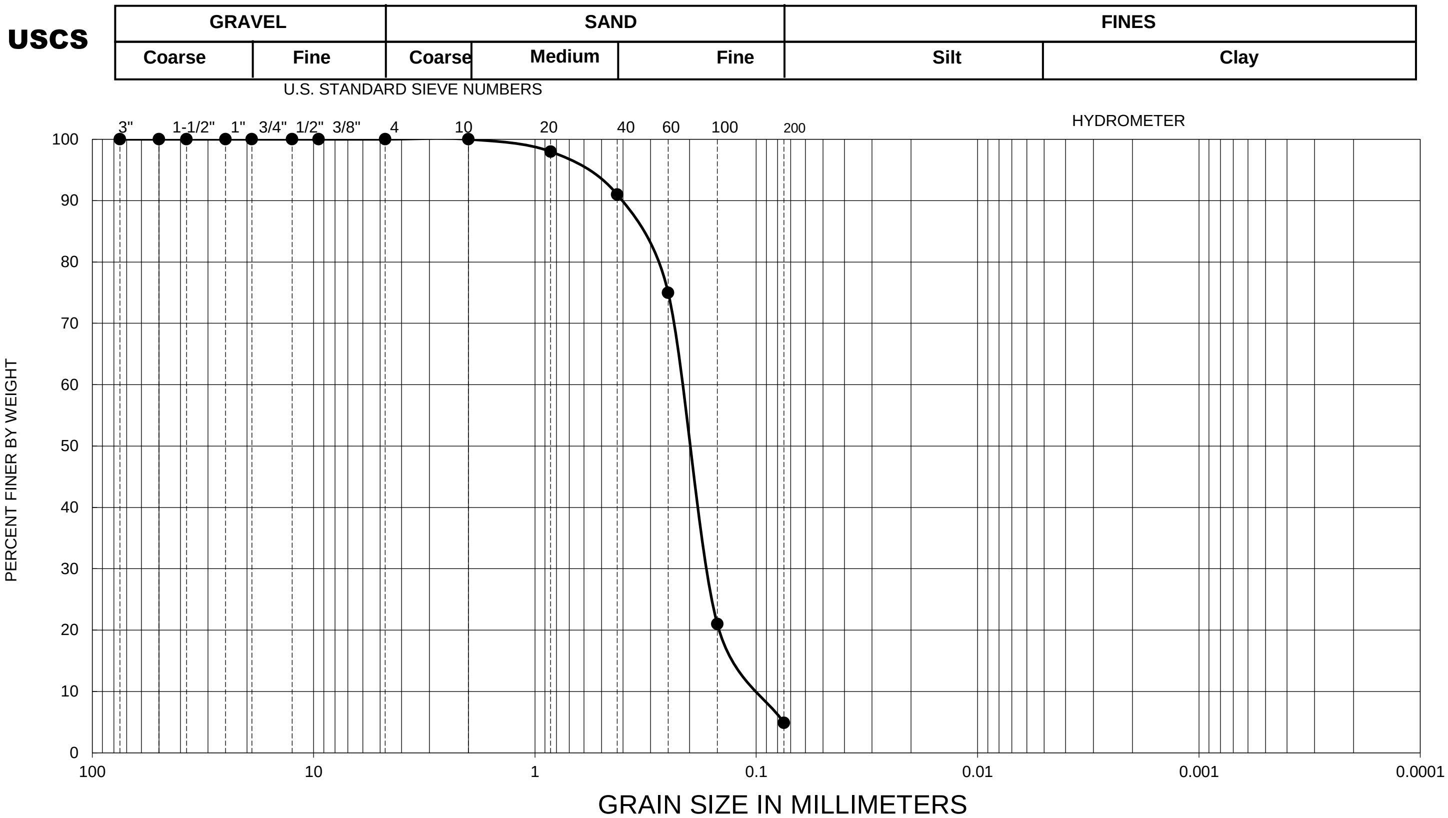
Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19

GRADATION TEST RESULTS

Carlsbad Double Track Trench alternative

FIGURE

Date Tested: **10/7/2019**



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
MW-3	43		4.9	SP

Sample Description	Light olive brown Poorly graded sand

	Sieve Size		% Passing
Sieve Analysis	3"	75 mm	100
	2"	50 mm	100
	1.5"	37.5 mm	100
	1"	25 mm	100
	3/4"	19 mm	100
	1/2"	12.5 mm	100
	3/8"	9.5 mm	100
	No. 4	4.75 mm	100
	No. 10	2.0 mm	100
	No. 20	0.85 mm	98
	No. 40	0.425 mm	91
	No. 60	0.25 mm	75
	No 100	0.15 mm	21
	No 200	.075 mm	4.9

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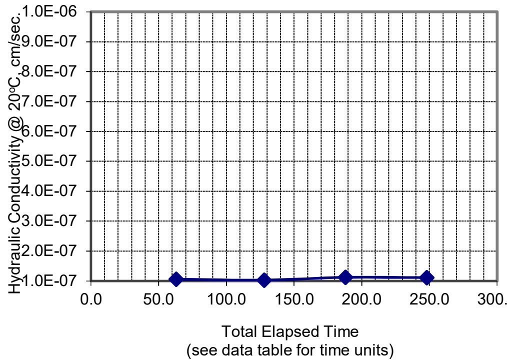
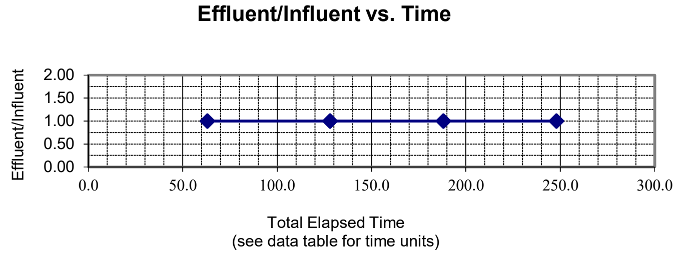
GRADATION TEST RESULTS

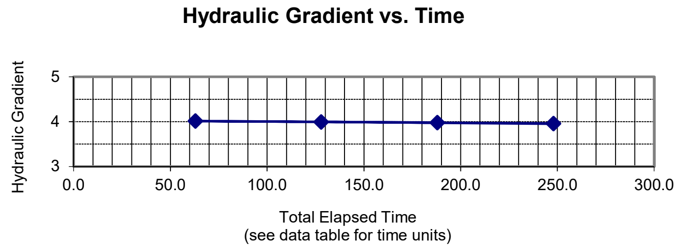
Carlsbad Double Track Trench alternative

FIGURE

Checked by:		Tech:	Uly
Project No.	20200172	Date:	9-Oct-19







Hydraulic Conductivity @ 20°C, cm/sec: **1.1E-07**

Trial:	Elapsed Time, mins	Temp, °C:	20°C, cm/sec.:	Dev. From Avg. k:	ΔEffluent/ ΔInfluent:	Hydraulic Gradient:
Start	0.00	21.0	Start	Start	Start	Start
1	63.00	21.5	1.1E-07	0.98	1.00	4.01
2	128.00	21.5	1.0E-07	0.95	1.00	3.99
3	188.00	21.5	1.1E-07	1.04	1.00	3.98
4	248.00	22.0	1.1E-07	1.03	1.00	3.96

Pressures, psi:	
Cell:	65.3
Influent:	50.0
Effluent:	50.0
Confining:	15.3

B-Value:	0.96
Pipette Area, cm^2:	0.8814
Permeant:	Deaired Water

Sample Data	Initial	Final
Length, in.:	2.46	2.39
Diameter, in.:	2.42	2.43
Area, in^2:	4.61	4.65
Volume, in^3:	11.33	11.14
Wet Density, pcf:	130.2	132.4
Dry Density, pcf:	109.8	111.8
Water Content, %:	18.5	18.4
Assumed Specific Gravity:	2.70	2.70
Saturation, %:	94	98

Remarks:

Limitations:
As the samples tested were sampled and/or transported to our laboratory by parties other than Kleinfelder staff, this report makes no representation of whether the samples are representative of the material onsite.

Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided.

Boring:	MW-2
Sample:	Perm-22
Depth:	22
Test Date:	10-29-19

Test Method: ASTM D5084, Method C
Falling Head, Rising Tailwater Elevation

Sample Description: Sandy Lean Clay

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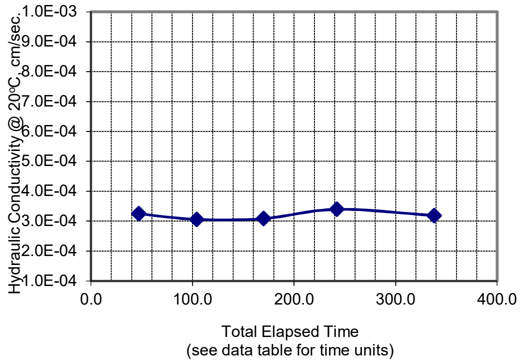
9969 Horn Rd., Sacramento, CA 95827

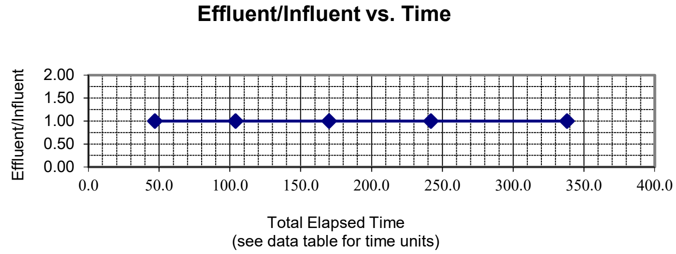
PROJECT NO.:	20200172
ENTRY BY:	J. Slinkard
CHECKED BY:	S. Rader
DATE:	11/4/2019

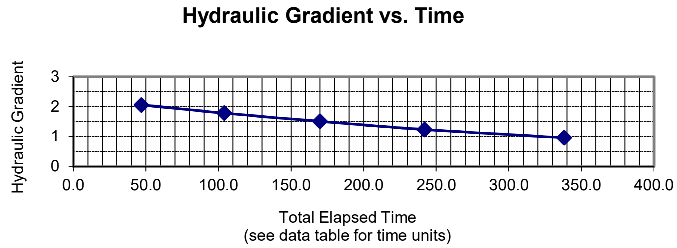
HYDRAULIC CONDUCTIVITY TEST

CARLSBAD VILLAGE
RAILROAD TRENCH

FIGURE







Hydraulic Conductivity @ 20°C, cm/sec: 3.2E-04

Trial:	Elapsed Time, secs	Temp, °C:	20°C, cm/sec.:	Dev. From Avg. k:	ΔEffluent/ ΔInfluent:	Hydraulic Gradient:
Start	0.00	21.0	Start	Start	Start	Start
1	47.00	21.0	3.2E-04	1.02	1.00	2.06
2	104.00	21.0	3.1E-04	0.96	1.00	1.78
3	170.00	21.0	3.1E-04	0.97	1.00	1.51
4	242.00	21.0	3.4E-04	1.06	1.00	1.24
5	338.00	21.0	3.2E-04	1.00	1.00	0.96

Pressures, psi:	
Cell:	76.4
Influent:	50.0
Effluent:	50.0
Confining:	26.4

B-Value:	0.96
Pipette Area, cm^2:	0.8814
Permeant:	Deaired Water

Sample Data	Initial	Final
Length, in.:	3.32	3.25
Diameter, in.:	2.38	2.40
Area, in^2:	4.45	4.52
Volume, in^3:	14.75	14.72
Wet Density, pcf:	131.7	131.5
Dry Density, pcf:	108.6	108.7
Water Content, %:	21.4	20.9
Assumed Specific Gravity:	2.75	2.75
Saturation, %:	101	100

Remarks:

Limitations:
As the samples tested were sampled and/or transported to our laboratory by parties other than Kleinfelder staff, this report makes no representation of whether the samples are representative of the material onsite.

Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided.

Boring:	MW-3
Sample:	Perm-38
Depth:	38
Test Date:	10-25-19

Test Method: ASTM D5084, Method C

Falling Head, Rising Tailwater Elevation

Sample Description: Sand

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9969 Horn Rd., Sacramento, CA 95827

PROJECT NO.:	20200172
ENTRY BY:	J. Slinkard
CHECKED BY:	S. Rader
DATE:	11/4/2019

HYDRAULIC CONDUCTIVITY TEST

CARLSBAD VILLAGE
RAILROAD TRENCH

FIGURE

APPENDIX D

Aquifer Test Results

Report Date: 10/3/2019 12:23
Report User Name: SBirardi
Report Computer Name: KA210006
Application: WinSitu.exe
Application Version: 5.7.6.1

Log File Properties
File Name MW-1 IN_1_2019-10-03_12-21-57-274.wsl
Create Date 10/3/2019 12:21

Device Properties
Device Level TROLL 700
Site Carlsbad Village Trench Project
Device Name
Serial Number 345086
Firmware Version 2.13
Hardware Version 3
Device Address 1
Device Comm Cfg 19200 8 Even 1 (Modbus-RTU)
Used Memory 4
Used Battery 43

Log Configuration

Log Name	MW-1 IN_1
Created By	SBirardi
Computer Name	KA210006
Application	WinSitu.exe
Application Version	5.7.6.1
Create Date	10/3/2019 8:55:42 AM Pacific Daylight Time
Log Setup Time Zone	Pacific Daylight Time
Notes Size(bytes)	4096
Overwrite when full	Disabled
Scheduled Start Time	Manual Start
Scheduled Stop Time	No Stop Time
Type	True Logarithmic
Max Interval	Days: 0 hrs: 00 mins: 01 secs: 00

Level Reference Settings At Log Creation

Level Measurement Mode	Depth
Specific Gravity	0.999

Other Log Settings

Pressure Offset:	0.00443077 (PSI)
Depth of Probe:	15.2361 (ft)
Head Pressure:	6.59868 (PSI)
Temperature:	25.676 (C)

Log Notes:

Date and Time	Note
10/3/2019 8:55	Used Battery: 43% Used Memory: 4% User Name: SBirardi
10/3/2019 9:05	Manual Start Command
10/3/2019 10:46	Used Battery: 43% Used Memory: 4% User Name: SBirardi
10/3/2019 10:46	Manual Stop Command

Log Data:
Record Count 198

Sensors 1

1 345086 Pressure/Temp 15 PSIG (11m/35ft)

Time Zone: Pacific Daylight Time

Date and Time	Elapsed Time Seconds	Sensor: Pres(G) 35ft SN#: 345086 Pressure (PSI)	Sensor: Pres(G) 35ft SN#: 345086 Temperature (C)	Sensor: Pres(G) 35ft SN#: 345086 Depth (ft)		Displacement	Normalized	
10/3/2019 9:05	0	7.562	25.809	17.461				
10/3/2019 9:05	0.25	7.754	25.831	17.904				
10/3/2019 9:05	0.5	7.783	25.879	17.971				
10/3/2019 9:05	0.831	7.89	25.874	18.218				
10/3/2019 9:05	1.05	8.247	25.878	19.043				
10/3/2019 9:05	1.269	8.637	25.883	19.943				
10/3/2019 9:05	1.5	8.716	25.885	20.125				
10/3/2019 9:05	1.75	8.578	25.887	19.806				
10/3/2019 9:05	2	8.336	25.889	19.247				
10/3/2019 9:05	2.25	8.13	25.891	18.773				
10/3/2019 9:05	2.5	8.191	25.894	18.914				
10/3/2019 9:05	2.75	8.508	25.891	19.646				
10/3/2019 9:05	3	8.618	25.894	19.899				
10/3/2019 9:05	3.25	8.544	25.898	19.728				
10/3/2019 9:05	3.5	8.485	25.896	19.592				
10/3/2019 9:05	3.75	8.27	25.898	19.096				
10/3/2019 9:05	4	7.737	25.899	17.865				
10/3/2019 9:05	4.25	7.747	25.899	17.889				
10/3/2019 9:05	4.5	7.687	25.9	17.749				
10/3/2019 9:05	4.75	8.162	25.899	18.847				
10/3/2019 9:05	5	8.503	25.899	19.634				
10/3/2019 9:05	5.25	7.87	25.905	18.172				
10/3/2019 9:05	5.5	7.859	25.904	18.147				
10/3/2019 9:05	5.75	7.548	25.906	17.428				
10/3/2019 9:05	6	7.64	25.907	17.64				
10/3/2019 9:05	6.36	8.141	25.895	18.798				
10/3/2019 9:05	6.721	8.271	25.893	19.097				
10/3/2019 9:05	7.141	7.826	25.886	18.071				
10/3/2019 9:05	7.56	7.815	25.886	18.044				
10/3/2019 9:05	7.98	8.111	25.883	18.729	0	3.512	1	Baseline reading = 15.217
10/3/2019 9:05	8.461	8.001	25.879	18.474	0.481	3.257	0.927392	
10/3/2019 9:05	9	7.859	25.876	18.147	1.02	2.93	0.834282	

10/3/2019 9:05	9.48	8.055	25.874	18.598	1.5	3.381	0.962699
10/3/2019 9:05	10.081	7.935	25.872	18.321	2.101	3.104	0.883827
10/3/2019 9:05	10.681	7.946	25.868	18.347	2.701	3.13	0.89123
10/3/2019 9:05	11.28	8.001	25.87	18.474	3.3	3.257	0.927392
10/3/2019 9:05	11.94	7.918	25.868	18.281	3.96	3.064	0.872437
10/3/2019 9:05	12.66	7.985	25.865	18.437	4.68	3.22	0.916856
10/3/2019 9:05	13.44	7.927	25.863	18.304	5.46	3.087	0.878986
10/3/2019 9:05	14.22	7.961	25.862	18.382	6.24	3.165	0.901196
10/3/2019 9:05	15.06	7.939	25.862	18.331	7.08	3.114	0.886674
10/3/2019 9:05	16.342	7.931	25.905	18.311	8.362	3.094	0.880979
10/3/2019 9:05	16.92	7.945	25.886	18.344	8.94	3.127	0.890376
10/3/2019 9:05	17.88	7.931	25.873	18.312	9.9	3.095	0.881264
10/3/2019 9:05	18.96	7.927	25.865	18.304	10.98	3.087	0.878986
10/3/2019 9:05	20.343	7.923	25.908	18.293	12.363	3.076	0.875854
10/3/2019 9:05	21.3	7.923	25.879	18.293	13.32	3.076	0.875854
10/3/2019 9:05	22.56	7.918	25.866	18.283	14.58	3.066	0.873007
10/3/2019 9:05	24.353	7.91	25.91	18.264	16.373	3.047	0.867597
10/3/2019 9:05	25.32	7.907	25.881	18.257	17.34	3.04	0.865604
10/3/2019 9:05	26.82	7.902	25.869	18.245	18.84	3.028	0.862187
10/3/2019 9:05	28.38	7.897	25.912	18.234	20.4	3.017	0.859055
10/3/2019 9:05	30.06	7.892	25.874	18.222	22.08	3.005	0.855638
10/3/2019 9:05	32.383	7.887	25.912	18.211	24.403	2.994	0.852506
10/3/2019 9:05	33.72	7.879	25.876	18.193	25.74	2.976	0.84738
10/3/2019 9:05	35.76	7.874	25.866	18.18	27.78	2.963	0.843679
10/3/2019 9:06	37.86	7.867	25.879	18.164	29.88	2.947	0.839123
10/3/2019 9:06	40.421	7.859	25.921	18.147	32.441	2.93	0.834282
10/3/2019 9:06	42.48	7.854	25.874	18.134	34.5	2.917	0.830581
10/3/2019 9:06	45	7.846	25.896	18.117	37.02	2.9	0.82574
10/3/2019 9:06	47.64	7.84	25.875	18.101	39.66	2.884	0.821185
10/3/2019 9:06	50.46	7.832	25.881	18.083	42.48	2.866	0.816059
10/3/2019 9:06	53.46	7.823	25.891	18.064	45.48	2.847	0.810649
10/3/2019 9:06	56.64	7.814	25.915	18.042	48.66	2.825	0.804385
10/3/2019 9:06	60.451	7.806	25.931	18.025	52.471	2.808	0.799544
10/3/2019 9:06	63.6	7.798	25.886	18.005	55.62	2.788	0.79385
10/3/2019 9:06	67.2	7.788	25.889	17.983	59.22	2.766	0.787585
10/3/2019 9:06	71.4	7.778	25.891	17.96	63.42	2.743	0.781036
10/3/2019 9:06	75.6	7.77	25.894	17.94	67.62	2.723	0.775342
10/3/2019 9:06	79.8	7.759	25.899	17.915	71.82	2.698	0.768223
10/3/2019 9:06	84.6	7.748	25.943	17.891	76.62	2.674	0.76139
10/3/2019 9:06	90	7.736	25.917	17.862	82.02	2.645	0.753132
10/3/2019 9:06	94.8	7.728	25.918	17.843	86.82	2.626	0.747722
10/3/2019 9:07	100.8	7.715	25.949	17.813	92.82	2.596	0.73918
10/3/2019 9:07	106.8	7.702	25.927	17.784	98.82	2.567	0.730923
10/3/2019 9:07	112.8	7.69	25.963	17.755	104.82	2.538	0.722665
10/3/2019 9:07	119.4	7.684	25.936	17.742	111.42	2.525	0.718964
10/3/2019 9:07	126.6	7.664	25.947	17.697	118.62	2.48	0.70615
10/3/2019 9:07	134.4	7.648	25.956	17.66	126.42	2.443	0.695615
10/3/2019 9:07	142.2	7.635	25.967	17.629	134.22	2.412	0.686788
10/3/2019 9:07	150.6	7.62	25.972	17.595	142.62	2.378	0.677107
10/3/2019 9:08	159.6	7.605	25.971	17.56	151.62	2.343	0.667141
10/3/2019 9:08	169.2	7.59	26	17.526	161.22	2.309	0.65746
10/3/2019 9:08	178.8	7.574	25.991	17.489	170.82	2.272	0.646925
10/3/2019 9:08	189.6	7.558	26.008	17.452	181.62	2.235	0.63639
10/3/2019 9:08	201	7.54	26.034	17.411	193.02	2.194	0.624715
10/3/2019 9:08	213	7.523	26.043	17.37	205.02	2.153	0.613041
10/3/2019 9:09	225.6	7.505	26.034	17.329	217.62	2.112	0.601367
10/3/2019 9:09	238.8	7.487	26.034	17.288	230.82	2.071	0.589692
10/3/2019 9:09	253.2	7.467	26.066	17.241	245.22	2.024	0.57631
10/3/2019 9:09	268.798	7.447	26.099	17.194	260.818	1.977	0.562927
10/3/2019 9:10	283.8	7.428	26.057	17.152	275.82	1.935	0.550968
10/3/2019 9:10	300.845	7.409	26.116	17.108	292.865	1.891	0.53844
10/3/2019 9:10	318.6	7.387	26.082	17.057	310.62	1.84	0.523918
10/3/2019 9:11	337.2	7.367	26.116	17.011	329.22	1.794	0.51082
10/3/2019 9:11	357.6	7.345	26.113	16.96	349.62	1.743	0.496298
10/3/2019 9:11	378.6	7.324	26.112	16.911	370.62	1.694	0.482346
10/3/2019 9:12	401.065	7.301	26.161	16.858	393.085	1.641	0.467255
10/3/2019 9:12	425.107	7.279	26.172	16.806	417.127	1.589	0.452449
10/3/2019 9:12	450	7.256	26.149	16.753	442.02	1.536	0.437358
10/3/2019 9:13	476.4	7.233	26.137	16.702	468.42	1.485	0.422836
10/3/2019 9:13	504.6	7.211	26.146	16.649	496.62	1.432	0.407745
10/3/2019 9:14	534.6	7.186	26.168	16.593	526.62	1.376	0.3918
10/3/2019 9:14	566.4	7.163	26.18	16.539	558.42	1.322	0.376424
10/3/2019 9:15	600	7.14	26.172	16.485	592.02	1.268	0.361048
10/3/2019 9:15	636	7.116	26.18	16.43	628.02	1.213	0.345387
10/3/2019 9:16	672	7.094	26.186	16.379	664.02	1.162	0.330866
10/3/2019 9:17	714	7.068	26.226	16.32	706.02	1.103	0.314066
10/3/2019 9:17	756	7.046	26.192	16.268	748.02	1.051	0.29926
10/3/2019 9:18	798.018	7.024	26.236	16.217	790.038	1	0.284738
10/3/2019 9:19	846.12	7	26.234	16.164	838.14	0.947	0.269647
10/3/2019 9:20	900	6.976	26.188	16.108	892.02	0.891	0.253702
10/3/2019 9:21	948	6.957	26.183	16.063	940.02	0.846	0.240888
10/3/2019 9:22	1008	6.934	26.174	16.01	1000.02	0.793	0.225797
10/3/2019 9:23	1068	6.912	26.166	15.96	1060.02	0.743	0.21156
10/3/2019 9:24	1128	6.893	26.161	15.916	1120.02	0.699	0.199032
10/3/2019 9:25	1188	6.875	26.162	15.875	1180.02	0.658	0.187358
10/3/2019 9:26	1248	6.858	26.153	15.835	1240.02	0.618	0.175968
10/3/2019 9:27	1308	6.844	26.146	15.803	1300.02	0.586	0.166856
10/3/2019 9:28	1368	6.83	26.145	15.769	1360.02	0.552	0.157175
10/3/2019 9:29	1428	6.816	26.137	15.739	1420.02	0.522	0.148633
10/3/2019 9:30	1488	6.803	26.131	15.709	1480.02	0.492	0.140091
10/3/2019 9:31	1548	6.794	26.135	15.686	1540.02	0.469	0.133542
10/3/2019 9:32	1608	6.783	26.138	15.662	1600.02	0.445	0.126708
10/3/2019 9:33	1668	6.773	26.142	15.639	1660.02	0.422	0.120159
10/3/2019 9:34	1728.1	6.762	26.14	15.614	1720.12	0.397	0.113041
10/3/2019 9:35	1788.236	6.754	26.136	15.596	1780.256	0.379	0.107916
10/3/2019 9:36	1848.346	6.746	26.135	15.575	1840.366	0.358	0.101936
10/3/2019 9:37	1908.447	6.739	26.13	15.561	1900.467	0.344	0.09795
10/3/2019 9:38	1968.571	6.732	26.132	15.544	1960.591	0.327	0.093109
10/3/2019 9:39	2028	6.727	26.073	15.532	2020.02	0.315	0.089692
10/3/2019 9:40	2088	6.721	26.077	15.519	2080.02	0.302	0.085991
10/3/2019 9:41	2148	6.715	26.071	15.506	2140.02	0.289	0.082289
10/3/2019 9:42	2208	6.71	26.071	15.493	2200.02	0.276	0.078588
10/3/2019 9:43	2268	6.705	26.069	15.481	2260.02	0.264	0.075171
10/3/2019 9:44	2328	6.7	26.067	15.47	2320.02	0.253	0.072039
10/3/2019 9:45	2388	6.696	26.061	15.46	2380.02	0.243	0.069191

10/3/2019 9:46	2448	6.692	26.062	15.452	2440.02	0.235	0.066913
10/3/2019 9:47	2508	6.688	26.057	15.443	2500.02	0.226	0.064351
10/3/2019 9:48	2568	6.685	26.059	15.435	2560.02	0.218	0.062073
10/3/2019 9:49	2628	6.682	26.058	15.428	2620.02	0.211	0.06008
10/3/2019 9:50	2688	6.678	26.057	15.42	2680.02	0.203	0.057802
10/3/2019 9:51	2748	6.676	26.057	15.414	2740.02	0.197	0.056093
10/3/2019 9:52	2808	6.673	26.054	15.407	2800.02	0.19	0.0541
10/3/2019 9:53	2868	6.669	26.051	15.398	2860.02	0.181	0.051538
10/3/2019 9:54	2928	6.667	26.051	15.395	2920.02	0.178	0.050683
10/3/2019 9:55	2988	6.666	26.05	15.391	2980.02	0.174	0.049544
10/3/2019 9:56	3048	6.663	26.049	15.386	3040.02	0.169	0.048121
10/3/2019 9:57	3108	6.661	26.051	15.38	3100.02	0.163	0.046412
10/3/2019 9:58	3168	6.657	26.046	15.371	3160.02	0.154	0.04385
10/3/2019 9:59	3228	6.656	26.05	15.368	3220.02	0.151	0.042995
10/3/2019 10:00	3288	6.654	26.049	15.364	3280.02	0.147	0.041856
10/3/2019 10:01	3348	6.652	26.046	15.36	3340.02	0.143	0.040718
10/3/2019 10:02	3408	6.652	26.06	15.358	3400.02	0.141	0.040148
10/3/2019 10:03	3468	6.651	26.071	15.356	3460.02	0.139	0.039579
10/3/2019 10:04	3528.118	6.649	26.07	15.352	3520.138	0.135	0.03844
10/3/2019 10:05	3588.205	6.652	26.069	15.36	3580.225	0.143	0.040718
10/3/2019 10:06	3648.269	6.647	26.065	15.348	3640.289	0.131	0.037301
10/3/2019 10:07	3708.383	6.646	26.061	15.345	3700.403	0.128	0.036446
10/3/2019 10:08	3768.534	6.644	26.064	15.342	3760.554	0.125	0.035592
10/3/2019 10:09	3828	6.643	26.017	15.34	3820.02	0.123	0.035023
10/3/2019 10:10	3888	6.642	26.01	15.336	3880.02	0.119	0.033884
10/3/2019 10:11	3948	6.641	26.012	15.335	3940.02	0.118	0.033599
10/3/2019 10:12	4008	6.64	26.007	15.331	4000.02	0.114	0.03246
10/3/2019 10:13	4068	6.64	26.011	15.33	4060.02	0.113	0.032175
10/3/2019 10:14	4128	6.638	26.006	15.327	4120.02	0.11	0.031321
10/3/2019 10:15	4188	6.637	26.003	15.325	4180.02	0.108	0.030752
10/3/2019 10:16	4248	6.638	26.006	15.326	4240.02	0.109	0.031036
10/3/2019 10:17	4308	6.636	25.999	15.323	4300.02	0.106	0.030182
10/3/2019 10:18	4368	6.636	26.001	15.322	4360.02	0.105	0.029897
10/3/2019 10:19	4428	6.635	26.005	15.32	4420.02	0.103	0.029328
10/3/2019 10:20	4488	6.635	26.001	15.319	4480.02	0.102	0.029043
10/3/2019 10:21	4548	6.634	25.999	15.317	4540.02	0.1	0.028474
10/3/2019 10:22	4608	6.633	25.999	15.316	4600.02	0.099	0.028189
10/3/2019 10:23	4668	6.633	26.002	15.316	4660.02	0.099	0.028189
10/3/2019 10:24	4728	6.633	25.999	15.316	4720.02	0.099	0.028189
10/3/2019 10:25	4788	6.632	26.001	15.313	4780.02	0.096	0.027335
10/3/2019 10:26	4848	6.632	25.998	15.313	4840.02	0.096	0.027335
10/3/2019 10:27	4908	6.632	26.001	15.312	4900.02	0.095	0.02705
10/3/2019 10:28	4968	6.63	25.999	15.309	4960.02	0.092	0.026196
10/3/2019 10:29	5028	6.63	26.001	15.309	5020.02	0.092	0.026196
10/3/2019 10:30	5088	6.631	26.003	15.31	5080.02	0.093	0.026481
10/3/2019 10:31	5148	6.629	26.002	15.307	5140.02	0.09	0.025626
10/3/2019 10:32	5208	6.63	26.007	15.308	5200.02	0.091	0.025911
10/3/2019 10:33	5268	6.63	26.01	15.308	5260.02	0.091	0.025911
10/3/2019 10:34	5328	6.629	26.015	15.306	5320.02	0.089	0.025342
10/3/2019 10:35	5388.06	6.628	26.023	15.305	5380.08	0.088	0.025057
10/3/2019 10:36	5448.218	6.628	26.022	15.305	5440.238	0.088	0.025057
10/3/2019 10:37	5508.374	6.628	26.024	15.305	5500.394	0.088	0.025057
10/3/2019 10:38	5568	6.628	25.958	15.304	5560.02	0.087	0.024772
10/3/2019 10:39	5628	6.627	25.94	15.302	5620.02	0.085	0.024203
10/3/2019 10:40	5688	6.628	25.956	15.303	5680.02	0.086	0.024487
10/3/2019 10:41	5748	6.628	25.963	15.303	5740.02	0.086	0.024487
10/3/2019 10:42	5808	6.626	25.964	15.3	5800.02	0.083	0.023633
10/3/2019 10:43	5868	6.628	25.969	15.304	5860.02	0.087	0.024772
10/3/2019 10:44	5928	6.627	25.97	15.302	5920.02	0.085	0.024203
10/3/2019 10:45	5988	6.628	25.971	15.303	5980.02	0.086	0.024487
10/3/2019 10:46	6048	6.627	25.973	15.301	6040.02	0.084	0.023918

Report Date:		10/3/2019 12:24			
Report User Name:	SBirardi				
Report Computer Name:	KA210006				
Application:	WinSitu.exe				
Application Version:	5.7.6.1				

Log File Properties

File Name	MW-1-OUT_1_2019-10-03_12-23-58-699.wsl	
Create Date		10/3/2019 12:23

Device Properties

Device	Level TROLL 700				
Site	Carlsbad Village Trench Project				
Device Name					
Serial Number		345086			
Firmware Version		2.13			
Hardware Version		3			
Device Address		1			
Device Comm Cfg		19200	8 Even	1	(Modbus-RTU)
Used Memory		4			
Used Battery		43			

Log Configuration

Log Name	MW-1-OUT_1
Created By	SBirardi
Computer Name	KA210006
Application	WinSitu.exe
Application Version	5.7.6.1
Create Date	10/3/2019 10:46:52 AM Pacific Daylight Time
Log Setup Time Zone	Pacific Daylight Time
Notes Size(bytes)	4096
Overwrite when full	Disabled
Scheduled Start Time	Manual Start
Scheduled Stop Time	No Stop Time
Type	True Logarithmic
Max Interval	Days: 0 hrs: 00 mins: 01 secs: 00

Level Reference Settings At Log Creation

Level Measurement Mode	Depth
Specific Gravity	0.999

Other Log Settings

Pressure Offset:	0.00443077 (PSI)
Depth of Probe:	15.2988 (ft)
Head Pressure:	6.62583 (PSI)
Temperature:	25.9555 (C)

Log Notes:

Date and Time	Note
10/3/2019 10:46	Used Battery: 43% Used Memory: 6% User Name: SBirardi
10/3/2019 10:48	Manual Start Command
10/3/2019 12:09	Used Battery: 43% Used Memory: 6% User Name: SBirardi
10/3/2019 12:09	Manual Stop Command

Log Data:

Record Count	178		
Sensors	1		
	1	345086	Pressure/Temp 15 PSIG (11m/35ft)

Time Zone: Pacific Daylight Time

Date and Time	Elapsed Time Seconds	Sensor: Pres(G) 35ft SN#: 345086 Pressure (PSI)	Sensor: Pres(G) 35ft SN#: 345086 Temperature (C)	Sensor: Pres(G) 35ft SN#: 345086 Depth (ft)		Displacement	Normalized	
10/3/2019 10:48	0	6.391	25.93	14.757				
10/3/2019 10:48	0.251	5.803	25.954	13.399				
10/3/2019 10:48	0.501	4.872	26.015	11.25				
10/3/2019 10:48	0.903	4.314	26.007	9.961	0	5.34	1	Transducer reading prior to slug out = 15.301
10/3/2019 10:48	1.123	4.874	26.006	11.254	0.22	4.047	0.757865	
10/3/2019 10:48	1.346	4.676	26.009	10.796	0.443	4.505	0.843633	
10/3/2019 10:48	1.565	4.821	26.012	11.131	0.662	4.17	0.780899	
10/3/2019 10:48	1.785	5.035	26.017	11.626	0.882	3.675	0.688202	
10/3/2019 10:48	2.005	4.928	26.018	11.379	1.102	3.922	0.734457	
10/3/2019 10:48	2.251	5.115	26.015	11.811	1.348	3.49	0.653558	
10/3/2019 10:48	2.501	5.298	26.016	12.232	1.598	3.069	0.574719	
10/3/2019 10:48	2.751	5.243	26.015	12.106	1.848	3.195	0.598315	
10/3/2019 10:48	3.001	5.065	26.02	11.695	2.098	3.606	0.675281	
10/3/2019 10:48	3.251	5.017	26.017	11.584	2.348	3.717	0.696067	
10/3/2019 10:48	3.501	5.151	26.02	11.894	2.598	3.407	0.638015	
10/3/2019 10:48	3.751	5.272	26.019	12.172	2.848	3.129	0.585955	
10/3/2019 10:48	4.001	5.235	26.023	12.086	3.098	3.215	0.60206	
10/3/2019 10:48	4.251	5.112	26.024	11.803	3.348	3.498	0.655056	
10/3/2019 10:48	4.501	5.081	26.023	11.733	3.598	3.568	0.668165	
10/3/2019 10:48	4.751	5.174	26.024	11.947	3.848	3.354	0.62809	
10/3/2019 10:48	5.001	5.251	26.023	12.124	4.098	3.177	0.594944	
10/3/2019 10:48	5.251	5.223	26.027	12.059	4.348	3.242	0.607116	
10/3/2019 10:48	5.501	5.14	26.027	11.868	4.598	3.433	0.642884	
10/3/2019 10:48	5.751	5.12	26.026	11.822	4.848	3.479	0.651498	
10/3/2019 10:48	6.001	5.186	26.027	11.974	5.098	3.327	0.623034	
10/3/2019 10:48	6.361	5.24	26.016	12.098	5.458	3.203	0.599813	
10/3/2019 10:48	6.721	5.164	26.015	11.924	5.818	3.377	0.632397	
10/3/2019 10:48	7.141	5.171	26.007	11.939	6.238	3.362	0.629588	
10/3/2019 10:48	7.561	5.234	26.003	12.085	6.658	3.216	0.602247	
10/3/2019 10:48	7.981	5.178	26.001	11.956	7.078	3.345	0.626404	
10/3/2019 10:48	8.461	5.2	25.999	12.007	7.558	3.294	0.616854	
10/3/2019 10:48	9.001	5.215	25.993	12.041	8.098	3.26	0.610487	
10/3/2019 10:48	9.481	5.19	25.996	11.984	8.578	3.317	0.621161	
10/3/2019 10:48	10.081	5.228	25.991	12.072	9.178	3.229	0.604682	
10/3/2019 10:48	10.681	5.201	25.989	12.01	9.778	3.291	0.616292	
10/3/2019 10:48	11.281	5.231	25.987	12.078	10.378	3.223	0.603558	
10/3/2019 10:48	11.941	5.213	25.981	12.038	11.038	3.263	0.611049	
10/3/2019 10:48	12.661	5.231	25.983	12.078	11.758	3.223	0.603558	
10/3/2019 10:48	13.441	5.232	25.977	12.081	12.538	3.22	0.602996	
10/3/2019 10:48	14.221	5.23	25.98	12.075	13.318	3.226	0.60412	

10/3/2019 10:48	15.619	5.237	26.015	12.093	14.716	3.208	0.600749
10/3/2019 10:48	15.961	5.244	26.012	12.109	15.058	3.192	0.597753
10/3/2019 10:48	16.921	5.245	25.985	12.112	16.018	3.189	0.597191
10/3/2019 10:48	17.881	5.25	25.979	12.123	16.978	3.178	0.595131
10/3/2019 10:48	19.33	5.256	26.02	12.137	18.427	3.164	0.592509
10/3/2019 10:48	20.101	5.26	25.993	12.145	19.198	3.156	0.591011
10/3/2019 10:48	21.301	5.265	25.977	12.157	20.398	3.144	0.588764
10/3/2019 10:48	22.561	5.27	25.975	12.168	21.658	3.133	0.586704
10/3/2019 10:48	23.881	5.274	25.998	12.178	22.978	3.123	0.584831
10/3/2019 10:48	25.321	5.28	25.977	12.191	24.418	3.11	0.582397
10/3/2019 10:48	27.34	5.287	26.017	12.208	26.437	3.093	0.579213
10/3/2019 10:48	28.381	5.291	25.984	12.217	27.478	3.084	0.577528
10/3/2019 10:48	30.061	5.295	25.97	12.227	29.158	3.074	0.575655
10/3/2019 10:48	31.861	5.302	25.992	12.242	30.958	3.059	0.572846
10/3/2019 10:48	33.721	5.308	25.971	12.257	32.818	3.044	0.570037
10/3/2019 10:48	35.761	5.315	25.993	12.271	34.858	3.03	0.567416
10/3/2019 10:48	37.861	5.32	25.969	12.283	36.958	3.018	0.565169
10/3/2019 10:48	40.081	5.327	25.987	12.3	39.178	3.001	0.561985
10/3/2019 10:48	42.481	5.333	25.961	12.314	41.578	2.987	0.559363
10/3/2019 10:48	45	5.34	25.975	12.33	44.097	2.971	0.556367
10/3/2019 10:48	47.641	5.347	25.999	12.345	46.738	2.956	0.553558
10/3/2019 10:48	50.461	5.355	25.961	12.364	49.558	2.937	0.55
10/3/2019 10:48	53.461	5.362	25.962	12.381	52.558	2.92	0.546816
10/3/2019 10:48	56.641	5.37	25.971	12.4	55.738	2.901	0.543258
10/3/2019 10:49	60	5.378	25.975	12.417	59.097	2.884	0.540075
10/3/2019 10:49	63.601	5.387	25.991	12.438	62.698	2.863	0.536142
10/3/2019 10:49	67.465	5.395	26.001	12.457	66.562	2.844	0.532584
10/3/2019 10:49	71.486	5.405	25.996	12.479	70.583	2.822	0.528464
10/3/2019 10:49	75.601	5.414	25.985	12.5	74.698	2.801	0.524532
10/3/2019 10:49	79.801	5.423	25.973	12.521	78.898	2.78	0.520599
10/3/2019 10:49	84.601	5.433	25.954	12.545	83.698	2.756	0.516105
10/3/2019 10:49	90	5.444	25.937	12.571	89.097	2.73	0.511236
10/3/2019 10:49	94.801	5.454	25.931	12.593	93.898	2.708	0.507116
10/3/2019 10:49	100.801	5.465	25.943	12.619	99.898	2.682	0.502247
10/3/2019 10:49	106.801	5.477	25.926	12.645	105.898	2.656	0.497378
10/3/2019 10:49	112.801	5.486	25.932	12.668	111.898	2.633	0.493071
10/3/2019 10:50	119.571	5.5	25.967	12.699	118.668	2.602	0.487266
10/3/2019 10:50	126.601	5.512	25.909	12.728	125.698	2.573	0.481835
10/3/2019 10:50	134.4	5.525	25.908	12.757	133.497	2.544	0.476404
10/3/2019 10:50	142.2	5.539	25.902	12.79	141.297	2.511	0.470225
10/3/2019 10:50	150.601	5.552	25.895	12.82	149.698	2.481	0.464607
10/3/2019 10:50	159.648	5.567	25.935	12.854	158.745	2.447	0.45824
10/3/2019 10:50	169.2	5.583	25.892	12.89	168.297	2.411	0.451498
10/3/2019 10:51	178.801	5.597	25.874	12.924	177.898	2.377	0.445131
10/3/2019 10:51	189.6	5.612	25.871	12.958	188.697	2.343	0.438764
10/3/2019 10:51	201	5.629	25.868	12.997	200.097	2.304	0.431461
10/3/2019 10:51	213	5.646	25.866	13.037	212.097	2.264	0.42397
10/3/2019 10:51	225.6	5.663	25.843	13.076	224.697	2.225	0.416667
10/3/2019 10:52	238.801	5.682	25.822	13.119	237.898	2.182	0.408614
10/3/2019 10:52	253.2	5.7	25.821	13.161	252.297	2.14	0.400749
10/3/2019 10:52	268.2	5.718	25.835	13.203	267.297	2.098	0.392884
10/3/2019 10:52	284.029	5.737	25.834	13.247	283.126	2.054	0.384644
10/3/2019 10:53	300.6	5.757	25.795	13.292	299.697	2.009	0.376217
10/3/2019 10:53	318.6	5.777	25.758	13.338	317.697	1.963	0.367603
10/3/2019 10:53	337.2	5.797	25.754	13.385	336.297	1.916	0.358801
10/3/2019 10:53	357.6	5.819	25.732	13.436	356.697	1.865	0.349251
10/3/2019 10:54	378.6	5.841	25.708	13.486	377.697	1.815	0.339888
10/3/2019 10:54	400.8	5.862	25.717	13.534	399.897	1.767	0.330899
10/3/2019 10:55	424.8	5.885	25.7	13.588	423.897	1.713	0.320787
10/3/2019 10:55	450	5.908	25.67	13.642	449.097	1.659	0.310674
10/3/2019 10:55	476.448	5.929	25.692	13.69	475.545	1.611	0.301685
10/3/2019 10:56	504.6	5.952	25.675	13.743	503.697	1.558	0.29176
10/3/2019 10:56	534.6	5.976	25.619	13.799	533.697	1.502	0.281273
10/3/2019 10:57	566.4	6.001	25.61	13.855	565.497	1.446	0.270787
10/3/2019 10:58	600	6.025	25.584	13.913	599.097	1.388	0.259925
10/3/2019 10:58	636	6.049	25.569	13.966	635.097	1.335	0.25
10/3/2019 10:59	672	6.072	25.558	14.021	671.097	1.28	0.2397
10/3/2019 10:59	714	6.098	25.558	14.08	713.097	1.221	0.228652
10/3/2019 11:00	756	6.122	25.533	14.135	755.097	1.166	0.218352
10/3/2019 11:01	798	6.142	25.542	14.183	797.097	1.118	0.209363
10/3/2019 11:02	846	6.167	25.539	14.239	845.097	1.062	0.198876
10/3/2019 11:03	900	6.192	25.505	14.298	899.097	1.003	0.187828
10/3/2019 11:03	948	6.214	25.502	14.347	947.097	0.954	0.178652
10/3/2019 11:04	1008	6.238	25.498	14.403	1007.097	0.898	0.168165
10/3/2019 11:05	1068	6.26	25.49	14.455	1067.097	0.846	0.158427
10/3/2019 11:06	1128	6.281	25.49	14.502	1127.097	0.799	0.149625
10/3/2019 11:07	1188	6.3	25.486	14.547	1187.097	0.754	0.141199
10/3/2019 11:08	1248	6.318	25.487	14.588	1247.097	0.713	0.133521
10/3/2019 11:09	1308	6.336	25.486	14.629	1307.097	0.672	0.125843
10/3/2019 11:10	1368	6.351	25.488	14.664	1367.097	0.637	0.119288
10/3/2019 11:11	1428	6.364	25.49	14.695	1427.097	0.606	0.113483
10/3/2019 11:12	1488	6.377	25.496	14.725	1487.097	0.576	0.107865
10/3/2019 11:13	1548	6.391	25.496	14.756	1547.097	0.545	0.10206
10/3/2019 11:14	1608	6.402	25.507	14.781	1607.097	0.52	0.097378
10/3/2019 11:15	1668	6.413	25.508	14.807	1667.097	0.494	0.092509
10/3/2019 11:16	1728	6.423	25.516	14.83	1727.097	0.471	0.088202
10/3/2019 11:17	1788	6.432	25.526	14.852	1787.097	0.449	0.084082
10/3/2019 11:18	1848	6.442	25.534	14.875	1847.097	0.426	0.079775
10/3/2019 11:19	1908	6.45	25.546	14.893	1907.097	0.408	0.076404
10/3/2019 11:20	1968.034	6.458	25.555	14.912	1967.131	0.389	0.072846
10/3/2019 11:21	2028.193	6.466	25.563	14.93	2027.29	0.371	0.069476
10/3/2019 11:22	2088.319	6.473	25.566	14.945	2087.416	0.356	0.066667
10/3/2019 11:23	2148.447	6.479	25.571	14.959	2147.544	0.342	0.064045
10/3/2019 11:24	2208.516	6.488	25.575	14.981	2207.613	0.32	0.059925
10/3/2019 11:25	2268.6	6.491	25.58	14.987	2267.697	0.314	0.058801
10/3/2019 11:26	2328	6.499	25.537	15.007	2327.097	0.294	0.055056
10/3/2019 11:27	2388	6.503	25.545	15.015	2387.097	0.286	0.053558
10/3/2019 11:28	2448	6.507	25.547	15.024	2447.097	0.277	0.051873
10/3/2019 11:29	2508	6.512	25.552	15.036	2507.097	0.265	0.049625
10/3/2019 11:30	2568	6.516	25.56	15.045	2567.097	0.256	0.04794
10/3/2019 11:31	2628	6.52	25.566	15.055	2627.097	0.246	0.046067
10/3/2019 11:32	2688	6.526	25.568	15.068	2687.097	0.233	0.043633
10/3/2019 11:33	2748	6.527	25.571	15.07	2747.097	0.231	0.043258
10/3/2019 11:34	2808	6.531	25.581	15.08	2807.097	0.221	0.041386
10/3/2019 11:35	2868	6.534	25.584	15.087	2867.097	0.214	0.040075
10/3/2019 11:36	2928	6.537	25.591	15.093	2927.097	0.208	0.038951
10/3/2019 11:37	2988	6.54	25.598	15.101	2987.097	0.2	0.037453
10/3/2019 11:38	3048	6.543	25.602	15.107	3047.097	0.194	0.03633
10/3/2019 11:39	3108	6.547	25.609	15.117	3107.097	0.184	0.034457
10/3/2019 11:40	3168	6.548	25.613	15.12	3167.097	0.181	0.033895
10/3/2019 11:41	3228	6.55	25.619	15.125	3227.097	0.176	0.032959
10/3/2019 11:42	3288	6.554	25.623	15.133	3287.097	0.168	0.031461
10/3/2019 11:43	3348	6.556	25.631	15.138	3347.097	0.163	0.030524

10/3/2019 11:44	3408	6.558	25.634	15.142	3407.097	0.159	0.029775
10/3/2019 11:45	3468	6.559	25.64	15.146	3467.097	0.155	0.029026
10/3/2019 11:46	3528	6.561	25.647	15.149	3527.097	0.152	0.028464
10/3/2019 11:47	3588	6.563	25.658	15.154	3587.097	0.147	0.027528
10/3/2019 11:48	3648	6.565	25.666	15.157	3647.097	0.144	0.026966
10/3/2019 11:49	3708	6.566	25.668	15.16	3707.097	0.141	0.026404
10/3/2019 11:50	3768	6.567	25.681	15.164	3767.097	0.137	0.025655
10/3/2019 11:51	3828	6.569	25.691	15.169	3827.097	0.132	0.024719
10/3/2019 11:52	3888.032	6.57	25.699	15.171	3887.129	0.13	0.024345
10/3/2019 11:53	3948.158	6.575	25.706	15.182	3947.255	0.119	0.022285
10/3/2019 11:54	4008.277	6.573	25.708	15.178	4007.374	0.123	0.023034
10/3/2019 11:55	4068.411	6.575	25.712	15.181	4067.508	0.12	0.022472
10/3/2019 11:56	4128.548	6.576	25.716	15.184	4127.645	0.117	0.02191
10/3/2019 11:57	4188	6.578	25.67	15.187	4187.097	0.114	0.021348
10/3/2019 11:58	4248	6.579	25.673	15.19	4247.097	0.111	0.020787
10/3/2019 11:59	4308	6.58	25.678	15.192	4307.097	0.109	0.020412
10/3/2019 12:00	4368	6.581	25.679	15.196	4367.097	0.105	0.019663
10/3/2019 12:01	4428	6.582	25.684	15.197	4427.097	0.104	0.019476
10/3/2019 12:02	4488	6.582	25.685	15.198	4487.097	0.103	0.019288
10/3/2019 12:03	4548	6.584	25.692	15.202	4547.097	0.099	0.018539
10/3/2019 12:04	4608	6.585	25.693	15.204	4607.097	0.097	0.018165
10/3/2019 12:05	4668	6.585	25.696	15.205	4667.097	0.096	0.017978
10/3/2019 12:06	4728	6.587	25.699	15.208	4727.097	0.093	0.017416
10/3/2019 12:07	4788	6.587	25.706	15.209	4787.097	0.092	0.017228
10/3/2019 12:08	4848	6.588	25.708	15.212	4847.097	0.089	0.016667

Report Date: 10/3/2019 18:10
Report User Name: SBirardi
Report Computer Name: KA210006
Application: WinSitu.exe
Application Version: 5.7.6.1

Log File Properties
File Name MW-2 IN_2_2019-10-03_18-10-22-090.wsl
Create Date 10/3/2019 18:10

Device Properties

Device	Level TROLL 700			
Site	Carlsbad Village Trench Project			
Device Name				
Serial Number	345086			
Firmware Version	2.13			
Hardware Version	3			
Device Address	1			
Device Comm Cfg	19200	8 Even	1	(Modbus-RTU)
Used Memory	15			
Used Battery	43			

Log Configuration

Log Name	MW-2 IN_2
Created By	SBirardi
Computer Name	KA210006
Application	WinSitu.exe
Application Version	5.7.6.1
Create Date	10/3/2019 4:51:59 PM Pacific Daylight Time
Log Setup Time Zone	Pacific Daylight Time
Notes Size(bytes)	4096
Overwrite when full	Disabled
Scheduled Start Time	Manual Start
Scheduled Stop Time	No Stop Time
Type	True Logarithmic
Max Interval	Days: 0 hrs: 00 mins: 01 secs: 00

Level Reference Settings At Log Creation

Level Measurement Mode	Depth
Specific Gravity	0.999

Other Log Settings

Pressure Offset:	0.00443077 (PSI)
Depth of Probe:	11.3328 (ft)
Head Pressure:	4.90817 (PSI)
Temperature:	23.2622 (C)

Log Notes:

Date and Time	Note
10/3/2019 16:52	Used Battery: 43% Used Memory: 17% User Name: SBirardi
10/3/2019 16:57	Manual Start Command
10/3/2019 17:30	Used Battery: 43% Used Memory: 17% User Name: SBirardi
10/3/2019 17:30	Manual Stop Command

Log Data:
Record Count 129

Sensors 1

1 345086 Pressure/Temp 15 PSIG (11m/35ft)

Time Zone: Pacific Daylight Time

Date and Time	Elapsed Time Seconds	Sensor: Pres(G) 35ft SN#: 345086 Pressure (PSI)	Sensor: Pres(G) 35ft SN#: 345086 Temperature (C)	Sensor: Pres(G) 35ft SN#: 345086 Depth (ft)		Displacement	Normalized	
10/3/2019 16:57	0	4.946	23.262	11.421				
10/3/2019 16:57	0.25	4.949	23.282	11.427				
10/3/2019 16:57	0.5	4.943	23.258	11.414				
10/3/2019 16:57	0.941	4.945	23.296	11.419				
10/3/2019 16:57	1.161	4.987	23.304	11.515				
10/3/2019 16:57	1.383	5.188	23.316	11.978				
10/3/2019 16:57	1.603	5.548	23.381	12.81				
10/3/2019 16:57	2.072	5.666	23.361	13.083				
10/3/2019 16:57	2.293	5.567	23.36	12.854				
10/3/2019 16:57	2.516	5.627	23.355	12.992				
10/3/2019 16:57	2.736	5.985	23.371	13.819				
10/3/2019 16:57	3.012	6.296	23.365	14.537				
10/3/2019 16:57	3.233	6.764	23.363	15.617				
10/3/2019 16:57	3.453	6.891	23.363	15.91	0	4.577	1	Baseline transducer reading before slug in = 11.333
10/3/2019 16:57	3.673	6.755	23.364	15.597	0.22	4.264	0.931615	
10/3/2019 16:57	3.892	6.601	23.365	15.242	0.439	3.909	0.854053	
10/3/2019 16:57	4.111	6.46	23.364	14.915	0.658	3.582	0.782609	
10/3/2019 16:57	4.331	6.495	23.364	14.996	0.878	3.663	0.800306	
10/3/2019 16:57	4.55	6.528	23.366	15.073	1.097	3.74	0.817129	
10/3/2019 16:57	4.77	6.467	23.366	14.931	1.317	3.598	0.786104	
10/3/2019 16:57	5	6.426	23.363	14.837	1.547	3.504	0.765567	
10/3/2019 16:57	5.25	6.453	23.364	14.9	1.797	3.567	0.779331	
10/3/2019 16:57	5.5	6.182	23.363	14.274	2.047	2.941	0.642561	
10/3/2019 16:57	5.75	5.941	23.361	13.718	2.297	2.385	0.521084	
10/3/2019 16:57	6	5.832	23.362	13.465	2.547	2.132	0.465807	
10/3/2019 16:57	6.36	5.991	23.35	13.834	2.907	2.501	0.546428	
10/3/2019 16:57	6.72	6.22	23.346	14.362	3.267	3.029	0.661787	
10/3/2019 16:57	7.14	6.165	23.338	14.234	3.687	2.901	0.633821	
10/3/2019 16:57	7.56	5.979	23.336	13.805	4.107	2.472	0.540092	
10/3/2019 16:57	7.98	6.049	23.334	13.967	4.527	2.634	0.575486	
10/3/2019 16:57	8.46	6.145	23.332	14.188	5.007	2.855	0.623771	
10/3/2019 16:57	9	6.042	23.321	13.951	5.547	2.618	0.57199	
10/3/2019 16:57	9.48	6.05	23.321	13.969	6.027	2.636	0.575923	
10/3/2019 16:57	10.08	6.091	23.32	14.065	6.627	2.732	0.596898	
10/3/2019 16:57	10.68	6.046	23.314	13.96	7.227	2.627	0.573957	
10/3/2019 16:57	11.505	6.07	23.359	14.015	8.052	2.682	0.585973	

10/3/2019 16:57	11.94	6.051	23.343	13.971	8.487	2.638	0.57636
10/3/2019 16:57	12.66	6.053	23.326	13.976	9.207	2.643	0.577452
10/3/2019 16:57	13.44	6.045	23.317	13.957	9.987	2.624	0.573301
10/3/2019 16:57	14.22	6.044	23.313	13.955	10.767	2.622	0.572864
10/3/2019 16:57	15.424	6.036	23.352	13.937	11.971	2.604	0.568932
10/3/2019 16:57	15.96	6.034	23.334	13.933	12.507	2.6	0.568058
10/3/2019 16:57	16.92	6.03	23.318	13.923	13.467	2.59	0.565873
10/3/2019 16:57	17.88	6.025	23.309	13.912	14.427	2.579	0.56347
10/3/2019 16:57	19.425	6.017	23.351	13.894	15.972	2.561	0.559537
10/3/2019 16:57	20.1	6.015	23.328	13.889	16.647	2.556	0.558444
10/3/2019 16:58	21.3	6.01	23.313	13.877	17.847	2.544	0.555823
10/3/2019 16:58	22.56	6.004	23.306	13.864	19.107	2.531	0.552982
10/3/2019 16:58	23.88	5.999	23.326	13.851	20.427	2.518	0.550142
10/3/2019 16:58	25.32	5.994	23.308	13.84	21.867	2.507	0.547739
10/3/2019 16:58	26.82	5.989	23.307	13.829	23.367	2.496	0.545335
10/3/2019 16:58	28.38	5.983	23.321	13.814	24.927	2.481	0.542058
10/3/2019 16:58	30.06	5.975	23.309	13.797	26.607	2.464	0.538344
10/3/2019 16:58	31.86	5.968	23.329	13.78	28.407	2.447	0.53463
10/3/2019 16:58	33.72	5.962	23.305	13.766	30.267	2.433	0.531571
10/3/2019 16:58	35.76	5.956	23.331	13.751	32.307	2.418	0.528294
10/3/2019 16:58	37.86	5.948	23.3	13.733	34.407	2.4	0.524361
10/3/2019 16:58	40.08	5.941	23.319	13.718	36.627	2.385	0.521084
10/3/2019 16:58	42.48	5.934	23.302	13.701	39.027	2.368	0.517369
10/3/2019 16:58	45	5.926	23.309	13.682	41.547	2.349	0.513218
10/3/2019 16:58	47.64	5.917	23.331	13.662	44.187	2.329	0.508849
10/3/2019 16:58	50.46	5.91	23.298	13.647	47.007	2.314	0.505571
10/3/2019 16:58	53.46	5.902	23.306	13.627	50.007	2.294	0.501202
10/3/2019 16:58	56.64	5.892	23.309	13.604	53.187	2.271	0.496177
10/3/2019 16:58	60	5.883	23.319	13.584	56.547	2.251	0.491807
10/3/2019 16:58	63.6	5.874	23.333	13.564	60.147	2.231	0.487437
10/3/2019 16:58	67.486	5.863	23.345	13.538	64.033	2.205	0.481757
10/3/2019 16:58	71.484	5.853	23.342	13.514	68.031	2.181	0.476513
10/3/2019 16:58	75.6	5.843	23.331	13.491	72.147	2.158	0.471488
10/3/2019 16:58	79.8	5.834	23.322	13.47	76.347	2.137	0.4669
10/3/2019 16:59	84.6	5.821	23.301	13.44	81.147	2.107	0.460345
10/3/2019 16:59	90	5.809	23.296	13.414	86.547	2.081	0.454665
10/3/2019 16:59	94.8	5.8	23.292	13.392	91.347	2.059	0.449858
10/3/2019 16:59	100.8	5.785	23.305	13.358	97.347	2.025	0.44243
10/3/2019 16:59	106.8	5.773	23.294	13.33	103.347	1.997	0.436312
10/3/2019 16:59	112.8	5.76	23.305	13.301	109.347	1.968	0.429976
10/3/2019 16:59	119.639	5.746	23.344	13.268	116.186	1.935	0.422766
10/3/2019 16:59	126.6	5.733	23.291	13.237	123.147	1.904	0.415993
10/3/2019 16:59	134.4	5.718	23.297	13.202	130.947	1.869	0.408346
10/3/2019 17:00	142.2	5.703	23.295	13.168	138.747	1.835	0.400918
10/3/2019 17:00	150.6	5.688	23.292	13.134	147.147	1.801	0.393489
10/3/2019 17:00	159.693	5.673	23.342	13.098	156.24	1.765	0.385624
10/3/2019 17:00	169.2	5.656	23.303	13.059	165.747	1.726	0.377103
10/3/2019 17:00	178.8	5.641	23.295	13.024	175.347	1.691	0.369456
10/3/2019 17:00	189.6	5.623	23.301	12.982	186.147	1.649	0.36028
10/3/2019 17:01	201	5.605	23.309	12.941	197.547	1.608	0.351322
10/3/2019 17:01	213	5.587	23.306	12.9	209.547	1.567	0.342364
10/3/2019 17:01	225.6	5.568	23.302	12.857	222.147	1.524	0.332969
10/3/2019 17:01	238.8	5.55	23.298	12.815	235.347	1.482	0.323793
10/3/2019 17:01	253.212	5.53	23.309	12.768	249.759	1.435	0.313524
10/3/2019 17:02	268.2	5.51	23.344	12.722	264.747	1.389	0.303474
10/3/2019 17:02	284.202	5.49	23.349	12.675	280.749	1.342	0.293205
10/3/2019 17:02	300.6	5.471	23.326	12.631	297.147	1.298	0.283592
10/3/2019 17:02	318.6	5.449	23.301	12.583	315.147	1.25	0.273105
10/3/2019 17:03	337.2	5.429	23.318	12.535	333.747	1.202	0.262617
10/3/2019 17:03	357.6	5.407	23.31	12.485	354.147	1.152	0.251693
10/3/2019 17:03	378.6	5.386	23.305	12.437	375.147	1.104	0.241206
10/3/2019 17:04	400.8	5.364	23.333	12.385	397.347	1.052	0.229845
10/3/2019 17:04	424.8	5.342	23.326	12.335	421.347	1.002	0.218921
10/3/2019 17:05	450	5.321	23.312	12.287	446.547	0.954	0.208433
10/3/2019 17:05	476.604	5.298	23.35	12.234	473.151	0.901	0.196854
10/3/2019 17:06	504.673	5.278	23.351	12.186	501.22	0.853	0.186367
10/3/2019 17:06	534.6	5.257	23.307	12.138	531.147	0.805	0.175879
10/3/2019 17:07	566.4	5.235	23.309	12.087	562.947	0.754	0.164737
10/3/2019 17:07	600	5.214	23.3	12.039	596.547	0.706	0.15425
10/3/2019 17:08	636	5.192	23.301	11.989	632.547	0.656	0.143325
10/3/2019 17:08	672	5.174	23.301	11.947	668.547	0.614	0.134149
10/3/2019 17:09	714	5.153	23.319	11.898	710.547	0.565	0.123443
10/3/2019 17:10	756	5.134	23.301	11.853	752.547	0.52	0.113612
10/3/2019 17:10	798	5.116	23.319	11.813	794.547	0.48	0.104872
10/3/2019 17:11	846	5.099	23.316	11.773	842.547	0.44	0.096133
10/3/2019 17:12	900	5.081	23.294	11.731	896.547	0.398	0.086957
10/3/2019 17:13	948	5.065	23.297	11.696	944.547	0.363	0.07931
10/3/2019 17:14	1008	5.049	23.291	11.658	1004.547	0.325	0.071007
10/3/2019 17:15	1068	5.035	23.301	11.625	1064.547	0.292	0.063797
10/3/2019 17:16	1128	5.021	23.294	11.594	1124.547	0.261	0.057024
10/3/2019 17:17	1188	5.011	23.296	11.57	1184.547	0.237	0.051781
10/3/2019 17:18	1248	5.001	23.299	11.548	1244.547	0.215	0.046974
10/3/2019 17:19	1308	4.992	23.298	11.527	1304.547	0.194	0.042386
10/3/2019 17:20	1368	4.985	23.299	11.509	1364.547	0.176	0.038453
10/3/2019 17:21	1428	4.978	23.293	11.493	1424.547	0.16	0.034957
10/3/2019 17:22	1488	4.972	23.296	11.48	1484.547	0.147	0.032117
10/3/2019 17:23	1548	4.967	23.294	11.468	1544.547	0.135	0.029495
10/3/2019 17:24	1608	4.962	23.296	11.456	1604.547	0.123	0.026873
10/3/2019 17:25	1668	4.958	23.294	11.448	1664.547	0.115	0.025126
10/3/2019 17:26	1728	4.953	23.296	11.436	1724.547	0.103	0.022504
10/3/2019 17:27	1788	4.951	23.299	11.431	1784.547	0.098	0.021411
10/3/2019 17:28	1848	4.948	23.297	11.425	1844.547	0.092	0.020101
10/3/2019 17:29	1908	4.946	23.301	11.42	1904.547	0.087	0.019008

Report Date: 10/3/2019 18:09
Report User Name: SBirardi
Report Computer Name: KA210006
Application: WinSitu.exe
Application Version: 5.7.6.1

Log File Properties
File Name MW-2 IN_2019-10-03_18-09-12-137.wsl
Create Date 10/3/2019 18:09

Device Properties
Device Level TROLL 700
Site Carlsbad Village Trench Project
Device Name
Serial Number 345086
Firmware Version 2.13
Hardware Version 3
Device Address 1
Device Comm Cfg 19200 8 Even 1 (Modbus-RTU)
Used Memory 12
Used Battery 43

Log Configuration

Log Name	MW-2 IN
Created By	SBirardi
Computer Name	KA210006
Application	WinSitu.exe
Application Version	5.7.6.1
Create Date	10/3/2019 3:49:57 PM Pacific Daylight Time
Log Setup Time Zone	Pacific Daylight Time
Notes Size(bytes)	4096
Overwrite when full	Disabled
Scheduled Start Time	Manual Start
Scheduled Stop Time	No Stop Time
Type	True Logarithmic
Max Interval	Days: 0 hrs: 00 mins: 01 secs: 00

Level Reference Settings At Log Creation

Level Measurement Mode	Depth
Specific Gravity	0.999

Other Log Settings

Pressure Offset:	0.00443077 (PSI)
Depth of Probe:	11.3522 (ft)
Head Pressure:	4.91657 (PSI)
Temperature:	23.4699 (C)

Log Notes:

Date and Time	Note
10/3/2019 15:50	Used Battery: 43% Used Memory: 14% User Name: SBirardi
10/3/2019 15:50	Manual Start Command
10/3/2019 16:18	Used Battery: 43% Used Memory: 14% User Name: SBirardi
10/3/2019 16:18	Manual Stop Command

Log Data:
Record Count 125

Sensors 1

1 345086 Pressure/Temp 15 PSIG (11m/35ft)

Time Zone: Pacific Daylight Time

Date and Time	Elapsed Time Seconds	Sensor: Pres(G) 35ft SN#: 345086 Pressure (PSI)	Sensor: Pres(G) 35ft SN#: 345086 Temperature (C)	Sensor: Pres(G) 35ft SN#: 345086 Depth (ft)		Displacement	Normalized	
10/3/2019 15:50	0	4.917	23.43	11.354				
10/3/2019 15:50	0.251	4.918	23.45	11.356				
10/3/2019 15:50	0.501	4.922	23.457	11.365				
10/3/2019 15:50	0.977	5.023	23.472	11.598				
10/3/2019 15:50	1.198	5.174	23.48	11.947				
10/3/2019 15:50	1.417	5.38	23.49	12.422				
10/3/2019 15:50	1.64	5.454	23.492	12.593				
10/3/2019 15:50	1.864	5.483	23.499	12.661				
10/3/2019 15:50	2.086	5.472	23.504	12.634				
10/3/2019 15:50	2.308	5.47	23.507	12.63				
10/3/2019 15:50	2.53	5.605	23.511	12.943				
10/3/2019 15:50	2.752	5.801	23.51	13.395				
10/3/2019 15:50	3.16	5.757	23.499	13.292				
10/3/2019 15:50	3.381	5.661	23.507	13.072				
10/3/2019 15:50	3.603	5.655	23.515	13.056				
10/3/2019 15:50	3.854	5.755	23.513	13.288				
10/3/2019 15:50	4.074	5.882	23.516	13.581				
10/3/2019 15:50	4.293	5.954	23.521	13.748				
10/3/2019 15:50	4.517	5.86	23.529	13.531				
10/3/2019 15:50	4.938	5.829	23.531	13.458				
10/3/2019 15:50	5.357	5.903	23.533	13.629				
10/3/2019 15:50	5.78	5.899	23.532	13.62				
10/3/2019 15:50	5.999	5.926	23.531	13.684	0	2.339	1	Baseline transducer before slug in = 11.345
10/3/2019 15:50	6.218	5.647	23.533	13.039	0.219	1.694	0.724241	
10/3/2019 15:50	6.438	5.378	23.536	12.418	0.439	1.073	0.458743	
10/3/2019 15:50	6.659	5.319	23.536	12.281	0.66	0.936	0.400171	
10/3/2019 15:50	6.88	5.463	23.533	12.614	0.881	1.269	0.54254	
10/3/2019 15:50	7.141	5.614	23.532	12.963	1.142	1.618	0.691749	
10/3/2019 15:50	7.561	5.611	23.516	12.956	1.562	1.611	0.688756	
10/3/2019 15:50	7.981	5.425	23.507	12.526	1.982	1.181	0.504917	
10/3/2019 15:50	9.058	5.498	23.528	12.694	3.059	1.349	0.576742	
10/3/2019 15:50	9.28	5.473	23.53	12.636	3.281	1.291	0.551945	
10/3/2019 15:50	9.501	5.493	23.531	12.683	3.502	1.338	0.572039	
10/3/2019 15:50	10.081	5.527	23.508	12.763	4.082	1.418	0.606242	
10/3/2019 15:50	10.681	5.493	23.493	12.684	4.682	1.339	0.572467	
10/3/2019 15:50	11.281	5.524	23.484	12.754	5.282	1.409	0.602394	
10/3/2019 15:50	11.941	5.491	23.485	12.679	5.942	1.334	0.570329	
10/3/2019 15:50	13.069	5.495	23.517	12.688	7.07	1.343	0.574177	

10/3/2019 15:50	13.441	5.498	23.51	12.695	7.442	1.35	0.57717
10/3/2019 15:50	14.221	5.495	23.489	12.687	8.222	1.342	0.573749
10/3/2019 15:50	15.061	5.496	23.479	12.69	9.062	1.345	0.575032
10/3/2019 15:50	15.961	5.493	23.472	12.682	9.962	1.337	0.571612
10/3/2019 15:50	17.082	5.489	23.514	12.673	11.083	1.328	0.567764
10/3/2019 15:50	17.881	5.486	23.487	12.668	11.882	1.323	0.565626
10/3/2019 15:50	18.961	5.484	23.474	12.662	12.962	1.317	0.563061
10/3/2019 15:50	20.101	5.481	23.467	12.656	14.102	1.311	0.560496
10/3/2019 15:50	21.301	5.477	23.496	12.646	15.302	1.301	0.556221
10/3/2019 15:50	22.561	5.475	23.473	12.641	16.562	1.296	0.554083
10/3/2019 15:50	23.881	5.471	23.46	12.633	17.882	1.288	0.550663
10/3/2019 15:50	25.321	5.467	23.492	12.623	19.322	1.278	0.546387
10/3/2019 15:50	26.821	5.464	23.465	12.617	20.822	1.272	0.543822
10/3/2019 15:50	28.381	5.465	23.455	12.618	22.382	1.273	0.54425
10/3/2019 15:50	30.061	5.456	23.47	12.598	24.062	1.253	0.535699
10/3/2019 15:50	31.861	5.453	23.455	12.59	25.862	1.245	0.532279
10/3/2019 15:50	33.721	5.447	23.468	12.578	27.722	1.233	0.527148
10/3/2019 15:51	35.761	5.444	23.452	12.57	29.762	1.225	0.523728
10/3/2019 15:51	37.861	5.44	23.463	12.561	31.862	1.216	0.51988
10/3/2019 15:51	40.081	5.434	23.447	12.547	34.082	1.202	0.513895
10/3/2019 15:51	42.481	5.43	23.454	12.539	36.482	1.194	0.510475
10/3/2019 15:51	45.131	5.424	23.487	12.524	39.132	1.179	0.504062
10/3/2019 15:51	47.641	5.419	23.44	12.513	41.642	1.168	0.499359
10/3/2019 15:51	50.461	5.415	23.447	12.502	44.462	1.157	0.494656
10/3/2019 15:51	53.461	5.408	23.461	12.488	47.462	1.143	0.48867
10/3/2019 15:51	57.155	5.401	23.477	12.472	51.156	1.127	0.48183
10/3/2019 15:51	60	5.397	23.425	12.461	54.001	1.116	0.477127
10/3/2019 15:51	63.601	5.39	23.425	12.446	57.602	1.101	0.470714
10/3/2019 15:51	67.2	5.384	23.425	12.431	61.201	1.086	0.464301
10/3/2019 15:51	71.401	5.382	23.418	12.426	65.402	1.081	0.462163
10/3/2019 15:51	75.601	5.369	23.412	12.397	69.602	1.052	0.449765
10/3/2019 15:51	79.801	5.362	23.406	12.381	73.802	1.036	0.442924
10/3/2019 15:51	84.601	5.354	23.4	12.362	78.602	1.017	0.434801
10/3/2019 15:51	90	5.346	23.416	12.344	84.001	0.999	0.427106
10/3/2019 15:51	94.801	5.339	23.397	12.328	88.802	0.983	0.420265
10/3/2019 15:52	101.29	5.328	23.436	12.303	95.291	0.958	0.409577
10/3/2019 15:52	106.801	5.321	23.391	12.286	100.802	0.941	0.402309
10/3/2019 15:52	113.301	5.311	23.426	12.264	107.302	0.919	0.392903
10/3/2019 15:52	119.4	5.303	23.375	12.245	113.401	0.9	0.38478
10/3/2019 15:52	126.601	5.293	23.379	12.222	120.602	0.877	0.374947
10/3/2019 15:52	134.4	5.283	23.372	12.199	128.401	0.854	0.365113
10/3/2019 15:52	142.2	5.273	23.375	12.176	136.201	0.831	0.35528
10/3/2019 15:52	150.601	5.263	23.366	12.152	144.602	0.807	0.345019
10/3/2019 15:53	159.601	5.252	23.352	12.128	153.602	0.783	0.334758
10/3/2019 15:53	169.48	5.241	23.39	12.102	163.481	0.757	0.323643
10/3/2019 15:53	178.801	5.231	23.345	12.078	172.802	0.733	0.313382
10/3/2019 15:53	189.6	5.219	23.372	12.05	183.601	0.705	0.301411
10/3/2019 15:53	201.567	5.206	23.369	12.021	195.568	0.676	0.289012
10/3/2019 15:53	213.603	5.194	23.363	11.993	207.604	0.648	0.277041
10/3/2019 15:54	225.64	5.182	23.359	11.965	219.641	0.62	0.265071
10/3/2019 15:54	238.801	5.171	23.315	11.94	232.802	0.595	0.254382
10/3/2019 15:54	253.696	5.158	23.347	11.909	247.697	0.564	0.241129
10/3/2019 15:54	268.2	5.147	23.292	11.885	262.201	0.54	0.230868
10/3/2019 15:55	283.8	5.135	23.291	11.856	277.801	0.511	0.218469
10/3/2019 15:55	300.6	5.123	23.28	11.828	294.601	0.483	0.206499
10/3/2019 15:55	318.6	5.11	23.293	11.799	312.601	0.454	0.1941
10/3/2019 15:56	337.2	5.097	23.273	11.769	331.201	0.424	0.181274
10/3/2019 15:56	357.864	5.085	23.318	11.742	351.865	0.397	0.169731
10/3/2019 15:56	378.6	5.073	23.286	11.713	372.601	0.368	0.157332
10/3/2019 15:57	400.8	5.062	23.264	11.689	394.801	0.344	0.147071
10/3/2019 15:57	424.8	5.051	23.263	11.662	418.801	0.317	0.135528
10/3/2019 15:57	450.088	5.04	23.307	11.638	444.089	0.293	0.125267
10/3/2019 15:58	476.4	5.029	23.264	11.612	470.401	0.267	0.114151
10/3/2019 15:58	504.6	5.018	23.26	11.586	498.601	0.241	0.103035
10/3/2019 15:59	534.6	5.008	23.287	11.564	528.601	0.219	0.09363
10/3/2019 15:59	566.4	4.999	23.293	11.542	560.401	0.197	0.084224
10/3/2019 16:00	600	4.99	23.259	11.521	594.001	0.176	0.075246
10/3/2019 16:01	636	4.98	23.257	11.499	630.001	0.154	0.06584
10/3/2019 16:01	672	4.973	23.263	11.483	666.001	0.138	0.059
10/3/2019 16:02	714	4.965	23.25	11.463	708.001	0.118	0.050449
10/3/2019 16:03	756	4.957	23.263	11.447	750.001	0.102	0.043608
10/3/2019 16:03	798	4.952	23.253	11.435	792.001	0.09	0.038478
10/3/2019 16:04	846	4.946	23.253	11.419	840.001	0.074	0.031637
10/3/2019 16:05	900	4.94	23.27	11.406	894.001	0.061	0.02608
10/3/2019 16:06	948	4.935	23.274	11.395	942.001	0.05	0.021377
10/3/2019 16:07	1008	4.931	23.276	11.386	1002.001	0.041	0.017529
10/3/2019 16:08	1068	4.928	23.28	11.378	1062.001	0.033	0.014109
10/3/2019 16:09	1128	4.925	23.285	11.372	1122.001	0.027	0.011543
10/3/2019 16:10	1188	4.921	23.296	11.362	1182.001	0.017	0.007268
10/3/2019 16:11	1248	4.919	23.3	11.358	1242.001	0.013	0.005558
10/3/2019 16:12	1308.212	4.919	23.303	11.358	1302.213	0.013	0.005558
10/3/2019 16:13	1368.259	4.917	23.304	11.353	1362.26	0.008	0.00342
10/3/2019 16:14	1428.374	4.916	23.308	11.35	1422.375	0.005	0.002138
10/3/2019 16:15	1488.492	4.914	23.306	11.347	1482.493	0.002	0.000855
10/3/2019 16:16	1548.577	4.915	23.307	11.348	1542.578	0.003	0.001283
10/3/2019 16:17	1608	4.914	23.258	11.347	1602.001	0.002	0.000855
10/3/2019 16:18	1668	4.914	23.262	11.345	1662.001	0	0

Report Date:	10/3/2019 18:10
Report User Name:	SBirardi
Report Computer Name:	KA210006
Application:	WinSitu.exe
Application Version:	5.7.6.1

Log File Properties

File Name	MW-2 OUT_2_2019-10-03_18-10-49-292.wsl
Create Date	10/3/2019 18:10

Device Properties

Device	Level TROLL 700				
Site	Carlsbad Village Trench Project				
Device Name					
Serial Number	345086				
Firmware Version	2.13				
Hardware Version	3				
Device Address	1				
Device Comm Cfg	19200	8	Even	1	(Modbus-RTU)
Used Memory	17				
Used Battery	43				

Log Configuration

Log Name	MW-2 OUT_2
Created By	SBirardi
Computer Name	KA210006
Application	WinSitu.exe
Application Version	5.7.6.1
Create Date	10/3/2019 5:30:44 PM Pacific Daylight Time
Log Setup Time Zone	Pacific Daylight Time
Notes Size(bytes)	4096
Overwrite when full	Disabled
Scheduled Start Time	Manual Start
Scheduled Stop Time	No Stop Time
Type	True Logarithmic
Max Interval	Days: 0 hrs: 00 mins: 01 secs: 00

Level Reference Settings At Log Creation

Level Measurement Mode	Depth
Specific Gravity	0.999

Other Log Settings

Pressure Offset:	0.00443077 (PSI)
Depth of Probe:	11.4126 (ft)
Head Pressure:	4.94273 (PSI)
Temperature:	23.2632 (C)

Log Notes:

Date and Time	Note
10/3/2019 17:30	Used Battery: 43% Used Memory: 18% User Name: SBirardi
10/3/2019 17:31	Manual Start Command
10/3/2019 18:08	Used Battery: 44% Used Memory: 18% User Name: SBirardi
10/3/2019 18:08	Manual Stop Command

Log Data:

Record Count	133		
Sensors	1		
	1	345086	Pressure/Temp 15 PSIG (11m/35ft)

Time Zone: Pacific Daylight Time

Date and Time	Elapsed Time Seconds	Sensor: Pres(G) 35ft SN#: 345086 Pressure (PSI)	Sensor: Pres(G) 35ft SN#: 345086 Temperature (C)	Sensor: Pres(G) 35ft SN#: 345086 Depth (ft)	Displacement	Normalized
10/3/2019 17:31	0	4.943	23.243	11.413		
10/3/2019 17:31	0.25	4.942	23.264	11.412		
10/3/2019 17:31	0.5	4.943	23.243	11.412		
10/3/2019 17:31	0.941	4.943	23.275	11.414		
10/3/2019 17:31	1.162	4.943	23.289	11.414		
10/3/2019 17:31	1.384	4.942	23.302	11.41		
10/3/2019 17:31	1.604	4.945	23.363	11.417		
10/3/2019 17:31	2.066	4.943	23.343	11.413		
10/3/2019 17:31	2.287	4.942	23.342	11.41		
10/3/2019 17:31	2.509	4.942	23.341	11.41		

10/3/2019 17:31	2.729	4.944	23.366	11.416			
10/3/2019 17:31	3.043	4.941	23.352	11.409			
10/3/2019 17:31	3.266	4.255	23.348	9.825			
10/3/2019 17:31	3.511	3.757	23.347	8.676			
10/3/2019 17:31	3.732	3.563	23.35	8.227			
10/3/2019 17:31	3.952	3.605	23.35	8.324			
10/3/2019 17:31	4.374	4.048	23.357	9.347			
10/3/2019 17:31	4.794	3.502	23.352	8.086			
10/3/2019 17:31	5.219	3.439	23.355	7.94	0	3.476	1
10/3/2019 17:31	5.44	3.695	23.352	8.533	0.221	2.883	0.829402
10/3/2019 17:31	5.659	3.819	23.354	8.818	0.44	2.598	0.747411
10/3/2019 17:31	5.879	3.635	23.354	8.394	0.66	3.022	0.86939
10/3/2019 17:31	6.099	3.59	23.355	8.29	0.88	3.126	0.89931
10/3/2019 17:31	6.319	3.727	23.356	8.606	1.1	2.81	0.8084
10/3/2019 17:31	6.538	3.746	23.356	8.649	1.319	2.767	0.79603
10/3/2019 17:31	6.76	3.657	23.356	8.443	1.541	2.973	0.855293
10/3/2019 17:31	6.981	3.671	23.359	8.475	1.762	2.941	0.846087
10/3/2019 17:31	7.203	3.733	23.362	8.619	1.984	2.797	0.804661
10/3/2019 17:31	7.56	3.693	23.346	8.527	2.341	2.889	0.831128
10/3/2019 17:31	8.508	3.703	23.358	8.55	3.289	2.866	0.824511
10/3/2019 17:31	8.731	3.705	23.355	8.554	3.512	2.862	0.82336
10/3/2019 17:31	9	3.728	23.352	8.607	3.781	2.809	0.808113
10/3/2019 17:31	9.48	3.716	23.337	8.581	4.261	2.835	0.815593
10/3/2019 17:31	10.08	3.722	23.322	8.595	4.861	2.821	0.811565
10/3/2019 17:31	10.68	3.743	23.312	8.643	5.461	2.773	0.797756
10/3/2019 17:31	11.28	3.75	23.309	8.659	6.061	2.757	0.793153
10/3/2019 17:31	12.513	3.748	23.345	8.655	7.294	2.761	0.794304
10/3/2019 17:31	12.736	3.756	23.346	8.673	7.517	2.743	0.789125
10/3/2019 17:31	13.44	3.768	23.319	8.7	8.221	2.716	0.781358
10/3/2019 17:31	14.22	3.774	23.311	8.713	9.001	2.703	0.777618
10/3/2019 17:31	15.06	3.779	23.301	8.726	9.841	2.69	0.773878
10/3/2019 17:31	16.526	3.786	23.34	8.742	11.307	2.674	0.769275
10/3/2019 17:31	16.92	3.788	23.331	8.746	11.701	2.67	0.768124
10/3/2019 17:31	17.88	3.793	23.307	8.759	12.661	2.657	0.764384
10/3/2019 17:31	18.96	3.792	23.301	8.755	13.741	2.661	0.765535
10/3/2019 17:31	20.537	3.811	23.338	8.8	15.318	2.616	0.752589
10/3/2019 17:31	21.3	3.816	23.314	8.81	16.081	2.606	0.749712
10/3/2019 17:31	22.56	3.814	23.3	8.806	17.341	2.61	0.750863
10/3/2019 17:31	23.88	3.819	23.29	8.818	18.661	2.598	0.747411
10/3/2019 17:31	25.32	3.824	23.312	8.83	20.101	2.586	0.743959
10/3/2019 17:31	26.82	3.831	23.298	8.845	21.601	2.571	0.739643
10/3/2019 17:31	28.549	3.837	23.339	8.86	23.33	2.556	0.735328
10/3/2019 17:32	30.06	3.845	23.297	8.877	24.841	2.539	0.730437
10/3/2019 17:32	31.86	3.856	23.29	8.903	26.641	2.513	0.722957
10/3/2019 17:32	33.72	3.862	23.299	8.917	28.501	2.499	0.71893
10/3/2019 17:32	35.76	3.869	23.291	8.933	30.541	2.483	0.714327
10/3/2019 17:32	37.86	3.875	23.3	8.947	32.641	2.469	0.710299
10/3/2019 17:32	40.596	3.884	23.337	8.967	35.377	2.449	0.704545
10/3/2019 17:32	42.48	3.889	23.297	8.981	37.261	2.435	0.700518
10/3/2019 17:32	45	3.897	23.315	8.998	39.781	2.418	0.695627
10/3/2019 17:32	47.64	3.905	23.281	9.017	42.421	2.399	0.690161
10/3/2019 17:32	50.46	3.914	23.292	9.036	45.241	2.38	0.684695
10/3/2019 17:32	53.46	3.922	23.301	9.055	48.241	2.361	0.679229
10/3/2019 17:32	56.64	3.93	23.331	9.074	51.421	2.342	0.673763
10/3/2019 17:32	60	3.94	23.281	9.097	54.781	2.319	0.667146
10/3/2019 17:32	63.6	3.948	23.285	9.116	58.381	2.3	0.66168
10/3/2019 17:32	67.2	3.958	23.285	9.139	61.981	2.277	0.655063
10/3/2019 17:32	71.4	3.968	23.285	9.162	66.181	2.254	0.648446
10/3/2019 17:32	75.6	3.978	23.283	9.185	70.381	2.231	0.64183
10/3/2019 17:32	79.8	3.988	23.279	9.209	74.581	2.207	0.634925
10/3/2019 17:32	84.711	4.002	23.33	9.241	79.492	2.175	0.625719
10/3/2019 17:33	90	4.012	23.292	9.262	84.781	2.154	0.619678
10/3/2019 17:33	94.8	4.026	23.285	9.295	89.581	2.121	0.610184
10/3/2019 17:33	100.8	4.035	23.321	9.316	95.581	2.1	0.604143
10/3/2019 17:33	106.8	4.048	23.283	9.347	101.581	2.069	0.595224
10/3/2019 17:33	112.8	4.06	23.326	9.374	107.581	2.042	0.587457
10/3/2019 17:33	119.4	4.074	23.278	9.407	114.181	2.009	0.577963
10/3/2019 17:33	126.6	4.088	23.285	9.44	121.381	1.976	0.56847
10/3/2019 17:33	134.4	4.104	23.29	9.475	129.181	1.941	0.5584
10/3/2019 17:33	142.2	4.119	23.293	9.51	136.981	1.906	0.548331
10/3/2019 17:34	150.6	4.135	23.287	9.547	145.381	1.869	0.537687
10/3/2019 17:34	159.6	4.151	23.279	9.585	154.381	1.831	0.526755
10/3/2019 17:34	169.2	4.168	23.305	9.623	163.981	1.793	0.515823
10/3/2019 17:34	178.8	4.185	23.286	9.664	173.581	1.752	0.504028
10/3/2019 17:34	189.6	4.204	23.299	9.707	184.381	1.709	0.491657
10/3/2019 17:34	201	4.222	23.325	9.747	195.781	1.669	0.48015
10/3/2019 17:35	213	4.241	23.326	9.792	207.781	1.624	0.467204
10/3/2019 17:35	225.6	4.261	23.304	9.839	220.381	1.577	0.453682
10/3/2019 17:35	238.8	4.281	23.294	9.884	233.581	1.532	0.440736
10/3/2019 17:35	253.2	4.302	23.319	9.934	247.981	1.482	0.426352
10/3/2019 17:35	268.208	4.324	23.286	9.984	262.989	1.432	0.411968
10/3/2019 17:36	283.8	4.345	23.287	10.033	278.581	1.383	0.397871
10/3/2019 17:36	301.136	4.368	23.336	10.085	295.917	1.331	0.382911

10/3/2019 17:36	318.6	4.39	23.299	10.137	313.381	1.279	0.367952
10/3/2019 17:37	337.245	4.413	23.337	10.19	332.026	1.226	0.352704
10/3/2019 17:37	357.6	4.437	23.322	10.244	352.381	1.172	0.337169
10/3/2019 17:37	378.6	4.46	23.298	10.299	373.381	1.117	0.321346
10/3/2019 17:38	401.347	4.485	23.342	10.357	396.128	1.059	0.304661
10/3/2019 17:38	425.388	4.51	23.348	10.413	420.169	1.003	0.28855
10/3/2019 17:39	450	4.532	23.32	10.464	444.781	0.952	0.273878
10/3/2019 17:39	476.4	4.558	23.3	10.524	471.181	0.892	0.256617
10/3/2019 17:39	504.6	4.58	23.302	10.575	499.381	0.841	0.241945
10/3/2019 17:40	534.6	4.604	23.322	10.631	529.381	0.785	0.225834
10/3/2019 17:40	566.4	4.628	23.329	10.685	561.181	0.731	0.210299
10/3/2019 17:41	599.999	4.651	23.315	10.738	594.78	0.678	0.195052
10/3/2019 17:42	635.999	4.672	23.322	10.788	630.78	0.628	0.180667
10/3/2019 17:42	671.999	4.694	23.323	10.839	666.78	0.577	0.165995
10/3/2019 17:43	713.999	4.717	23.37	10.89	708.78	0.526	0.151323
10/3/2019 17:44	755.999	4.737	23.33	10.937	750.78	0.479	0.137802
10/3/2019 17:44	798.144	4.754	23.372	10.976	792.925	0.44	0.126582
10/3/2019 17:45	846.244	4.772	23.369	11.019	841.025	0.397	0.114212
10/3/2019 17:46	899.999	4.791	23.338	11.062	894.78	0.354	0.101841
10/3/2019 17:47	947.999	4.805	23.337	11.095	942.78	0.321	0.092348
10/3/2019 17:48	1007.999	4.821	23.335	11.132	1002.78	0.284	0.081703
10/3/2019 17:49	1067.999	4.835	23.343	11.163	1062.78	0.253	0.072785
10/3/2019 17:50	1127.999	4.846	23.346	11.189	1122.78	0.227	0.065305
10/3/2019 17:51	1187.999	4.856	23.358	11.212	1182.78	0.204	0.058688
10/3/2019 17:52	1247.999	4.864	23.357	11.23	1242.78	0.186	0.05351
10/3/2019 17:53	1307.999	4.871	23.363	11.248	1302.78	0.168	0.048331
10/3/2019 17:54	1367.999	4.877	23.364	11.262	1362.78	0.154	0.044304
10/3/2019 17:55	1427.999	4.883	23.368	11.274	1422.78	0.142	0.040852
10/3/2019 17:56	1487.999	4.887	23.372	11.284	1482.78	0.132	0.037975
10/3/2019 17:57	1547.999	4.891	23.382	11.294	1542.78	0.122	0.035098
10/3/2019 17:58	1607.999	4.893	23.392	11.299	1602.78	0.117	0.033659
10/3/2019 17:59	1668.115	4.897	23.384	11.306	1662.896	0.11	0.031646
10/3/2019 18:00	1728.263	4.899	23.381	11.312	1723.044	0.104	0.029919
10/3/2019 18:01	1788.358	4.901	23.381	11.317	1783.139	0.099	0.028481
10/3/2019 18:02	1847.999	4.907	23.326	11.329	1842.78	0.087	0.025029
10/3/2019 18:03	1907.999	4.904	23.328	11.322	1902.78	0.094	0.027043
10/3/2019 18:04	1967.999	4.906	23.318	11.328	1962.78	0.088	0.025316
10/3/2019 18:05	2027.999	4.907	23.322	11.329	2022.78	0.087	0.025029
10/3/2019 18:06	2087.999	4.907	23.319	11.331	2082.78	0.085	0.024453
10/3/2019 18:07	2147.999	4.908	23.318	11.332	2142.78	0.084	0.024166

Report Date:		10/3/2019 18:09			
Report User Name:	SBirardi				
Report Computer Name:	KA210006				
Application:	WinSitu.exe				
Application Version:	5.7.6.1				

Log File Properties

File Name	MW-2 OUT_2019-10-03_18-09-51-704.wsl
Create Date	10/3/2019 18:09

Device Properties

Device	Level TROLL 700			
Site	Carlsbad Village Trench Project			
Device Name				
Serial Number	345086			
Firmware Version	2.13			
Hardware Version	3			
Device Address	1			
Device Comm Cfg	19200	8 Even	1	(Modbus-RTU)
Used Memory	14			
Used Battery	43			

Log Configuration

Log Name	MW-2 OUT
Created By	SBirardi
Computer Name	KA210006
Application	WinSitu.exe
Application Version	5.7.6.1
Create Date	10/3/2019 4:19:14 PM Pacific Daylight Time
Log Setup Time Zone	Pacific Daylight Time
Notes Size(bytes)	4096
Overwrite when full	Disabled
Scheduled Start Time	Manual Start
Scheduled Stop Time	No Stop Time
Type	True Logarithmic
Max Interval	Days: 0 hrs: 00 mins: 01 secs: 00

Level Reference Settings At Log Creation

Level Measurement Mode	Depth
Specific Gravity	0.999

Other Log Settings

Pressure Offset:	0.00443077 (PSI)
Depth of Probe:	11.3443 (ft)
Head Pressure:	4.91316 (PSI)
Temperature:	23.2486 (C)

Log Notes:

Date and Time	Note
10/3/2019 16:19	Used Battery: 43% Used Memory: 15% User Name: SBirardi
10/3/2019 16:19	Manual Start Command
10/3/2019 16:49	Used Battery: 43% Used Memory: 15% User Name: SBirardi
10/3/2019 16:49	Manual Stop Command

Log Data:

Record Count	126		
Sensors	1		
	1	345086	Pressure/Temp 15 PSIG (11m/35ft)

Time Zone: Pacific Daylight Time

Date and Time	Elapsed Time Seconds	Sensor: Pres(G) 35ft SN#: 345086 Pressure (PSI)	Sensor: Pres(G) 35ft SN#: 345086 Temperature (C)	Sensor: Pres(G) 35ft SN#: 345086 Depth (ft)		Displacement	Normalized	
10/3/2019 16:19	0	4.915	23.235	11.348				
10/3/2019 16:19	0.25	4.912	23.256	11.342				
10/3/2019 16:19	0.5	3.821	23.259	8.824				
10/3/2019 16:19	0.972	3.652	23.276	8.431				
10/3/2019 16:19	1.193	3.738	23.287	8.632				
10/3/2019 16:19	1.412	3.672	23.298	8.479				
10/3/2019 16:19	1.635	3.552	23.302	8.202				
10/3/2019 16:19	1.859	4.195	23.307	9.686				
10/3/2019 16:19	2.081	4.139	23.313	9.556				
10/3/2019 16:19	2.304	4.287	23.312	9.898				
10/3/2019 16:19	2.526	4.053	23.317	9.359				
10/3/2019 16:19	2.748	3.851	23.319	8.892				
10/3/2019 16:19	3.207	4.535	23.301	10.471				
10/3/2019 16:19	3.428	4.242	23.311	9.794				
10/3/2019 16:19	3.649	4.061	23.314	9.377				
10/3/2019 16:19	3.873	4.256	23.323	9.828				
10/3/2019 16:19	4.098	4.411	23.328	10.186				
10/3/2019 16:19	4.319	4.303	23.329	9.935				
10/3/2019 16:19	4.538	4.176	23.332	9.643				
10/3/2019 16:19	4.758	4.239	23.336	9.789				
10/3/2019 16:19	5	4.344	23.333	10.031				
10/3/2019 16:19	5.25	4.293	23.332	9.911				
10/3/2019 16:19	5.5	4.231	23.332	9.769				
10/3/2019 16:19	5.75	4.282	23.332	9.888				
10/3/2019 16:19	6	4.318	23.331	9.97				
10/3/2019 16:19	6.36	4.263	23.324	9.843	0	1.502	1	Transducer reading prior to slug out = 11.345
10/3/2019 16:19	7.187	4.281	23.34	9.886	0.827	1.459	0.971371505	
10/3/2019 16:19	7.409	4.28	23.344	9.881	1.049	1.464	0.974700399	

10/3/2019 16:19	7.631	4.295	23.345	9.917	1.271	1.428	0.950732357
10/3/2019 16:19	7.98	4.293	23.337	9.913	1.62	1.432	0.953395473
10/3/2019 16:19	8.46	4.294	23.317	9.914	2.1	1.431	0.952729694
10/3/2019 16:19	9	4.294	23.305	9.914	2.64	1.431	0.952729694
10/3/2019 16:19	9.48	4.299	23.307	9.927	3.12	1.418	0.944074567
10/3/2019 16:19	10.08	4.299	23.298	9.926	3.72	1.419	0.944740346
10/3/2019 16:19	11.024	4.302	23.334	9.934	4.664	1.411	0.939414115
10/3/2019 16:19	11.28	4.305	23.332	9.939	4.92	1.406	0.93608522
10/3/2019 16:19	11.94	4.307	23.306	9.946	5.58	1.399	0.931424767
10/3/2019 16:19	12.66	4.309	23.296	9.949	6.3	1.396	0.92942743
10/3/2019 16:19	13.44	4.31	23.289	9.953	7.08	1.392	0.926764314
10/3/2019 16:19	14.22	4.314	23.288	9.96	7.86	1.385	0.922103862
10/3/2019 16:19	15.056	4.317	23.33	9.968	8.696	1.377	0.91677763
10/3/2019 16:19	15.96	4.318	23.297	9.97	9.6	1.375	0.915446072
10/3/2019 16:19	16.92	4.321	23.287	9.978	10.56	1.367	0.91011984
10/3/2019 16:19	17.88	4.323	23.279	9.981	11.52	1.364	0.908122503
10/3/2019 16:19	19.048	4.326	23.326	9.988	12.688	1.357	0.903462051
10/3/2019 16:20	20.1	4.33	23.29	9.998	13.74	1.347	0.896804261
10/3/2019 16:20	21.3	4.332	23.282	10.003	14.94	1.342	0.893475366
10/3/2019 16:20	23.051	4.336	23.323	10.012	16.691	1.333	0.887483356
10/3/2019 16:20	23.88	4.338	23.292	10.017	17.52	1.328	0.884154461
10/3/2019 16:20	25.32	4.342	23.282	10.025	18.96	1.32	0.878828229
10/3/2019 16:20	27.056	4.344	23.321	10.031	20.696	1.314	0.874833555
10/3/2019 16:20	28.38	4.348	23.284	10.039	22.02	1.306	0.869507324
10/3/2019 16:20	30.06	4.352	23.273	10.048	23.7	1.297	0.863515313
10/3/2019 16:20	31.86	4.355	23.29	10.054	25.5	1.291	0.859520639
10/3/2019 16:20	33.72	4.358	23.274	10.064	27.36	1.281	0.85286285
10/3/2019 16:20	35.76	4.362	23.285	10.071	29.4	1.274	0.848202397
10/3/2019 16:20	37.86	4.367	23.271	10.083	31.5	1.262	0.840213049
10/3/2019 16:20	40.08	4.371	23.28	10.092	33.72	1.253	0.834221039
10/3/2019 16:20	42.48	4.377	23.27	10.105	36.12	1.24	0.825565912
10/3/2019 16:20	45	4.379	23.274	10.111	38.64	1.234	0.821571238
10/3/2019 16:20	47.64	4.384	23.289	10.123	41.28	1.222	0.813581891
10/3/2019 16:20	50.46	4.39	23.264	10.137	44.1	1.208	0.804260985
10/3/2019 16:20	53.46	4.394	23.273	10.146	47.1	1.199	0.798268975
10/3/2019 16:20	56.64	4.399	23.276	10.157	50.28	1.188	0.790945406
10/3/2019 16:20	60	4.406	23.279	10.173	53.64	1.172	0.780292943
10/3/2019 16:20	63.6	4.411	23.286	10.184	57.24	1.161	0.772969374
10/3/2019 16:20	67.2	4.417	23.303	10.199	60.84	1.146	0.76298269
10/3/2019 16:20	71.4	4.424	23.293	10.214	65.04	1.131	0.752996005
10/3/2019 16:20	75.6	4.429	23.286	10.227	69.24	1.118	0.744340879
10/3/2019 16:21	79.8	4.436	23.28	10.243	73.44	1.102	0.733688415
10/3/2019 16:21	84.612	4.442	23.272	10.256	78.252	1.089	0.725033289
10/3/2019 16:21	90	4.451	23.257	10.278	83.64	1.067	0.710386152
10/3/2019 16:21	95.218	4.461	23.304	10.301	88.858	1.044	0.695073236
10/3/2019 16:21	100.8	4.466	23.267	10.311	94.44	1.034	0.688415446
10/3/2019 16:21	107.25	4.474	23.304	10.331	100.89	1.014	0.675099867
10/3/2019 16:21	112.8	4.481	23.264	10.347	106.44	0.998	0.664447403
10/3/2019 16:21	119.4	4.49	23.294	10.366	113.04	0.979	0.651797603
10/3/2019 16:21	126.6	4.5	23.255	10.389	120.24	0.956	0.636484687
10/3/2019 16:21	134.4	4.509	23.253	10.412	128.04	0.933	0.621171771
10/3/2019 16:22	142.2	4.519	23.254	10.434	135.84	0.911	0.606524634
10/3/2019 16:22	150.6	4.528	23.252	10.455	144.24	0.89	0.592543276
10/3/2019 16:22	159.6	4.538	23.286	10.477	153.24	0.868	0.577896138
10/3/2019 16:22	169.2	4.549	23.26	10.503	162.84	0.842	0.560585885
10/3/2019 16:22	179.379	4.56	23.307	10.528	173.019	0.817	0.543941411
10/3/2019 16:22	189.599	4.571	23.258	10.554	183.239	0.791	0.526631158
10/3/2019 16:23	201	4.582	23.265	10.58	194.64	0.765	0.509320905
10/3/2019 16:23	213	4.594	23.266	10.608	206.64	0.737	0.490679095
10/3/2019 16:23	225.599	4.606	23.261	10.635	219.239	0.71	0.472703063
10/3/2019 16:23	238.8	4.621	23.258	10.67	232.44	0.675	0.449400799
10/3/2019 16:23	253.2	4.63	23.266	10.691	246.84	0.654	0.435419441
10/3/2019 16:24	268.2	4.642	23.283	10.717	261.84	0.628	0.418109188
10/3/2019 16:24	283.799	4.654	23.296	10.747	277.439	0.598	0.398135819
10/3/2019 16:24	300.599	4.667	23.282	10.776	294.239	0.569	0.378828229
10/3/2019 16:24	318.599	4.681	23.266	10.807	312.239	0.538	0.358189081
10/3/2019 16:25	337.2	4.693	23.276	10.836	330.84	0.509	0.338881491
10/3/2019 16:25	357.599	4.706	23.272	10.865	351.239	0.48	0.319573901
10/3/2019 16:25	378.599	4.719	23.274	10.896	372.239	0.449	0.298934754
10/3/2019 16:26	400.799	4.73	23.295	10.922	394.439	0.423	0.281624501
10/3/2019 16:26	424.799	4.743	23.294	10.952	418.439	0.393	0.261651132
10/3/2019 16:27	450	4.755	23.288	10.98	443.64	0.365	0.243009321
10/3/2019 16:27	476.4	4.767	23.31	11.007	470.04	0.338	0.225033289
10/3/2019 16:28	504.599	4.779	23.306	11.035	498.239	0.31	0.206391478
10/3/2019 16:28	534.599	4.792	23.289	11.063	528.239	0.282	0.187749667
10/3/2019 16:29	566.4	4.802	23.292	11.087	560.04	0.258	0.171770972
10/3/2019 16:29	600.265	4.813	23.337	11.112	593.905	0.233	0.155126498
10/3/2019 16:30	636.359	4.824	23.342	11.138	629.999	0.207	0.137816245
10/3/2019 16:30	672.474	4.834	23.343	11.161	666.114	0.184	0.122503329
10/3/2019 16:31	713.999	4.843	23.302	11.183	707.639	0.162	0.107856192
10/3/2019 16:32	755.999	4.85	23.292	11.198	749.639	0.147	0.097869507
10/3/2019 16:32	797.999	4.858	23.308	11.216	791.639	0.129	0.085885486
10/3/2019 16:33	845.999	4.865	23.308	11.234	839.639	0.111	0.073901465
10/3/2019 16:34	899.999	4.872	23.302	11.25	893.639	0.095	0.063249001
10/3/2019 16:35	947.999	4.878	23.307	11.263	941.639	0.082	0.054593875
10/3/2019 16:36	1007.999	4.884	23.312	11.277	1001.639	0.068	0.045272969
10/3/2019 16:37	1067.999	4.889	23.314	11.288	1061.639	0.057	0.037949401
10/3/2019 16:38	1127.999	4.893	23.32	11.297	1121.639	0.048	0.03195739
10/3/2019 16:39	1187.999	4.895	23.322	11.302	1181.639	0.043	0.028628495
10/3/2019 16:40	1247.999	4.898	23.318	11.31	1241.639	0.035	0.023302264
10/3/2019 16:41	1307.999	4.899	23.32	11.312	1301.639	0.033	0.021970706
10/3/2019 16:42	1367.999	4.901	23.318	11.317	1361.639	0.028	0.018641811
10/3/2019 16:43	1427.999	4.902	23.315	11.319	1421.639	0.026	0.017310253
10/3/2019 16:44	1487.999	4.905	23.317	11.326	1481.639	0.019	0.0126498
10/3/2019 16:45	1547.999	4.906	23.32	11.327	1541.639	0.018	0.011984021
10/3/2019 16:46	1607.999	4.907	23.316	11.331	1601.639	0.014	0.009320905
10/3/2019 16:47	1667.999	4.907	23.315	11.331	1661.639	0.014	0.009320905
10/3/2019 16:48	1727.999	4.907	23.311	11.331	1721.639	0.014	0.009320905

Report Date:		10/3/2019 14:41						
Report User Name:	SBirardi							
Report Computer Name:	KA210006							
Application:	WinSitu.exe							
Application Version:	5.7.6.1							

Log File Properties						
File Name	MW-3-IN_2_2019-10-03_14-41-46-799.wsl					
Create Date		10/3/2019 14:41				
Device Properties						
Device	Level TROLL 700					
Site	Carlsbad Village Trench Project					
Device Name						
Serial Number		345086				
Firmware Version		2.13				
Hardware Version		3				
Device Address		1				
Device Comm Cfg		19200	8	Even	1	(Modbus-RTU)
Used Memory		9				
Used Battery		43				

Log Configuration

Log Name	MW-3-IN_2
Created By	SBirardi
Computer Name	KA210006
Application	WinSitu.exe
Application Version	5.7.6.1
Create Date	10/3/2019 2:07:41 PM Pacific Daylight Time
Log Setup Time Zone	Pacific Daylight Time
Notes Size(bytes)	4096
Overwrite when full	Disabled
Scheduled Start Time	Manual Start
Scheduled Stop Time	No Stop Time
Type	True Logarithmic
Max Interval	Days: 0 hrs: 00 mins: 01 secs: 00

Level Reference Settings At Log Creation

Level Measurement Mode	Depth
Specific Gravity	0.999

Other Log Settings

Pressure Offset:	0.00443077 (PSI)
Depth of Probe:	7.59958 (ft)
Head Pressure:	3.29133 (PSI)
Temperature:	21.6362 (C)

Log Notes:

Date and Time	Note
10/3/2019 14:07	Used Battery: 43% Used Memory: 10% User Name: SBirardi
10/3/2019 14:10	Manual Start Command
10/3/2019 14:26	Used Battery: 43% Used Memory: 10% User Name: SBirardi
10/3/2019 14:26	Manual Stop Command

Log Data:

Record Count	112		
Sensors	1		
	1	345086	Pressure/Temp 15 PSIG (11m/35ft)

Time Zone: Pacific Daylight Time

Date and Time	Elapsed Time Seconds	Sensor: Pres(G) 35ft SN#: 345086 Pressure (PSI)	Sensor: Pres(G) 35ft SN#: 345086 Temperature (C)	Sensor: Pres(G) 35ft SN#: 345086 Depth (ft)			
10/3/2019 14:10	0	3.545	21.627	8.185			
10/3/2019 14:10	0.25	3.851	21.652	8.892			
10/3/2019 14:10	0.5	4.067	21.662	9.391			
10/3/2019 14:10	0.75	4.095	21.672	9.455			
10/3/2019 14:10	1	4.061	21.68	9.376			
10/3/2019 14:10	1.25	3.428	21.687	7.915			
10/3/2019 14:10	1.5	4.201	21.692	9.699	0	2.103	1
10/3/2019 14:10	1.75	4.01	21.693	9.258	0.25	1.662	0.790299572
10/3/2019 14:10	2	3.928	21.696	9.069	0.5	1.473	0.70042796
10/3/2019 14:10	2.25	3.837	21.699	8.86	0.75	1.264	0.601046125

10/3/2019 14:10	2.5	3.622	21.702	8.363	1	0.767	0.364717071
10/3/2019 14:10	2.75	3.997	21.706	9.228	1.25	1.632	0.776034237
10/3/2019 14:10	2.996	3.412	21.703	7.878	1.496	0.282	0.134094151
10/3/2019 14:10	3.25	3.707	21.711	8.56	1.75	0.964	0.458392772
10/3/2019 14:10	3.5	3.761	21.711	8.685	2	1.089	0.517831669
10/3/2019 14:10	3.75	4.08	21.713	9.42	2.25	1.824	0.867332382
10/3/2019 14:10	4	3.9	21.712	9.005	2.5	1.409	0.669995245
10/3/2019 14:10	4.25	3.768	21.713	8.699	2.75	1.103	0.524488825
10/3/2019 14:10	4.5	3.833	21.714	8.85	3	1.254	0.596291013
10/3/2019 14:10	4.75	3.564	21.716	8.228	3.25	0.632	0.300523062
10/3/2019 14:10	5	3.601	21.72	8.315	3.5	0.719	0.341892534
10/3/2019 14:10	5.25	3.576	21.72	8.257	3.75	0.661	0.314312886
10/3/2019 14:10	6.076	3.607	21.736	8.328	4.576	0.732	0.34807418
10/3/2019 14:10	6.296	3.602	21.732	8.317	4.796	0.721	0.342843557
10/3/2019 14:10	6.515	3.587	21.732	8.283	5.015	0.687	0.326676177
10/3/2019 14:10	6.736	3.577	21.735	8.259	5.236	0.663	0.315263909
10/3/2019 14:10	6.956	3.57	21.736	8.244	5.456	0.648	0.308131241
10/3/2019 14:10	7.177	3.564	21.739	8.228	5.677	0.632	0.300523062
10/3/2019 14:10	7.56	3.552	21.723	8.202	6.06	0.606	0.288159772
10/3/2019 14:10	7.98	3.53	21.714	8.151	6.48	0.555	0.263908702
10/3/2019 14:10	8.46	3.531	21.704	8.153	6.96	0.557	0.264859724
10/3/2019 14:11	9	3.514	21.696	8.113	7.5	0.517	0.245839277
10/3/2019 14:11	9.874	3.493	21.732	8.064	8.374	0.468	0.22253923
10/3/2019 14:11	10.095	3.49	21.737	8.058	8.595	0.462	0.219686163
10/3/2019 14:11	10.68	3.477	21.709	8.028	9.18	0.432	0.205420827
10/3/2019 14:11	11.28	3.465	21.699	8	9.78	0.404	0.192106515
10/3/2019 14:11	11.94	3.454	21.691	7.974	10.44	0.378	0.179743224
10/3/2019 14:11	12.66	3.442	21.684	7.947	11.16	0.351	0.166904422
10/3/2019 14:11	13.888	3.423	21.722	7.904	12.388	0.308	0.146457442
10/3/2019 14:11	14.22	3.418	21.713	7.892	12.72	0.296	0.140751308
10/3/2019 14:11	15.06	3.408	21.691	7.869	13.56	0.273	0.129814551
10/3/2019 14:11	15.96	3.398	21.682	7.845	14.46	0.249	0.118402282
10/3/2019 14:11	16.92	3.387	21.676	7.821	15.42	0.225	0.106990014
10/3/2019 14:11	17.903	3.378	21.725	7.8	16.403	0.204	0.09700428
10/3/2019 14:11	18.96	3.37	21.685	7.781	17.46	0.185	0.087969567
10/3/2019 14:11	20.1	3.361	21.679	7.76	18.6	0.164	0.077983833
10/3/2019 14:11	21.3	3.353	21.673	7.742	19.8	0.146	0.069424631
10/3/2019 14:11	22.56	3.345	21.699	7.724	21.06	0.128	0.06086543
10/3/2019 14:11	23.88	3.34	21.679	7.711	22.38	0.115	0.054683785
10/3/2019 14:11	25.932	3.33	21.717	7.689	24.432	0.093	0.044222539
10/3/2019 14:11	26.82	3.327	21.688	7.683	25.32	0.087	0.041369472
10/3/2019 14:11	28.38	3.322	21.675	7.67	26.88	0.074	0.035187827
10/3/2019 14:11	30.06	3.317	21.712	7.659	28.56	0.063	0.029957204
10/3/2019 14:11	31.86	3.313	21.674	7.651	30.36	0.055	0.026153115
10/3/2019 14:11	33.96	3.309	21.721	7.641	32.46	0.045	0.021398003
10/3/2019 14:11	35.76	3.306	21.676	7.633	34.26	0.037	0.017593913
10/3/2019 14:11	37.976	3.305	21.718	7.63	36.476	0.034	0.01616738
10/3/2019 14:11	40.08	3.302	21.675	7.624	38.58	0.028	0.013314313
10/3/2019 14:11	42.48	3.3	21.693	7.619	40.98	0.023	0.010936757
10/3/2019 14:11	45	3.299	21.67	7.617	43.5	0.021	0.009985735
10/3/2019 14:11	47.64	3.297	21.673	7.613	46.14	0.017	0.00808369
10/3/2019 14:11	50.46	3.296	21.694	7.611	48.96	0.015	0.007132668
10/3/2019 14:11	53.46	3.295	21.666	7.609	51.96	0.013	0.006181645
10/3/2019 14:11	56.64	3.294	21.669	7.607	55.14	0.011	0.005230623
10/3/2019 14:11	60	3.294	21.668	7.606	58.5	0.01	0.004755112
10/3/2019 14:11	63.6	3.294	21.673	7.605	62.1	0.009	0.004279601
10/3/2019 14:11	67.2	3.293	21.677	7.604	65.7	0.008	0.003804089
10/3/2019 14:12	71.4	3.294	21.672	7.607	69.9	0.011	0.005230623
10/3/2019 14:12	75.6	3.294	21.67	7.605	74.1	0.009	0.004279601
10/3/2019 14:12	79.8	3.294	21.674	7.606	78.3	0.01	0.004755112
10/3/2019 14:12	84.6	3.294	21.666	7.605	83.1	0.009	0.004279601
10/3/2019 14:12	90.162	3.294	21.713	7.605	88.662	0.009	0.004279601
10/3/2019 14:12	94.8	3.294	21.684	7.605	93.3	0.009	0.004279601
10/3/2019 14:12	100.8	3.293	21.661	7.604	99.3	0.008	0.003804089
10/3/2019 14:12	106.8	3.291	21.681	7.6	105.3	0.004	0.001902045
10/3/2019 14:12	112.8	3.292	21.661	7.601	111.3	0.005	0.002377556
10/3/2019 14:12	119.4	3.292	21.674	7.6	117.9	0.004	0.001902045
10/3/2019 14:12	126.6	3.293	21.689	7.603	125.1	0.007	0.003328578
10/3/2019 14:13	134.4	3.292	21.699	7.602	132.9	0.006	0.002853067
10/3/2019 14:13	142.335	3.292	21.708	7.602	140.835	0.006	0.002853067
10/3/2019 14:13	150.6	3.292	21.692	7.602	149.1	0.006	0.002853067
10/3/2019 14:13	159.6	3.292	21.67	7.6	158.1	0.004	0.001902045
10/3/2019 14:13	169.2	3.292	21.661	7.602	167.7	0.006	0.002853067
10/3/2019 14:13	178.8	3.293	21.69	7.603	177.3	0.007	0.003328578
10/3/2019 14:14	189.599	3.292	21.657	7.601	188.099	0.005	0.002377556
10/3/2019 14:14	201	3.292	21.659	7.601	199.5	0.005	0.002377556
10/3/2019 14:14	213	3.292	21.66	7.601	211.5	0.005	0.002377556
10/3/2019 14:14	225.599	3.293	21.655	7.603	224.099	0.007	0.003328578
10/3/2019 14:14	238.8	3.292	21.698	7.601	237.3	0.005	0.002377556
10/3/2019 14:15	253.2	3.292	21.659	7.601	251.7	0.005	0.002377556
10/3/2019 14:15	268.2	3.292	21.667	7.6	266.7	0.004	0.001902045
10/3/2019 14:15	283.799	3.292	21.673	7.6	282.299	0.004	0.001902045
10/3/2019 14:15	300.599	3.293	21.668	7.602	299.099	0.006	0.002853067

10/3/2019 14:16	319.044	3.292	21.702	7.602	317.544	0.006	0.002853067
10/3/2019 14:16	337.2	3.292	21.659	7.602	335.7	0.006	0.002853067
10/3/2019 14:16	357.599	3.292	21.657	7.602	356.099	0.006	0.002853067
10/3/2019 14:17	379.183	3.292	21.706	7.602	377.683	0.006	0.002853067
10/3/2019 14:17	400.799	3.292	21.662	7.601	399.299	0.005	0.002377556
10/3/2019 14:17	424.799	3.292	21.66	7.6	423.299	0.004	0.001902045
10/3/2019 14:18	450	3.292	21.654	7.6	448.5	0.004	0.001902045
10/3/2019 14:18	476.4	3.291	21.671	7.599	474.9	0.003	0.001426534
10/3/2019 14:19	504.599	3.292	21.666	7.601	503.099	0.005	0.002377556
10/3/2019 14:19	534.599	3.292	21.649	7.601	533.099	0.005	0.002377556
10/3/2019 14:20	566.4	3.292	21.653	7.6	564.9	0.004	0.001902045
10/3/2019 14:20	600.007	3.292	21.698	7.6	598.507	0.004	0.001902045
10/3/2019 14:21	636.135	3.291	21.698	7.599	634.635	0.003	0.001426534
10/3/2019 14:22	672.265	3.292	21.697	7.6	670.765	0.004	0.001902045
10/3/2019 14:22	713.999	3.292	21.654	7.601	712.499	0.005	0.002377556
10/3/2019 14:23	756.584	3.292	21.692	7.602	755.084	0.006	0.002853067
10/3/2019 14:24	797.999	3.291	21.657	7.598	796.499	0.002	0.000951022
10/3/2019 14:24	845.999	3.291	21.656	7.598	844.499	0.002	0.000951022
10/3/2019 14:25	899.999	3.294	21.643	7.605	898.499	0.009	0.004279601

Report Date: 10/3/2019 14:39
Report User Name: SBirardi
Report Computer Name: KA210006
Application: WinSitu.exe
Application Version: 5.7.6.1

Log File Properties
File Name MW-3-IN_2019-10-03_14-38-34-205.wsl
Create Date 10/3/2019 14:38

Device Properties

Device	Level TROLL 700				
Site	Carlsbad Village Trench Project				
Device Name					
Serial Number	345086				
Firmware Version	2.13				
Hardware Version	3				
Device Address	1				
Device Comm Cfg	19200	8	Even	1	(Modbus-RTU)
Used Memory	6				
Used Battery	43				

Log Configuration

Log Name	MW-3-IN
Created By	SBirardi
Computer Name	KA210006
Application	WinSitu.exe
Application Version	5.7.6.1
Create Date	10/3/2019 1:30:09 PM Pacific Daylight Time
Log Setup Time Zone	Pacific Daylight Time
Notes Size(bytes)	4096
Overwrite when full	Disabled
Scheduled Start Time	Manual Start
Scheduled Stop Time	No Stop Time
Type	True Logarithmic
Max Interval	Days: 0 hrs: 00 mins: 01 secs: 00

Level Reference Settings At Log Creation

Level Measurement Mode	Depth
Specific Gravity	0.999

Other Log Settings

Pressure Offset:	0.00443077 (PSI)
Depth of Probe:	7.60255 (ft)
Head Pressure:	3.29262 (PSI)
Temperature:	22.8603 (C)

Log Notes:

Date and Time	Note
10/3/2019 13:30	Used Battery: 43% Used Memory: 7% User Name: SBirardi
10/3/2019 13:31	Manual Start Command
10/3/2019 13:45	Used Battery: 43% Used Memory: 7% User Name: SBirardi
10/3/2019 13:45	Manual Stop Command

Log Data:
Record Count 111

Sensors 1

1 345086 Pressure/Temp 15 PSIG (11m/35ft)

Time Zone: Pacific Daylight Time

Date and Time	Elapsed Time Seconds	Sensor: Pres(G) 35ft SN#: 345086 Pressure (PSI)	Sensor: Pres(G) 35ft SN#: 345086 Temperature (C)	Sensor: Pres(G) 35ft SN#: 345086 Depth (ft)		Displacement	Normalized
10/3/2019 13:31	0	3.562	22.558	8.226			
10/3/2019 13:31	0.25	3.953	22.58	9.127			
10/3/2019 13:31	0.74	3.999	22.577	9.233			
10/3/2019 13:31	0.961	4.2	22.597	9.699	0	2.103	1

10/3/2019 13:31	1.183	4.136	22.604	9.55	0.222	1.954	0.929148835
10/3/2019 13:31	1.405	4.182	22.611	9.655	0.444	2.059	0.979077508
10/3/2019 13:31	1.624	4.146	22.62	9.573	0.663	1.977	0.940085592
10/3/2019 13:31	1.844	4.087	22.624	9.437	0.883	1.841	0.875416072
10/3/2019 13:31	2.063	4.01	22.626	9.26	1.102	1.664	0.791250594
10/3/2019 13:31	2.282	3.865	22.626	8.924	1.321	1.328	0.63147884
10/3/2019 13:31	2.5	3.688	22.633	8.516	1.539	0.92	0.437470281
10/3/2019 13:31	2.75	3.511	22.629	8.108	1.789	0.512	0.243461721
10/3/2019 13:31	3	3.555	22.631	8.208	2.039	0.612	0.291012839
10/3/2019 13:31	3.25	3.939	22.625	9.096	2.289	1.5	0.713266762
10/3/2019 13:31	3.5	3.607	22.626	8.328	2.539	0.732	0.34807418
10/3/2019 13:31	3.75	3.691	22.63	8.522	2.789	0.926	0.440323348
10/3/2019 13:31	4	3.658	22.631	8.445	3.039	0.849	0.403708987
10/3/2019 13:31	4.25	3.651	22.629	8.431	3.289	0.835	0.397051831
10/3/2019 13:31	4.5	3.641	22.629	8.408	3.539	0.812	0.386115074
10/3/2019 13:31	4.75	3.643	22.629	8.412	3.789	0.816	0.388017118
10/3/2019 13:31	5	3.628	22.626	8.377	4.039	0.781	0.371374227
10/3/2019 13:31	5.25	3.606	22.631	8.327	4.289	0.731	0.347598669
10/3/2019 13:31	5.5	3.609	22.625	8.334	4.539	0.738	0.350927247
10/3/2019 13:31	5.75	3.59	22.627	8.289	4.789	0.693	0.329529244
10/3/2019 13:31	6	3.582	22.627	8.271	5.039	0.675	0.320970043
10/3/2019 13:31	6.36	3.564	22.618	8.23	5.399	0.634	0.301474085
10/3/2019 13:31	6.72	3.558	22.614	8.216	5.759	0.62	0.294816928
10/3/2019 13:31	7.14	3.544	22.606	8.183	6.179	0.587	0.279125059
10/3/2019 13:31	7.56	3.532	22.599	8.154	6.599	0.558	0.265335235
10/3/2019 13:31	7.98	3.521	22.593	8.129	7.019	0.533	0.253447456
10/3/2019 13:31	8.46	3.507	22.59	8.098	7.499	0.502	0.23870661
10/3/2019 13:31	9	3.494	22.584	8.068	8.039	0.472	0.224441274
10/3/2019 13:31	9.48	3.483	22.58	8.042	8.519	0.446	0.212077984
10/3/2019 13:31	10.08	3.47	22.573	8.013	9.119	0.417	0.19828816
10/3/2019 13:31	10.68	3.459	22.571	7.987	9.719	0.391	0.185924869
10/3/2019 13:31	11.28	3.448	22.566	7.961	10.319	0.365	0.173561579
10/3/2019 13:31	11.94	3.436	22.559	7.934	10.979	0.338	0.160722777
10/3/2019 13:31	12.66	3.424	22.555	7.907	11.699	0.311	0.147883975
10/3/2019 13:31	13.44	3.414	22.551	7.883	12.479	0.287	0.136471707
10/3/2019 13:31	14.27	3.403	22.596	7.858	13.309	0.262	0.124583928
10/3/2019 13:31	15.06	3.393	22.563	7.834	14.099	0.238	0.11317166
10/3/2019 13:31	15.96	3.383	22.546	7.812	14.999	0.216	0.102710414
10/3/2019 13:31	16.92	3.374	22.538	7.79	15.959	0.194	0.092249168
10/3/2019 13:31	18.215	3.363	22.574	7.764	17.254	0.168	0.079885877
10/3/2019 13:31	18.96	3.358	22.545	7.752	17.999	0.156	0.074179743
10/3/2019 13:31	20.1	3.349	22.528	7.733	19.139	0.137	0.065145031
10/3/2019 13:31	21.3	3.341	22.522	7.715	20.339	0.119	0.05658583
10/3/2019 13:31	22.56	3.335	22.541	7.7	21.599	0.104	0.049453162
10/3/2019 13:31	23.88	3.329	22.511	7.686	22.919	0.09	0.042796006
10/3/2019 13:31	25.32	3.323	22.5	7.673	24.359	0.077	0.03661436
10/3/2019 13:31	26.82	3.318	22.513	7.661	25.859	0.065	0.030908226
10/3/2019 13:31	28.38	3.313	22.491	7.651	27.419	0.055	0.026153115
10/3/2019 13:31	30.258	3.309	22.523	7.641	29.297	0.045	0.021398003
10/3/2019 13:31	31.86	3.307	22.475	7.635	30.899	0.039	0.018544936
10/3/2019 13:31	34.273	3.303	22.507	7.627	33.312	0.031	0.014740846
10/3/2019 13:31	35.76	3.301	22.461	7.621	34.799	0.025	0.011887779
10/3/2019 13:31	38.288	3.297	22.49	7.614	37.327	0.018	0.008559201
10/3/2019 13:31	40.08	3.297	22.444	7.612	39.119	0.016	0.007608179
10/3/2019 13:31	42.48	3.295	22.457	7.607	41.519	0.011	0.005230623
10/3/2019 13:31	45	3.295	22.417	7.607	44.039	0.011	0.005230623
10/3/2019 13:31	47.64	3.293	22.415	7.605	46.679	0.009	0.004279601
10/3/2019 13:31	50.46	3.292	22.43	7.601	49.499	0.005	0.002377556
10/3/2019 13:32	53.46	3.292	22.379	7.601	52.499	0.005	0.002377556
10/3/2019 13:32	56.64	3.291	22.373	7.599	55.679	0.003	0.001426534
10/3/2019 13:32	60	3.291	22.366	7.599	59.039	0.003	0.001426534
10/3/2019 13:32	63.6	3.29	22.351	7.597	62.639	0.001	0.000475511
10/3/2019 13:32	67.199	3.29	22.343	7.596	66.238	0	0
10/3/2019 13:32	71.4	3.289	22.326	7.595	70.439	-0.001	-0.000475511
10/3/2019 13:32	75.6	3.291	22.312	7.598	74.639	0.002	0.000951022
10/3/2019 13:32	79.8	3.29	22.29	7.597	78.839	0.001	0.000475511
10/3/2019 13:32	84.6	3.291	22.268	7.599	83.639	0.003	0.001426534
10/3/2019 13:32	90.474	3.29	22.292	7.597	89.513	0.001	0.000475511
10/3/2019 13:32	94.8	3.29	22.263	7.597	93.839	0.001	0.000475511
10/3/2019 13:32	100.8	3.291	22.219	7.599	99.839	0.003	0.001426534
10/3/2019 13:32	106.8	3.29	22.229	7.596	105.839	0	0
10/3/2019 13:33	112.8	3.291	22.186	7.599	111.839	0.003	0.001426534
10/3/2019 13:33	119.399	3.291	22.176	7.598	118.438	0.002	0.000951022
10/3/2019 13:33	126.6	3.29	22.189	7.597	125.639	0.001	0.000475511
10/3/2019 13:33	134.679	3.29	22.169	7.596	133.718	0	0
10/3/2019 13:33	142.646	3.29	22.152	7.597	141.685	0.001	0.000475511
10/3/2019 13:33	150.676	3.29	22.132	7.595	149.715	-0.001	-0.000475511

10/3/2019 13:33	159.6	3.29	22.078	7.597	158.639	0.001	0.000475511
10/3/2019 13:33	169.199	3.291	22.046	7.599	168.238	0.003	0.001426534
10/3/2019 13:34	178.8	3.29	22.074	7.597	177.839	0.001	0.000475511
10/3/2019 13:34	189.599	3.29	22.007	7.597	188.638	0.001	0.000475511
10/3/2019 13:34	201	3.291	21.992	7.598	200.039	0.002	0.000951022
10/3/2019 13:34	213	3.29	21.972	7.597	212.039	0.001	0.000475511
10/3/2019 13:34	225.599	3.291	21.951	7.598	224.638	0.002	0.000951022
10/3/2019 13:35	238.992	3.289	21.977	7.595	238.031	-0.001	-0.000475511
10/3/2019 13:35	253.199	3.291	21.916	7.598	252.238	0.002	0.000951022
10/3/2019 13:35	268.199	3.29	21.907	7.597	267.238	0.001	0.000475511
10/3/2019 13:35	283.799	3.29	21.896	7.597	282.838	0.001	0.000475511
10/3/2019 13:36	300.599	3.29	21.868	7.595	299.638	-0.001	-0.000475511
10/3/2019 13:36	318.599	3.291	21.843	7.598	317.638	0.002	0.000951022
10/3/2019 13:36	337.199	3.29	21.833	7.596	336.238	0	0
10/3/2019 13:37	357.599	3.291	21.816	7.598	356.638	0.002	0.000951022
10/3/2019 13:37	378.599	3.291	21.797	7.598	377.638	0.002	0.000951022
10/3/2019 13:37	400.799	3.291	21.793	7.599	399.838	0.003	0.001426534
10/3/2019 13:38	424.799	3.29	21.777	7.597	423.838	0.001	0.000475511
10/3/2019 13:38	450	3.291	21.763	7.598	449.039	0.002	0.000951022
10/3/2019 13:39	476.399	3.29	21.761	7.596	475.438	0	0
10/3/2019 13:39	504.599	3.289	21.748	7.593	503.638	-0.003	-0.001426534
10/3/2019 13:40	534.599	3.291	21.716	7.598	533.638	0.002	0.000951022
10/3/2019 13:40	566.399	3.29	21.711	7.597	565.438	0.001	0.000475511
10/3/2019 13:41	600.288	3.29	21.745	7.597	599.327	0.001	0.000475511
10/3/2019 13:41	636.417	3.291	21.736	7.598	635.456	0.002	0.000951022
10/3/2019 13:42	672.548	3.291	21.726	7.598	671.587	0.002	0.000951022
10/3/2019 13:43	714	3.29	21.678	7.596	713.039	0	0
10/3/2019 13:43	756	3.29	21.66	7.597	755.039	0.001	0.000475511
10/3/2019 13:44	798	3.29	21.67	7.596	797.039	0	0
10/3/2019 13:45	846	3.289	21.666	7.595	845.039	-0.001	-0.000475511

Report Date: 10/3/2019 14:42
Report User Name: SBirardi
Report Computer Name: KA210006
Application: WinSitu.exe
Application Version: 5.7.6.1

Log File Properties
File Name MW-3-OUT_2_2019-10-03_14-42-13-877.wsl
Create Date 10/3/2019 14:42

Device Properties
Device Level TROLL 700
Site Carlsbad Village Trench Project
Device Name
Serial Number 345086
Firmware Version 2.13
Hardware Version 3
Device Address 1
Device Comm Cfg 19200 8 Even 1 (Modbus-RTU)
Used Memory 10
Used Battery 43

Log Configuration

Log Name	MW-3-OUT_2
Created By	SBirardi
Computer Name	KA210006
Application	WinSitu.exe
Application Version	5.7.6.1
Create Date	10/3/2019 2:26:42 PM Pacific Daylight Time
Log Setup Time Zone	Pacific Daylight Time
Notes Size(bytes)	4096
Overwrite when full	Disabled
Scheduled Start Time	Manual Start
Scheduled Stop Time	No Stop Time
Type	True Logarithmic
Max Interval	Days: 0 hrs: 00 mins: 01 secs: 00

Level Reference Settings At Log Creation

Level Measurement Mode	Depth
Specific Gravity	0.999

Other Log Settings

Pressure Offset:	0.00443077 (PSI)
Depth of Probe:	7.59877 (ft)
Head Pressure:	3.29098 (PSI)
Temperature:	21.6299 (C)

Log Notes:

Date and Time	Note
10/3/2019 14:26	Used Battery: 43% Used Memory: 12% User Name: SBirardi
10/3/2019 14:27	Manual Start Command
10/3/2019 14:37	Used Battery: 43% Used Memory: 12% User Name: SBirardi
10/3/2019 14:37	Manual Stop Command

Log Data:
Record Count 105

Sensors 1

1 345086 Pressure/Temp 15 PSIG (11m/35ft)

Time Zone: Pacific Daylight Time

Date and Time	Elapsed Time Seconds	Sensor: Pres(G) 35ft SN#: 345086 Pressure (PSI)	Sensor: Pres(G) 35ft SN#: 345086 Temperature (C)	Sensor: Pres(G) 35ft SN#: 345086 Depth (ft)			
10/3/2019 14:27	0	2.109	21.619	4.87			
10/3/2019 14:27	0.25	1.631	21.638	3.767	0	3.832	1
10/3/2019 14:27	0.5	2.696	21.612	6.226	0.25	1.373	0.358298539
10/3/2019 14:27	0.941	2.706	21.645	6.248	0.691	1.351	0.352557411
10/3/2019 14:27	1.161	2.712	21.661	6.263	0.911	1.336	0.348643006
10/3/2019 14:27	1.383	2.738	21.672	6.321	1.133	1.278	0.333507307
10/3/2019 14:27	1.602	2.768	21.718	6.39	1.352	1.209	0.315501044

10/3/2019 14:27	1.968	2.781	21.71	6.422	1.718	1.177	0.307150313
10/3/2019 14:27	2.191	2.797	21.705	6.459	1.941	1.14	0.297494781
10/3/2019 14:27	2.419	2.806	21.706	6.48	2.169	1.119	0.292014614
10/3/2019 14:27	2.639	2.816	21.707	6.502	2.389	1.097	0.286273486
10/3/2019 14:27	2.858	2.831	21.708	6.537	2.608	1.062	0.277139875
10/3/2019 14:27	3.078	2.851	21.712	6.583	2.828	1.016	0.265135699
10/3/2019 14:27	3.501	2.871	21.715	6.628	3.251	0.971	0.253392484
10/3/2019 14:27	3.92	2.893	21.721	6.679	3.67	0.92	0.240083507
10/3/2019 14:27	4.346	2.904	21.721	6.706	4.096	0.893	0.233037578
10/3/2019 14:27	4.566	2.912	21.719	6.724	4.316	0.875	0.228340292
10/3/2019 14:27	4.785	2.92	21.719	6.741	4.535	0.858	0.223903967
10/3/2019 14:27	5.005	2.928	21.721	6.761	4.755	0.838	0.21868476
10/3/2019 14:27	5.225	2.937	21.725	6.781	4.975	0.818	0.213465553
10/3/2019 14:27	5.445	2.946	21.724	6.802	5.195	0.797	0.207985386
10/3/2019 14:27	5.664	2.958	21.726	6.83	5.414	0.769	0.200678497
10/3/2019 14:27	5.883	2.959	21.726	6.833	5.633	0.766	0.199895616
10/3/2019 14:27	6.102	2.969	21.724	6.855	5.852	0.744	0.194154489
10/3/2019 14:27	6.321	2.976	21.726	6.871	6.071	0.728	0.189979123
10/3/2019 14:27	6.543	2.983	21.73	6.887	6.293	0.712	0.185803758
10/3/2019 14:27	6.764	2.991	21.729	6.906	6.514	0.693	0.180845511
10/3/2019 14:27	7.59	3.017	21.737	6.966	7.34	0.633	0.165187891
10/3/2019 14:27	7.813	3.024	21.736	6.983	7.563	0.616	0.160751566
10/3/2019 14:27	8.034	3.029	21.737	6.993	7.784	0.606	0.158141962
10/3/2019 14:27	8.46	3.039	21.716	7.016	8.21	0.583	0.152139875
10/3/2019 14:27	9	3.054	21.698	7.05	8.75	0.549	0.143267223
10/3/2019 14:27	9.48	3.065	21.693	7.077	9.23	0.522	0.136221294
10/3/2019 14:27	10.08	3.078	21.685	7.107	9.83	0.492	0.128392484
10/3/2019 14:27	10.68	3.092	21.679	7.139	10.43	0.46	0.120041754
10/3/2019 14:27	11.531	3.108	21.721	7.177	11.281	0.422	0.110125261
10/3/2019 14:27	11.94	3.115	21.705	7.194	11.69	0.405	0.105688935
10/3/2019 14:27	12.66	3.128	21.686	7.223	12.41	0.376	0.098121086
10/3/2019 14:27	13.44	3.141	21.681	7.253	13.19	0.346	0.090292276
10/3/2019 14:27	14.22	3.151	21.675	7.276	13.97	0.323	0.084290188
10/3/2019 14:27	15.545	3.169	21.71	7.318	15.295	0.281	0.073329854
10/3/2019 14:27	15.96	3.174	21.703	7.329	15.71	0.27	0.07045929
10/3/2019 14:27	16.92	3.185	21.681	7.355	16.67	0.244	0.063674322
10/3/2019 14:27	17.88	3.196	21.671	7.379	17.63	0.22	0.057411273
10/3/2019 14:27	19.56	3.21	21.708	7.411	19.31	0.188	0.049060543
10/3/2019 14:27	20.1	3.215	21.693	7.423	19.85	0.176	0.045929019
10/3/2019 14:27	21.3	3.224	21.678	7.443	21.05	0.156	0.040709812
10/3/2019 14:27	22.56	3.229	21.668	7.455	22.31	0.144	0.037578288
10/3/2019 14:27	23.88	3.238	21.694	7.477	23.63	0.122	0.031837161
10/3/2019 14:27	25.32	3.247	21.674	7.496	25.07	0.103	0.026878914
10/3/2019 14:27	26.82	3.252	21.66	7.51	26.57	0.089	0.02322547
10/3/2019 14:27	28.38	3.259	21.683	7.524	28.13	0.075	0.019572025
10/3/2019 14:27	30.06	3.264	21.665	7.537	29.81	0.062	0.016179541
10/3/2019 14:27	31.86	3.268	21.693	7.546	31.61	0.053	0.013830898
10/3/2019 14:27	33.72	3.272	21.667	7.556	33.47	0.043	0.011221294
10/3/2019 14:27	35.76	3.276	21.698	7.564	35.51	0.035	0.009133612
10/3/2019 14:27	37.86	3.278	21.664	7.57	37.61	0.029	0.00756785
10/3/2019 14:27	40.08	3.281	21.685	7.575	39.83	0.024	0.006263048
10/3/2019 14:27	42.48	3.284	21.658	7.582	42.23	0.017	0.004436326
10/3/2019 14:27	45	3.285	21.669	7.584	44.75	0.015	0.003914405
10/3/2019 14:27	47.659	3.284	21.704	7.583	47.409	0.016	0.004175365
10/3/2019 14:27	50.46	3.287	21.657	7.59	50.21	0.009	0.002348643
10/3/2019 14:28	53.46	3.288	21.66	7.593	53.21	0.006	0.001565762
10/3/2019 14:28	56.64	3.287	21.669	7.588	56.39	0.011	0.002870564
10/3/2019 14:28	60	3.291	21.684	7.6	59.75	-0.001	-0.00026096
10/3/2019 14:28	63.718	3.294	21.701	7.606	63.468	-0.007	-0.001826722
10/3/2019 14:28	67.733	3.291	21.701	7.599	67.483	0	0
10/3/2019 14:28	71.748	3.291	21.7	7.598	71.498	0.001	0.00026096
10/3/2019 14:28	75.763	3.292	21.7	7.601	75.513	-0.002	-0.000521921
10/3/2019 14:28	79.8	3.291	21.699	7.599	79.55	0	0
10/3/2019 14:28	84.6	3.29	21.665	7.598	84.35	0.001	0.00026096
10/3/2019 14:28	90	3.291	21.653	7.599	89.75	0	0
10/3/2019 14:28	94.8	3.291	21.647	7.599	94.55	0	0
10/3/2019 14:28	100.8	3.291	21.661	7.6	100.55	-0.001	-0.00026096
10/3/2019 14:28	106.8	3.291	21.646	7.599	106.55	0	0
10/3/2019 14:29	112.8	3.291	21.659	7.599	112.55	0	0
10/3/2019 14:29	119.92	3.291	21.688	7.599	119.67	0	0
10/3/2019 14:29	126.6	3.291	21.643	7.599	126.35	0	0
10/3/2019 14:29	134.4	3.292	21.641	7.601	134.15	-0.002	-0.000521921
10/3/2019 14:29	142.2	3.292	21.641	7.6	141.95	-0.001	-0.00026096
10/3/2019 14:29	150.6	3.291	21.638	7.599	150.35	0	0
10/3/2019 14:29	160.064	3.29	21.687	7.596	159.814	0.003	0.000782881
10/3/2019 14:29	169.2	3.291	21.647	7.599	168.95	0	0
10/3/2019 14:30	178.8	3.291	21.637	7.599	178.55	0	0
10/3/2019 14:30	189.6	3.291	21.645	7.6	189.35	-0.001	-0.00026096
10/3/2019 14:30	201	3.291	21.653	7.599	200.75	0	0
10/3/2019 14:30	213	3.291	21.656	7.6	212.75	-0.001	-0.00026096

10/3/2019 14:30	225.6	3.292	21.642	7.602	225.35	-0.003	-0.000782881
10/3/2019 14:31	238.8	3.292	21.631	7.6	238.55	-0.001	-0.00026096
10/3/2019 14:31	253.2	3.29	21.649	7.597	252.95	0.002	0.000521921
10/3/2019 14:31	268.452	3.29	21.681	7.597	268.202	0.002	0.000521921
10/3/2019 14:31	283.8	3.294	21.63	7.606	283.55	-0.007	-0.001826722
10/3/2019 14:32	300.602	3.291	21.676	7.599	300.352	0	0
10/3/2019 14:32	318.6	3.292	21.637	7.601	318.35	-0.002	-0.000521921
10/3/2019 14:32	337.2	3.291	21.657	7.599	336.95	0	0
10/3/2019 14:33	357.6	3.291	21.647	7.599	357.35	0	0
10/3/2019 14:33	378.6	3.291	21.639	7.598	378.35	0.001	0.00026096
10/3/2019 14:33	400.926	3.29	21.68	7.597	400.676	0.002	0.000521921
10/3/2019 14:34	425.03	3.292	21.682	7.6	424.78	-0.001	-0.00026096
10/3/2019 14:34	450	3.29	21.647	7.598	449.75	0.001	0.00026096
10/3/2019 14:35	476.4	3.291	21.635	7.599	476.15	0	0
10/3/2019 14:35	504.6	3.295	21.634	7.609	504.35	-0.01	-0.002609603
10/3/2019 14:36	534.6	3.293	21.644	7.603	534.35	-0.004	-0.001043841
10/3/2019 14:36	566.4	3.292	21.614	7.602	566.15	-0.003	-0.000782881
10/3/2019 14:37	600	3.292	21.606	7.602	599.75	-0.003	-0.000782881

Report Date:	10/3/2019 14:40			
Report User Name:	SBirardi			
Report Computer Name:	KA210006			
Application:	WinSitu.exe			
Application Version:	5.7.6.1			

Log File Properties

File Name	MW-3-OUT_2019-10-03_14-40-20-663.wsl
Create Date	10/3/2019 14:40

Device Properties

Device	Level TROLL 700			
Site	Carlsbad Village Trench Project			
Device Name				
Serial Number	345086			
Firmware Version	2.13			
Hardware Version	3			
Device Address	1			
Device Comm Cfg	19200	8 Even	1	(Modbus-RTU)
Used Memory	7			
Used Battery	43			

Log Configuration

Log Name	MW-3-OUT
Created By	SBirardi
Computer Name	KA210006
Application	WinSitu.exe
Application Version	5.7.6.1
Create Date	10/3/2019 1:45:56 PM Pacific Daylight Time
Log Setup Time Zone	Pacific Daylight Time
Notes Size(bytes)	4096
Overwrite when full	Disabled
Scheduled Start Time	Manual Start
Scheduled Stop Time	No Stop Time
Type	True Logarithmic
Max Interval	Days: 0 hrs: 00 mins: 01 secs: 00

Level Reference Settings At Log Creation

Level Measurement Mode	Depth
Specific Gravity	0.999

Other Log Settings

Pressure Offset:	0.00443077 (PSI)
Depth of Probe:	7.5959 (ft)
Head Pressure:	3.28974 (PSI)
Temperature:	21.6347 (C)

Log Notes:

Date and Time	Note
10/3/2019 13:46	Used Battery: 43% Used Memory: 9% User Name: SBirardi
10/3/2019 13:46	Manual Start Command
10/3/2019 14:06	Used Battery: 43% Used Memory: 9% User Name: SBirardi
10/3/2019 14:06	Manual Stop Command

Log Data:

Record Count	117		
Sensors	1		
	1	345086	Pressure/Temp 15 PSIG (11m/35ft)

Time Zone: Pacific Daylight Time

Date and Time	Elapsed Time Seconds	Sensor: Pres(G) 35ft SN#: 345086 Pressure (PSI)	Sensor: Pres(G) 35ft SN#: 345086 Temperature (C)	Sensor: Pres(G) 35ft SN#: 345086 Depth (ft)
10/3/2019 13:46	0	3.358	21.616	7.752
10/3/2019 13:46	0.251	2.775	21.641	6.408

10/3/2019 13:46	0.501	1.886	21.615	4.354	0	3.242	1
10/3/2019 13:46	0.941	2.035	21.649	4.698	0.44	2.898	0.893892659
10/3/2019 13:46	1.162	2.543	21.665	5.872	0.661	1.724	0.531770512
10/3/2019 13:46	1.383	2.691	21.673	6.213	0.882	1.383	0.426588526
10/3/2019 13:46	1.604	2.707	21.691	6.249	1.103	1.347	0.415484269
10/3/2019 13:46	1.868	2.715	21.692	6.27	1.367	1.326	0.409006786
10/3/2019 13:46	2.089	2.742	21.698	6.332	1.588	1.264	0.389882788
10/3/2019 13:46	2.309	2.759	21.698	6.371	1.808	1.225	0.377853177
10/3/2019 13:46	2.528	2.767	21.701	6.388	2.027	1.208	0.3726095
10/3/2019 13:46	2.748	2.782	21.707	6.424	2.247	1.172	0.361505244
10/3/2019 13:46	3.001	2.795	21.704	6.454	2.5	1.142	0.352251696
10/3/2019 13:46	3.251	2.809	21.707	6.486	2.75	1.11	0.342381246
10/3/2019 13:46	3.501	2.828	21.705	6.53	3	1.066	0.328809377
10/3/2019 13:46	3.751	2.841	21.705	6.56	3.25	1.036	0.31955583
10/3/2019 13:46	4.001	2.852	21.71	6.585	3.5	1.011	0.31184454
10/3/2019 13:46	4.251	2.867	21.705	6.619	3.75	0.977	0.301357187
10/3/2019 13:46	4.501	2.878	21.71	6.646	4	0.95	0.293028994
10/3/2019 13:46	4.751	2.888	21.706	6.668	4.25	0.928	0.28624306
10/3/2019 13:46	5.001	2.9	21.711	6.696	4.5	0.9	0.277606416
10/3/2019 13:46	5.251	2.91	21.711	6.72	4.75	0.876	0.270203578
10/3/2019 13:46	5.501	2.922	21.712	6.747	5	0.849	0.261875386
10/3/2019 13:46	5.751	2.932	21.715	6.77	5.25	0.826	0.254780999
10/3/2019 13:46	6.001	2.939	21.715	6.787	5.5	0.809	0.249537323
10/3/2019 13:46	6.836	2.97	21.73	6.857	6.335	0.739	0.227945713
10/3/2019 13:46	7.072	2.98	21.727	6.88	6.571	0.716	0.220851326
10/3/2019 13:46	7.293	2.987	21.732	6.897	6.792	0.699	0.21560765
10/3/2019 13:46	7.56	2.997	21.725	6.919	7.059	0.677	0.208821715
10/3/2019 13:46	7.98	3.008	21.708	6.945	7.479	0.651	0.200801974
10/3/2019 13:46	8.461	3.022	21.698	6.979	7.96	0.617	0.190314621
10/3/2019 13:46	9	3.038	21.691	7.014	8.499	0.582	0.179518816
10/3/2019 13:46	9.48	3.05	21.691	7.044	8.979	0.552	0.170265268
10/3/2019 13:46	10.081	3.065	21.681	7.077	9.58	0.519	0.160086366
10/3/2019 13:46	10.914	3.084	21.725	7.121	10.413	0.475	0.146514497
10/3/2019 13:46	11.28	3.092	21.711	7.14	10.779	0.456	0.140653917
10/3/2019 13:46	11.94	3.105	21.689	7.168	11.439	0.428	0.132017273
10/3/2019 13:46	12.66	3.119	21.681	7.201	12.159	0.395	0.121838371
10/3/2019 13:46	13.44	3.133	21.673	7.234	12.939	0.362	0.111659469
10/3/2019 13:46	14.826	3.153	21.712	7.281	14.325	0.315	0.097162246
10/3/2019 13:46	15.06	3.158	21.717	7.291	14.559	0.305	0.09407773
10/3/2019 13:46	15.96	3.168	21.685	7.315	15.459	0.281	0.086674892
10/3/2019 13:46	16.92	3.18	21.672	7.343	16.419	0.253	0.078038248
10/3/2019 13:46	17.88	3.19	21.668	7.365	17.379	0.231	0.071252313
10/3/2019 13:46	18.96	3.201	21.706	7.391	18.459	0.205	0.063232572
10/3/2019 13:46	20.101	3.211	21.676	7.415	19.6	0.181	0.055829735
10/3/2019 13:46	21.3	3.219	21.667	7.433	20.799	0.163	0.050277606
10/3/2019 13:46	22.871	3.231	21.711	7.461	22.37	0.135	0.041640962
10/3/2019 13:46	23.88	3.237	21.678	7.474	23.379	0.122	0.037631092
10/3/2019 13:46	25.321	3.244	21.666	7.49	24.82	0.106	0.032695867
10/3/2019 13:46	26.885	3.251	21.712	7.506	26.384	0.09	0.027760642
10/3/2019 13:46	28.38	3.256	21.669	7.518	27.879	0.078	0.024059223
10/3/2019 13:46	30.06	3.261	21.663	7.53	29.559	0.066	0.020357804
10/3/2019 13:46	31.86	3.266	21.675	7.54	31.359	0.056	0.017273288
10/3/2019 13:46	33.72	3.27	21.661	7.55	33.219	0.046	0.014188772
10/3/2019 13:46	35.76	3.273	21.674	7.557	35.259	0.039	0.012029611
10/3/2019 13:46	37.86	3.278	21.662	7.568	37.359	0.028	0.008636644
10/3/2019 13:46	40.08	3.281	21.671	7.575	39.579	0.021	0.006477483
10/3/2019 13:47	42.944	3.282	21.708	7.578	42.443	0.018	0.005552128
10/3/2019 13:47	45	3.283	21.659	7.58	44.499	0.016	0.004935225
10/3/2019 13:47	47.64	3.285	21.676	7.585	47.139	0.011	0.003392967
10/3/2019 13:47	50.974	3.287	21.706	7.59	50.473	0.006	0.001850709
10/3/2019 13:47	53.46	3.288	21.659	7.591	52.959	0.005	0.001542258
10/3/2019 13:47	56.64	3.29	21.662	7.596	56.139	0	0
10/3/2019 13:47	60	3.292	21.666	7.6	59.499	-0.004	-0.001233806
10/3/2019 13:47	63.6	3.292	21.671	7.601	63.099	-0.005	-0.001542258
10/3/2019 13:47	67.2	3.292	21.686	7.601	66.699	-0.005	-0.001542258
10/3/2019 13:47	71.4	3.292	21.674	7.601	70.899	-0.005	-0.001542258
10/3/2019 13:47	75.6	3.292	21.672	7.602	75.099	-0.006	-0.001850709
10/3/2019 13:47	79.8	3.293	21.666	7.604	79.299	-0.008	-0.002467613
10/3/2019 13:47	84.6	3.292	21.659	7.601	84.099	-0.005	-0.001542258
10/3/2019 13:47	90	3.292	21.645	7.602	89.499	-0.006	-0.001850709
10/3/2019 13:47	95.116	3.292	21.693	7.601	94.615	-0.005	-0.001542258
10/3/2019 13:47	100.8	3.293	21.651	7.604	100.299	-0.008	-0.002467613
10/3/2019 13:48	107.156	3.293	21.691	7.603	106.655	-0.007	-0.002159161
10/3/2019 13:48	112.8	3.293	21.65	7.603	112.299	-0.007	-0.002159161
10/3/2019 13:48	119.4	3.292	21.683	7.602	118.899	-0.006	-0.001850709

10/3/2019 13:48	126.6	3.294	21.642	7.605	126.099	-0.009	-0.002776064
10/3/2019 13:48	134.4	3.293	21.641	7.605	133.899	-0.009	-0.002776064
10/3/2019 13:48	142.2	3.293	21.642	7.603	141.699	-0.007	-0.002159161
10/3/2019 13:48	150.6	3.297	21.641	7.612	150.099	-0.016	-0.004935225
10/3/2019 13:48	159.6	3.293	21.677	7.603	159.099	-0.007	-0.002159161
10/3/2019 13:49	169.2	3.294	21.643	7.605	168.699	-0.009	-0.002776064
10/3/2019 13:49	178.8	3.294	21.639	7.606	178.299	-0.01	-0.003084516
10/3/2019 13:49	189.6	3.293	21.646	7.603	189.099	-0.007	-0.002159161
10/3/2019 13:49	201	3.294	21.649	7.605	200.499	-0.009	-0.002776064
10/3/2019 13:49	213	3.293	21.651	7.603	212.499	-0.007	-0.002159161
10/3/2019 13:50	225.6	3.293	21.646	7.603	225.099	-0.007	-0.002159161
10/3/2019 13:50	238.8	3.293	21.64	7.603	238.299	-0.007	-0.002159161
10/3/2019 13:50	253.2	3.292	21.647	7.602	252.699	-0.006	-0.001850709
10/3/2019 13:50	268.2	3.293	21.667	7.604	267.699	-0.008	-0.002467613
10/3/2019 13:51	283.8	3.293	21.689	7.604	283.299	-0.008	-0.002467613
10/3/2019 13:51	300.6	3.293	21.655	7.603	300.099	-0.007	-0.002159161
10/3/2019 13:51	318.6	3.292	21.645	7.602	318.099	-0.006	-0.001850709
10/3/2019 13:51	337.2	3.293	21.658	7.603	336.699	-0.007	-0.002159161
10/3/2019 13:52	357.6	3.292	21.656	7.6	357.099	-0.004	-0.001233806
10/3/2019 13:52	378.6	3.293	21.649	7.604	378.099	-0.008	-0.002467613
10/3/2019 13:52	400.8	3.293	21.673	7.603	400.299	-0.007	-0.002159161
10/3/2019 13:53	424.8	3.293	21.676	7.604	424.299	-0.008	-0.002467613
10/3/2019 13:53	450	3.293	21.659	7.604	449.499	-0.008	-0.002467613
10/3/2019 13:54	476.497	3.293	21.7	7.604	475.996	-0.008	-0.002467613
10/3/2019 13:54	504.616	3.293	21.704	7.604	504.115	-0.008	-0.002467613
10/3/2019 13:55	534.6	3.292	21.657	7.602	534.099	-0.006	-0.001850709
10/3/2019 13:55	566.4	3.294	21.657	7.606	565.899	-0.01	-0.003084516
10/3/2019 13:56	600	3.294	21.652	7.605	599.499	-0.009	-0.002776064
10/3/2019 13:56	636	3.293	21.652	7.602	635.499	-0.006	-0.001850709
10/3/2019 13:57	672	3.294	21.654	7.606	671.499	-0.01	-0.003084516
10/3/2019 13:58	714	3.293	21.67	7.604	713.499	-0.008	-0.002467613
10/3/2019 13:58	756	3.293	21.655	7.603	755.499	-0.007	-0.002159161
10/3/2019 13:59	798	3.294	21.685	7.605	797.499	-0.009	-0.002776064
10/3/2019 14:00	846	3.293	21.693	7.604	845.499	-0.008	-0.002467613
10/3/2019 14:01	900	3.293	21.662	7.604	899.499	-0.008	-0.002467613
10/3/2019 14:02	948	3.293	21.666	7.604	947.499	-0.008	-0.002467613
10/3/2019 14:03	1008	3.293	21.668	7.604	1007.499	-0.008	-0.002467613
10/3/2019 14:04	1068	3.294	21.677	7.605	1067.499	-0.009	-0.002776064
10/3/2019 14:05	1128	3.293	21.678	7.605	1127.499	-0.009	-0.002776064
10/3/2019 14:06	1188	3.294	21.681	7.605	1187.499	-0.009	-0.002776064

Report Date:	10/2/2019 19:26				
Report User Name:	SBirardi				
Report Computer Name:	KA210006				
Application:	WinSitu.exe				
Application Version:	5.7.6.1				

Log File Properties

File Name	MW-4 IN_2019-10-02_19-25-04-645.wsl
Create Date	10/2/2019 19:25

Device Properties

Device	Level TROLL 700				
Site	Carlsbad Village Trench Project				
Device Name					
Serial Number	345086				
Firmware Version	2.13				
Hardware Version	3				
Device Address	1				
Device Comm Cfg	19200	8	Even	1	(Modbus-RTU)
Used Memory	0				
Used Battery	43				

Log Configuration

Log Name	MW-4 IN
Created By	SBirardi
Computer Name	KA210006
Application	WinSitu.exe
Application Version	5.7.6.1
Create Date	10/2/2019 3:28:55 PM Pacific Daylight Time
Log Setup Time Zone	Pacific Daylight Time
Notes Size(bytes)	4096
Overwrite when full	Disabled
Scheduled Start Time	Manual Start
Scheduled Stop Time	No Stop Time
Type	True Logarithmic
Max Interval	Days: 0 hrs: 00 mins: 01 secs: 00

Level Reference Settings At Log Creation

Level Measurement Mode	Depth
Specific Gravity	0.999

Other Log Settings

Pressure Offset:	0.00443077 (PSI)
Depth of Probe:	-0.00460439 (ft)
Head Pressure:	-0.00199413 (PSI)
Temperature:	25.1174 (C)

Log Notes:

Date and Time	Note
10/2/2019 15:28	Used Battery: 43% Used Memory: 1% User Name: SBirardi
10/2/2019 15:33	Manual Start Command
10/2/2019 16:24	Suspend Command
10/2/2019 16:24	Used Battery: 43% Used Memory: 1% User Name: SBirardi
10/2/2019 16:24	Manual Stop Command

Log Data:

Record Count	147		
Sensors	1		
	1	345086	Pressure/Temp 15 PSIG (11m/35ft)

Time Zone: Pacific Daylight Time

Date and Time	Elapsed Time Seconds	Sensor: Pres(G) 35ft SN#: 345086 Pressure (PSI)	Sensor: Pres(G) 35ft SN#: 345086 Temperature (C)	Sensor: Pres(G) 35ft SN#: 345086 Depth (ft)
10/2/2019 15:33	0	6.779	23.088	15.653
10/2/2019 15:33	0.25	6.781	23.108	15.657
10/2/2019 15:33	0.5	6.783	23.127	15.661

10/2/2019 15:33	0.75	6.781	23.134	15.657			
10/2/2019 15:33	1	6.781	23.138	15.658			
10/2/2019 15:33	1.25	6.778	23.143	15.65			
10/2/2019 15:33	1.5	6.898	23.146	15.928			
10/2/2019 15:33	1.75	7.237	23.148	16.711			
10/2/2019 15:33	2	6.907	23.153	15.948			
10/2/2019 15:33	2.25	7.151	23.157	16.512			
10/2/2019 15:33	2.5	7.201	23.154	16.627			
10/2/2019 15:33	2.75	7.26	23.156	16.762			
10/2/2019 15:33	3	7.071	23.159	16.328			
10/2/2019 15:33	3.25	7.014	23.159	16.196			
10/2/2019 15:33	3.5	7.26	23.158	16.762			
10/2/2019 15:33	3.75	7.12	23.159	16.44			
10/2/2019 15:33	4	7.195	23.16	16.613			
10/2/2019 15:33	4.25	7.086	23.16	16.361			
10/2/2019 15:33	4.5	7.01	23.162	16.185			
10/2/2019 15:33	4.75	7.131	23.162	16.465			
10/2/2019 15:33	5	7.365	23.16	17.005			
10/2/2019 15:33	5.25	7.247	23.161	16.733			
10/2/2019 15:33	5.5	6.913	23.162	15.962			
10/2/2019 15:34	5.75	7.414	23.162	17.118	0	1.489	1
10/2/2019 15:34	6.001	7.344	23.158	16.958	0.251	1.329	0.892545332
10/2/2019 15:34	6.361	7.329	23.149	16.922	0.611	1.293	0.868368032
10/2/2019 15:34	6.721	7.092	23.142	16.376	0.971	0.747	0.501678979
10/2/2019 15:34	7.141	7.196	23.138	16.615	1.391	0.986	0.662189389
10/2/2019 15:34	7.561	6.866	23.129	15.854	1.811	0.225	0.151108126
10/2/2019 15:34	7.98	7.135	23.128	16.476	2.23	0.847	0.568838146
10/2/2019 15:34	8.461	6.804	23.119	15.709	2.711	0.08	0.053727334
10/2/2019 15:34	9	6.973	23.114	16.1	3.25	0.471	0.316319678
10/2/2019 15:34	9.48	6.91	23.111	15.955	3.73	0.326	0.218938885
10/2/2019 15:34	10.081	6.908	23.104	15.95	4.331	0.321	0.215580927
10/2/2019 15:34	10.681	6.906	23.103	15.945	4.931	0.316	0.212222968
10/2/2019 15:34	11.28	6.908	23.098	15.951	5.53	0.322	0.216252518
10/2/2019 15:34	11.94	6.901	23.092	15.934	6.19	0.305	0.20483546
10/2/2019 15:34	12.66	6.897	23.091	15.925	6.91	0.296	0.198791135
10/2/2019 15:34	13.44	6.892	23.081	15.913	7.69	0.284	0.190732035
10/2/2019 15:34	14.22	6.89	23.08	15.909	8.47	0.28	0.188045668
10/2/2019 15:34	15.06	6.886	23.075	15.901	9.31	0.272	0.182672935
10/2/2019 15:34	15.96	6.884	23.069	15.894	10.21	0.265	0.177971793
10/2/2019 15:34	16.92	6.881	23.067	15.888	11.17	0.259	0.173942243
10/2/2019 15:34	17.88	6.878	23.061	15.882	12.13	0.253	0.169912693
10/2/2019 15:34	18.96	6.875	23.055	15.875	13.21	0.246	0.165211551
10/2/2019 15:34	20.101	6.872	23.049	15.868	14.351	0.239	0.16051041
10/2/2019 15:34	21.38	6.868	23.094	15.859	15.63	0.23	0.154466085
10/2/2019 15:34	22.56	6.867	23.052	15.856	16.81	0.227	0.15245131
10/2/2019 15:34	23.88	6.863	23.043	15.846	18.13	0.217	0.145735393
10/2/2019 15:34	25.32	6.86	23.03	15.839	19.57	0.21	0.141034251
10/2/2019 15:34	26.82	6.857	23.049	15.832	21.07	0.203	0.136333109
10/2/2019 15:34	28.38	6.854	23.025	15.826	22.63	0.197	0.132303559
10/2/2019 15:34	30.06	6.852	23.018	15.82	24.31	0.191	0.128274009
10/2/2019 15:34	31.86	6.849	23.027	15.814	26.11	0.185	0.124244459
10/2/2019 15:34	33.72	6.846	23.004	15.806	27.97	0.177	0.118871726
10/2/2019 15:34	36.136	6.842	23.043	15.798	30.386	0.169	0.113498993
10/2/2019 15:34	37.86	6.841	22.997	15.795	32.11	0.166	0.111484218
10/2/2019 15:34	40.08	6.838	22.981	15.788	34.33	0.159	0.106783076
10/2/2019 15:34	42.48	6.836	22.982	15.783	36.73	0.154	0.103425118
10/2/2019 15:34	45	6.834	22.962	15.779	39.25	0.15	0.100738751
10/2/2019 15:34	47.64	6.83	22.968	15.77	41.89	0.141	0.094694426
10/2/2019 15:34	50.46	6.828	22.949	15.766	44.71	0.137	0.092008059
10/2/2019 15:34	53.46	6.825	22.944	15.76	47.71	0.131	0.087978509
10/2/2019 15:34	56.64	6.823	22.952	15.754	50.89	0.125	0.083948959
10/2/2019 15:34	60	6.821	22.918	15.749	54.25	0.12	0.080591001
10/2/2019 15:34	63.6	6.819	22.906	15.744	57.85	0.115	0.077233042
10/2/2019 15:35	67.2	6.817	22.907	15.74	61.45	0.111	0.074546676
10/2/2019 15:35	71.4	6.814	22.915	15.734	65.65	0.105	0.070517126
10/2/2019 15:35	76.169	6.813	22.916	15.732	70.419	0.103	0.069173942
10/2/2019 15:35	79.8	6.812	22.859	15.728	74.05	0.099	0.066487576
10/2/2019 15:35	84.6	6.81	22.848	15.723	78.85	0.094	0.063129617
10/2/2019 15:35	90	6.808	22.829	15.72	84.25	0.091	0.061114842
10/2/2019 15:35	94.8	6.807	22.817	15.716	89.05	0.087	0.058428475
10/2/2019 15:35	101.211	6.806	22.849	15.714	95.461	0.085	0.057085292
10/2/2019 15:35	106.8	6.803	22.809	15.708	101.05	0.079	0.053055742
10/2/2019 15:35	112.8	6.802	22.781	15.706	107.05	0.077	0.051712559
10/2/2019 15:35	119.4	6.802	22.759	15.704	113.65	0.075	0.050369375
10/2/2019 15:36	126.6	6.801	22.769	15.704	120.85	0.075	0.050369375
10/2/2019 15:36	134.4	6.799	22.727	15.698	128.65	0.069	0.046339825
10/2/2019 15:36	142.2	6.8	22.725	15.701	136.45	0.072	0.0483546

10/2/2019 15:36	150.6	6.799	22.688	15.699	144.85	0.07	0.047011417
10/2/2019 15:36	159.6	6.797	22.674	15.694	153.85	0.065	0.043653459
10/2/2019 15:36	169.2	6.796	22.658	15.692	163.45	0.063	0.042310275
10/2/2019 15:36	178.8	6.795	22.645	15.69	173.05	0.061	0.040967092
10/2/2019 15:37	189.6	6.795	22.621	15.688	183.85	0.059	0.039623909
10/2/2019 15:37	201.469	6.795	22.649	15.69	195.719	0.061	0.040967092
10/2/2019 15:37	213	6.794	22.592	15.687	207.25	0.058	0.038952317
10/2/2019 15:37	225.6	6.794	22.562	15.686	219.85	0.057	0.038280725
10/2/2019 15:37	238.8	6.792	22.551	15.683	233.05	0.054	0.03626595
10/2/2019 15:38	253.2	6.792	22.537	15.684	247.45	0.055	0.036937542
10/2/2019 15:38	268.2	6.792	22.524	15.683	262.45	0.054	0.03626595
10/2/2019 15:38	283.8	6.793	22.497	15.684	278.05	0.055	0.036937542
10/2/2019 15:38	300.6	6.793	22.476	15.684	294.85	0.055	0.036937542
10/2/2019 15:39	318.6	6.791	22.468	15.68	312.85	0.051	0.034251175
10/2/2019 15:39	337.2	6.792	22.465	15.681	331.45	0.052	0.034922767
10/2/2019 15:39	357.6	6.792	22.446	15.682	351.85	0.053	0.035594359
10/2/2019 15:40	378.6	6.791	22.426	15.681	372.85	0.052	0.034922767
10/2/2019 15:40	400.8	6.792	22.402	15.682	395.05	0.053	0.035594359
10/2/2019 15:40	424.8	6.791	22.391	15.681	419.05	0.052	0.034922767
10/2/2019 15:41	450	6.791	22.382	15.681	444.25	0.052	0.034922767
10/2/2019 15:41	476.93	6.79	22.416	15.678	471.18	0.049	0.032907992
10/2/2019 15:42	504.6	6.79	22.359	15.678	498.85	0.049	0.032907992
10/2/2019 15:42	534.6	6.79	22.35	15.677	528.85	0.048	0.0322364
10/2/2019 15:43	566.4	6.79	22.334	15.678	560.65	0.049	0.032907992
10/2/2019 15:43	600	6.789	22.33	15.677	594.25	0.048	0.0322364
10/2/2019 15:44	636	6.79	22.325	15.677	630.25	0.048	0.0322364
10/2/2019 15:45	672.284	6.79	22.369	15.677	666.534	0.048	0.0322364
10/2/2019 15:45	714	6.79	22.322	15.677	708.25	0.048	0.0322364
10/2/2019 15:46	756	6.791	22.311	15.68	750.25	0.051	0.034251175
10/2/2019 15:47	798	6.789	22.326	15.676	792.25	0.047	0.031564809
10/2/2019 15:48	846	6.79	22.302	15.677	840.25	0.048	0.0322364
10/2/2019 15:48	900	6.79	22.302	15.677	894.25	0.048	0.0322364
10/2/2019 15:49	948	6.789	22.331	15.676	942.25	0.047	0.031564809
10/2/2019 15:50	1008	6.789	22.332	15.676	1002.25	0.047	0.031564809
10/2/2019 15:51	1068	6.789	22.332	15.675	1062.25	0.046	0.030893217
10/2/2019 15:52	1128	6.788	22.341	15.674	1122.25	0.045	0.030221625
10/2/2019 15:53	1188.073	6.788	22.338	15.674	1182.323	0.045	0.030221625
10/2/2019 15:54	1248.208	6.789	22.338	15.676	1242.458	0.047	0.031564809
10/2/2019 15:55	1308.312	6.788	22.338	15.674	1302.562	0.045	0.030221625
10/2/2019 15:56	1368.363	6.788	22.336	15.673	1362.613	0.044	0.029550034
10/2/2019 15:57	1428.416	6.788	22.337	15.673	1422.666	0.044	0.029550034
10/2/2019 15:58	1488.522	6.788	22.335	15.674	1482.772	0.045	0.030221625
10/2/2019 15:59	1548.579	6.788	22.334	15.673	1542.829	0.044	0.029550034
10/2/2019 16:00	1608	6.788	22.283	15.674	1602.25	0.045	0.030221625
10/2/2019 16:01	1668	6.789	22.286	15.675	1662.25	0.046	0.030893217
10/2/2019 16:02	1728	6.787	22.284	15.67	1722.25	0.041	0.027535259
10/2/2019 16:03	1788	6.787	22.287	15.671	1782.25	0.042	0.02820685
10/2/2019 16:04	1848	6.789	22.283	15.675	1842.25	0.046	0.030893217
10/2/2019 16:05	1908	6.788	22.284	15.674	1902.25	0.045	0.030221625
10/2/2019 16:06	1968	6.786	22.287	15.67	1962.25	0.041	0.027535259
10/2/2019 16:07	2028	6.787	22.286	15.67	2022.25	0.041	0.027535259
10/2/2019 16:08	2088	6.788	22.288	15.673	2082.25	0.044	0.029550034
10/2/2019 16:09	2148	6.788	22.284	15.673	2142.25	0.044	0.029550034
10/2/2019 16:10	2208	6.786	22.282	15.669	2202.25	0.04	0.026863667
10/2/2019 16:11	2268	6.788	22.282	15.672	2262.25	0.043	0.028878442
10/2/2019 16:12	2328	6.788	22.281	15.674	2322.25	0.045	0.030221625
10/2/2019 16:13	2388	6.787	22.288	15.672	2382.25	0.043	0.028878442
10/2/2019 16:14	2448	6.788	22.288	15.673	2442.25	0.044	0.029550034
10/2/2019 16:15	2508	6.787	22.287	15.671	2502.25	0.042	0.02820685
10/2/2019 16:16	2568	6.787	22.284	15.672	2562.25	0.043	0.028878442
10/2/2019 16:17	2628	6.787	22.286	15.672	2622.25	0.043	0.028878442
10/2/2019 16:18	2688	6.786	22.283	15.669	2682.25	0.04	0.026863667
10/2/2019 16:19	2748	6.787	22.286	15.671	2742.25	0.042	0.02820685
10/2/2019 16:20	2808	6.787	22.283	15.671	2802.25	0.042	0.02820685
10/2/2019 16:21	2868	6.786	22.29	15.67	2862.25	0.041	0.027535259
10/2/2019 16:22	2928	6.786	22.288	15.669	2922.25	0.04	0.026863667
10/2/2019 16:23	2988	6.787	22.291	15.67	2982.25	0.041	0.027535259

Report Date:	10/2/2019 19:30				
Report User Name:	SBirardi				
Report Computer Name:	KA210006				
Application:	WinSitu.exe				
Application Version:	5.7.6.1				

Log File Properties

File Name	MW-4 OUT_2019-10-02_19-26-52-683.wsl
Create Date	10/2/2019 19:26

Device Properties

Device	Level TROLL 700			
Site	Carlsbad Village Trench Project			
Device Name				
Serial Number	345086			
Firmware Version	2.13			
Hardware Version	3			
Device Address	1			
Device Comm Cfg	19200	8 Even	1	(Modbus-RTU)
Used Memory	1			
Used Battery	43			

Log Configuration

Log Name	MW-4 OUT
Created By	SBirardi
Computer Name	KA210006
Application	WinSitu.exe
Application Version	5.7.6.1
Create Date	10/2/2019 4:25:08 PM Pacific Daylight Time
Log Setup Time Zone	Pacific Daylight Time
Notes Size(bytes)	4096
Overwrite when full	Disabled
Scheduled Start Time	Manual Start
Scheduled Stop Time	No Stop Time
Type	True Logarithmic
Max Interval	Days: 0 hrs: 00 mins: 01 secs: 00

Level Reference Settings At Log Creation

Level Measurement Mode	Depth	
Specific Gravity		0.999

Other Log Settings

Pressure Offset:	0.00443077 (PSI)
Depth of Probe:	15.6671 (ft)
Head Pressure:	6.78533 (PSI)
Temperature:	22.2732 (C)

Log Notes:

Date and Time	Note
10/2/2019 16:25	Used Battery: 43% Used Memory: 3% User Name: SBirardi
10/2/2019 16:27	Manual Start Command
10/2/2019 17:37	Used Battery: 43% Used Memory: 3% User Name: SBirardi
10/2/2019 17:37	Manual Stop Command

Log Data:

Record Count	167		
Sensors	1		
	1	345086	Pressure/Temp 15 PSIG (11m/35ft)

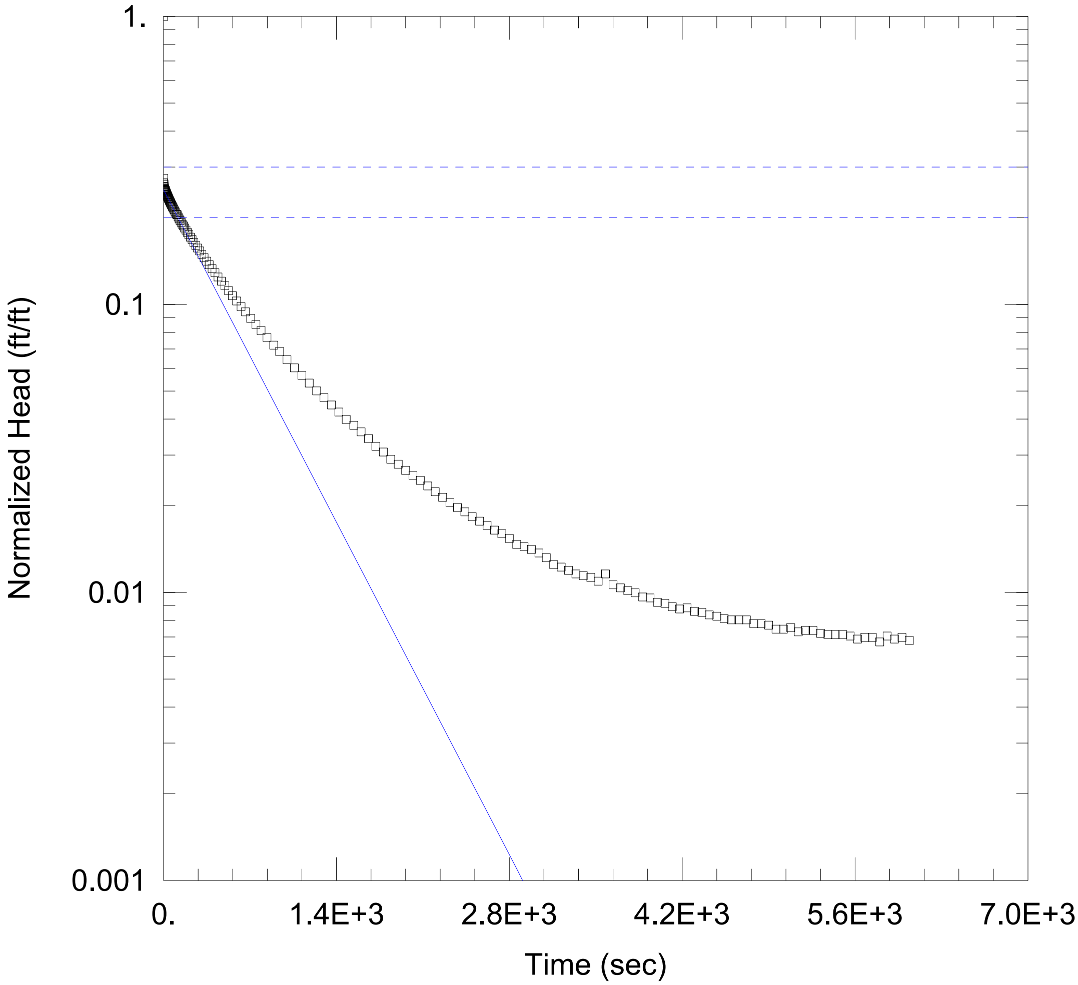
Time Zone: Pacific Daylight Time

Date and Time	Elapsed Time Seconds	Sensor: Pres(G) 35ft SN#: 345086 Pressure (PSI)	Sensor: Pres(G) 35ft SN#: 345086 Temperature (C)	Sensor: Pres(G) 35ft SN#: 345086 Depth (ft)
10/2/2019 16:27	0	6.789	22.255	15.675
10/2/2019 16:27	0.25	6.787	22.277	15.671
10/2/2019 16:27	0.5	6.789	22.265	15.677

10/2/2019 16:27	0.779	6.788	22.293	15.672			
10/2/2019 16:27	0.999	6.787	22.302	15.671			
10/2/2019 16:27	1.25	6.787	22.308	15.671			
10/2/2019 16:27	1.5	6.787	22.316	15.671			
10/2/2019 16:27	1.75	6.372	22.322	14.713			
10/2/2019 16:27	2	5.44	22.322	12.561			
10/2/2019 16:27	2.25	5.538	22.328	12.788			
10/2/2019 16:27	2.5	4.68	22.327	10.807			
10/2/2019 16:27	2.75	4.977	22.328	11.492			
10/2/2019 16:27	3	5.512	22.334	12.728			
10/2/2019 16:27	3.25	5.193	22.333	11.991			
10/2/2019 16:27	3.5	5.275	22.334	12.181			
10/2/2019 16:27	3.75	4.574	22.339	10.561	0	5.11	1
10/2/2019 16:27	4	5.597	22.342	12.924	0.25	2.747	0.537573386
10/2/2019 16:27	4.25	5.579	22.341	12.881	0.5	2.79	0.545988258
10/2/2019 16:27	4.5	5.647	22.344	13.04	0.75	2.631	0.514872798
10/2/2019 16:27	4.75	5.69	22.345	13.137	1	2.534	0.495890411
10/2/2019 16:27	5	5.727	22.347	13.224	1.25	2.447	0.478864971
10/2/2019 16:27	5.25	5.78	22.342	13.346	1.5	2.325	0.454990215
10/2/2019 16:27	5.5	5.818	22.347	13.434	1.75	2.237	0.43776908
10/2/2019 16:27	5.75	5.869	22.346	13.551	2	2.12	0.414872798
10/2/2019 16:27	6	5.913	22.347	13.652	2.25	2.019	0.395107632
10/2/2019 16:27	6.36	5.964	22.336	13.771	2.61	1.9	0.371819961
10/2/2019 16:27	6.72	5.839	22.336	13.483	2.97	2.188	0.428180039
10/2/2019 16:27	7.14	6.174	22.328	14.256	3.39	1.415	0.276908023
10/2/2019 16:27	7.56	6.199	22.326	14.313	3.81	1.358	0.265753425
10/2/2019 16:27	7.98	6.254	22.324	14.441	4.23	1.23	0.240704501
10/2/2019 16:27	8.46	6.302	22.32	14.552	4.71	1.119	0.218982387
10/2/2019 16:27	9	6.348	22.317	14.658	5.25	1.013	0.198238748
10/2/2019 16:27	9.48	6.387	22.316	14.747	5.73	0.924	0.180821918
10/2/2019 16:27	10.08	6.437	22.31	14.863	6.33	0.808	0.158121331
10/2/2019 16:27	10.68	6.482	22.31	14.967	6.93	0.704	0.13776908
10/2/2019 16:27	11.28	6.523	22.311	15.063	7.53	0.608	0.118982387
10/2/2019 16:27	11.94	6.563	22.307	15.155	8.19	0.516	0.100978474
10/2/2019 16:27	12.66	6.601	22.303	15.241	8.91	0.43	0.084148728
10/2/2019 16:27	13.44	6.635	22.3	15.319	9.69	0.352	0.06888454
10/2/2019 16:27	14.22	6.663	22.301	15.386	10.47	0.285	0.055772994
10/2/2019 16:27	15.06	6.687	22.3	15.44	11.31	0.231	0.045205479
10/2/2019 16:27	15.96	6.708	22.298	15.488	12.21	0.183	0.035812133
10/2/2019 16:27	16.92	6.725	22.297	15.527	13.17	0.144	0.028180039
10/2/2019 16:27	17.88	6.738	22.295	15.557	14.13	0.114	0.022309198
10/2/2019 16:27	18.96	6.744	22.295	15.571	15.21	0.1	0.019569472
10/2/2019 16:27	20.1	6.753	22.292	15.593	16.35	0.078	0.015264188
10/2/2019 16:27	21.3	6.76	22.292	15.609	17.55	0.062	0.012133072
10/2/2019 16:27	22.56	6.768	22.292	15.627	18.81	0.044	0.008610568
10/2/2019 16:27	23.88	6.773	22.293	15.638	20.13	0.033	0.006457926
10/2/2019 16:27	25.32	6.78	22.293	15.656	21.57	0.015	0.002935421
10/2/2019 16:27	26.82	6.786	22.291	15.669	23.07	0.002	0.000391389
10/2/2019 16:27	28.38	6.793	22.292	15.686	24.63	-0.015	-0.002935421
10/2/2019 16:27	30.06	6.799	22.292	15.7	26.31	-0.029	-0.005675147
10/2/2019 16:27	31.86	6.805	22.289	15.713	28.11	-0.042	-0.008219178
10/2/2019 16:27	33.72	6.809	22.287	15.721	29.97	-0.05	-0.009784736
10/2/2019 16:27	35.76	6.814	22.288	15.734	32.01	-0.063	-0.012328767
10/2/2019 16:27	37.86	6.821	22.285	15.749	34.11	-0.078	-0.015264188
10/2/2019 16:27	40.08	6.826	22.286	15.762	36.33	-0.091	-0.017808219
10/2/2019 16:27	42.48	6.831	22.282	15.773	38.73	-0.102	-0.019960861
10/2/2019 16:27	45	6.835	22.281	15.782	41.25	-0.111	-0.021722114
10/2/2019 16:27	47.64	6.84	22.28	15.794	43.89	-0.123	-0.02407045
10/2/2019 16:27	50.46	6.845	22.28	15.805	46.71	-0.134	-0.026223092
10/2/2019 16:28	53.46	6.849	22.278	15.814	49.71	-0.143	-0.027984344
10/2/2019 16:28	56.64	6.851	22.273	15.819	52.89	-0.148	-0.028962818
10/2/2019 16:28	60	6.856	22.279	15.83	56.25	-0.159	-0.03111546
10/2/2019 16:28	63.6	6.859	22.275	15.838	59.85	-0.167	-0.032681018
10/2/2019 16:28	67.2	6.863	22.274	15.847	63.45	-0.176	-0.03444227
10/2/2019 16:28	71.4	6.867	22.271	15.855	67.65	-0.184	-0.036007828
10/2/2019 16:28	75.6	6.87	22.271	15.862	71.85	-0.191	-0.037377691
10/2/2019 16:28	79.8	6.872	22.271	15.867	76.05	-0.196	-0.038356164
10/2/2019 16:28	84.6	6.875	22.274	15.873	80.85	-0.202	-0.039530333
10/2/2019 16:28	90	6.877	22.266	15.878	86.25	-0.207	-0.040508806
10/2/2019 16:28	94.8	6.879	22.268	15.884	91.05	-0.213	-0.041682975
10/2/2019 16:28	100.8	6.881	22.268	15.888	97.05	-0.217	-0.042465753
10/2/2019 16:28	106.8	6.882	22.263	15.891	103.05	-0.22	-0.043052838
10/2/2019 16:29	112.8	6.884	22.266	15.895	109.05	-0.224	-0.043835616
10/2/2019 16:29	119.4	6.886	22.278	15.9	115.65	-0.229	-0.04481409
10/2/2019 16:29	126.6	6.886	22.272	15.9	122.85	-0.229	-0.04481409
10/2/2019 16:29	134.4	6.887	22.282	15.901	130.65	-0.23	-0.045009785

10/2/2019 16:29	142.644	6.889	22.322	15.907	138.894	-0.236	-0.046183953
10/2/2019 16:29	150.6	6.89	22.277	15.908	146.85	-0.237	-0.046379648
10/2/2019 16:29	159.6	6.889	22.287	15.907	155.85	-0.236	-0.046183953
10/2/2019 16:29	169.2	6.89	22.288	15.909	165.45	-0.238	-0.046575342
10/2/2019 16:30	178.8	6.889	22.279	15.907	175.05	-0.236	-0.046183953
10/2/2019 16:30	189.6	6.89	22.273	15.908	185.85	-0.237	-0.046379648
10/2/2019 16:30	201	6.89	22.318	15.91	197.25	-0.239	-0.046771037
10/2/2019 16:30	213	6.89	22.283	15.909	209.25	-0.238	-0.046575342
10/2/2019 16:30	225.915	6.89	22.329	15.909	222.165	-0.238	-0.046575342
10/2/2019 16:31	238.8	6.89	22.283	15.91	235.05	-0.239	-0.046771037
10/2/2019 16:31	253.2	6.89	22.283	15.909	249.45	-0.238	-0.046575342
10/2/2019 16:31	268.2	6.89	22.288	15.909	264.45	-0.238	-0.046575342
10/2/2019 16:31	283.799	6.889	22.285	15.906	280.049	-0.235	-0.045988258
10/2/2019 16:32	301.061	6.889	22.334	15.907	297.311	-0.236	-0.046183953
10/2/2019 16:32	318.599	6.889	22.283	15.907	314.849	-0.236	-0.046183953
10/2/2019 16:32	337.2	6.889	22.301	15.906	333.45	-0.235	-0.045988258
10/2/2019 16:33	357.599	6.887	22.292	15.902	353.849	-0.231	-0.045205479
10/2/2019 16:33	378.599	6.888	22.287	15.904	374.849	-0.233	-0.045596869
10/2/2019 16:33	401.268	6.887	22.333	15.903	397.518	-0.232	-0.045401174
10/2/2019 16:34	424.799	6.886	22.285	15.899	421.049	-0.228	-0.044618395
10/2/2019 16:34	450	6.885	22.282	15.898	446.25	-0.227	-0.044422701
10/2/2019 16:35	476.4	6.885	22.329	15.897	472.65	-0.226	-0.044227006
10/2/2019 16:35	504.599	6.885	22.284	15.898	500.849	-0.227	-0.044422701
10/2/2019 16:36	534.599	6.885	22.284	15.897	530.849	-0.226	-0.044227006
10/2/2019 16:36	566.489	6.885	22.329	15.896	562.739	-0.225	-0.044031311
10/2/2019 16:37	599.999	6.883	22.283	15.893	596.249	-0.222	-0.043444227
10/2/2019 16:37	636.596	6.882	22.335	15.891	632.846	-0.22	-0.043052838
10/2/2019 16:38	671.999	6.883	22.309	15.892	668.249	-0.221	-0.043248532
10/2/2019 16:39	713.999	6.883	22.283	15.893	710.249	-0.222	-0.043444227
10/2/2019 16:39	755.999	6.883	22.28	15.893	752.249	-0.222	-0.043444227
10/2/2019 16:40	797.999	6.881	22.292	15.889	794.249	-0.218	-0.042661448
10/2/2019 16:41	845.999	6.881	22.277	15.889	842.249	-0.218	-0.042661448
10/2/2019 16:42	899.999	6.88	22.28	15.887	896.249	-0.216	-0.042270059
10/2/2019 16:42	947.999	6.88	22.297	15.885	944.249	-0.214	-0.041878669
10/2/2019 16:43	1007.999	6.878	22.296	15.881	1004.249	-0.21	-0.04109589
10/2/2019 16:44	1067.999	6.879	22.295	15.882	1064.249	-0.211	-0.041291585
10/2/2019 16:45	1127.999	6.878	22.295	15.882	1124.249	-0.211	-0.041291585
10/2/2019 16:46	1187.999	6.877	22.299	15.878	1184.249	-0.207	-0.040508806
10/2/2019 16:47	1247.999	6.878	22.305	15.881	1244.249	-0.21	-0.04109589
10/2/2019 16:48	1307.999	6.877	22.31	15.878	1304.249	-0.207	-0.040508806
10/2/2019 16:49	1367.999	6.876	22.312	15.876	1364.249	-0.205	-0.040117417
10/2/2019 16:50	1427.999	6.876	22.319	15.876	1424.249	-0.205	-0.040117417
10/2/2019 16:51	1487.999	6.875	22.32	15.874	1484.249	-0.203	-0.039726027
10/2/2019 16:52	1547.999	6.875	22.329	15.874	1544.249	-0.203	-0.039726027
10/2/2019 16:53	1608.098	6.874	22.33	15.871	1604.348	-0.2	-0.039138943
10/2/2019 16:54	1668.201	6.874	22.33	15.872	1664.451	-0.201	-0.039334638
10/2/2019 16:55	1728.264	6.873	22.328	15.871	1724.514	-0.2	-0.039138943
10/2/2019 16:56	1788.361	6.874	22.33	15.871	1784.611	-0.2	-0.039138943
10/2/2019 16:57	1848.423	6.873	22.323	15.87	1844.673	-0.199	-0.038943249
10/2/2019 16:58	1908.47	6.872	22.325	15.868	1904.72	-0.197	-0.038551859
10/2/2019 16:59	1968.586	6.873	22.326	15.868	1964.836	-0.197	-0.038551859
10/2/2019 17:00	2027.999	6.873	22.282	15.868	2024.249	-0.197	-0.038551859
10/2/2019 17:01	2087.999	6.871	22.279	15.864	2084.249	-0.193	-0.03776908
10/2/2019 17:02	2147.999	6.87	22.279	15.863	2144.249	-0.192	-0.037573386
10/2/2019 17:03	2207.999	6.872	22.281	15.868	2204.249	-0.197	-0.038551859
10/2/2019 17:04	2267.999	6.87	22.281	15.863	2264.249	-0.192	-0.037573386
10/2/2019 17:05	2327.999	6.87	22.282	15.863	2324.249	-0.192	-0.037573386
10/2/2019 17:06	2387.999	6.871	22.278	15.866	2384.249	-0.195	-0.03816047
10/2/2019 17:07	2447.999	6.871	22.283	15.865	2444.249	-0.194	-0.037964775
10/2/2019 17:08	2507.999	6.869	22.281	15.86	2504.249	-0.189	-0.036986301
10/2/2019 17:09	2567.999	6.868	22.281	15.858	2564.249	-0.187	-0.036594912
10/2/2019 17:10	2627.999	6.87	22.277	15.863	2624.249	-0.192	-0.037573386
10/2/2019 17:11	2687.999	6.868	22.28	15.859	2684.249	-0.188	-0.036790607
10/2/2019 17:12	2747.999	6.868	22.28	15.859	2744.249	-0.188	-0.036790607
10/2/2019 17:13	2807.999	6.867	22.28	15.856	2804.249	-0.185	-0.036203523
10/2/2019 17:14	2867.999	6.868	22.278	15.857	2864.249	-0.186	-0.036399217
10/2/2019 17:15	2927.999	6.867	22.282	15.857	2924.249	-0.186	-0.036399217
10/2/2019 17:16	2987.999	6.867	22.285	15.856	2984.249	-0.185	-0.036203523
10/2/2019 17:17	3047.999	6.866	22.28	15.854	3044.249	-0.183	-0.035812133
10/2/2019 17:18	3107.999	6.868	22.287	15.857	3104.249	-0.186	-0.036399217
10/2/2019 17:19	3167.999	6.868	22.282	15.857	3164.249	-0.186	-0.036399217
10/2/2019 17:20	3227.999	6.865	22.287	15.852	3224.249	-0.181	-0.035420744
10/2/2019 17:21	3287.999	6.866	22.286	15.853	3284.249	-0.182	-0.035616438
10/2/2019 17:22	3347.999	6.867	22.288	15.855	3344.249	-0.184	-0.036007828
10/2/2019 17:23	3407.999	6.867	22.286	15.855	3404.249	-0.184	-0.036007828
10/2/2019 17:24	3467.999	6.866	22.287	15.854	3464.249	-0.183	-0.035812133

10/2/2019 17:25	3527.999	6.866	22.287	15.853	3524.249	-0.182	-0.035616438
10/2/2019 17:26	3587.999	6.865	22.289	15.851	3584.249	-0.18	-0.035225049
10/2/2019 17:27	3647.999	6.866	22.291	15.853	3644.249	-0.182	-0.035616438
10/2/2019 17:28	3707.999	6.863	22.288	15.847	3704.249	-0.176	-0.03444227
10/2/2019 17:29	3767.999	6.865	22.289	15.851	3764.249	-0.18	-0.035225049
10/2/2019 17:30	3827.999	6.865	22.292	15.852	3824.249	-0.181	-0.035420744
10/2/2019 17:31	3887.999	6.865	22.293	15.85	3884.249	-0.179	-0.035029354
10/2/2019 17:32	3947.999	6.864	22.296	15.85	3944.249	-0.179	-0.035029354
10/2/2019 17:33	4007.999	6.864	22.3	15.85	4004.249	-0.179	-0.035029354
10/2/2019 17:34	4067.999	6.863	22.3	15.845	4064.249	-0.174	-0.034050881
10/2/2019 17:35	4127.999	6.864	22.3	15.849	4124.249	-0.178	-0.034833659
10/2/2019 17:36	4187.999	6.863	22.304	15.847	4184.249	-0.176	-0.03444227



MW-1 SLUG IN 1

Data Set: U:\...\MW-1 Slug In 1.aqt
Date: 10/11/19 Time: 11:52:34

PROJECT INFORMATION

Company: Kleinfelder
Client: City of San Diego
Project: 20200172.001A
Location: Carlsbad, CA
Test Well: MW-1
Test Date: 10/3/19

AQUIFER DATA

Saturated Thickness: 41.22 ft Anisotropy Ratio (Kz/Kr): 1.

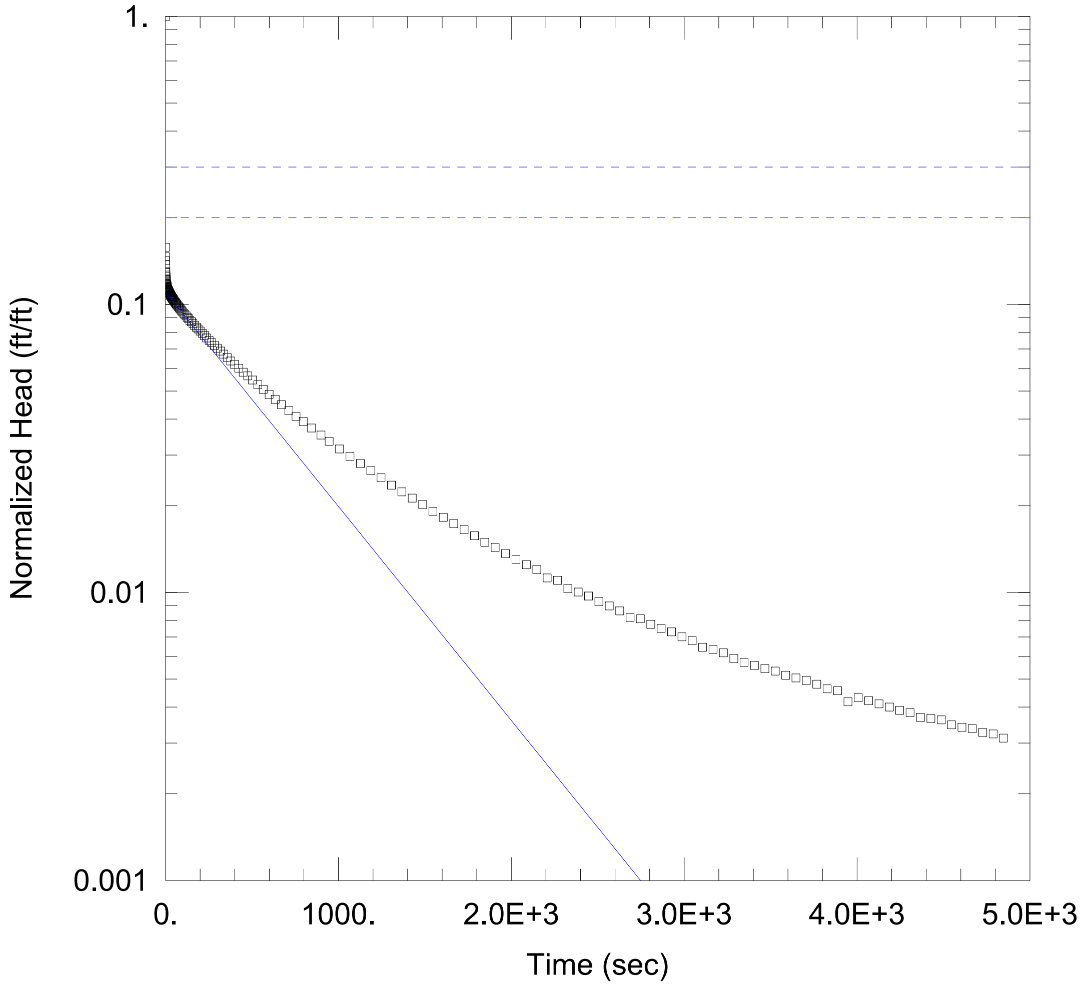
WELL DATA (MW-1)

Initial Displacement: 3.512 ft Static Water Column Height: 41.22 ft
Total Well Penetration Depth: 41.22 ft Screen Length: 10. ft
Casing Radius: 0.167 ft Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.061E-5 ft/sec y0 = 0.8777 ft



MW-1 SLUG OUT 1

Data Set: U:\...\MW-1 Slug Out 1.aqt
Date: 10/11/19 Time: 11:54:03

PROJECT INFORMATION

Company: Kleinfelder
Client: City of San Diego
Project: 20200172.001A
Location: Carlsbad, CA
Test Well: MW-1
Test Date: 10/3/19

AQUIFER DATA

Saturated Thickness: 41.22 ft Anisotropy Ratio (Kz/Kr): 1.

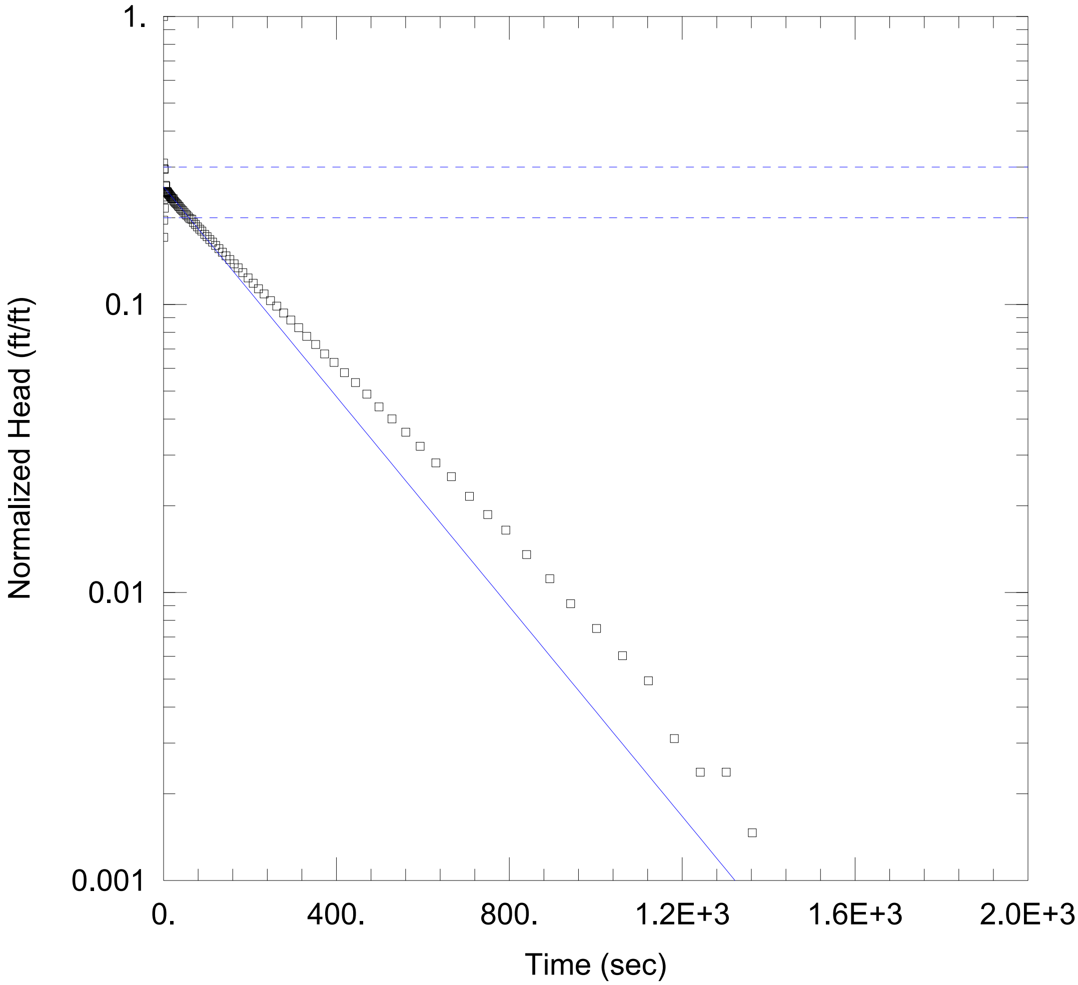
WELL DATA (MW-1)

Initial Displacement: 5.34 ft Static Water Column Height: 41.22 ft
Total Well Penetration Depth: 41.22 ft Screen Length: 10. ft
Casing Radius: 0.167 ft Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 9.56E-6 ft/sec y0 = 0.5874 ft



MW-2 SLUG IN 1

Data Set: U:\...\MW-2 Slug In 1.aqt
Date: 10/11/19 Time: 11:56:10

PROJECT INFORMATION

Company: Kleinfelder
Client: City of San Diego
Project: 20200172.001A
Location: Carlsbad, CA
Test Well: MW-2
Test Date: 10/3/19

AQUIFER DATA

Saturated Thickness: 14.17 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-2)

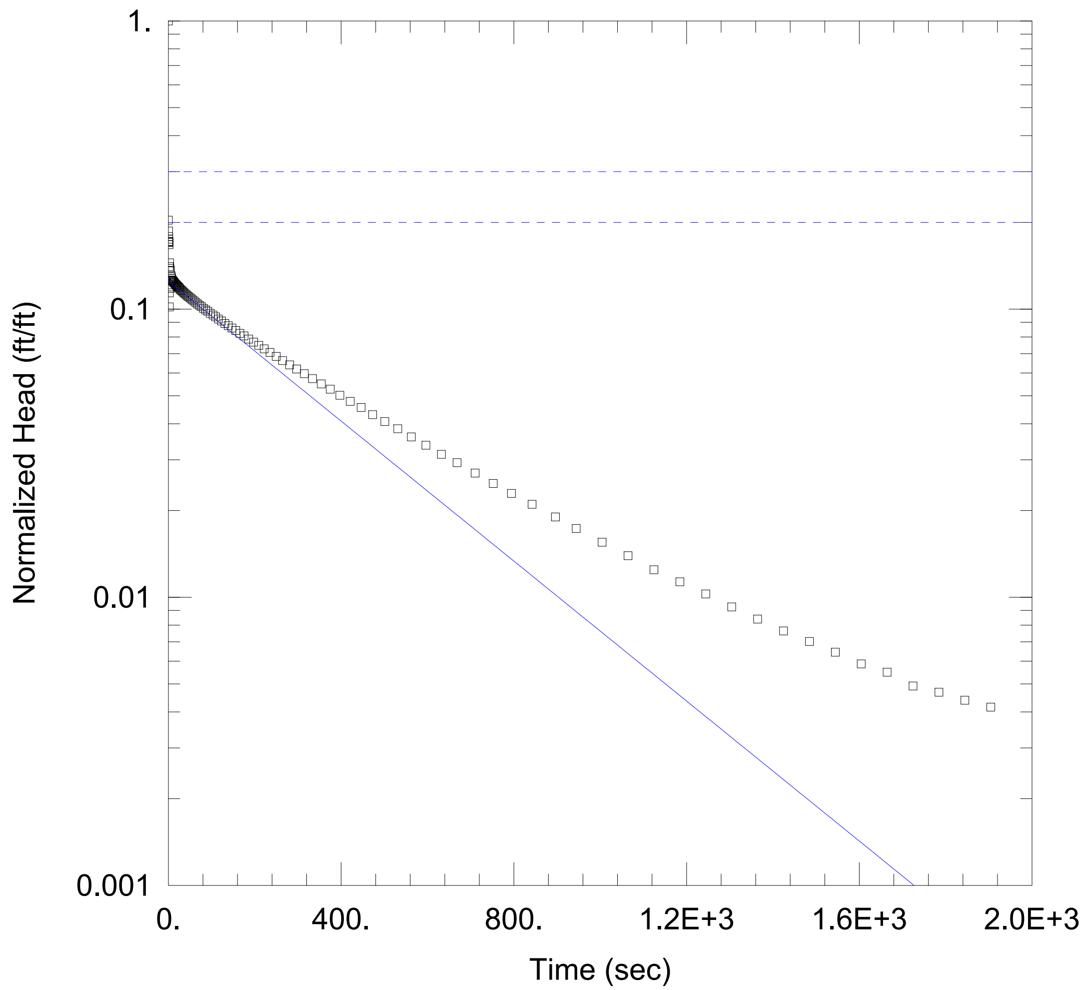
Initial Displacement: 2.339 ft
Total Well Penetration Depth: 15.44 ft
Casing Radius: 0.167 ft

Static Water Column Height: 14.17 ft
Screen Length: 10. ft
Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.997E-5 ft/sec y0 = 0.5991 ft



MW-2 SLUG IN 2

Data Set: U:\...\MW-2 Slug In 2.aqt
Date: 10/11/19 Time: 11:57:11

PROJECT INFORMATION

Company: Kleinfelder
Client: City of San Diego
Project: 20200172.001A
Location: Carlsbad, CA
Test Well: MW-2
Test Date: 10/3/19

AQUIFER DATA

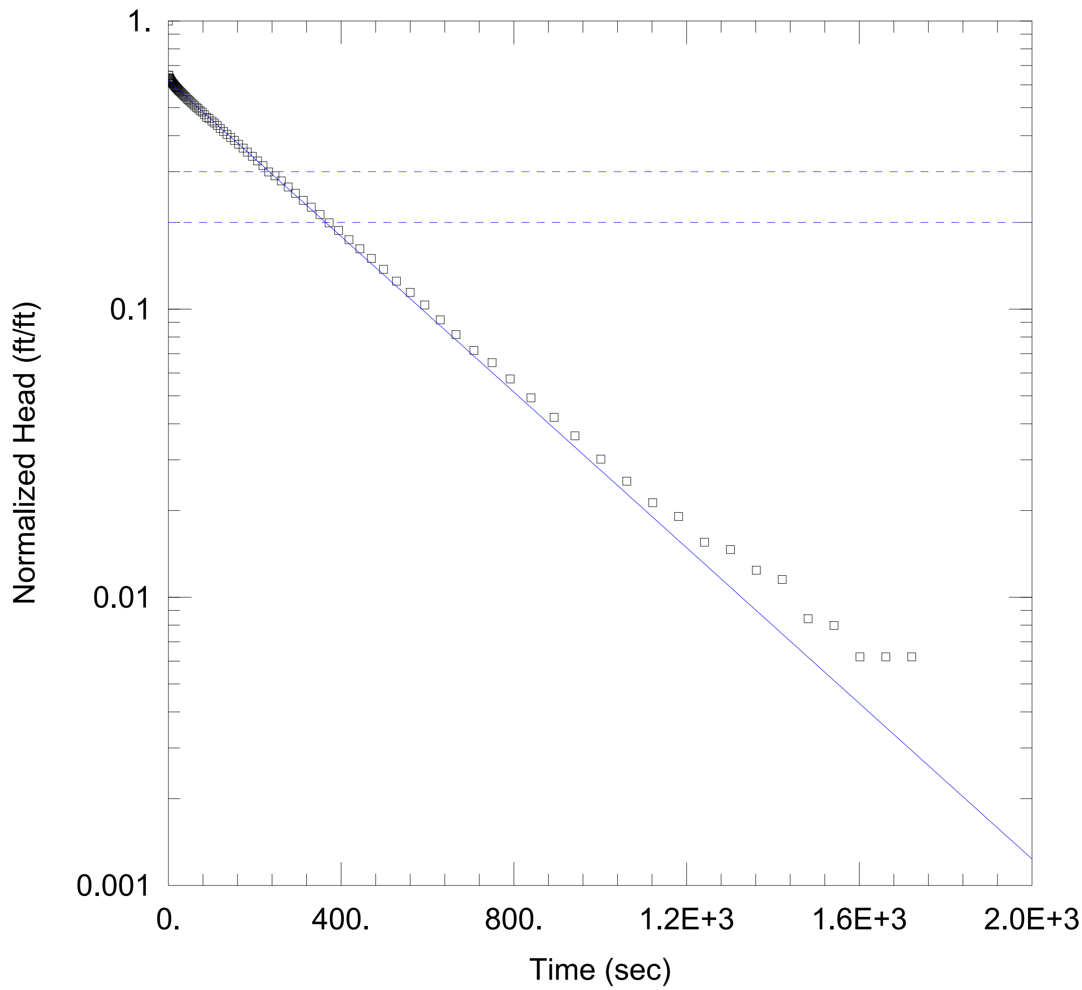
Saturated Thickness: 14.17 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-2)

Initial Displacement: 4.577 ft
Static Water Column Height: 14.17 ft
Total Well Penetration Depth: 15.44 ft
Screen Length: 10. ft
Casing Radius: 0.167 ft
Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.332E-5 ft/sec
y0 = 0.5723 ft



MW-2 SLUG OUT 1

Data Set: U:\...\MW-2 Slug Out 1.aqt
Date: 10/11/19
Time: 11:58:23

PROJECT INFORMATION

Company: Kleinfelder
Client: City of San Diego
Project: 20200172.001A
Location: Carlsbad, CA
Test Well: MW-2
Test Date: 10/3/19

AQUIFER DATA

Saturated Thickness: 14.17 ft
Anisotropy Ratio (Kz/Kr): 1.

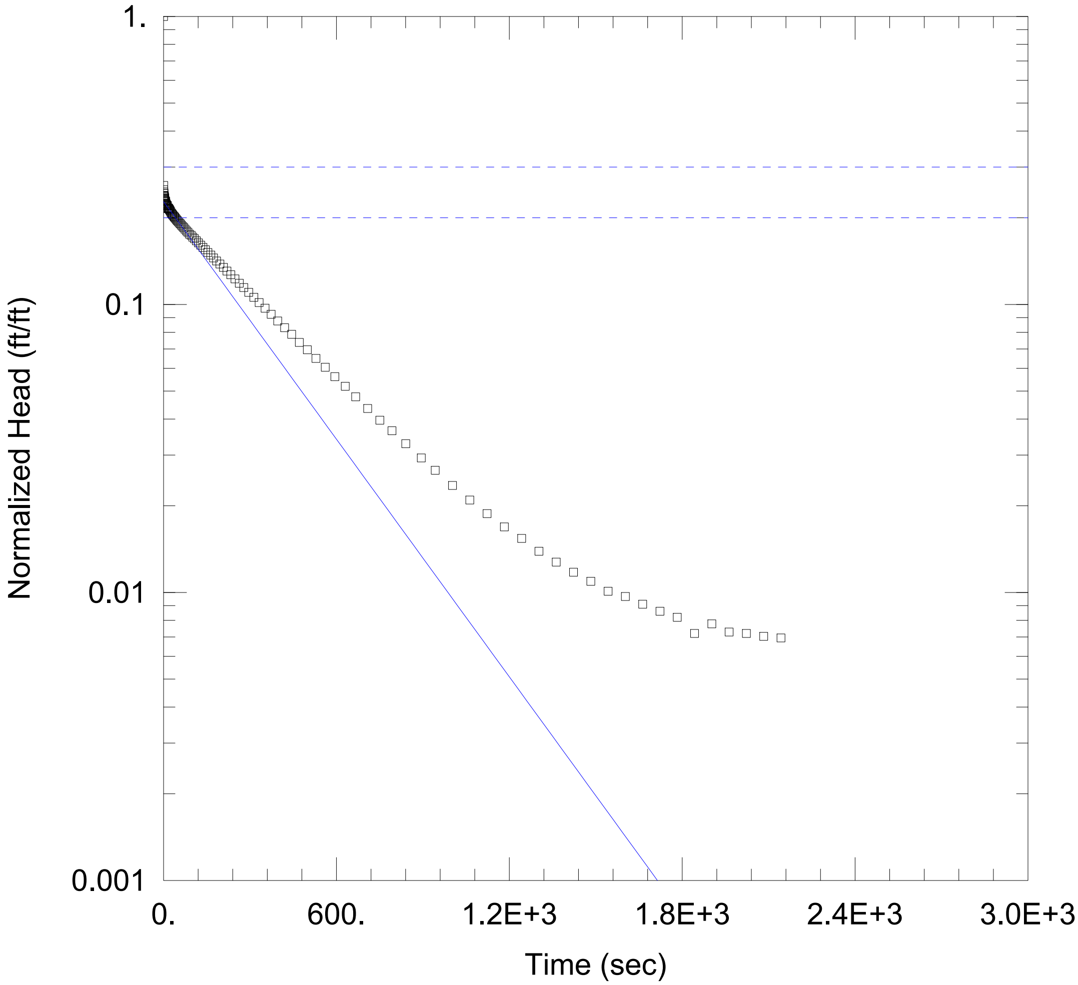
WELL DATA (MW-2)

Initial Displacement: 1.502 ft
Static Water Column Height: 14.17 ft
Total Well Penetration Depth: 15.44 ft
Screen Length: 10. ft
Casing Radius: 0.167 ft
Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 1.48E-5 ft/sec
y0 = 0.9306 ft



MW-2 SLUG OUT 2

Data Set: U:\...\MW-2 Slug Out 2.aqt
Date: 10/11/19 Time: 12:00:37

PROJECT INFORMATION

Company: Kleinfelder
Client: City of San Diego
Project: 20200172.001A
Location: Carlsbad, CA
Test Well: MW-2
Test Date: 10/3/19

AQUIFER DATA

Saturated Thickness: 14.17 ft Anisotropy Ratio (Kz/Kr): 1.

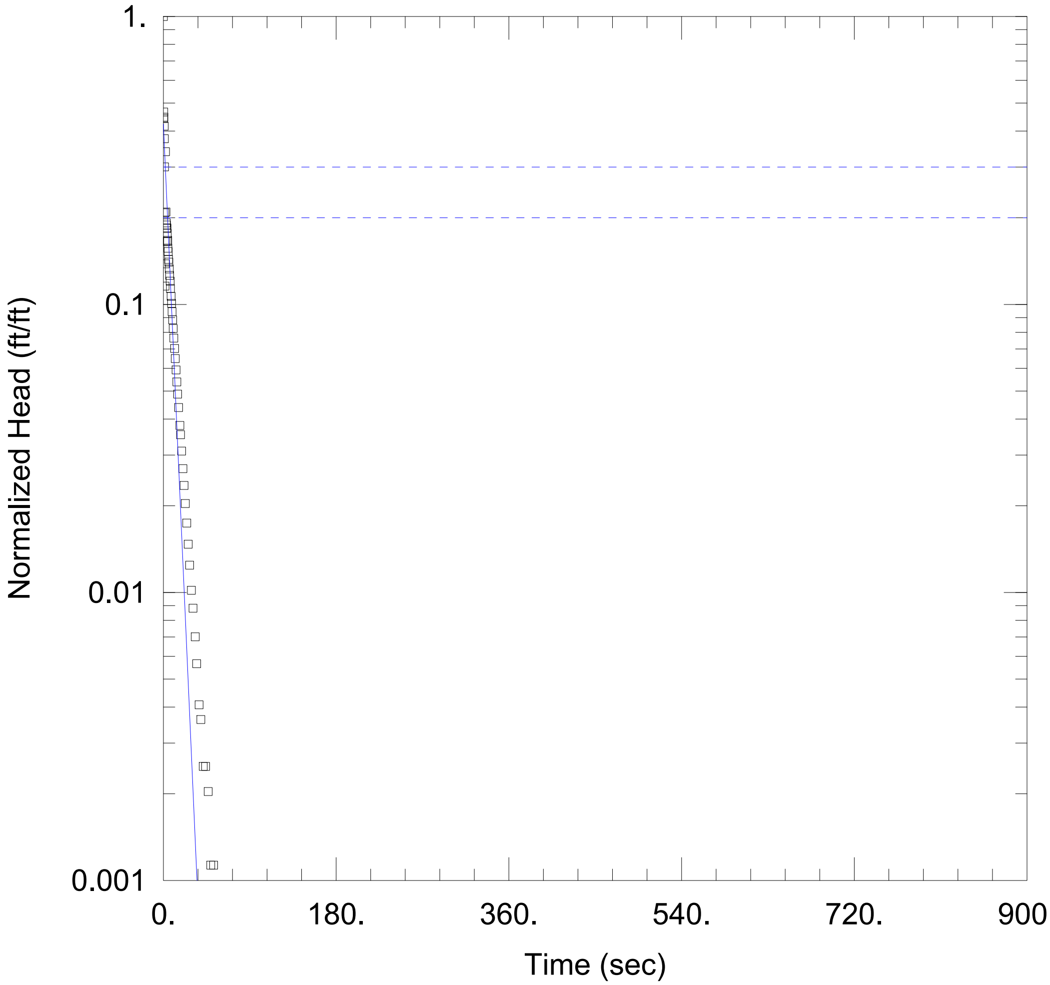
WELL DATA (MW-2)

Initial Displacement: 3.476 ft Static Water Column Height: 14.17 ft
Total Well Penetration Depth: 15.44 ft Screen Length: 10. ft
Casing Radius: 0.167 ft Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.508E-5 ft/sec y0 = 0.7911 ft



MW-3 SLUG IN 1

Data Set: U:\...\MW-3 Slug In 1.aqt
Date: 10/11/19 Time: 11:26:36

PROJECT INFORMATION

Company: Kleinfelder
Client: City of San Diego
Project: 20200172.001A
Location: Carlsbad, CA
Test Well: MW-3
Test Date: 10/3/19

AQUIFER DATA

Saturated Thickness: 10.08 ft Anisotropy Ratio (Kz/Kr): 1.

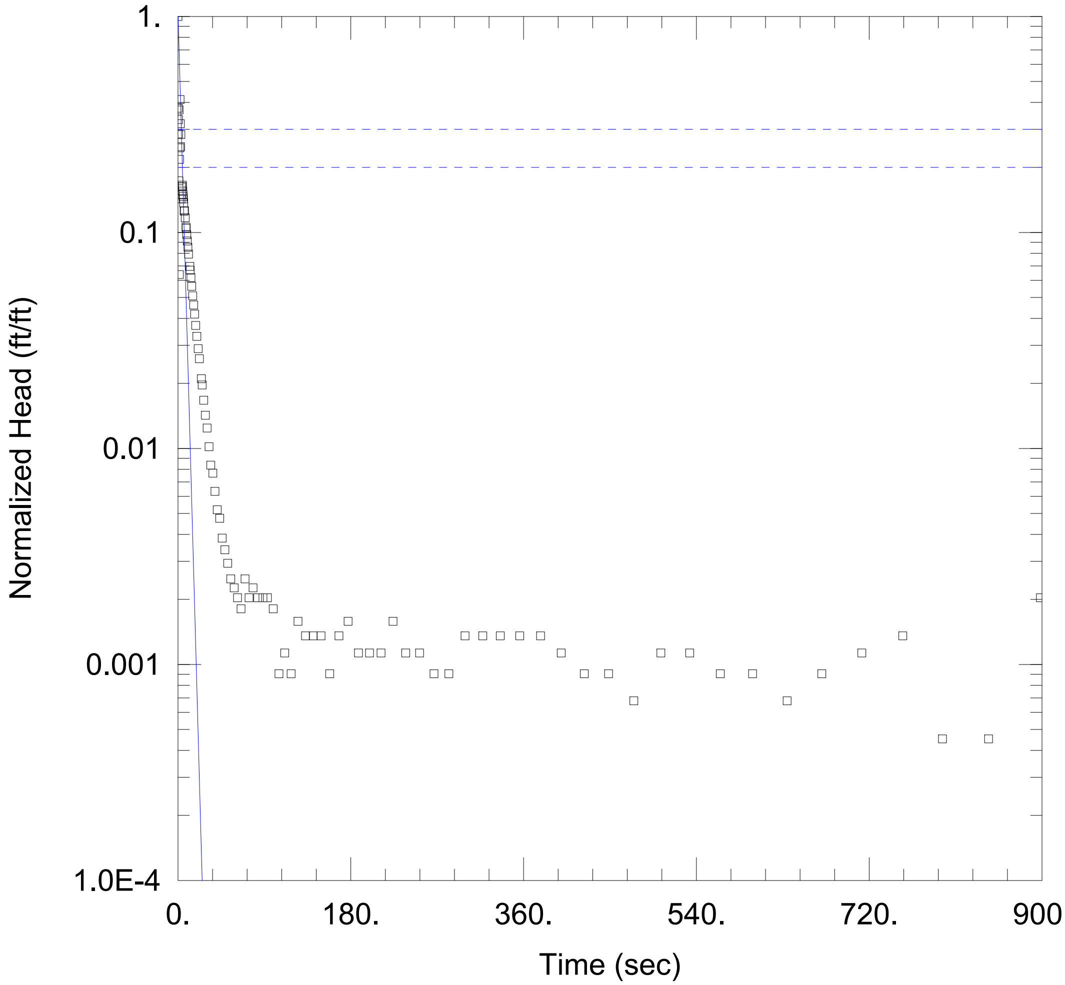
WELL DATA (MW-3)

Initial Displacement: 2.103 ft Static Water Column Height: 10.08 ft
Total Well Penetration Depth: 10.08 ft Screen Length: 10. ft
Casing Radius: 0.167 ft Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0007571 ft/sec y0 = 0.8898 ft



MW-3 SLUG IN 2

Data Set: U:\...\MW-3 Slug In 2.aqt
Date: 10/11/19 Time: 11:35:54

PROJECT INFORMATION

Company: Kleinfelder
Client: City of San Diego
Project: 20200172.001A
Location: Carlsbad, CA
Test Well: MW-3
Test Date: 10/3/19

AQUIFER DATA

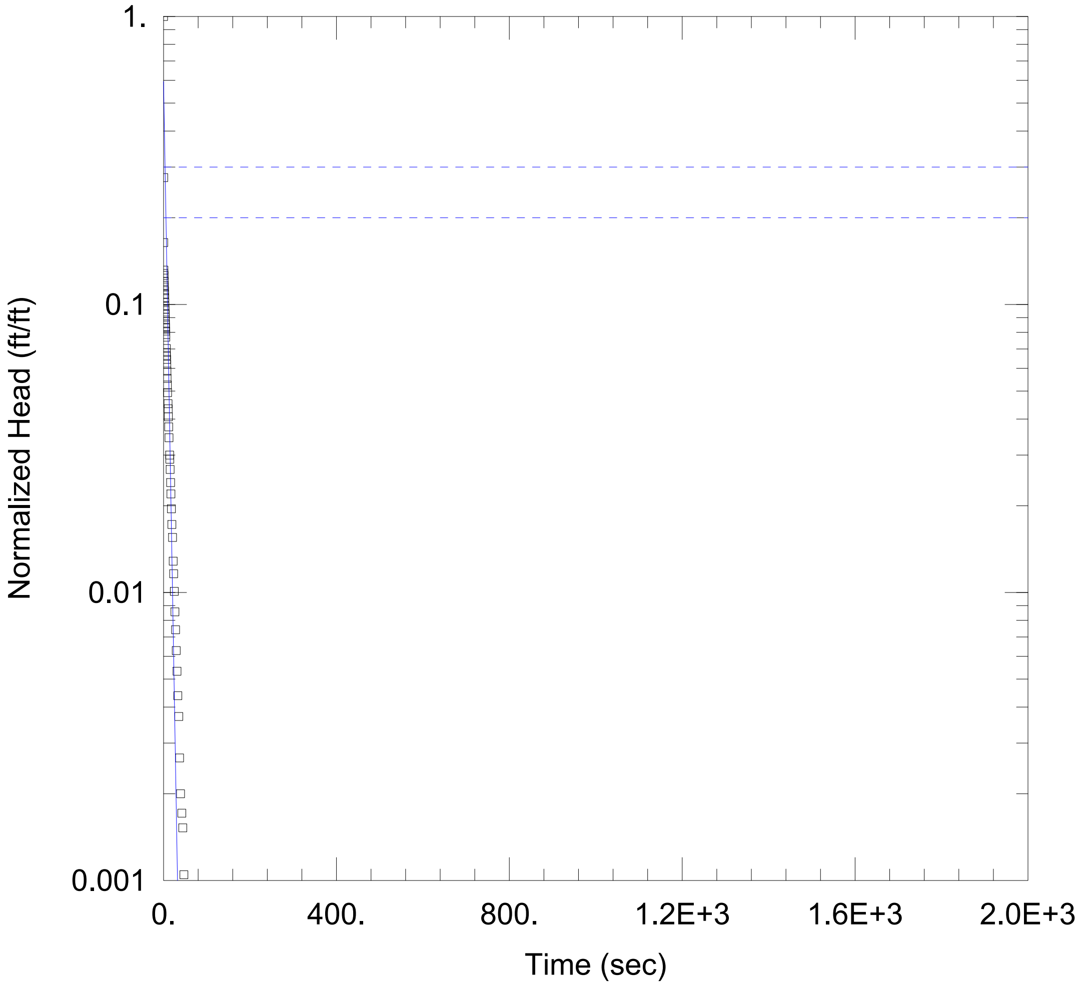
Saturated Thickness: 10.08 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-3)

Initial Displacement: 2.103 ft
Static Water Column Height: 10.08 ft
Total Well Penetration Depth: 10.08 ft
Screen Length: 10. ft
Casing Radius: 0.167 ft
Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.001615 ft/sec
y0 = 2.299 ft



MW-3 SLUG OUT 1

Data Set: U:\...\MW-3 Slug Out 1.aqt
Date: 10/11/19 Time: 11:32:15

PROJECT INFORMATION

Company: Kleinfelder
Client: City of San Diego
Project: 20200172.001A
Location: Carlsbad, CA
Test Well: MW-3
Test Date: 10/3/19

AQUIFER DATA

Saturated Thickness: 10.08 ft Anisotropy Ratio (Kz/Kr): 1.

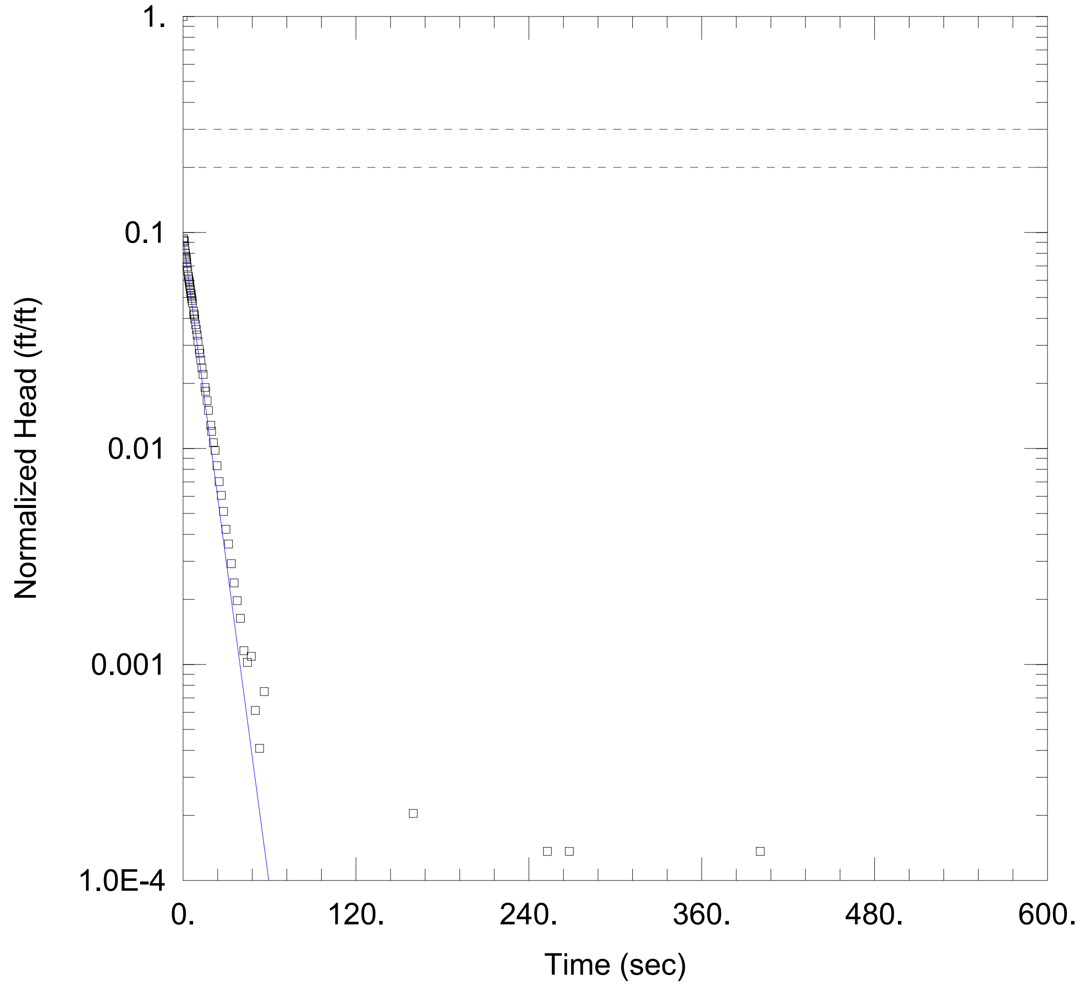
WELL DATA (MW-3)

Initial Displacement: 3.242 ft
Total Well Penetration Depth: 10.08 ft
Casing Radius: 0.167 ft
Static Water Column Height: 10.08 ft
Screen Length: 10. ft
Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0008631 ft/sec y0 = 1.927 ft



MW-3 SLUG OUT 2

Data Set: U:\...\MW-3 Slug Out 2.aqt
Date: 10/11/19 Time: 11:38:34

PROJECT INFORMATION

Company: Kleinfelder
Client: City of San Diego
Project: 20200172.001A
Location: Carlsbad, CA
Test Well: MW-3
Test Date: 10/3/19

AQUIFER DATA

Saturated Thickness: 10.08 ft Anisotropy Ratio (Kz/Kr): 1.

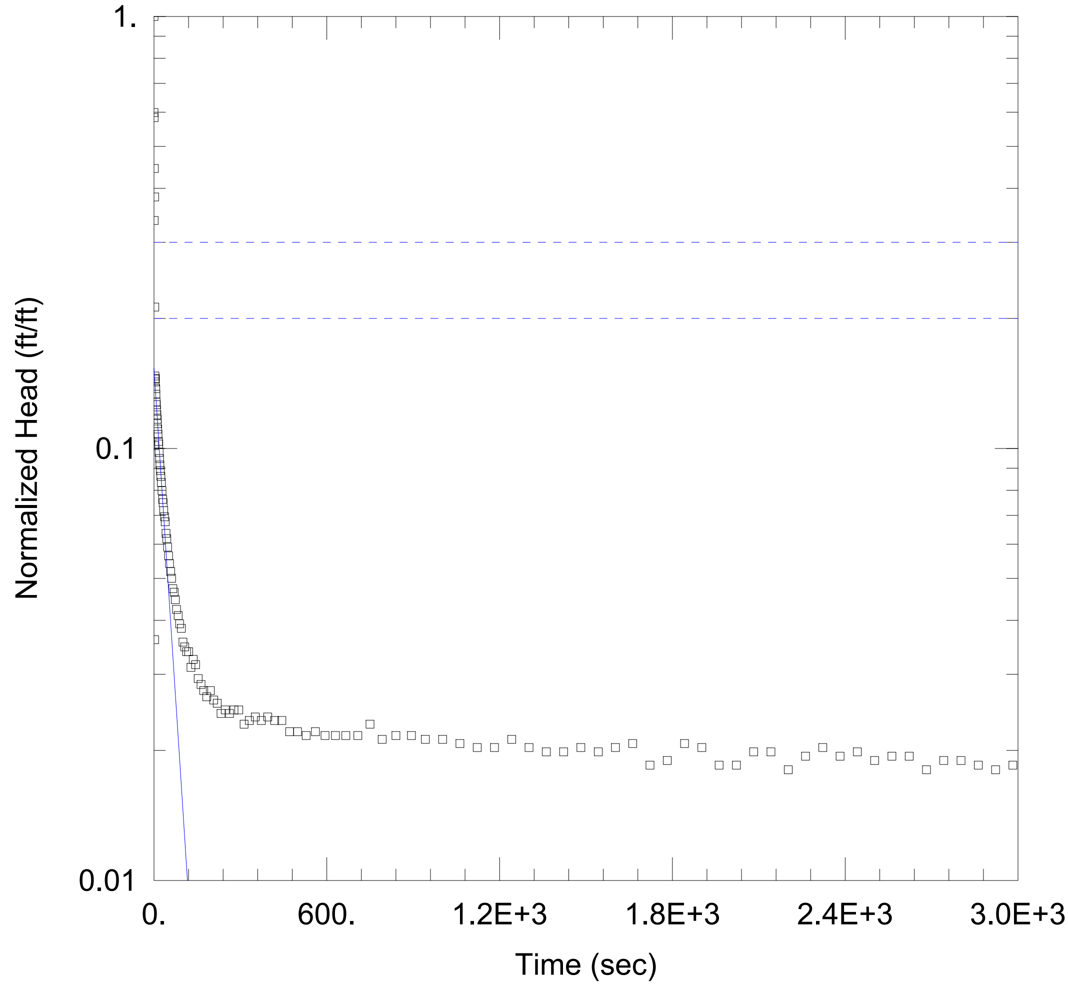
WELL DATA (MW-3)

Initial Displacement: 3.832 ft Static Water Column Height: 10.08 ft
Total Well Penetration Depth: 10.08 ft Screen Length: 10. ft
Casing Radius: 0.167 ft Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0005047 ft/sec y0 = 0.3601 ft



MW-4 SLUG IN 1

Data Set: U:\...\MW-4 Slug In 1.aqt
Date: 10/11/19 Time: 11:46:18

PROJECT INFORMATION

Company: Kleinfelder
Client: City of San Diego
Project: 20200172.001A
Location: Carlsbad, CA
Test Well: MW-4
Test Date: 10/2/19

AQUIFER DATA

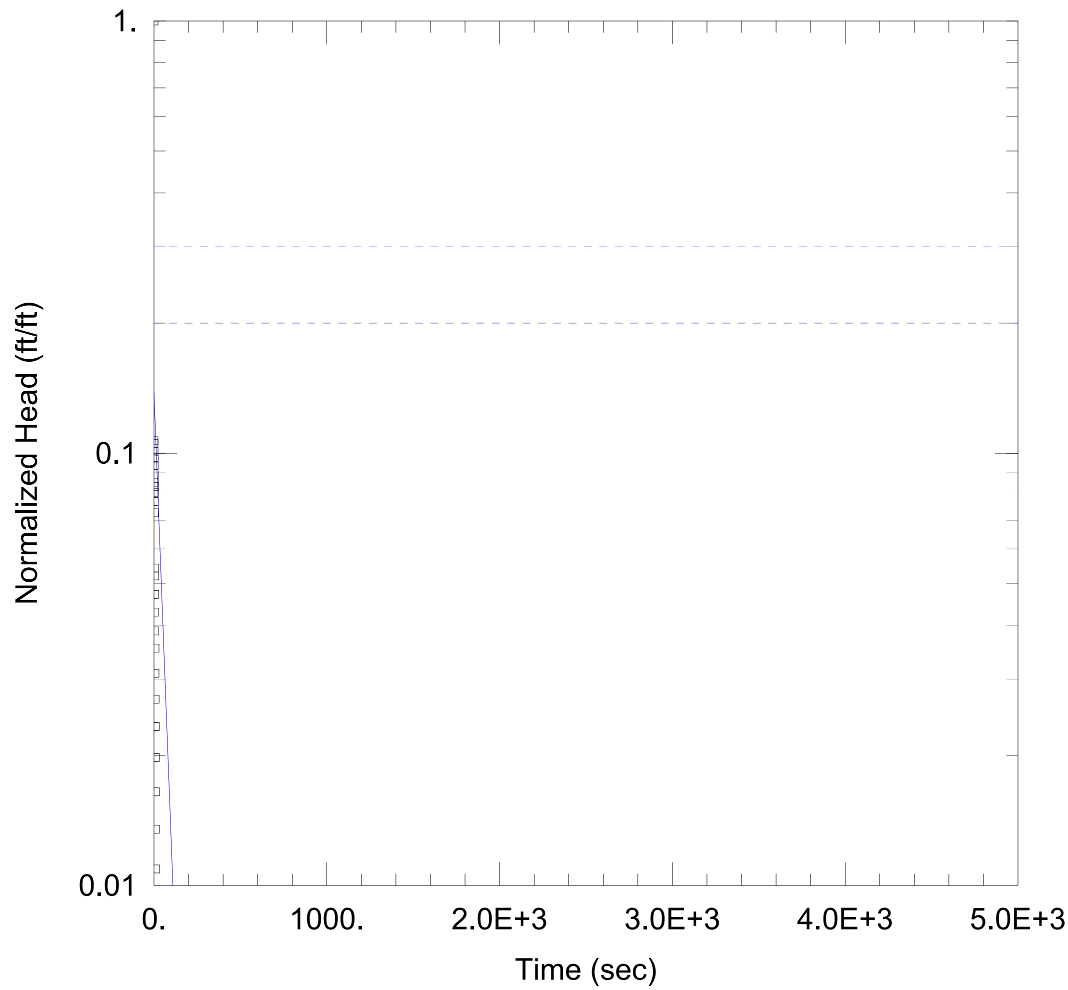
Saturated Thickness: 21.63 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-4)

Initial Displacement: 1.489 ft
Static Water Column Height: 21.63 ft
Total Well Penetration Depth: 21.63 ft
Screen Length: 10. ft
Casing Radius: 0.167 ft
Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0001183 ft/sec
y0 = 0.2282 ft



MW-4 SLUG OUT 1

Data Set: U:\...\MW-4 Slug Out 1.aqt
Date: 10/11/19 Time: 11:49:54

PROJECT INFORMATION

Company: Kleinfelder
Client: City of San Diego
Project: 20200172.001A
Location: Carlsbad, CA
Test Well: MW-4
Test Date: 10/2/19

AQUIFER DATA

Saturated Thickness: 21.63 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-4)

Initial Displacement: 5.11 ft
Total Well Penetration Depth: 21.63 ft
Casing Radius: 0.167 ft
Static Water Column Height: 21.63 ft
Screen Length: 10. ft
Well Radius: 0.167 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.000121 ft/sec y0 = 0.7037 ft

APPENDIX E

Waste Manifests and Laboratory Results

Pace Analytical®
National Center for Testing & Innovation

ANALYTICAL REPORT

October 07, 2019

Kleinfelder- San Diego, CA

Sample Delivery Group:	L1144477
Samples Received:	09/28/2019
Project Number:	20200172
Description:	Carlsbad Double Track Trench Alternatives
Report To:	Lindsay Ellingson 550 West C St, Suite 1200 San Diego, CA 92101

Entire Report Reviewed By: Brian Ford

Brian Ford
Project Manager

TABLE OF CONTENTS

IDW-3-SS L1144477-01 Solid

Collected by	Collected date/time	Received date/time
Steve Treadway	09/25/19 11:45	09/28/19 09:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1357138	1	10/04/19 15:17	10/04/19 15:30	KDW	Mt. Juliet, TN
Mercury by Method 7471A	WG1357517	1	10/05/19 10:11	10/07/19 12:23	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1357171	1	10/03/19 22:30	10/05/19 10:59	TRB	Mt. Juliet, TN
Volatile Organic Compounds (GC) by Method 8015	WG1357783	1	10/03/19 09:13	10/05/19 03:04	DWR	Mt. Juliet, TN
Semi-Volatile Organic Compounds (GC) by Method 8015	WG1356980	1	10/03/19 17:07	10/04/19 11:29	FM	Mt. Juliet, TN

IDW-2-SS L1144477-02 Solid

Collected by	Collected date/time	Received date/time
Steve Treadway	09/26/19 09:11	09/28/19 09:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1357138	1	10/04/19 15:17	10/04/19 15:30	KDW	Mt. Juliet, TN
Mercury by Method 7471A	WG1357517	1	10/05/19 10:11	10/07/19 12:29	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1357171	1	10/03/19 22:30	10/05/19 11:02	TRB	Mt. Juliet, TN
Volatile Organic Compounds (GC) by Method 8015	WG1357783	1	10/03/19 09:13	10/05/19 03:24	DWR	Mt. Juliet, TN
Semi-Volatile Organic Compounds (GC) by Method 8015	WG1356980	1	10/03/19 17:07	10/04/19 11:43	FM	Mt. Juliet, TN

IDW-1-SS L1144477-03 Solid

Collected by	Collected date/time	Received date/time
Steve Treadway	09/26/19 14:38	09/28/19 09:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1357138	1	10/04/19 15:17	10/04/19 15:30	KDW	Mt. Juliet, TN
Mercury by Method 7471A	WG1357517	1	10/05/19 10:11	10/07/19 12:31	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1357171	1	10/03/19 22:30	10/05/19 11:05	TRB	Mt. Juliet, TN
Volatile Organic Compounds (GC) by Method 8015	WG1357783	1	10/03/19 09:13	10/05/19 03:45	DWR	Mt. Juliet, TN
Semi-Volatile Organic Compounds (GC) by Method 8015	WG1356980	1	10/03/19 17:07	10/04/19 11:56	FM	Mt. Juliet, TN

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

Brian Ford

Brian Ford
Project Manager

Total Solids by Method 2540 G-2011

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Total Solids	82.3		1	10/04/2019 15:30	WG1357138

Mercury by Method 7471A

Analyte	Result (dry) mg/kg	Qualifier	MDL (dry) mg/kg	RDL (dry) mg/kg	Dilution	Analysis date / time	Batch
Mercury	U		0.00340	0.0365	1	10/07/2019 12:23	WG1357517

Metals (ICP) by Method 6010B

Analyte	Result (dry) mg/kg	Qualifier	MDL (dry) mg/kg	RDL (dry) mg/kg	Dilution	Analysis date / time	Batch
Antimony	U		0.912	2.43	1	10/05/2019 10:59	WG1357171
Arsenic	0.948	J	0.559	2.43	1	10/05/2019 10:59	WG1357171
Barium	18.6		0.207	0.608	1	10/05/2019 10:59	WG1357171
Beryllium	U		0.0851	0.243	1	10/05/2019 10:59	WG1357171
Cadmium	U		0.0851	0.608	1	10/05/2019 10:59	WG1357171
Chromium	6.29		0.170	1.22	1	10/05/2019 10:59	WG1357171
Cobalt	1.81		0.280	1.22	1	10/05/2019 10:59	WG1357171
Copper	2.13	J	0.644	2.43	1	10/05/2019 10:59	WG1357171
Lead	0.693		0.231	0.608	1	10/05/2019 10:59	WG1357171
Molybdenum	U		0.194	0.608	1	10/05/2019 10:59	WG1357171
Nickel	1.87	J	0.596	2.43	1	10/05/2019 10:59	WG1357171
Selenium	U		0.754	2.43	1	10/05/2019 10:59	WG1357171
Silver	U		0.146	1.22	1	10/05/2019 10:59	WG1357171
Thallium	U		0.790	2.43	1	10/05/2019 10:59	WG1357171
Vanadium	12.7		0.292	2.43	1	10/05/2019 10:59	WG1357171
Zinc	9.16	B	0.717	6.08	1	10/05/2019 10:59	WG1357171

Volatile Organic Compounds (GC) by Method 8015

Analyte	Result (dry) mg/kg	Qualifier	MDL (dry) mg/kg	RDL (dry) mg/kg	Dilution	Analysis date / time	Batch
TPHG C5 - C12	0.0974	B J	0.0404	0.122	1	10/05/2019 03:04	WG1357783
(S) a,a,a-Trifluorotoluene(FID)	*92.1*			*77.0-120*		*10/05/2019 03:04*	WG1357783

Semi-Volatile Organic Compounds (GC) by Method 8015

Analyte	Result (dry) mg/kg	Qualifier	MDL (dry) mg/kg	RDL (dry) mg/kg	Dilution	Analysis date / time	Batch
C12-C22 Hydrocarbons	3.90	J	0.891	4.86	1	10/04/2019 11:29	WG1356980
C22-C32 Hydrocarbons	6.49		1.62	4.86	1	10/04/2019 11:29	WG1356980
C32-C40 Hydrocarbons	1.79	J	1.62	4.86	1	10/04/2019 11:29	WG1356980
(S) o-Terphenyl	*85.3*			*18.0-148*		*10/04/2019 11:29*	WG1356980

Total Solids by Method 2540 G-2011

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Total Solids	85.7		1	10/04/2019 15:30	WG1357138

Mercury by Method 7471A

Analyte	Result (dry) mg/kg	Qualifier	MDL (dry) mg/kg	RDL (dry) mg/kg	Dilution	Analysis date / time	Batch
Mercury	U		0.00327	0.0350	1	10/07/2019 12:29	WG1357517

Metals (ICP) by Method 6010B

Analyte	Result (dry) mg/kg	Qualifier	MDL (dry) mg/kg	RDL (dry) mg/kg	Dilution	Analysis date / time	Batch
Antimony	U		0.875	2.33	1	10/05/2019 11:02	WG1357171
Arsenic	0.843	J	0.537	2.33	1	10/05/2019 11:02	WG1357171
Barium	47.7		0.198	0.583	1	10/05/2019 11:02	WG1357171
Beryllium	0.207	J	0.0817	0.233	1	10/05/2019 11:02	WG1357171
Cadmium	U		0.0817	0.583	1	10/05/2019 11:02	WG1357171
Chromium	35.7		0.163	1.17	1	10/05/2019 11:02	WG1357171
Cobalt	3.13		0.268	1.17	1	10/05/2019 11:02	WG1357171
Copper	5.96		0.618	2.33	1	10/05/2019 11:02	WG1357171
Lead	1.43		0.222	0.583	1	10/05/2019 11:02	WG1357171
Molybdenum	0.402	J	0.187	0.583	1	10/05/2019 11:02	WG1357171
Nickel	4.70		0.572	2.33	1	10/05/2019 11:02	WG1357171
Selenium	U		0.723	2.33	1	10/05/2019 11:02	WG1357171
Silver	U		0.140	1.17	1	10/05/2019 11:02	WG1357171
Thallium	U		0.758	2.33	1	10/05/2019 11:02	WG1357171
Vanadium	21.0		0.280	2.33	1	10/05/2019 11:02	WG1357171
Zinc	14.9		0.688	5.83	1	10/05/2019 11:02	WG1357171

Volatile Organic Compounds (GC) by Method 8015

Analyte	Result (dry) mg/kg	Qualifier	MDL (dry) mg/kg	RDL (dry) mg/kg	Dilution	Analysis date / time	Batch
TPHG C5 - C12	0.125	B	0.0387	0.117	1	10/05/2019 03:24	WG1357783
(S) a,a,a-Trifluorotoluene(FID)	*91.4*			*77.0-120*		*10/05/2019 03:24*	WG1357783

Semi-Volatile Organic Compounds (GC) by Method 8015

Analyte	Result (dry) mg/kg	Qualifier	MDL (dry) mg/kg	RDL (dry) mg/kg	Dilution	Analysis date / time	Batch
C12-C22 Hydrocarbons	2.48	J	0.855	4.67	1	10/04/2019 11:43	WG1356980
C22-C32 Hydrocarbons	3.44	J	1.55	4.67	1	10/04/2019 11:43	WG1356980
C32-C40 Hydrocarbons	2.36	J	1.55	4.67	1	10/04/2019 11:43	WG1356980
(S) o-Terphenyl	*82.0*			*18.0-148*		*10/04/2019 11:43*	WG1356980

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Total Solids by Method 2540 G-2011

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Total Solids	87.5		1	10/04/2019 15:30	WG1357138

Mercury by Method 7471A

Analyte	Result (dry) mg/kg	Qualifier	MDL (dry) mg/kg	RDL (dry) mg/kg	Dilution	Analysis date / time	Batch
Mercury	U		0.00320	0.0343	1	10/07/2019 12:31	WG1357517

Metals (ICP) by Method 6010B

Analyte	Result (dry) mg/kg	Qualifier	MDL (dry) mg/kg	RDL (dry) mg/kg	Dilution	Analysis date / time	Batch
Antimony	U		0.857	2.29	1	10/05/2019 11:05	WG1357171
Arsenic	1.36	J	0.526	2.29	1	10/05/2019 11:05	WG1357171
Barium	28.2		0.194	0.571	1	10/05/2019 11:05	WG1357171
Beryllium	0.543		0.0800	0.229	1	10/05/2019 11:05	WG1357171
Cadmium	U		0.0800	0.571	1	10/05/2019 11:05	WG1357171
Chromium	7.97		0.160	1.14	1	10/05/2019 11:05	WG1357171
Cobalt	3.18		0.263	1.14	1	10/05/2019 11:05	WG1357171
Copper	9.69		0.606	2.29	1	10/05/2019 11:05	WG1357171
Lead	2.09		0.217	0.571	1	10/05/2019 11:05	WG1357171
Molybdenum	U		0.183	0.571	1	10/05/2019 11:05	WG1357171
Nickel	4.02		0.560	2.29	1	10/05/2019 11:05	WG1357171
Selenium	U		0.709	2.29	1	10/05/2019 11:05	WG1357171
Silver	U		0.137	1.14	1	10/05/2019 11:05	WG1357171
Thallium	U		0.743	2.29	1	10/05/2019 11:05	WG1357171
Vanadium	21.5		0.274	2.29	1	10/05/2019 11:05	WG1357171
Zinc	22.5		0.674	5.71	1	10/05/2019 11:05	WG1357171

Volatile Organic Compounds (GC) by Method 8015

Analyte	Result (dry) mg/kg	Qualifier	MDL (dry) mg/kg	RDL (dry) mg/kg	Dilution	Analysis date / time	Batch
TPHG C5 - C12	0.0489	B J	0.0379	0.114	1	10/05/2019 03:45	WG1357783
(S) a,a,a-Trifluorotoluene(FID)	*92.6*			*77.0-120*		*10/05/2019 03:45*	WG1357783

Semi-Volatile Organic Compounds (GC) by Method 8015

Analyte	Result (dry) mg/kg	Qualifier	MDL (dry) mg/kg	RDL (dry) mg/kg	Dilution	Analysis date / time	Batch
C12-C22 Hydrocarbons	6.66		0.838	4.57	1	10/04/2019 11:56	WG1356980
C22-C32 Hydrocarbons	7.11		1.52	4.57	1	10/04/2019 11:56	WG1356980
C32-C40 Hydrocarbons	1.62	J	1.52	4.57	1	10/04/2019 11:56	WG1356980
(S) o-Terphenyl	*80.6*			*18.0-148*		*10/04/2019 11:56*	WG1356980

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Method Blank (MB)

(MB) R3457932-1 10/04/19 15:30

Analyte	MB Result %	MB Qualifier	MB MDL %	MB RDL %
Total Solids	0.00100			

L1144490-02 Original Sample (OS) • Duplicate (DUP)

(OS) L1144490-02 10/04/19 15:30 • (DUP) R3457932-3 10/04/19 15:30

Analyte	Original Result %	DUP Result %	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Total Solids	69.4	67.1	1	3.39		10

Laboratory Control Sample (LCS)

(LCS) R3457932-2 10/04/19 15:30

Analyte	Spike Amount %	LCS Result %	LCS Rec. %	Rec. Limits %	LCS Qualifier
Total Solids	50.0	50.0	99.9	85.0-115	

Cp Tc Ss Cn Sr Qc Gl Al Sc

Method Blank (MB)

(MB) R3458393-1 10/07/19 11:34

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Mercury	U		0.00280	0.0300

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3458393-2 10/07/19 11:40 • (LCSD) R3458393-3 10/07/19 11:42

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Mercury	0.500	0.491	0.491	98.1	98.2	80.0-120			0.0407	20

L1144398-02 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1144398-02 10/07/19 11:44 • (MS) R3458393-4 10/07/19 11:46 • (MSD) R3458393-5 10/07/19 11:48

Analyte	Spike Amount (dry) mg/kg	Original Result (dry) mg/kg	MS Result (dry) mg/kg	MSD Result (dry) mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Mercury	0.565	U	0.494	0.546	87.4	96.5	1	75.0-125			9.94	20

Method Blank (MB)

(MB) R3458018-1 10/05/19 09:49

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Antimony	U		0.750	2.00
Arsenic	U		0.460	2.00
Barium	U		0.170	0.500
Beryllium	U		0.0700	0.200
Cadmium	U		0.0700	0.500
Chromium	U		0.140	1.00
Cobalt	U		0.230	1.00
Copper	U		0.530	2.00
Lead	U		0.190	0.500
Molybdenum	U		0.160	0.500
Nickel	U		0.490	2.00
Selenium	U		0.620	2.00
Silver	U		0.120	1.00
Thallium	U		0.650	2.00
Vanadium	U		0.240	2.00
Zinc	1.14	J	0.590	5.00

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3458018-2 10/05/19 09:51 • (LCSD) R3458018-3 10/05/19 09:54

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Antimony	100	94.1	93.4	94.1	93.4	80.0-120			0.694	20
Arsenic	100	92.2	91.7	92.2	91.7	80.0-120			0.538	20
Barium	100	99.6	98.9	99.6	98.9	80.0-120			0.636	20
Beryllium	100	99.3	98.8	99.3	98.8	80.0-120			0.541	20
Cadmium	100	94.6	94.1	94.6	94.1	80.0-120			0.571	20
Chromium	100	98.5	98.0	98.5	98.0	80.0-120			0.494	20
Cobalt	100	97.6	97.0	97.6	97.0	80.0-120			0.621	20
Copper	100	102	101	102	101	80.0-120			0.179	20
Lead	100	93.4	92.9	93.4	92.9	80.0-120			0.533	20
Molybdenum	100	98.6	97.9	98.6	97.9	80.0-120			0.741	20
Nickel	100	96.3	95.9	96.3	95.9	80.0-120			0.434	20
Selenium	100	93.6	93.0	93.6	93.0	80.0-120			0.596	20
Silver	20.0	19.0	19.1	95.2	95.5	80.0-120			0.375	20
Thallium	100	93.4	93.2	93.4	93.2	80.0-120			0.204	20
Vanadium	100	97.7	97.0	97.7	97.0	80.0-120			0.754	20
Zinc	100	96.7	96.0	96.7	96.0	80.0-120			0.729	20

L1144398-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1144398-01 10/05/19 09:56 • (MS) R3458018-6 10/05/19 10:04 • (MSD) R3458018-7 10/05/19 10:07

Analyte	Spike Amount (dry) mg/kg	Original Result (dry) mg/kg	MS Result (dry) mg/kg	MSD Result (dry) mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Antimony	111	U	48.5	48.7	43.8	44.0	1	75.0-125	J6	J6	0.425	20
Arsenic	111	3.07	99.7	95.0	87.2	82.9	1	75.0-125			4.82	20
Barium	111	110	200	204	81.3	85.1	1	75.0-125			2.09	20
Beryllium	111	1.27	101	104	90.3	92.5	1	75.0-125			2.38	20
Cadmium	111	0.159	96.8	97.8	87.2	88.1	1	75.0-125			1.11	20
Chromium	111	16.8	118	125	91.3	97.3	1	75.0-125			5.51	20
Cobalt	111	9.56	114	115	94.6	95.4	1	75.0-125			0.755	20
Copper	111	15.5	124	133	98.1	106	1	75.0-125			6.80	20
Lead	111	13.9	114	114	90.7	89.9	1	75.0-125			0.767	20
Molybdenum	111	0.195	94.1	95.4	84.8	85.9	1	75.0-125			1.34	20
Nickel	111	15.6	120	124	94.6	97.7	1	75.0-125			2.84	20
Selenium	111	U	93.5	93.6	84.4	84.4	1	75.0-125			0.0268	20
Silver	22.2	U	19.8	20.1	89.2	90.8	1	75.0-125			1.72	20
Thallium	111	U	94.4	96.1	85.2	86.8	1	75.0-125			1.80	20
Vanadium	111	19.4	124	128	94.5	98.4	1	75.0-125			3.43	20
Zinc	111	54.0	144	139	81.5	76.9	1	75.0-125			3.66	20

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Method Blank (MB)

(MB) R3458150-3 10/04/19 23:24

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
TPHG C5 - C12	0.0436	J	0.0332	0.100
(S) a,a,a-Trifluorotoluene(FID)	*89.8*			*77.0-120*

Laboratory Control Sample (LCS)

(LCS) R3458150-2 10/04/19 22:10

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	LCS Qualifier
TPHG C5 - C12	5.50	4.84	88.0	72.0-125	
(S) a,a,a-Trifluorotoluene(FID)			*107*	*77.0-120*	

L1144624-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1144624-01 10/05/19 08:38 • (MS) R3458150-6 10/05/19 10:06 • (MSD) R3458150-7 10/05/19 10:26

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
TPHG C5 - C12	138	ND	117	159	77.2	108	25	10.0-141		J3	30.4	29
(S) a,a,a-Trifluorotoluene(FID)					*104*	*112*		*77.0-120*				

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Method Blank (MB)

(MB) R3457789-1 10/04/19 11:01

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
C12-C22 Hydrocarbons	U		0.733	4.00
C22-C32 Hydrocarbons	U		1.33	4.00
C32-C40 Hydrocarbons	U		1.33	4.00
(S) o-Terphenyl	*74.6*			*18.0-148*

Laboratory Control Sample (LCS)

(LCS) R3457789-2 10/04/19 11:15

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	LCS Qualifier
C22-C32 Hydrocarbons	25.0	21.2	84.8	50.0-150	
C12-C22 Hydrocarbons	25.0	18.4	73.6	50.0-150	
(S) o-Terphenyl			*89.8*	*18.0-148*	

L1144492-04 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1144492-04 10/04/19 18:33 • (MS) R3457789-3 10/04/19 18:47 • (MSD) R3457789-4 10/04/19 19:01

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
C22-C32 Hydrocarbons	25.0	U	82.2	24.3	329	97.2	10	50.0-150	J5	J3	109	20
C12-C22 Hydrocarbons	25.0	U	26.2	19.1	105	76.4	10	50.0-150		J3	31.3	20
(S) o-Terphenyl					*99.1*	*91.0*		*18.0-148*				

Sample Narrative:

OS: Dilution due to matrix impact during extraction procedure

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

(dry)	Results are reported based on the dry weight of the sample. [this will only be present on a dry report basis for soils].
MDL	Method Detection Limit.
MDL (dry)	Method Detection Limit.
ND	Not detected at the Reporting Limit (or MDL where applicable).
RDL	Reported Detection Limit.
RDL (dry)	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
(S)	Surrogate (Surrogate Standard) - Analytes added to every blank, sample, Laboratory Control Sample/Duplicate and Matrix Spike/Duplicate; used to evaluate analytical efficiency by measuring recovery. Surrogates are not expected to be detected in all environmental media.
U	Not detected at the Reporting Limit (or MDL where applicable).
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state “ND” (Not Detected) or “BDL” (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
B	The same analyte is found in the associated blank.
J	The identification of the analyte is acceptable; the reported value is an estimate.
J3	The associated batch QC was outside the established quality control range for precision.
J5	The sample matrix interfered with the ability to make any accurate determination; spike value is high.
J6	The sample matrix interfered with the ability to make any accurate determination; spike value is low.

Pace National is the only environmental laboratory accredited/certified to support your work nationwide from one location. One phone call, one point of contact, one laboratory. No other lab is as accessible or prepared to handle your needs throughout the country. Our capacity and capability from our single location laboratory is comparable to the collective totals of the network laboratories in our industry. The most significant benefit to our one location design is the design of our laboratory campus. The model is conducive to accelerated productivity, decreasing turn-around time, and preventing cross contamination, thus protecting sample integrity. Our focus on premium quality and prompt service allows us to be YOUR LAB OF CHOICE.

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace National.

State Accreditations

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN-03-2002-34
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey–NELAP	TN002
California	2932	New Mexico [1]	n/a
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina [1]	DW21704
Georgia	NELAP	North Carolina [3]	41
Georgia [1]	923	North Dakota	R-140
Idaho	TN00003	Ohio–VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LAO00356
Kentucky [1,6]	90010	South Carolina	84004
Kentucky [2]	16	South Dakota	n/a
Louisiana	AI30792	Tennessee [1,4]	2006
Louisiana [1]	LA180010	Texas	T104704245-18-15
Maine	TN0002	Texas [5]	LAB0152
Maryland	324	Utah	TN00003
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	460132
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	9980939910
Montana	CERT0086	Wyoming	A2LA

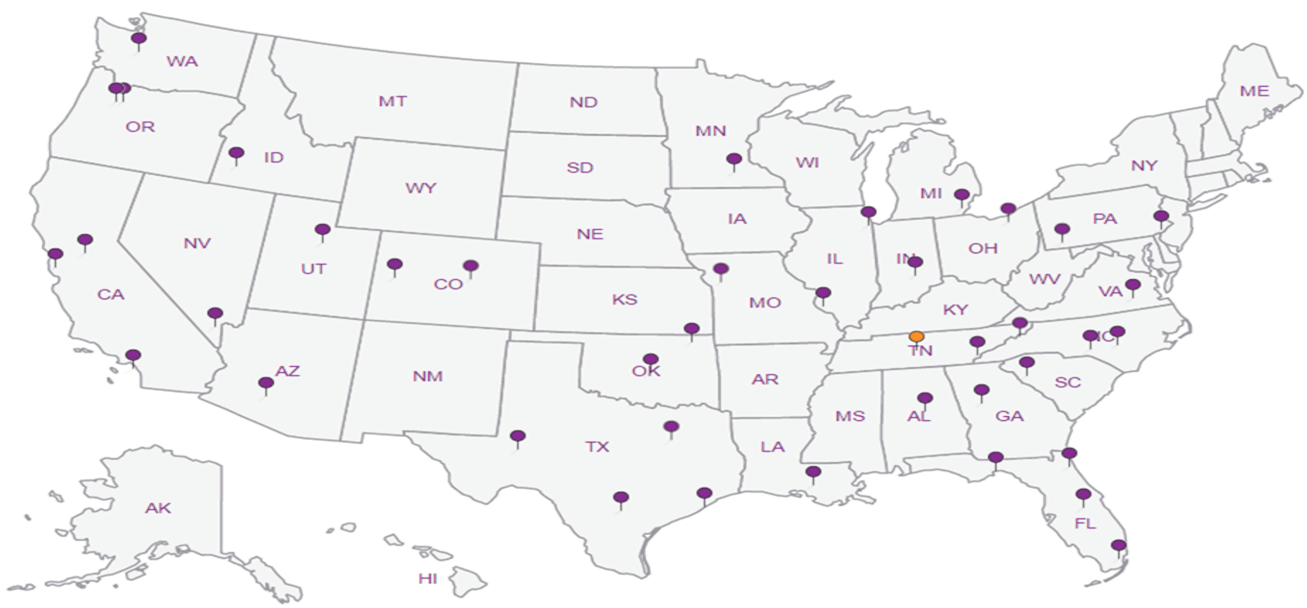
Third Party Federal Accreditations

A2LA – ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA – ISO 17025 [5]	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA–Crypto	TN00003		

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

Our Locations

Pace National has sixty-four client support centers that provide sample pickup and/or the delivery of sampling supplies. If you would like assistance from one of our support offices, please contact our main office. Pace National performs all testing at our central laboratory.



Kleinfelder- San Diego, CA

550 West C St, Suite 1200
San Diego, CA 92101

Billing Information:

Accounts Payable
550 West C St., Ste. 1200
San Diego, CA 92101

Pres Chk

Report to:
Lindsay Ellingson

Email To: LEllingson@kleinfelder.com

Project Description: Carlsbad Double Track Trench Alternatives

City/State Collected: Carlsbad, CA

Please Circle: PT MT CT ET

Phone: 619-831-4600
Fax:

Client Project # 20200172

Lab Project # KLEINSDCA-CARLSBADDT

Collected by (print): Steve Treadway

Site/Facility ID #

P.O. # 20200172.001A

Collected by (signature): Steve Treadway

Rush? (Lab MUST Be Notified)
___ Same Day X Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Immediately Packed on Ice N___ Y X

Analysis / Container / Preservative

Chain of Custody Page ___ of ___

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Fax: 615-758-5859

SDG # B216 1144477

Ta

Acctnum: KLEINSDCA
Template: T156118
Prelogin: P730782
PM: 110 - Brian Ford
PB:
Shipped Via:

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	soil CAM17 Metals 4ozClr-NoPres	soil DRO/ORO-CA 4ozClr-NoPres	soil GRO-CA 40mlAmb/MeOH5ml/Syr	soil VOCs 8260 2ozClr-NoPres	soil VOCs 8260 40mlAmb/MeOH5ml/Syr	water DRO/ORO-CA 40mlAmb-HCl-BT	water GRO-CA 40mlAmb HCl	water Total CAM17 250mlHDPE-HNO3	water VOCs 8260 40mlAmb-HCl		Remarks	Sample # (lab only)
IDW-3-SS-1		SS		9/25	11:45			X									01	
IDW-3-SS-2		SS		9/25	11:45		X										01	
IDW-3-SS-3		SS		9/25	11:45				X								01	
IDW-2-SS-1		~~GW~~ SS		9/26	9:11				X								02	
IDW-2-SS-2		~~GW~~ SS		9/26	9:11			X									02	
IDW-2-SS-3		~~GW~~ SS		9/26	9:11		X										02	
IDW-1-SS-1		SS		9/26	14:35			X									03	
IDW-1-SS-2		SS		9/26	14:36				X								03	
IDW-1-SS-3		SS		9/26	14:38		X										03	

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
~~OT - Other~~

Remarks:

pH _______ Temp _______

Flow _______ Other _______

Samples returned via:
__ UPS __ FedEx X Courier ________

Tracking # 4794 8838 7178

Sample Receipt Checklist
COC Seal Present/Intact: ✓ NP __Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N
RAD Screen <0.5 mR/hr: ✓Y __N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)		
[signature]	9/27/19	1300	[signature]	Trip Blank Received: Yes / No HCL / MeoH TBR	
Relinquished by : (Signature) [signature]	Date: 9/27/19	Time: 1625	Received by: (Signature)	Temp: 2.4+0=2.4 °C Bottles Received: 9	If preservation required by Login: Date/Time
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature) [signature]	Date: 9/28 Time: 0900	Hold: Condition: NCF / OK

ANALYTICAL REPORT

October 16, 2019

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Kleinfelder- San Diego, CA

Sample Delivery Group:	L1146364
Samples Received:	10/04/2019
Project Number:	20200172.001A
Description:	
Report To:	Lindsay Ellingson 550 West C St, Suite 1200 San Diego, CA 92101

Entire Report Reviewed By:

Brian Ford
Project Manager

TABLE OF CONTENTS

MW-1-IDW L1146364-01 GW

Collected by	Collected date/time	Received date/time
Stefan B.	10/02/19 13:20	10/04/19 08:30

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Mercury by Method 7470A	WG1357911	1	10/05/19 09:15	10/07/19 11:37	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1357923	1	10/08/19 14:01	10/09/19 01:03	CCE	Mt. Juliet, TN
Metals (ICPMS) by Method 6020	WG1357928	1	10/08/19 19:02	10/09/19 00:09	LAT	Mt. Juliet, TN
Volatile Organic Compounds (GC) by Method 8015	WG1359147	1	10/08/19 15:32	10/08/19 15:32	DWR	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1361672	1	10/11/19 22:01	10/11/19 22:01	ADM	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1362648	1	10/15/19 00:08	10/15/19 00:08	ADM	Mt. Juliet, TN
Semi-Volatile Organic Compounds (GC) by Method 3511/8015	WG1359278	1	10/08/19 17:32	10/09/19 00:46	SHG	Mt. Juliet, TN

MW-2-IDW L1146364-02 GW

Collected by	Collected date/time	Received date/time
Stefan B.	10/02/19 13:35	10/04/19 08:30

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Mercury by Method 7470A	WG1357911	1	10/05/19 09:15	10/07/19 11:40	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1357923	1	10/08/19 14:01	10/09/19 01:11	CCE	Mt. Juliet, TN
Metals (ICPMS) by Method 6020	WG1357928	1	10/08/19 19:02	10/09/19 00:13	LAT	Mt. Juliet, TN
Volatile Organic Compounds (GC) by Method 8015	WG1359147	1	10/08/19 15:56	10/08/19 15:56	DWR	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1361672	1	10/11/19 22:21	10/11/19 22:21	ADM	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1362648	1	10/15/19 00:28	10/15/19 00:28	ADM	Mt. Juliet, TN
Semi-Volatile Organic Compounds (GC) by Method 3511/8015	WG1359278	1	10/08/19 17:32	10/09/19 01:14	SHG	Mt. Juliet, TN

MW-3-IDW L1146364-03 GW

Collected by	Collected date/time	Received date/time
Stefan B.	10/02/19 13:50	10/04/19 08:30

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Mercury by Method 7470A	WG1357911	1	10/05/19 09:15	10/07/19 11:42	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1357923	1	10/08/19 14:01	10/09/19 01:14	CCE	Mt. Juliet, TN
Metals (ICPMS) by Method 6020	WG1357928	1	10/08/19 19:02	10/09/19 00:16	LAT	Mt. Juliet, TN
Volatile Organic Compounds (GC) by Method 8015	WG1359147	1	10/08/19 16:20	10/08/19 16:20	DWR	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1361672	1	10/11/19 22:41	10/11/19 22:41	ADM	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1362648	1	10/15/19 00:48	10/15/19 00:48	ADM	Mt. Juliet, TN
Semi-Volatile Organic Compounds (GC) by Method 3511/8015	WG1359278	1	10/08/19 17:32	10/09/19 01:42	SHG	Mt. Juliet, TN

TRIP BLANK L1146364-04 GW

Collected by	Collected date/time	Received date/time
Stefan B.	10/02/19 00:00	10/04/19 08:30

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1361672	1	10/11/19 18:40	10/11/19 18:40	ADM	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1362648	1	10/14/19 23:27	10/14/19 23:27	ADM	Mt. Juliet, TN

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

Brian Ford

Brian Ford
Project Manager

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Mercury by Method 7470A

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Mercury	U		0.0490	0.200	1	10/07/2019 11:37	WG1357911

Metals (ICP) by Method 6010B

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Barium	40.4		1.70	5.00	1	10/09/2019 01:03	WG1357923
Beryllium	U		0.700	2.00	1	10/09/2019 01:03	WG1357923
Chromium	2.02	J	1.40	10.0	1	10/09/2019 01:03	WG1357923
Cobalt	8.87	J	2.30	10.0	1	10/09/2019 01:03	WG1357923
Molybdenum	13.3		1.60	5.00	1	10/09/2019 01:03	WG1357923
Vanadium	4.86	J	2.40	20.0	1	10/09/2019 01:03	WG1357923

Metals (ICPMS) by Method 6020

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Antimony	U		0.754	2.00	1	10/09/2019 00:09	WG1357928
Arsenic	0.649	J	0.250	2.00	1	10/09/2019 00:09	WG1357928
Cadmium	U		0.160	1.00	1	10/09/2019 00:09	WG1357928
Copper	6.39	B	0.520	5.00	1	10/09/2019 00:09	WG1357928
Lead	2.28	B	0.240	2.00	1	10/09/2019 00:09	WG1357928
Nickel	5.14		0.350	2.00	1	10/09/2019 00:09	WG1357928
Selenium	6.58		0.380	2.00	1	10/09/2019 00:09	WG1357928
Silver	U		0.310	2.00	1	10/09/2019 00:09	WG1357928
Thallium	U		0.190	2.00	1	10/09/2019 00:09	WG1357928
Zinc	34.0		2.56	25.0	1	10/09/2019 00:09	WG1357928

Volatile Organic Compounds (GC) by Method 8015

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
TPHG C5 - C12	U		30.4	100	1	10/08/2019 15:32	WG1359147
(S) a,a,a-Trifluorotoluene(FID)	*110*			*78.0-120*		*10/08/2019 15:32*	WG1359147

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Acetone	U		10.0	50.0	1	10/11/2019 22:01	WG1361672
Acrolein	U	J4	8.87	50.0	1	10/11/2019 22:01	WG1361672
Acrylonitrile	U		1.87	10.0	1	10/11/2019 22:01	WG1361672
Benzene	U		0.331	1.00	1	10/11/2019 22:01	WG1361672
Bromobenzene	U		0.352	1.00	1	10/11/2019 22:01	WG1361672
Bromodichloromethane	U		0.380	1.00	1	10/11/2019 22:01	WG1361672
Bromoform	U		0.469	1.00	1	10/11/2019 22:01	WG1361672
Bromomethane	U		0.866	5.00	1	10/11/2019 22:01	WG1361672
n-Butylbenzene	U		0.361	1.00	1	10/11/2019 22:01	WG1361672
sec-Butylbenzene	U		0.365	1.00	1	10/11/2019 22:01	WG1361672
tert-Butylbenzene	U		0.399	1.00	1	10/11/2019 22:01	WG1361672
Carbon disulfide	U		0.275	1.00	1	10/11/2019 22:01	WG1361672
Carbon tetrachloride	U		0.379	1.00	1	10/11/2019 22:01	WG1361672
Chlorobenzene	U		0.348	1.00	1	10/11/2019 22:01	WG1361672
Chlorodibromomethane	U		0.327	1.00	1	10/11/2019 22:01	WG1361672
Chloroethane	U		0.453	5.00	1	10/11/2019 22:01	WG1361672
Chloroform	U		0.324	5.00	1	10/11/2019 22:01	WG1361672
Chloromethane	U		0.276	2.50	1	10/11/2019 22:01	WG1361672

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
2-Chlorotoluene	U		0.375	1.00	1	10/11/2019 22:01	WG1361672
4-Chlorotoluene	U		0.351	1.00	1	10/11/2019 22:01	WG1361672
1,2-Dibromo-3-Chloropropane	U		1.33	5.00	1	10/11/2019 22:01	WG1361672
1,2-Dibromoethane	U		0.381	1.00	1	10/11/2019 22:01	WG1361672
Dibromomethane	U		0.346	1.00	1	10/11/2019 22:01	WG1361672
1,2-Dichlorobenzene	U		0.349	1.00	1	10/11/2019 22:01	WG1361672
1,3-Dichlorobenzene	U		0.220	1.00	1	10/11/2019 22:01	WG1361672
1,4-Dichlorobenzene	U		0.274	1.00	1	10/11/2019 22:01	WG1361672
Dichlorodifluoromethane	U		0.551	5.00	1	10/11/2019 22:01	WG1361672
1,1-Dichloroethane	U		0.259	1.00	1	10/11/2019 22:01	WG1361672
1,2-Dichloroethane	U		0.361	1.00	1	10/11/2019 22:01	WG1361672
1,1-Dichloroethene	U		0.398	1.00	1	10/11/2019 22:01	WG1361672
cis-1,2-Dichloroethene	U		0.260	1.00	1	10/11/2019 22:01	WG1361672
trans-1,2-Dichloroethene	U		0.396	1.00	1	10/11/2019 22:01	WG1361672
1,2-Dichloropropane	U		0.306	1.00	1	10/11/2019 22:01	WG1361672
1,1-Dichloropropene	U		0.352	1.00	1	10/11/2019 22:01	WG1361672
1,3-Dichloropropane	U		0.366	1.00	1	10/15/2019 00:08	WG1362648
cis-1,3-Dichloropropene	U		0.418	1.00	1	10/11/2019 22:01	WG1361672
trans-1,3-Dichloropropene	U		0.419	1.00	1	10/11/2019 22:01	WG1361672
2,2-Dichloropropane	U		0.321	1.00	1	10/11/2019 22:01	WG1361672
Di-isopropyl ether	U		0.320	1.00	1	10/11/2019 22:01	WG1361672
Ethylbenzene	U		0.384	1.00	1	10/11/2019 22:01	WG1361672
Hexachloro-1,3-butadiene	U		0.256	1.00	1	10/11/2019 22:01	WG1361672
Isopropylbenzene	U		0.326	1.00	1	10/11/2019 22:01	WG1361672
p-Isopropyltoluene	U		0.350	1.00	1	10/11/2019 22:01	WG1361672
2-Butanone (MEK)	U		3.93	10.0	1	10/11/2019 22:01	WG1361672
Methylene Chloride	U		1.00	5.00	1	10/11/2019 22:01	WG1361672
4-Methyl-2-pentanone (MIBK)	U		2.14	10.0	1	10/11/2019 22:01	WG1361672
Methyl tert-butyl ether	U		0.367	1.00	1	10/11/2019 22:01	WG1361672
Naphthalene	U		1.00	5.00	1	10/11/2019 22:01	WG1361672
n-Propylbenzene	U		0.349	1.00	1	10/11/2019 22:01	WG1361672
Styrene	U		0.307	1.00	1	10/11/2019 22:01	WG1361672
1,1,1,2-Tetrachloroethane	U		0.385	1.00	1	10/11/2019 22:01	WG1361672
1,1,2,2-Tetrachloroethane	U		0.130	1.00	1	10/11/2019 22:01	WG1361672
1,1,2-Trichlorotrifluoroethane	U		0.303	1.00	1	10/11/2019 22:01	WG1361672
Tetrachloroethene	U		0.372	1.00	1	10/11/2019 22:01	WG1361672
Toluene	U		0.412	1.00	1	10/11/2019 22:01	WG1361672
1,2,3-Trichlorobenzene	U		0.230	1.00	1	10/11/2019 22:01	WG1361672
1,2,4-Trichlorobenzene	U		0.355	1.00	1	10/11/2019 22:01	WG1361672
1,1,1-Trichloroethane	U		0.319	1.00	1	10/11/2019 22:01	WG1361672
1,1,2-Trichloroethane	U	J4	0.383	1.00	1	10/11/2019 22:01	WG1361672
Trichloroethene	U		0.398	1.00	1	10/11/2019 22:01	WG1361672
Trichlorofluoromethane	U		1.20	5.00	1	10/11/2019 22:01	WG1361672
1,2,3-Trichloropropane	U		0.807	2.50	1	10/11/2019 22:01	WG1361672
1,2,4-Trimethylbenzene	U		0.373	1.00	1	10/11/2019 22:01	WG1361672
1,2,3-Trimethylbenzene	U		0.321	1.00	1	10/11/2019 22:01	WG1361672
1,3,5-Trimethylbenzene	U		0.387	1.00	1	10/11/2019 22:01	WG1361672
Vinyl chloride	U		0.259	1.00	1	10/11/2019 22:01	WG1361672
Xylenes, Total	U		1.06	3.00	1	10/11/2019 22:01	WG1361672
(S) Toluene-d8	*94.3*			*80.0-120*		*10/11/2019 22:01*	WG1361672
(S) Toluene-d8	*111*			*80.0-120*		*10/15/2019 00:08*	WG1362648
(S) 4-Bromofluorobenzene	*106*			*77.0-126*		*10/11/2019 22:01*	WG1361672
(S) 4-Bromofluorobenzene	*93.1*			*77.0-126*		*10/15/2019 00:08*	WG1362648
(S) 1,2-Dichloroethane-d4	*99.1*			*70.0-130*		*10/11/2019 22:01*	WG1361672
(S) 1,2-Dichloroethane-d4	*94.5*			*70.0-130*		*10/15/2019 00:08*	WG1362648

Semi-Volatile Organic Compounds (GC) by Method 3511/8015

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
C12-C22 Hydrocarbons	132		33.0	100	1	10/09/2019 00:46	WG1359278
C22-C32 Hydrocarbons	200		33.0	100	1	10/09/2019 00:46	WG1359278
C32-C40 Hydrocarbons	U		33.0	100	1	10/09/2019 00:46	WG1359278
(S) o-Terphenyl	*85.8*			*52.0-156*		*10/09/2019 00:46*	WG1359278

Mercury by Method 7470A

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Mercury	U		0.0490	0.200	1	10/07/2019 11:40	WG1357911

Metals (ICP) by Method 6010B

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Barium	85.0		1.70	5.00	1	10/09/2019 01:11	WG1357923
Beryllium	U		0.700	2.00	1	10/09/2019 01:11	WG1357923
Chromium	U		1.40	10.0	1	10/09/2019 01:11	WG1357923
Cobalt	U		2.30	10.0	1	10/09/2019 01:11	WG1357923
Molybdenum	18.2		1.60	5.00	1	10/09/2019 01:11	WG1357923
Vanadium	2.83	J	2.40	20.0	1	10/09/2019 01:11	WG1357923

Metals (ICPMS) by Method 6020

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Antimony	U		0.754	2.00	1	10/09/2019 00:13	WG1357928
Arsenic	1.31	J	0.250	2.00	1	10/09/2019 00:13	WG1357928
Cadmium	U		0.160	1.00	1	10/09/2019 00:13	WG1357928
Copper	7.21	B	0.520	5.00	1	10/09/2019 00:13	WG1357928
Lead	1.32	B J	0.240	2.00	1	10/09/2019 00:13	WG1357928
Nickel	2.87		0.350	2.00	1	10/09/2019 00:13	WG1357928
Selenium	1.46	J	0.380	2.00	1	10/09/2019 00:13	WG1357928
Silver	U		0.310	2.00	1	10/09/2019 00:13	WG1357928
Thallium	U		0.190	2.00	1	10/09/2019 00:13	WG1357928
Zinc	16.0	J	2.56	25.0	1	10/09/2019 00:13	WG1357928

Volatile Organic Compounds (GC) by Method 8015

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
TPHG C5 - C12	U		30.4	100	1	10/08/2019 15:56	WG1359147
(S) a,a,a-Trifluorotoluene(FID)	*110*			*78.0-120*		*10/08/2019 15:56*	WG1359147

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Acetone	14.4	J	10.0	50.0	1	10/11/2019 22:21	WG1361672
Acrolein	U	J4	8.87	50.0	1	10/11/2019 22:21	WG1361672
Acrylonitrile	U		1.87	10.0	1	10/11/2019 22:21	WG1361672
Benzene	U		0.331	1.00	1	10/11/2019 22:21	WG1361672
Bromobenzene	U		0.352	1.00	1	10/11/2019 22:21	WG1361672
Bromodichloromethane	0.571	J	0.380	1.00	1	10/11/2019 22:21	WG1361672
Bromoform	U		0.469	1.00	1	10/11/2019 22:21	WG1361672
Bromomethane	U		0.866	5.00	1	10/11/2019 22:21	WG1361672
n-Butylbenzene	U		0.361	1.00	1	10/11/2019 22:21	WG1361672
sec-Butylbenzene	U		0.365	1.00	1	10/11/2019 22:21	WG1361672
tert-Butylbenzene	U		0.399	1.00	1	10/11/2019 22:21	WG1361672
Carbon disulfide	U		0.275	1.00	1	10/11/2019 22:21	WG1361672
Carbon tetrachloride	U		0.379	1.00	1	10/11/2019 22:21	WG1361672
Chlorobenzene	U		0.348	1.00	1	10/11/2019 22:21	WG1361672
Chlorodibromomethane	0.719	J	0.327	1.00	1	10/11/2019 22:21	WG1361672
Chloroethane	U		0.453	5.00	1	10/11/2019 22:21	WG1361672
Chloroform	0.419	J	0.324	5.00	1	10/11/2019 22:21	WG1361672
Chloromethane	U		0.276	2.50	1	10/11/2019 22:21	WG1361672

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
2-Chlorotoluene	U		0.375	1.00	1	10/11/2019 22:21	WG1361672
4-Chlorotoluene	U		0.351	1.00	1	10/11/2019 22:21	WG1361672
1,2-Dibromo-3-Chloropropane	U		1.33	5.00	1	10/11/2019 22:21	WG1361672
1,2-Dibromoethane	U		0.381	1.00	1	10/11/2019 22:21	WG1361672
Dibromomethane	U		0.346	1.00	1	10/11/2019 22:21	WG1361672
1,2-Dichlorobenzene	U		0.349	1.00	1	10/11/2019 22:21	WG1361672
1,3-Dichlorobenzene	U		0.220	1.00	1	10/11/2019 22:21	WG1361672
1,4-Dichlorobenzene	U		0.274	1.00	1	10/11/2019 22:21	WG1361672
Dichlorodifluoromethane	U		0.551	5.00	1	10/11/2019 22:21	WG1361672
1,1-Dichloroethane	U		0.259	1.00	1	10/11/2019 22:21	WG1361672
1,2-Dichloroethane	U		0.361	1.00	1	10/11/2019 22:21	WG1361672
1,1-Dichloroethene	U		0.398	1.00	1	10/11/2019 22:21	WG1361672
cis-1,2-Dichloroethene	U		0.260	1.00	1	10/11/2019 22:21	WG1361672
trans-1,2-Dichloroethene	U		0.396	1.00	1	10/11/2019 22:21	WG1361672
1,2-Dichloropropane	U		0.306	1.00	1	10/11/2019 22:21	WG1361672
1,1-Dichloropropene	U		0.352	1.00	1	10/11/2019 22:21	WG1361672
1,3-Dichloropropane	U		0.366	1.00	1	10/15/2019 00:28	WG1362648
cis-1,3-Dichloropropene	U		0.418	1.00	1	10/11/2019 22:21	WG1361672
trans-1,3-Dichloropropene	U		0.419	1.00	1	10/11/2019 22:21	WG1361672
2,2-Dichloropropane	U		0.321	1.00	1	10/11/2019 22:21	WG1361672
Di-isopropyl ether	U		0.320	1.00	1	10/11/2019 22:21	WG1361672
Ethylbenzene	U		0.384	1.00	1	10/11/2019 22:21	WG1361672
Hexachloro-1,3-butadiene	U		0.256	1.00	1	10/11/2019 22:21	WG1361672
Isopropylbenzene	U		0.326	1.00	1	10/11/2019 22:21	WG1361672
p-Isopropyltoluene	U		0.350	1.00	1	10/11/2019 22:21	WG1361672
2-Butanone (MEK)	U		3.93	10.0	1	10/11/2019 22:21	WG1361672
Methylene Chloride	U		1.00	5.00	1	10/11/2019 22:21	WG1361672
4-Methyl-2-pentanone (MIBK)	U		2.14	10.0	1	10/11/2019 22:21	WG1361672
Methyl tert-butyl ether	U		0.367	1.00	1	10/11/2019 22:21	WG1361672
Naphthalene	U		1.00	5.00	1	10/11/2019 22:21	WG1361672
n-Propylbenzene	U		0.349	1.00	1	10/11/2019 22:21	WG1361672
Styrene	U		0.307	1.00	1	10/11/2019 22:21	WG1361672
1,1,1,2-Tetrachloroethane	U		0.385	1.00	1	10/11/2019 22:21	WG1361672
1,1,2,2-Tetrachloroethane	U		0.130	1.00	1	10/11/2019 22:21	WG1361672
1,1,2-Trichlorotrifluoroethane	U		0.303	1.00	1	10/11/2019 22:21	WG1361672
Tetrachloroethene	U		0.372	1.00	1	10/11/2019 22:21	WG1361672
Toluene	0.639	J	0.412	1.00	1	10/11/2019 22:21	WG1361672
1,2,3-Trichlorobenzene	U		0.230	1.00	1	10/11/2019 22:21	WG1361672
1,2,4-Trichlorobenzene	U		0.355	1.00	1	10/11/2019 22:21	WG1361672
1,1,1-Trichloroethane	U		0.319	1.00	1	10/11/2019 22:21	WG1361672
1,1,2-Trichloroethane	U	J4	0.383	1.00	1	10/11/2019 22:21	WG1361672
Trichloroethene	U		0.398	1.00	1	10/11/2019 22:21	WG1361672
Trichlorofluoromethane	U		1.20	5.00	1	10/11/2019 22:21	WG1361672
1,2,3-Trichloropropane	U		0.807	2.50	1	10/11/2019 22:21	WG1361672
1,2,4-Trimethylbenzene	U		0.373	1.00	1	10/11/2019 22:21	WG1361672
1,2,3-Trimethylbenzene	U		0.321	1.00	1	10/11/2019 22:21	WG1361672
1,3,5-Trimethylbenzene	U		0.387	1.00	1	10/11/2019 22:21	WG1361672
Vinyl chloride	U		0.259	1.00	1	10/11/2019 22:21	WG1361672
Xylenes, Total	U		1.06	3.00	1	10/11/2019 22:21	WG1361672
(S) Toluene-d8	*93.9*			*80.0-120*		*10/11/2019 22:21*	WG1361672
(S) Toluene-d8	*110*			*80.0-120*		*10/15/2019 00:28*	WG1362648
(S) 4-Bromofluorobenzene	*108*			*77.0-126*		*10/11/2019 22:21*	WG1361672
(S) 4-Bromofluorobenzene	*91.3*			*77.0-126*		*10/15/2019 00:28*	WG1362648
(S) 1,2-Dichloroethane-d4	*99.3*			*70.0-130*		*10/11/2019 22:21*	WG1361672
(S) 1,2-Dichloroethane-d4	*96.5*			*70.0-130*		*10/15/2019 00:28*	WG1362648

Semi-Volatile Organic Compounds (GC) by Method 3511/8015

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
C12-C22 Hydrocarbons	171		33.0	100	1	10/09/2019 01:14	WG1359278
C22-C32 Hydrocarbons	153		33.0	100	1	10/09/2019 01:14	WG1359278
C32-C40 Hydrocarbons	U		33.0	100	1	10/09/2019 01:14	WG1359278
(S) o-Terphenyl	*91.1*			*52.0-156*		*10/09/2019 01:14*	WG1359278

Mercury by Method 7470A

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Mercury	U		0.0490	0.200	1	10/07/2019 11:42	WG1357911

Metals (ICP) by Method 6010B

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Barium	44.6		1.70	5.00	1	10/09/2019 01:14	WG1357923
Beryllium	U		0.700	2.00	1	10/09/2019 01:14	WG1357923
Chromium	1.79	J	1.40	10.0	1	10/09/2019 01:14	WG1357923
Cobalt	U		2.30	10.0	1	10/09/2019 01:14	WG1357923
Molybdenum	7.03		1.60	5.00	1	10/09/2019 01:14	WG1357923
Vanadium	5.58	J	2.40	20.0	1	10/09/2019 01:14	WG1357923

Metals (ICPMS) by Method 6020

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Antimony	U		0.754	2.00	1	10/09/2019 00:16	WG1357928
Arsenic	1.19	J	0.250	2.00	1	10/09/2019 00:16	WG1357928
Cadmium	U		0.160	1.00	1	10/09/2019 00:16	WG1357928
Copper	3.03	B J	0.520	5.00	1	10/09/2019 00:16	WG1357928
Lead	1.01	B J	0.240	2.00	1	10/09/2019 00:16	WG1357928
Nickel	2.26		0.350	2.00	1	10/09/2019 00:16	WG1357928
Selenium	0.692	J	0.380	2.00	1	10/09/2019 00:16	WG1357928
Silver	U		0.310	2.00	1	10/09/2019 00:16	WG1357928
Thallium	U		0.190	2.00	1	10/09/2019 00:16	WG1357928
Zinc	15.0	J	2.56	25.0	1	10/09/2019 00:16	WG1357928

Volatile Organic Compounds (GC) by Method 8015

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
TPHG C5 - C12	U		30.4	100	1	10/08/2019 16:20	WG1359147
(S) a,a,a-Trifluorotoluene(FID)	*111*			*78.0-120*		*10/08/2019 16:20*	WG1359147

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Acetone	U		10.0	50.0	1	10/11/2019 22:41	WG1361672
Acrolein	U	J4	8.87	50.0	1	10/11/2019 22:41	WG1361672
Acrylonitrile	U		1.87	10.0	1	10/11/2019 22:41	WG1361672
Benzene	U		0.331	1.00	1	10/11/2019 22:41	WG1361672
Bromobenzene	U		0.352	1.00	1	10/11/2019 22:41	WG1361672
Bromodichloromethane	U		0.380	1.00	1	10/11/2019 22:41	WG1361672
Bromoform	U		0.469	1.00	1	10/11/2019 22:41	WG1361672
Bromomethane	U		0.866	5.00	1	10/11/2019 22:41	WG1361672
n-Butylbenzene	U		0.361	1.00	1	10/11/2019 22:41	WG1361672
sec-Butylbenzene	U		0.365	1.00	1	10/11/2019 22:41	WG1361672
tert-Butylbenzene	U		0.399	1.00	1	10/11/2019 22:41	WG1361672
Carbon disulfide	U		0.275	1.00	1	10/11/2019 22:41	WG1361672
Carbon tetrachloride	U		0.379	1.00	1	10/11/2019 22:41	WG1361672
Chlorobenzene	U		0.348	1.00	1	10/11/2019 22:41	WG1361672
Chlorodibromomethane	U		0.327	1.00	1	10/11/2019 22:41	WG1361672
Chloroethane	U		0.453	5.00	1	10/11/2019 22:41	WG1361672
Chloroform	U		0.324	5.00	1	10/11/2019 22:41	WG1361672
Chloromethane	U		0.276	2.50	1	10/11/2019 22:41	WG1361672

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
2-Chlorotoluene	U		0.375	1.00	1	10/11/2019 22:41	WG1361672
4-Chlorotoluene	U		0.351	1.00	1	10/11/2019 22:41	WG1361672
1,2-Dibromo-3-Chloropropane	U		1.33	5.00	1	10/11/2019 22:41	WG1361672
1,2-Dibromoethane	U		0.381	1.00	1	10/11/2019 22:41	WG1361672
Dibromomethane	U		0.346	1.00	1	10/11/2019 22:41	WG1361672
1,2-Dichlorobenzene	U		0.349	1.00	1	10/11/2019 22:41	WG1361672
1,3-Dichlorobenzene	U		0.220	1.00	1	10/11/2019 22:41	WG1361672
1,4-Dichlorobenzene	U		0.274	1.00	1	10/11/2019 22:41	WG1361672
Dichlorodifluoromethane	U		0.551	5.00	1	10/11/2019 22:41	WG1361672
1,1-Dichloroethane	U		0.259	1.00	1	10/11/2019 22:41	WG1361672
1,2-Dichloroethane	U		0.361	1.00	1	10/11/2019 22:41	WG1361672
1,1-Dichloroethene	U		0.398	1.00	1	10/11/2019 22:41	WG1361672
cis-1,2-Dichloroethene	U		0.260	1.00	1	10/11/2019 22:41	WG1361672
trans-1,2-Dichloroethene	U		0.396	1.00	1	10/11/2019 22:41	WG1361672
1,2-Dichloropropane	U		0.306	1.00	1	10/11/2019 22:41	WG1361672
1,1-Dichloropropene	U		0.352	1.00	1	10/11/2019 22:41	WG1361672
1,3-Dichloropropane	U		0.366	1.00	1	10/15/2019 00:48	WG1362648
cis-1,3-Dichloropropene	U		0.418	1.00	1	10/11/2019 22:41	WG1361672
trans-1,3-Dichloropropene	U		0.419	1.00	1	10/11/2019 22:41	WG1361672
2,2-Dichloropropane	U		0.321	1.00	1	10/11/2019 22:41	WG1361672
Di-isopropyl ether	U		0.320	1.00	1	10/11/2019 22:41	WG1361672
Ethylbenzene	U		0.384	1.00	1	10/11/2019 22:41	WG1361672
Hexachloro-1,3-butadiene	U		0.256	1.00	1	10/11/2019 22:41	WG1361672
Isopropylbenzene	U		0.326	1.00	1	10/11/2019 22:41	WG1361672
p-Isopropyltoluene	U		0.350	1.00	1	10/11/2019 22:41	WG1361672
2-Butanone (MEK)	U		3.93	10.0	1	10/11/2019 22:41	WG1361672
Methylene Chloride	U		1.00	5.00	1	10/11/2019 22:41	WG1361672
4-Methyl-2-pentanone (MIBK)	U		2.14	10.0	1	10/11/2019 22:41	WG1361672
Methyl tert-butyl ether	U		0.367	1.00	1	10/11/2019 22:41	WG1361672
Naphthalene	U		1.00	5.00	1	10/11/2019 22:41	WG1361672
n-Propylbenzene	U		0.349	1.00	1	10/11/2019 22:41	WG1361672
Styrene	U		0.307	1.00	1	10/11/2019 22:41	WG1361672
1,1,1,2-Tetrachloroethane	U		0.385	1.00	1	10/11/2019 22:41	WG1361672
1,1,2,2-Tetrachloroethane	U		0.130	1.00	1	10/11/2019 22:41	WG1361672
1,1,2-Trichlorotrifluoroethane	U		0.303	1.00	1	10/11/2019 22:41	WG1361672
Tetrachloroethene	U		0.372	1.00	1	10/11/2019 22:41	WG1361672
Toluene	U		0.412	1.00	1	10/11/2019 22:41	WG1361672
1,2,3-Trichlorobenzene	U		0.230	1.00	1	10/11/2019 22:41	WG1361672
1,2,4-Trichlorobenzene	U		0.355	1.00	1	10/11/2019 22:41	WG1361672
1,1,1-Trichloroethane	U		0.319	1.00	1	10/11/2019 22:41	WG1361672
1,1,2-Trichloroethane	U	J4	0.383	1.00	1	10/11/2019 22:41	WG1361672
Trichloroethene	U		0.398	1.00	1	10/11/2019 22:41	WG1361672
Trichlorofluoromethane	U		1.20	5.00	1	10/11/2019 22:41	WG1361672
1,2,3-Trichloropropane	U		0.807	2.50	1	10/11/2019 22:41	WG1361672
1,2,4-Trimethylbenzene	U		0.373	1.00	1	10/11/2019 22:41	WG1361672
1,2,3-Trimethylbenzene	U		0.321	1.00	1	10/11/2019 22:41	WG1361672
1,3,5-Trimethylbenzene	U		0.387	1.00	1	10/11/2019 22:41	WG1361672
Vinyl chloride	U		0.259	1.00	1	10/11/2019 22:41	WG1361672
Xylenes, Total	1.08	J	1.06	3.00	1	10/11/2019 22:41	WG1361672
(S) Toluene-d8	*94.7*			*80.0-120*		*10/11/2019 22:41*	WG1361672
(S) Toluene-d8	*111*			*80.0-120*		*10/15/2019 00:48*	WG1362648
(S) 4-Bromofluorobenzene	*109*			*77.0-126*		*10/11/2019 22:41*	WG1361672
(S) 4-Bromofluorobenzene	*94.6*			*77.0-126*		*10/15/2019 00:48*	WG1362648
(S) 1,2-Dichloroethane-d4	*97.1*			*70.0-130*		*10/11/2019 22:41*	WG1361672
(S) 1,2-Dichloroethane-d4	*95.3*			*70.0-130*		*10/15/2019 00:48*	WG1362648

Semi-Volatile Organic Compounds (GC) by Method 3511/8015

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
C12-C22 Hydrocarbons	151		33.0	100	1	10/09/2019 01:42	WG1359278
C22-C32 Hydrocarbons	144		33.0	100	1	10/09/2019 01:42	WG1359278
C32-C40 Hydrocarbons	U		33.0	100	1	10/09/2019 01:42	WG1359278
(S) o-Terphenyl	*88.4*			*52.0-156*		*10/09/2019 01:42*	WG1359278

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Acetone	13.4	J	10.0	50.0	1	10/11/2019 18:40	WG1361672
Acrolein	U	J4	8.87	50.0	1	10/11/2019 18:40	WG1361672
Acrylonitrile	U		1.87	10.0	1	10/11/2019 18:40	WG1361672
Benzene	U		0.331	1.00	1	10/11/2019 18:40	WG1361672
Bromobenzene	U		0.352	1.00	1	10/11/2019 18:40	WG1361672
Bromodichloromethane	U		0.380	1.00	1	10/11/2019 18:40	WG1361672
Bromoform	U		0.469	1.00	1	10/11/2019 18:40	WG1361672
Bromomethane	U		0.866	5.00	1	10/11/2019 18:40	WG1361672
n-Butylbenzene	U		0.361	1.00	1	10/11/2019 18:40	WG1361672
sec-Butylbenzene	U		0.365	1.00	1	10/11/2019 18:40	WG1361672
tert-Butylbenzene	U		0.399	1.00	1	10/11/2019 18:40	WG1361672
Carbon disulfide	U		0.275	1.00	1	10/11/2019 18:40	WG1361672
Carbon tetrachloride	U		0.379	1.00	1	10/11/2019 18:40	WG1361672
Chlorobenzene	U		0.348	1.00	1	10/11/2019 18:40	WG1361672
Chlorodibromomethane	U		0.327	1.00	1	10/11/2019 18:40	WG1361672
Chloroethane	U		0.453	5.00	1	10/11/2019 18:40	WG1361672
Chloroform	U		0.324	5.00	1	10/11/2019 18:40	WG1361672
Chloromethane	U		0.276	2.50	1	10/11/2019 18:40	WG1361672
2-Chlorotoluene	U		0.375	1.00	1	10/11/2019 18:40	WG1361672
4-Chlorotoluene	U		0.351	1.00	1	10/11/2019 18:40	WG1361672
1,2-Dibromo-3-Chloropropane	U		1.33	5.00	1	10/11/2019 18:40	WG1361672
1,2-Dibromoethane	U		0.381	1.00	1	10/11/2019 18:40	WG1361672
Dibromomethane	U		0.346	1.00	1	10/11/2019 18:40	WG1361672
1,2-Dichlorobenzene	U		0.349	1.00	1	10/11/2019 18:40	WG1361672
1,3-Dichlorobenzene	U		0.220	1.00	1	10/11/2019 18:40	WG1361672
1,4-Dichlorobenzene	U		0.274	1.00	1	10/11/2019 18:40	WG1361672
Dichlorodifluoromethane	U		0.551	5.00	1	10/11/2019 18:40	WG1361672
1,1-Dichloroethane	U		0.259	1.00	1	10/11/2019 18:40	WG1361672
1,2-Dichloroethane	U		0.361	1.00	1	10/11/2019 18:40	WG1361672
1,1-Dichloroethene	U		0.398	1.00	1	10/11/2019 18:40	WG1361672
cis-1,2-Dichloroethene	U		0.260	1.00	1	10/11/2019 18:40	WG1361672
trans-1,2-Dichloroethene	U		0.396	1.00	1	10/11/2019 18:40	WG1361672
1,2-Dichloropropane	U		0.306	1.00	1	10/11/2019 18:40	WG1361672
1,1-Dichloropropene	U		0.352	1.00	1	10/11/2019 18:40	WG1361672
1,3-Dichloropropane	U		0.366	1.00	1	10/14/2019 23:27	WG1362648
cis-1,3-Dichloropropene	U		0.418	1.00	1	10/11/2019 18:40	WG1361672
trans-1,3-Dichloropropene	U		0.419	1.00	1	10/11/2019 18:40	WG1361672
2,2-Dichloropropane	U		0.321	1.00	1	10/11/2019 18:40	WG1361672
Di-isopropyl ether	U		0.320	1.00	1	10/11/2019 18:40	WG1361672
Ethylbenzene	U		0.384	1.00	1	10/11/2019 18:40	WG1361672
Hexachloro-1,3-butadiene	U		0.256	1.00	1	10/11/2019 18:40	WG1361672
Isopropylbenzene	U		0.326	1.00	1	10/11/2019 18:40	WG1361672
p-Isopropyltoluene	U		0.350	1.00	1	10/11/2019 18:40	WG1361672
2-Butanone (MEK)	U		3.93	10.0	1	10/11/2019 18:40	WG1361672
Methylene Chloride	2.00	J	1.00	5.00	1	10/11/2019 18:40	WG1361672
4-Methyl-2-pentanone (MIBK)	U		2.14	10.0	1	10/11/2019 18:40	WG1361672
Methyl tert-butyl ether	U		0.367	1.00	1	10/11/2019 18:40	WG1361672
Naphthalene	U		1.00	5.00	1	10/11/2019 18:40	WG1361672
n-Propylbenzene	U		0.349	1.00	1	10/11/2019 18:40	WG1361672
Styrene	U		0.307	1.00	1	10/11/2019 18:40	WG1361672
1,1,1,2-Tetrachloroethane	U		0.385	1.00	1	10/11/2019 18:40	WG1361672
1,1,2,2-Tetrachloroethane	U		0.130	1.00	1	10/11/2019 18:40	WG1361672
1,1,2-Trichlorotrifluoroethane	U		0.303	1.00	1	10/11/2019 18:40	WG1361672
Tetrachloroethene	U		0.372	1.00	1	10/11/2019 18:40	WG1361672
Toluene	U		0.412	1.00	1	10/11/2019 18:40	WG1361672
1,2,3-Trichlorobenzene	U		0.230	1.00	1	10/11/2019 18:40	WG1361672

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
1,2,4-Trichlorobenzene	U		0.355	1.00	1	10/11/2019 18:40	WG1361672
1,1,1-Trichloroethane	U		0.319	1.00	1	10/11/2019 18:40	WG1361672
1,1,2-Trichloroethane	U	J4	0.383	1.00	1	10/11/2019 18:40	WG1361672
Trichloroethene	U		0.398	1.00	1	10/11/2019 18:40	WG1361672
Trichlorofluoromethane	U		1.20	5.00	1	10/11/2019 18:40	WG1361672
1,2,3-Trichloropropane	U		0.807	2.50	1	10/11/2019 18:40	WG1361672
1,2,4-Trimethylbenzene	U		0.373	1.00	1	10/11/2019 18:40	WG1361672
1,2,3-Trimethylbenzene	U		0.321	1.00	1	10/11/2019 18:40	WG1361672
1,3,5-Trimethylbenzene	U		0.387	1.00	1	10/11/2019 18:40	WG1361672
Vinyl chloride	U		0.259	1.00	1	10/11/2019 18:40	WG1361672
Xylenes, Total	U		1.06	3.00	1	10/11/2019 18:40	WG1361672
(S) Toluene-d8	*95.9*			*80.0-120*		*10/11/2019 18:40*	WG1361672
(S) Toluene-d8	*111*			*80.0-120*		*10/14/2019 23:27*	WG1362648
(S) 4-Bromofluorobenzene	*106*			*77.0-126*		*10/11/2019 18:40*	WG1361672
(S) 4-Bromofluorobenzene	*90.0*			*77.0-126*		*10/14/2019 23:27*	WG1362648
(S) 1,2-Dichloroethane-d4	*99.2*			*70.0-130*		*10/11/2019 18:40*	WG1361672
(S) 1,2-Dichloroethane-d4	*94.3*			*70.0-130*		*10/14/2019 23:27*	WG1362648

Cp Tc Ss Cn Sr Qc Gl Al Sc

Method Blank (MB)

(MB) R3458457-1 10/07/19 11:09

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Mercury	U		0.0490	0.200

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3458457-2 10/07/19 11:11 • (LCSD) R3458457-3 10/07/19 11:13

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Mercury	3.00	2.95	2.95	98.3	98.4	80.0-120			0.0692	20

L1146191-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1146191-01 10/07/19 11:16 • (MS) R3458457-4 10/07/19 11:23 • (MSD) R3458457-5 10/07/19 11:25

Analyte	Spike Amount ug/l	Original Result ug/l	MS Result ug/l	MSD Result ug/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Mercury	3.00	ND	3.05	2.99	102	99.8	1	75.0-125			1.81	20

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Method Blank (MB)

(MB) R3459074-1 10/09/19 00:07

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Barium	U		1.70	5.00
Beryllium	U		0.700	2.00
Chromium	U		1.40	10.0
Cobalt	U		2.30	10.0
Molybdenum	U		1.60	5.00
Vanadium	U		2.40	20.0

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3459074-2 10/09/19 00:10 • (LCSD) R3459074-3 10/09/19 00:12

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Barium	1000	1010	1010	101	101	80.0-120			0.109	20
Beryllium	1000	982	978	98.2	97.8	80.0-120			0.427	20
Chromium	1000	968	963	96.8	96.3	80.0-120			0.543	20
Cobalt	1000	993	992	99.3	99.2	80.0-120			0.0862	20
Molybdenum	1000	999	993	99.9	99.3	80.0-120			0.543	20
Vanadium	1000	990	986	99.0	98.6	80.0-120			0.386	20

L1146300-32 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1146300-32 10/09/19 00:15 • (MS) R3459074-5 10/09/19 00:20 • (MSD) R3459074-6 10/09/19 00:23

Analyte	Spike Amount ug/l	Original Result ug/l	MS Result ug/l	MSD Result ug/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Barium	1000	59.5	1060	1070	100	101	1	75.0-125			0.558	20
Beryllium	1000	U	968	977	96.8	97.7	1	75.0-125			0.877	20
Chromium	1000	U	952	958	95.2	95.8	1	75.0-125			0.679	20
Cobalt	1000	U	996	1000	99.6	100	1	75.0-125			0.503	20
Molybdenum	1000	U	990	1000	99.0	100	1	75.0-125			1.30	20
Vanadium	1000	3.21	986	998	98.3	99.5	1	75.0-125			1.19	20

Method Blank (MB)

(MB) R3459096-1 10/08/19 23:31

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Antimony	U		0.754	2.00
Arsenic	U		0.250	2.00
Cadmium	U		0.160	1.00
Copper	0.833	J	0.520	5.00
Lead	1.12	J	0.240	2.00
Nickel	U		0.350	2.00
Selenium	U		0.380	2.00
Silver	U		0.310	2.00
Thallium	U		0.190	2.00
Zinc	U		2.56	25.0

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3459096-2 10/08/19 23:35 • (LCSD) R3459096-3 10/08/19 23:39

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Antimony	50.0	50.2	48.1	100	96.1	80.0-120			4.44	20
Arsenic	50.0	49.0	48.4	97.9	96.8	80.0-120			1.18	20
Cadmium	50.0	51.9	50.8	104	102	80.0-120			2.07	20
Copper	50.0	45.9	44.8	91.9	89.5	80.0-120			2.61	20
Lead	50.0	49.5	49.8	99.1	99.5	80.0-120			0.447	20
Nickel	50.0	51.9	51.1	104	102	80.0-120			1.60	20
Selenium	50.0	56.1	53.0	112	106	80.0-120			5.68	20
Silver	50.0	50.3	48.9	101	97.8	80.0-120			2.74	20
Thallium	50.0	47.8	47.5	95.7	95.0	80.0-120			0.678	20
Zinc	50.0	50.0	48.4	100	96.8	80.0-120			3.31	20

L1146501-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1146501-03 10/08/19 23:43 • (MS) R3459096-5 10/08/19 23:50 • (MSD) R3459096-6 10/08/19 23:54

Analyte	Spike Amount ug/l	Original Result ug/l	MS Result ug/l	MSD Result ug/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Antimony	50.0	U	50.9	49.7	102	99.4	1	75.0-125			2.34	20
Arsenic	50.0	2.75	51.4	52.6	97.2	99.7	1	75.0-125			2.37	20
Cadmium	50.0	U	51.9	49.6	104	99.2	1	75.0-125			4.64	20
Copper	50.0	1.48	45.2	44.5	87.4	86.1	1	75.0-125			1.55	20
Lead	50.0	0.901	50.4	50.1	99.1	98.3	1	75.0-125			0.705	20
Nickel	50.0	18.2	66.1	68.2	95.7	100	1	75.0-125			3.21	20
Selenium	50.0	U	51.9	52.6	104	105	1	75.0-125			1.31	20

L1146501-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1146501-03 10/08/19 23:43 • (MS) R3459096-5 10/08/19 23:50 • (MSD) R3459096-6 10/08/19 23:54

	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Analyte	ug/l	ug/l	ug/l	ug/l	%	%		%			%	%
Silver	50.0	U	49.6	49.7	99.2	99.3	1	75.0-125			0.0945	20
Thallium	50.0	U	48.9	48.7	97.8	97.5	1	75.0-125			0.266	20
Zinc	50.0	3.36	50.0	51.2	93.3	95.7	1	75.0-125			2.35	20

Method Blank (MB)

(MB) R3459548-2 10/08/19 12:11

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
TPHG C5 - C12	U		30.4	100
(S) a,a,a-Trifluorotoluene(FID)	*111*			*78.0-120*

Laboratory Control Sample (LCS)

(LCS) R3459548-1 10/08/19 09:36

Analyte	Spike Amount ug/l	LCS Result ug/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
TPHG C5 - C12	5500	5390	98.0	71.0-127	
(S) a,a,a-Trifluorotoluene(FID)			*93.5*	*78.0-120*	

L1146610-04 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1146610-04 10/08/19 18:19 • (MS) R3459548-3 10/08/19 20:42 • (MSD) R3459548-4 10/08/19 21:06

Analyte	Spike Amount ug/l	Original Result ug/l	MS Result ug/l	MSD Result ug/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
TPHG C5 - C12	5500	U	337	577	6.13	10.5	1	10.0-158	J6	J3	52.5	20
(S) a,a,a-Trifluorotoluene(FID)					*105*	*101*		*78.0-120*				

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Method Blank (MB)

(MB) R3460710-2 10/11/19 18:20

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Acetone	U		10.0	50.0
Acrolein	U		8.87	50.0
Acrylonitrile	U		1.87	10.0
Benzene	U		0.331	1.00
Bromobenzene	U		0.352	1.00
Bromodichloromethane	U		0.380	1.00
Bromoform	U		0.469	1.00
Bromomethane	U		0.866	5.00
n-Butylbenzene	U		0.361	1.00
sec-Butylbenzene	U		0.365	1.00
tert-Butylbenzene	U		0.399	1.00
Carbon disulfide	U		0.275	1.00
Carbon tetrachloride	U		0.379	1.00
Chlorobenzene	U		0.348	1.00
Chlorodibromomethane	U		0.327	1.00
Chloroethane	U		0.453	5.00
Chloroform	U		0.324	5.00
Chloromethane	U		0.276	2.50
2-Chlorotoluene	U		0.375	1.00
4-Chlorotoluene	U		0.351	1.00
1,2-Dibromo-3-Chloropropane	U		1.33	5.00
1,2-Dibromoethane	U		0.381	1.00
Dibromomethane	U		0.346	1.00
1,2-Dichlorobenzene	U		0.349	1.00
1,3-Dichlorobenzene	U		0.220	1.00
1,4-Dichlorobenzene	U		0.274	1.00
Dichlorodifluoromethane	U		0.551	5.00
1,1-Dichloroethane	U		0.259	1.00
1,2-Dichloroethane	U		0.361	1.00
1,1-Dichloroethene	U		0.398	1.00
cis-1,2-Dichloroethene	U		0.260	1.00
trans-1,2-Dichloroethene	U		0.396	1.00
1,2-Dichloropropane	U		0.306	1.00
1,1-Dichloropropene	U		0.352	1.00
cis-1,3-Dichloropropene	U		0.418	1.00
trans-1,3-Dichloropropene	U		0.419	1.00
2,2-Dichloropropane	U		0.321	1.00
Di-isopropyl ether	U		0.320	1.00
Ethylbenzene	U		0.384	1.00
Hexachloro-1,3-butadiene	0.352	J	0.256	1.00

Method Blank (MB)

(MB) R3460710-2 10/11/19 18:20

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Isopropylbenzene	U		0.326	1.00
p-Isopropyltoluene	U		0.350	1.00
2-Butanone (MEK)	U		3.93	10.0
Methylene Chloride	U		1.00	5.00
4-Methyl-2-pentanone (MIBK)	U		2.14	10.0
Methyl tert-butyl ether	U		0.367	1.00
Naphthalene	U		1.00	5.00
n-Propylbenzene	U		0.349	1.00
Styrene	U		0.307	1.00
1,1,1,2-Tetrachloroethane	U		0.385	1.00
1,1,2,2-Tetrachloroethane	U		0.130	1.00
Tetrachloroethene	U		0.372	1.00
Toluene	U		0.412	1.00
1,1,2-Trichlorotrifluoroethane	U		0.303	1.00
1,2,3-Trichlorobenzene	1.22		0.230	1.00
1,2,4-Trichlorobenzene	0.379	J	0.355	1.00
1,1,1-Trichloroethane	U		0.319	1.00
1,1,2-Trichloroethane	U		0.383	1.00
Trichloroethene	U		0.398	1.00
Trichlorofluoromethane	U		1.20	5.00
1,2,3-Trichloropropane	U		0.807	2.50
1,2,3-Trimethylbenzene	U		0.321	1.00
1,2,4-Trimethylbenzene	U		0.373	1.00
1,3,5-Trimethylbenzene	U		0.387	1.00
Vinyl chloride	U		0.259	1.00
Xylenes, Total	U		1.06	3.00
(S) Toluene-d8	*95.8*			*80.0-120*
(S) 4-Bromofluorobenzene	*108*			*77.0-126*
(S) 1,2-Dichloroethane-d4	*96.4*			*70.0-130*

Laboratory Control Sample (LCS)

(LCS) R3460710-1 10/11/19 17:41

Analyte	Spike Amount ug/l	LCS Result ug/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Acetone	125	133	106	19.0-160	
Acrolein	125	227	182	10.0-160	J4
Acrylonitrile	125	130	104	55.0-149	
Benzene	25.0	22.6	90.4	70.0-123	

Laboratory Control Sample (LCS)

(LCS) R3460710-1 10/11/19 17:41

Analyte	Spike Amount ug/l	LCS Result ug/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Bromobenzene	25.0	24.1	96.4	73.0-121	
Bromodichloromethane	25.0	22.4	89.6	75.0-120	
Bromoform	25.0	19.5	78.0	68.0-132	
Bromomethane	25.0	20.9	83.6	10.0-160	
n-Butylbenzene	25.0	19.9	79.6	73.0-125	
sec-Butylbenzene	25.0	24.7	98.8	75.0-125	
tert-Butylbenzene	25.0	26.9	108	76.0-124	
Carbon disulfide	25.0	21.8	87.2	61.0-128	
Carbon tetrachloride	25.0	24.8	99.2	68.0-126	
Chlorobenzene	25.0	24.0	96.0	80.0-121	
Chlorodibromomethane	25.0	21.3	85.2	77.0-125	
Chloroethane	25.0	22.2	88.8	47.0-150	
Chloroform	25.0	22.5	90.0	73.0-120	
Chloromethane	25.0	26.1	104	41.0-142	
2-Chlorotoluene	25.0	26.8	107	76.0-123	
4-Chlorotoluene	25.0	27.7	111	75.0-122	
1,2-Dibromo-3-Chloropropane	25.0	15.4	61.6	58.0-134	
1,2-Dibromoethane	25.0	20.1	80.4	80.0-122	
Dibromomethane	25.0	21.7	86.8	80.0-120	
1,2-Dichlorobenzene	25.0	20.1	80.4	79.0-121	
1,3-Dichlorobenzene	25.0	23.7	94.8	79.0-120	
1,4-Dichlorobenzene	25.0	22.0	88.0	79.0-120	
Dichlorodifluoromethane	25.0	18.5	74.0	51.0-149	
1,1-Dichloroethane	25.0	24.3	97.2	70.0-126	
1,2-Dichloroethane	25.0	22.5	90.0	70.0-128	
1,1-Dichloroethene	25.0	23.2	92.8	71.0-124	
cis-1,2-Dichloroethene	25.0	23.4	93.6	73.0-120	
trans-1,2-Dichloroethene	25.0	22.4	89.6	73.0-120	
1,2-Dichloropropane	25.0	25.4	102	77.0-125	
1,1-Dichloropropene	25.0	24.0	96.0	74.0-126	
cis-1,3-Dichloropropene	25.0	23.6	94.4	80.0-123	
trans-1,3-Dichloropropene	25.0	20.2	80.8	78.0-124	
2,2-Dichloropropane	25.0	25.2	101	58.0-130	
Di-isopropyl ether	25.0	25.5	102	58.0-138	
Ethylbenzene	25.0	22.5	90.0	79.0-123	
Hexachloro-1,3-butadiene	25.0	16.1	64.4	54.0-138	
Isopropylbenzene	25.0	23.1	92.4	76.0-127	
p-Isopropyltoluene	25.0	24.3	97.2	76.0-125	
2-Butanone (MEK)	125	120	96.0	44.0-160	
Methylene Chloride	25.0	23.6	94.4	67.0-120	

Laboratory Control Sample (LCS)

(LCS) R3460710-1 10/11/19 17:41

Analyte	Spike Amount ug/l	LCS Result ug/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
4-Methyl-2-pentanone (MIBK)	125	90.5	72.4	68.0-142	
Methyl tert-butyl ether	25.0	23.3	93.2	68.0-125	
Naphthalene	25.0	19.1	76.4	54.0-135	
n-Propylbenzene	25.0	25.7	103	77.0-124	
Styrene	25.0	24.2	96.8	73.0-130	
1,1,1,2-Tetrachloroethane	25.0	21.3	85.2	75.0-125	
1,1,2,2-Tetrachloroethane	25.0	19.3	77.2	65.0-130	
Tetrachloroethene	25.0	21.5	86.0	72.0-132	
Toluene	25.0	21.4	85.6	79.0-120	
1,1,2-Trichlorotrifluoroethane	25.0	23.2	92.8	69.0-132	
1,2,3-Trichlorobenzene	25.0	15.6	62.4	50.0-138	
1,2,4-Trichlorobenzene	25.0	18.2	72.8	57.0-137	
1,1,1-Trichloroethane	25.0	24.8	99.2	73.0-124	
1,1,2-Trichloroethane	25.0	19.6	78.4	80.0-120	J4
Trichloroethene	25.0	26.4	106	78.0-124	
Trichlorofluoromethane	25.0	24.0	96.0	59.0-147	
1,2,3-Trichloropropane	25.0	24.1	96.4	73.0-130	
1,2,3-Trimethylbenzene	25.0	22.2	88.8	77.0-120	
1,2,4-Trimethylbenzene	25.0	27.4	110	76.0-121	
1,3,5-Trimethylbenzene	25.0	26.9	108	76.0-122	
Vinyl chloride	25.0	22.0	88.0	67.0-131	
Xylenes, Total	75.0	70.2	93.6	79.0-123	
(S) Toluene-d8			*96.6*	*80.0-120*	
(S) 4-Bromofluorobenzene			*110*	*77.0-126*	
(S) 1,2-Dichloroethane-d4			*98.9*	*70.0-130*	

Method Blank (MB)

(MB) R3461024-2 10/14/19 20:37

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
1,3-Dichloropropane	U		0.366	1.00
(S) Toluene-d8	*111*			*80.0-120*
(S) 4-Bromofluorobenzene	*92.9*			*77.0-126*
(S) 1,2-Dichloroethane-d4	*94.8*			*70.0-130*

Laboratory Control Sample (LCS)

(LCS) R3461024-1 10/14/19 19:15

Analyte	Spike Amount ug/l	LCS Result ug/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
1,3-Dichloropropane	25.0	29.7	119	80.0-120	
(S) Toluene-d8			*110*	*80.0-120*	
(S) 4-Bromofluorobenzene			*90.9*	*77.0-126*	
(S) 1,2-Dichloroethane-d4			*105*	*70.0-130*	

Method Blank (MB)

(MB) R3459110-1 10/08/19 23:24

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
C12-C22 Hydrocarbons	U		33.0	100
C22-C32 Hydrocarbons	U		33.0	100
C32-C40 Hydrocarbons	U		33.0	100
(S) o-Terphenyl	*82.5*			*52.0-156*

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3459110-2 10/08/19 23:51 • (LCSD) R3459110-3 10/09/19 00:19

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
C22-C32 Hydrocarbons	750	778	753	104	100	50.0-150			3.27	20
C12-C22 Hydrocarbons	750	765	715	102	95.3	50.0-150			6.76	20
(S) o-Terphenyl				*96.5*	*102*	*52.0-156*				

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

MDL	Method Detection Limit.
ND	Not detected at the Reporting Limit (or MDL where applicable).
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
(S)	Surrogate (Surrogate Standard) - Analytes added to every blank, sample, Laboratory Control Sample/Duplicate and Matrix Spike/Duplicate; used to evaluate analytical efficiency by measuring recovery. Surrogates are not expected to be detected in all environmental media.
U	Not detected at the Reporting Limit (or MDL where applicable).
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
B	The same analyte is found in the associated blank.
J	The identification of the analyte is acceptable; the reported value is an estimate.
J3	The associated batch QC was outside the established quality control range for precision.
J4	The associated batch QC was outside the established quality control range for accuracy.
J6	The sample matrix interfered with the ability to make any accurate determination; spike value is low.

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Pace National is the only environmental laboratory accredited/certified to support your work nationwide from one location. One phone call, one point of contact, one laboratory. No other lab is as accessible or prepared to handle your needs throughout the country. Our capacity and capability from our single location laboratory is comparable to the collective totals of the network laboratories in our industry. The most significant benefit to our one location design is the design of our laboratory campus. The model is conducive to accelerated productivity, decreasing turn-around time, and preventing cross contamination, thus protecting sample integrity. Our focus on premium quality and prompt service allows us to be YOUR LAB OF CHOICE.

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.
* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace National.

State Accreditations

Alabama	40660
Alaska	17-026
Arizona	AZ0612
Arkansas	88-0469
California	2932
Colorado	TN00003
Connecticut	PH-0197
Florida	E87487
Georgia	NELAP
Georgia [1]	923
Idaho	TN00003
Illinois	200008
Indiana	C-TN-01
Iowa	364
Kansas	E-10277
Kentucky [1 6]	90010
Kentucky [2]	16
Louisiana	AI30792
Louisiana [1]	LA180010
Maine	TN0002
Maryland	324
Massachusetts	M-TN003
Michigan	9958
Minnesota	047-999-395
Mississippi	TN00003
Missouri	340
Montana	CERT0086

Nebraska	NE-OS-15-05
Nevada	TN-03-2002-34
New Hampshire	2975
New Jersey–NELAP	TN002
New Mexico [1]	n/a
New York	11742
North Carolina	Env375
North Carolina [1]	DW21704
North Carolina [3]	41
North Dakota	R-140
Ohio–VAP	CL0069
Oklahoma	9915
Oregon	TN200002
Pennsylvania	68-02979
Rhode Island	LAO00356
South Carolina	84004
South Dakota	n/a
Tennessee [1 4]	2006
Texas	T104704245-18-15
Texas [5]	LAB0152
Utah	TN00003
Vermont	VT2006
Virginia	460132
Washington	C847
West Virginia	233
Wisconsin	9980939910
Wyoming	A2LA

Third Party Federal Accreditations

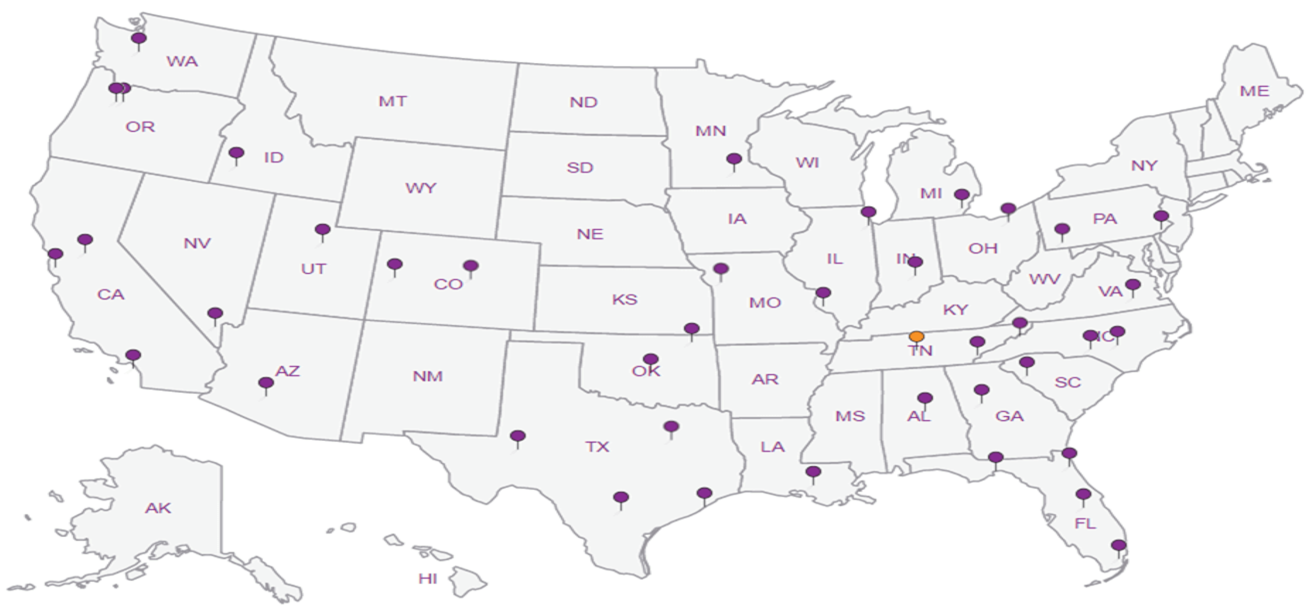
A2LA – ISO 17025	1461.01
A2LA – ISO 17025 [5]	1461.02
Canada	1461.01
EPA–Crypto	TN00003

AIHA-LAP,LLC EMLAP	100789
DOD	1461.01
USDA	P330-15-00234

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

Our Locations

Pace National has sixty-four client support centers that provide sample pickup and/or the delivery of sampling supplies. If you would like assistance from one of our support offices, please contact our main office. Pace National performs all testing at our central laboratory.



Kleinfelder- San Diego, CA

550 West C St, Suite 1200
San Diego, CA 92101

Billing Information:
Accounts Payable
550 West C St., Ste. 1200
San Diego, CA 92101

Pres Chk

Report to: Lindsay Ellingson

Email To: LEllingson@kleinfelder.com

Project Description:

City/State Collected: Carlsbad CA

Please Circle: PT MT CT ET

Phone: 619-831-4600
Fax:

Client Project # 20200172.001A

Lab Project # KLEINSDCA-CARLSBADDT

Collected by (print): Stefan Binardi

Site/Facility ID #

P.O. #

Collected by (signature):

Immediately Packed on Ice N___ Y___

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Analysis / Container / Preservative

Chain of Custody Page 1 of 1

Pace Analytical®
National Center for Testing & Innovation

12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

SDG # L1146364
G165
Tabl
Acctnum: KLEINSDCA
Template: T156118
Prelogin: P730782
PM: 110 - Brian Ford
PB:
Shipped Via:

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	soil CAM17 Metals 4ozClr-NoPres	soil DRO/ORO-CA 4ozClr-NoPres	soil GRO-CA 40mlAmb/MeOH5ml/Syr	soil VOCs 8260 2ozClr-NoPres	soil VOCs 8260 40mlAmb/MeOH5ml/Syr	water DRO/ORO-CA 40mlAmb-HCl-BT	water GRO-CA 40mlAmb HCl	water Total CAM17 250mlHDPE-HNO3 <2	water VOCs 8260 40mlAmb-HCl		Remarks	Sample # (lab only)
		SS																
		SS																
		SS																
MW-1-IDW	G	GW	—	10/2/19	1320	8						X	X	X	X			-01
MW-2-IDW	G	GW	—	↓	1335	↓						↓	↓	↓	↓			-02
MW-3-IDW	G	GW	—		1350													-03
Trip Blank	—	W	—		—	2												-04

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks:

pH _______ Temp _______

Flow_______ Other _______

Samples returned via:
__ UPS __ FedEx __ Courier ________

Tracking # 4794 8838 3877

Sample Receipt Checklist
COC Seal Present/Intact: X NP __Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: ✓Y __N
Preservation Correct/Checked: ✓Y __N
RAD Screen <0.5 mR/hr: X Y __N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)		
	10/3/19	0800	1220	Trip Blank Received: Yes / No HCL / MeoH TBR	
Relinquished by : (Signature)	Date: 10/3/19	Time: 1740	Received by: (Signature)	Temp: ~~NSPO~~ °C 5.5-.1=5.4 Bottles Received: 24	If preservation required by Login: Date/Time
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature) W Kaylor	Date: 10/4/19 Time: 08:30	Hold: Condition: NCF / OK

Pace Analytical®
National Center for Testing & Innovation

ANALYTICAL REPORT

October 28, 2019

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Kleinfelder- San Diego, CA

Sample Delivery Group:	L1150871
Samples Received:	10/17/2019
Project Number:	20200172.001A
Description:	Calrsbad Village Double Track Trench
Report To:	LIndsay Ellingson 550 West C St, Suite 1200 San Diego, CA 92101

Entire Report Reviewed By:

Brian Ford

Brian Ford
Project Manager

Results relate only to the items tested or calibrated and are reported as rounded values. This test report shall not be reproduced, except in full, without written approval of the laboratory. Where applicable, sampling conducted by Pace Analytical National is performed per guidance provided in laboratory standard operating procedures ENV-SOP-MTJL-0067 and ENV-SOP-MTJL-0068. Where sampling conducted by the customer, results relate to the accuracy of the information provided, and as the samples are received.

TABLE OF CONTENTS

Collected by: Steve Treadway | Collected date/time: 10/15/19 12:04 | Received date/time: 10/17/19 08:45

IDW-VOC-1 L1150871-01 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1368467	1	10/24/19 14:52	10/24/19 15:02	JHH	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1369867	1	10/17/19 12:08	10/25/19 18:01	JAH	Mt. Juliet, TN

Collected by: Steve Treadway | Collected date/time: 10/15/19 12:30 | Received date/time: 10/17/19 08:45

IDW-VOC-5 L1150871-02 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1370430	2.62	10/15/19 12:30	10/28/19 02:13	JHH	Mt. Juliet, TN

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

Brian Ford

Brian Ford
Project Manager

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Total Solids by Method 2540 G-2011

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Total Solids	87.4		1	10/24/2019 15:02	WG1368467

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result (dry) mg/kg	Qualifier	MDL (dry) mg/kg	RDL (dry) mg/kg	Dilution	Analysis date / time	Batch
Acetone	U		0.0157	0.0286	1	10/25/2019 18:01	WG1369867
Acrylonitrile	U		0.00217	0.0143	1	10/25/2019 18:01	WG1369867
Benzene	U		0.000458	0.00114	1	10/25/2019 18:01	WG1369867
Bromobenzene	U		0.00120	0.0143	1	10/25/2019 18:01	WG1369867
Bromodichloromethane	U		0.000901	0.00286	1	10/25/2019 18:01	WG1369867
Bromoform	U		0.00684	0.0286	1	10/25/2019 18:01	WG1369867
Bromomethane	U		0.00423	0.0143	1	10/25/2019 18:01	WG1369867
n-Butylbenzene	U		0.00439	0.0143	1	10/25/2019 18:01	WG1369867
sec-Butylbenzene	U		0.00289	0.0143	1	10/25/2019 18:01	WG1369867
tert-Butylbenzene	U		0.00177	0.00572	1	10/25/2019 18:01	WG1369867
Carbon disulfide	U		0.00464	0.0143	1	10/25/2019 18:01	WG1369867
Carbon tetrachloride	U		0.00124	0.00572	1	10/25/2019 18:01	WG1369867
Chlorobenzene	U		0.000655	0.00286	1	10/25/2019 18:01	WG1369867
Chlorodibromomethane	U		0.000515	0.00286	1	10/25/2019 18:01	WG1369867
Chloroethane	U		0.00124	0.00572	1	10/25/2019 18:01	WG1369867
Chloroform	U		0.000475	0.00286	1	10/25/2019 18:01	WG1369867
Chloromethane	U		0.00159	0.0143	1	10/25/2019 18:01	WG1369867
2-Chlorotoluene	U		0.00105	0.00286	1	10/25/2019 18:01	WG1369867
4-Chlorotoluene	U		0.00129	0.00572	1	10/25/2019 18:01	WG1369867
1,2-Dibromo-3-Chloropropane	U		0.00583	0.0286	1	10/25/2019 18:01	WG1369867
1,2-Dibromoethane	U		0.000601	0.00286	1	10/25/2019 18:01	WG1369867
Dibromomethane	U		0.00114	0.00572	1	10/25/2019 18:01	WG1369867
1,2-Dichlorobenzene	U		0.00166	0.00572	1	10/25/2019 18:01	WG1369867
1,3-Dichlorobenzene	U		0.00194	0.00572	1	10/25/2019 18:01	WG1369867
1,4-Dichlorobenzene	U		0.00225	0.00572	1	10/25/2019 18:01	WG1369867
Dichlorodifluoromethane	U		0.000936	0.00286	1	10/25/2019 18:01	WG1369867
1,1-Dichloroethane	U		0.000658	0.00286	1	10/25/2019 18:01	WG1369867
1,2-Dichloroethane	U		0.000543	0.00286	1	10/25/2019 18:01	WG1369867
1,1-Dichloroethene	U		0.000572	0.00286	1	10/25/2019 18:01	WG1369867
cis-1,2-Dichloroethene	U		0.000789	0.00286	1	10/25/2019 18:01	WG1369867
trans-1,2-Dichloroethene	U		0.00164	0.00572	1	10/25/2019 18:01	WG1369867
1,2-Dichloropropane	U		0.00145	0.00572	1	10/25/2019 18:01	WG1369867
1,1-Dichloropropene	U		0.000801	0.00286	1	10/25/2019 18:01	WG1369867
1,3-Dichloropropane	U		0.00200	0.00572	1	10/25/2019 18:01	WG1369867
cis-1,3-Dichloropropene	U		0.000776	0.00286	1	10/25/2019 18:01	WG1369867
trans-1,3-Dichloropropene	U		0.00175	0.00572	1	10/25/2019 18:01	WG1369867
2,2-Dichloropropane	U		0.000907	0.00286	1	10/25/2019 18:01	WG1369867
Di-isopropyl ether	U		0.000400	0.00114	1	10/25/2019 18:01	WG1369867
Ethylbenzene	U		0.000606	0.00286	1	10/25/2019 18:01	WG1369867
Hexachloro-1,3-butadiene	U		0.0145	0.0286	1	10/25/2019 18:01	WG1369867
Isopropylbenzene	U		0.000987	0.00286	1	10/25/2019 18:01	WG1369867
p-Isopropyltoluene	U		0.00267	0.00572	1	10/25/2019 18:01	WG1369867
2-Butanone (MEK)	0.0162	B J	0.0143	0.0286	1	10/25/2019 18:01	WG1369867
Methylene Chloride	U		0.00760	0.0286	1	10/25/2019 18:01	WG1369867
4-Methyl-2-pentanone (MIBK)	U		0.0114	0.0286	1	10/25/2019 18:01	WG1369867
Methyl tert-butyl ether	U		0.000337	0.00114	1	10/25/2019 18:01	WG1369867
Naphthalene	U		0.00357	0.0143	1	10/25/2019 18:01	WG1369867
n-Propylbenzene	U		0.00135	0.00572	1	10/25/2019 18:01	WG1369867
Styrene	U		0.00312	0.0143	1	10/25/2019 18:01	WG1369867
1,1,1,2-Tetrachloroethane	U		0.000572	0.00286	1	10/25/2019 18:01	WG1369867

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result (dry) mg/kg	Qualifier	MDL (dry) mg/kg	RDL (dry) mg/kg	Dilution	Analysis date / time	Batch
1,1,2,2-Tetrachloroethane	U		0.000446	0.00286	1	10/25/2019 18:01	WG1369867
1,1,2-Trichlorotrifluoroethane	U		0.000772	0.00286	1	10/25/2019 18:01	WG1369867
Tetrachloroethene	U		0.000801	0.00286	1	10/25/2019 18:01	WG1369867
Toluene	U		0.00143	0.00572	1	10/25/2019 18:01	WG1369867
1,2,3-Trichlorobenzene	U		0.000715	0.00286	1	10/25/2019 18:01	WG1369867
1,2,4-Trichlorobenzene	U		0.00551	0.0143	1	10/25/2019 18:01	WG1369867
1,1,1-Trichloroethane	U		0.000315	0.00286	1	10/25/2019 18:01	WG1369867
1,1,2-Trichloroethane	U		0.00101	0.00286	1	10/25/2019 18:01	WG1369867
Trichloroethene	U		0.000458	0.00114	1	10/25/2019 18:01	WG1369867
Trichlorofluoromethane	U		0.000572	0.00286	1	10/25/2019 18:01	WG1369867
1,2,3-Trichloropropane	U		0.00583	0.0143	1	10/25/2019 18:01	WG1369867
1,2,4-Trimethylbenzene	U		0.00133	0.00572	1	10/25/2019 18:01	WG1369867
1,2,3-Trimethylbenzene	U		0.00132	0.00572	1	10/25/2019 18:01	WG1369867
Vinyl chloride	U		0.000781	0.00286	1	10/25/2019 18:01	WG1369867
1,3,5-Trimethylbenzene	U		0.00124	0.00572	1	10/25/2019 18:01	WG1369867
Xylenes, Total	U		0.00547	0.00743	1	10/25/2019 18:01	WG1369867
(S) Toluene-d8	*109*			*75.0-131*		*10/25/2019 18:01*	WG1369867
(S) 4-Bromofluorobenzene	*100*			*67.0-138*		*10/25/2019 18:01*	WG1369867
(S) 1,2-Dichloroethane-d4	*97.9*			*70.0-130*		*10/25/2019 18:01*	WG1369867

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result mg/kg	Qualifier	MDL mg/kg	RDL mg/kg	Dilution	Analysis date / time	Batch
Acetone	U		0.0359	0.0655	2.62	10/28/2019 02:13	WG1370430
Acrylonitrile	U		0.00498	0.0328	2.62	10/28/2019 02:13	WG1370430
Benzene	U		0.00105	0.00262	2.62	10/28/2019 02:13	WG1370430
Bromobenzene	U		0.00275	0.0328	2.62	10/28/2019 02:13	WG1370430
Bromodichloromethane	U		0.00206	0.00655	2.62	10/28/2019 02:13	WG1370430
Bromoform	U		0.0157	0.0655	2.62	10/28/2019 02:13	WG1370430
Bromomethane	U		0.00969	0.0328	2.62	10/28/2019 02:13	WG1370430
n-Butylbenzene	U		0.0101	0.0328	2.62	10/28/2019 02:13	WG1370430
sec-Butylbenzene	U		0.00663	0.0328	2.62	10/28/2019 02:13	WG1370430
tert-Butylbenzene	U		0.00406	0.0131	2.62	10/28/2019 02:13	WG1370430
Carbon disulfide	U		0.0106	0.0328	2.62	10/28/2019 02:13	WG1370430
Carbon tetrachloride	U		0.00283	0.0131	2.62	10/28/2019 02:13	WG1370430
Chlorobenzene	U		0.00150	0.00655	2.62	10/28/2019 02:13	WG1370430
Chlorodibromomethane	U		0.00118	0.00655	2.62	10/28/2019 02:13	WG1370430
Chloroethane	U		0.00283	0.0131	2.62	10/28/2019 02:13	WG1370430
Chloroform	0.00111	J	0.00109	0.00655	2.62	10/28/2019 02:13	WG1370430
Chloromethane	U		0.00364	0.0328	2.62	10/28/2019 02:13	WG1370430
2-Chlorotoluene	U		0.00241	0.00655	2.62	10/28/2019 02:13	WG1370430
4-Chlorotoluene	U		0.00296	0.0131	2.62	10/28/2019 02:13	WG1370430
1,2-Dibromo-3-Chloropropane	U		0.0134	0.0655	2.62	10/28/2019 02:13	WG1370430
1,2-Dibromoethane	U		0.00138	0.00655	2.62	10/28/2019 02:13	WG1370430
Dibromomethane	U		0.00262	0.0131	2.62	10/28/2019 02:13	WG1370430
1,2-Dichlorobenzene	U		0.00380	0.0131	2.62	10/28/2019 02:13	WG1370430
1,3-Dichlorobenzene	U		0.00445	0.0131	2.62	10/28/2019 02:13	WG1370430
1,4-Dichlorobenzene	U	J4	0.00516	0.0131	2.62	10/28/2019 02:13	WG1370430
Dichlorodifluoromethane	U		0.00214	0.00655	2.62	10/28/2019 02:13	WG1370430
1,1-Dichloroethane	U		0.00151	0.00655	2.62	10/28/2019 02:13	WG1370430
1,2-Dichloroethane	U		0.00124	0.00655	2.62	10/28/2019 02:13	WG1370430
1,1-Dichloroethene	U		0.00131	0.00655	2.62	10/28/2019 02:13	WG1370430
cis-1,2-Dichloroethene	U		0.00181	0.00655	2.62	10/28/2019 02:13	WG1370430
trans-1,2-Dichloroethene	U		0.00375	0.0131	2.62	10/28/2019 02:13	WG1370430
1,2-Dichloropropane	U		0.00333	0.0131	2.62	10/28/2019 02:13	WG1370430
1,1-Dichloropropene	U		0.00183	0.00655	2.62	10/28/2019 02:13	WG1370430
1,3-Dichloropropane	U		0.00459	0.0131	2.62	10/28/2019 02:13	WG1370430
cis-1,3-Dichloropropene	U		0.00178	0.00655	2.62	10/28/2019 02:13	WG1370430
trans-1,3-Dichloropropene	U		0.00401	0.0131	2.62	10/28/2019 02:13	WG1370430
2,2-Dichloropropane	U	J4	0.00208	0.00655	2.62	10/28/2019 02:13	WG1370430
Di-isopropyl ether	U		0.000917	0.00262	2.62	10/28/2019 02:13	WG1370430
Ethylbenzene	0.00413	J	0.00139	0.00655	2.62	10/28/2019 02:13	WG1370430
Hexachloro-1,3-butadiene	U		0.0333	0.0655	2.62	10/28/2019 02:13	WG1370430
Isopropylbenzene	U		0.00226	0.00655	2.62	10/28/2019 02:13	WG1370430
p-Isopropyltoluene	U		0.00610	0.0131	2.62	10/28/2019 02:13	WG1370430
2-Butanone (MEK)	U		0.0328	0.0655	2.62	10/28/2019 02:13	WG1370430
Methylene Chloride	U		0.0174	0.0655	2.62	10/28/2019 02:13	WG1370430
4-Methyl-2-pentanone (MIBK)	U		0.0262	0.0655	2.62	10/28/2019 02:13	WG1370430
Methyl tert-butyl ether	U		0.000773	0.00262	2.62	10/28/2019 02:13	WG1370430
Naphthalene	U		0.00817	0.0328	2.62	10/28/2019 02:13	WG1370430
n-Propylbenzene	U		0.00309	0.0131	2.62	10/28/2019 02:13	WG1370430
Styrene	U		0.00715	0.0328	2.62	10/28/2019 02:13	WG1370430
1,1,1,2-Tetrachloroethane	U		0.00131	0.00655	2.62	10/28/2019 02:13	WG1370430
1,1,2,2-Tetrachloroethane	U		0.00102	0.00655	2.62	10/28/2019 02:13	WG1370430
1,1,2-Trichlorotrifluoroethane	U		0.00177	0.00655	2.62	10/28/2019 02:13	WG1370430
Tetrachloroethene	0.00229	J	0.00183	0.00655	2.62	10/28/2019 02:13	WG1370430
Toluene	0.00917	J J4	0.00328	0.0131	2.62	10/28/2019 02:13	WG1370430
1,2,3-Trichlorobenzene	U		0.00164	0.00655	2.62	10/28/2019 02:13	WG1370430
1,2,4-Trichlorobenzene	U		0.0126	0.0328	2.62	10/28/2019 02:13	WG1370430

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result mg/kg	Qualifier	MDL mg/kg	RDL mg/kg	Dilution	Analysis date / time	Batch
1,1,1-Trichloroethane	U		0.000721	0.00655	2.62	10/28/2019 02:13	WG1370430
1,1,2-Trichloroethane	U	J4	0.00231	0.00655	2.62	10/28/2019 02:13	WG1370430
Trichloroethene	0.00144	J	0.00105	0.00262	2.62	10/28/2019 02:13	WG1370430
Trichlorofluoromethane	U		0.00131	0.00655	2.62	10/28/2019 02:13	WG1370430
1,2,3-Trichloropropane	U		0.0134	0.0328	2.62	10/28/2019 02:13	WG1370430
1,2,4-Trimethylbenzene	0.00413	J	0.00304	0.0131	2.62	10/28/2019 02:13	WG1370430
1,2,3-Trimethylbenzene	U		0.00301	0.0131	2.62	10/28/2019 02:13	WG1370430
Vinyl chloride	U		0.00179	0.00655	2.62	10/28/2019 02:13	WG1370430
1,3,5-Trimethylbenzene	U		0.00283	0.0131	2.62	10/28/2019 02:13	WG1370430
Xylenes, Total	0.0139	J	0.0125	0.0170	2.62	10/28/2019 02:13	WG1370430
(S) Toluene-d8	*102*			*75.0-131*		*10/28/2019 02:13*	WG1370430
(S) 4-Bromofluorobenzene	*91.8*			*67.0-138*		*10/28/2019 02:13*	WG1370430
(S) 1,2-Dichloroethane-d4	*98.9*			*70.0-130*		*10/28/2019 02:13*	WG1370430

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Method Blank (MB)

(MB) R3464948-1 10/24/19 15:02

Analyte	MB Result %	MB Qualifier	MB MDL %	MB RDL %
Total Solids	0.00500			

L1151020-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1151020-01 10/24/19 15:02 • (DUP) R3464948-3 10/24/19 15:02

Analyte	Original Result %	DUP Result %	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Total Solids	80.8	80.4	1	0.500		10

Laboratory Control Sample (LCS)

(LCS) R3464948-2 10/24/19 15:02

Analyte	Spike Amount %	LCS Result %	LCS Rec. %	Rec. Limits %	LCS Qualifier
Total Solids	50.0	50.0	99.9	85.0-115	

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Method Blank (MB)

(MB) R3465424-2 10/25/19 16:02

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Acetone	U		0.0137	0.0250
Acrylonitrile	U		0.00190	0.0125
Benzene	U		0.000400	0.00100
Bromobenzene	U		0.00105	0.0125
Bromodichloromethane	U		0.000788	0.00250
Bromoform	U		0.00598	0.0250
Bromomethane	U		0.00370	0.0125
n-Butylbenzene	U		0.00384	0.0125
sec-Butylbenzene	U		0.00253	0.0125
tert-Butylbenzene	U		0.00155	0.00500
Carbon disulfide	U		0.00406	0.0125
Carbon tetrachloride	U		0.00108	0.00500
Chlorobenzene	U		0.000573	0.00250
Chlorodibromomethane	U		0.000450	0.00250
Chloroethane	U		0.00108	0.00500
Chloroform	U		0.000415	0.00250
Chloromethane	U		0.00139	0.0125
2-Chlorotoluene	U		0.000920	0.00250
4-Chlorotoluene	U		0.00113	0.00500
1,2-Dibromo-3-Chloropropane	U		0.00510	0.0250
1,2-Dibromoethane	U		0.000525	0.00250
Dibromomethane	U		0.00100	0.00500
1,2-Dichlorobenzene	U		0.00145	0.00500
1,3-Dichlorobenzene	U		0.00170	0.00500
1,4-Dichlorobenzene	U		0.00197	0.00500
Dichlorodifluoromethane	U		0.000818	0.00250
1,1-Dichloroethane	U		0.000575	0.00250
1,2-Dichloroethane	U		0.000475	0.00250
1,1-Dichloroethene	U		0.000500	0.00250
cis-1,2-Dichloroethene	U		0.000690	0.00250
trans-1,2-Dichloroethene	U		0.00143	0.00500
1,2-Dichloropropane	U		0.00127	0.00500
1,1-Dichloropropene	U		0.000700	0.00250
1,3-Dichloropropane	U		0.00175	0.00500
cis-1,3-Dichloropropene	U		0.000678	0.00250
trans-1,3-Dichloropropene	U		0.00153	0.00500
2,2-Dichloropropane	U		0.000793	0.00250
Di-isopropyl ether	U		0.000350	0.00100
Ethylbenzene	U		0.000530	0.00250
Hexachloro-1,3-butadiene	U		0.0127	0.0250

Method Blank (MB)

(MB) R3465424-2 10/25/19 16:02

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Isopropylbenzene	U		0.000863	0.00250
p-Isopropyltoluene	U		0.00233	0.00500
2-Butanone (MEK)	0.0256		0.0125	0.0250
Methylene Chloride	0.0201	J	0.00664	0.0250
4-Methyl-2-pentanone (MIBK)	U		0.0100	0.0250
Methyl tert-butyl ether	U		0.000295	0.00100
Naphthalene	U		0.00312	0.0125
n-Propylbenzene	U		0.00118	0.00500
Styrene	U		0.00273	0.0125
1,1,1,2-Tetrachloroethane	U		0.000500	0.00250
1,1,2,2-Tetrachloroethane	U		0.000390	0.00250
Tetrachloroethene	U		0.000700	0.00250
Toluene	U		0.00125	0.00500
1,1,2-Trichlorotrifluoroethane	U		0.000675	0.00250
1,2,3-Trichlorobenzene	0.00115	J	0.000625	0.00250
1,2,4-Trichlorobenzene	U		0.00482	0.0125
1,1,1-Trichloroethane	U		0.000275	0.00250
1,1,2-Trichloroethane	U		0.000883	0.00250
Trichloroethene	U		0.000400	0.00100
Trichlorofluoromethane	U		0.000500	0.00250
1,2,3-Trichloropropane	U		0.00510	0.0125
1,2,3-Trimethylbenzene	U		0.00115	0.00500
1,2,4-Trimethylbenzene	U		0.00116	0.00500
1,3,5-Trimethylbenzene	U		0.00108	0.00500
Vinyl chloride	U		0.000683	0.00250
Xylenes, Total	U		0.00478	0.00650
(S) Toluene-d8	*106*			*75.0-131*
(S) 4-Bromofluorobenzene	*99.3*			*67.0-138*
(S) 1,2-Dichloroethane-d4	*99.0*			*70.0-130*

Laboratory Control Sample (LCS)

(LCS) R3465424-1 10/25/19 14:40

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	LCS Qualifier
Acetone	0.625	0.703	112	10.0-160	
Acrylonitrile	0.625	0.623	99.7	45.0-153	
Benzene	0.125	0.125	100	70.0-123	
Bromobenzene	0.125	0.119	95.2	73.0-121	

Laboratory Control Sample (LCS)

(LCS) R3465424-1 10/25/19 14:40

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	LCS Qualifier
Bromodichloromethane	0.125	0.124	99.2	73.0-121	
Bromoform	0.125	0.114	91.2	64.0-132	
Bromomethane	0.125	0.0779	62.3	56.0-147	
n-Butylbenzene	0.125	0.114	91.2	68.0-135	
sec-Butylbenzene	0.125	0.103	82.4	74.0-130	
tert-Butylbenzene	0.125	0.126	101	75.0-127	
Carbon disulfide	0.125	0.106	84.8	56.0-133	
Carbon tetrachloride	0.125	0.139	111	66.0-128	
Chlorobenzene	0.125	0.111	88.8	76.0-128	
Chlorodibromomethane	0.125	0.118	94.4	74.0-127	
Chloroethane	0.125	0.0980	78.4	61.0-134	
Chloroform	0.125	0.115	92.0	72.0-123	
Chloromethane	0.125	0.0941	75.3	51.0-138	
2-Chlorotoluene	0.125	0.109	87.2	75.0-124	
4-Chlorotoluene	0.125	0.121	96.8	75.0-124	
1,2-Dibromo-3-Chloropropane	0.125	0.117	93.6	59.0-130	
1,2-Dibromoethane	0.125	0.120	96.0	74.0-128	
Dibromomethane	0.125	0.119	95.2	75.0-122	
1,2-Dichlorobenzene	0.125	0.122	97.6	76.0-124	
1,3-Dichlorobenzene	0.125	0.115	92.0	76.0-125	
1,4-Dichlorobenzene	0.125	0.124	99.2	77.0-121	
Dichlorodifluoromethane	0.125	0.137	110	43.0-156	
1,1-Dichloroethane	0.125	0.120	96.0	70.0-127	
1,2-Dichloroethane	0.125	0.137	110	65.0-131	
1,1-Dichloroethene	0.125	0.115	92.0	65.0-131	
cis-1,2-Dichloroethene	0.125	0.106	84.8	73.0-125	
trans-1,2-Dichloroethene	0.125	0.0928	74.2	71.0-125	
1,2-Dichloropropane	0.125	0.117	93.6	74.0-125	
1,1-Dichloropropene	0.125	0.100	80.0	73.0-125	
1,3-Dichloropropane	0.125	0.126	101	80.0-125	
cis-1,3-Dichloropropene	0.125	0.119	95.2	76.0-127	
trans-1,3-Dichloropropene	0.125	0.128	102	73.0-127	
2,2-Dichloropropane	0.125	0.118	94.4	59.0-135	
Di-isopropyl ether	0.125	0.129	103	60.0-136	
Ethylbenzene	0.125	0.114	91.2	74.0-126	
Hexachloro-1,3-butadiene	0.125	0.135	108	57.0-150	
Isopropylbenzene	0.125	0.106	84.8	72.0-127	
p-Isopropyltoluene	0.125	0.108	86.4	72.0-133	
2-Butanone (MEK)	0.625	0.776	124	30.0-160	
Methylene Chloride	0.125	0.107	85.6	68.0-123	

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Laboratory Control Sample (LCS)

(LCS) R3465424-1 10/25/19 14:40

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	LCS Qualifier
4-Methyl-2-pentanone (MIBK)	0.625	0.696	111	56.0-143	
Methyl tert-butyl ether	0.125	0.107	85.6	66.0-132	
Naphthalene	0.125	0.111	88.8	59.0-130	
n-Propylbenzene	0.125	0.136	109	74.0-126	
Styrene	0.125	0.123	98.4	72.0-127	
1,1,1,2-Tetrachloroethane	0.125	0.106	84.8	74.0-129	
1,1,2,2-Tetrachloroethane	0.125	0.136	109	68.0-128	
Tetrachloroethene	0.125	0.136	109	70.0-136	
Toluene	0.125	0.110	88.0	75.0-121	
1,1,2-Trichlorotrifluoroethane	0.125	0.113	90.4	61.0-139	
1,2,3-Trichlorobenzene	0.125	0.132	106	59.0-139	
1,2,4-Trichlorobenzene	0.125	0.108	86.4	62.0-137	
1,1,1-Trichloroethane	0.125	0.118	94.4	69.0-126	
1,1,2-Trichloroethane	0.125	0.121	96.8	78.0-123	
Trichloroethene	0.125	0.117	93.6	76.0-126	
Trichlorofluoromethane	0.125	0.121	96.8	61.0-142	
1,2,3-Trichloropropane	0.125	0.122	97.6	67.0-129	
1,2,3-Trimethylbenzene	0.125	0.112	89.6	74.0-124	
1,2,4-Trimethylbenzene	0.125	0.128	102	70.0-126	
1,3,5-Trimethylbenzene	0.125	0.114	91.2	73.0-127	
Vinyl chloride	0.125	0.109	87.2	63.0-134	
Xylenes, Total	0.375	0.303	80.8	72.0-127	
(S) Toluene-d8			*102*	*75.0-131*	
(S) 4-Bromofluorobenzene			*96.3*	*67.0-138*	
(S) 1,2-Dichloroethane-d4			*112*	*70.0-130*	

Method Blank (MB)

(MB) R3465753-2 10/27/19 21:55

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Acetone	U		0.0137	0.0250
Acrylonitrile	U		0.00190	0.0125
Benzene	U		0.000400	0.00100
Bromobenzene	U		0.00105	0.0125
Bromodichloromethane	U		0.000788	0.00250
Bromoform	U		0.00598	0.0250
Bromomethane	U		0.00370	0.0125
n-Butylbenzene	U		0.00384	0.0125
sec-Butylbenzene	U		0.00253	0.0125
tert-Butylbenzene	U		0.00155	0.00500
Carbon disulfide	U		0.00406	0.0125
Carbon tetrachloride	U		0.00108	0.00500
Chlorobenzene	U		0.000573	0.00250
Chlorodibromomethane	U		0.000450	0.00250
Chloroethane	U		0.00108	0.00500
Chloroform	U		0.000415	0.00250
Chloromethane	U		0.00139	0.0125
2-Chlorotoluene	U		0.000920	0.00250
4-Chlorotoluene	U		0.00113	0.00500
1,2-Dibromo-3-Chloropropane	U		0.00510	0.0250
1,2-Dibromoethane	U		0.000525	0.00250
Dibromomethane	U		0.00100	0.00500
1,2-Dichlorobenzene	U		0.00145	0.00500
1,3-Dichlorobenzene	U		0.00170	0.00500
1,4-Dichlorobenzene	U		0.00197	0.00500
Dichlorodifluoromethane	U		0.000818	0.00250
1,1-Dichloroethane	U		0.000575	0.00250
1,2-Dichloroethane	U		0.000475	0.00250
1,1-Dichloroethene	U		0.000500	0.00250
cis-1,2-Dichloroethene	U		0.000690	0.00250
trans-1,2-Dichloroethene	U		0.00143	0.00500
1,2-Dichloropropane	U		0.00127	0.00500
1,1-Dichloropropene	U		0.000700	0.00250
1,3-Dichloropropane	U		0.00175	0.00500
cis-1,3-Dichloropropene	U		0.000678	0.00250
trans-1,3-Dichloropropene	U		0.00153	0.00500
2,2-Dichloropropane	U		0.000793	0.00250
Di-isopropyl ether	U		0.000350	0.00100
Ethylbenzene	U		0.000530	0.00250
Hexachloro-1,3-butadiene	U		0.0127	0.0250

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Method Blank (MB)

(MB) R3465753-2 10/27/19 21:55

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Isopropylbenzene	U		0.000863	0.00250
p-Isopropyltoluene	U		0.00233	0.00500
2-Butanone (MEK)	0.0293		0.0125	0.0250
Methylene Chloride	U		0.00664	0.0250
4-Methyl-2-pentanone (MIBK)	U		0.0100	0.0250
Methyl tert-butyl ether	U		0.000295	0.00100
Naphthalene	U		0.00312	0.0125
n-Propylbenzene	U		0.00118	0.00500
Styrene	U		0.00273	0.0125
1,1,1,2-Tetrachloroethane	U		0.000500	0.00250
1,1,2,2-Tetrachloroethane	U		0.000390	0.00250
Tetrachloroethene	U		0.000700	0.00250
Toluene	U		0.00125	0.00500
1,1,2-Trichlorotrifluoroethane	U		0.000675	0.00250
1,2,3-Trichlorobenzene	U		0.000625	0.00250
1,2,4-Trichlorobenzene	U		0.00482	0.0125
1,1,1-Trichloroethane	U		0.000275	0.00250
1,1,2-Trichloroethane	U		0.000883	0.00250
Trichloroethene	U		0.000400	0.00100
Trichlorofluoromethane	U		0.000500	0.00250
1,2,3-Trichloropropane	U		0.00510	0.0125
1,2,3-Trimethylbenzene	U		0.00115	0.00500
1,2,4-Trimethylbenzene	U		0.00116	0.00500
1,3,5-Trimethylbenzene	U		0.00108	0.00500
Vinyl chloride	U		0.000683	0.00250
Xylenes, Total	U		0.00478	0.00650
(S) Toluene-d8	*98.6*			*75.0-131*
(S) 4-Bromofluorobenzene	*91.7*			*67.0-138*
(S) 1,2-Dichloroethane-d4	*119*			*70.0-130*

Laboratory Control Sample (LCS)

(LCS) R3465753-1 10/27/19 20:57

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	LCS Qualifier
Acetone	0.625	0.701	112	10.0-160	
Acrylonitrile	0.625	0.625	100	45.0-153	
Benzene	0.125	0.116	92.8	70.0-123	
Bromobenzene	0.125	0.130	104	73.0-121	

Laboratory Control Sample (LCS)

(LCS) R3465753-1 10/27/19 20:57

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	LCS Qualifier
Bromodichloromethane	0.125	0.113	90.4	73.0-121	
Bromoform	0.125	0.0912	73.0	64.0-132	
Bromomethane	0.125	0.115	92.0	56.0-147	
n-Butylbenzene	0.125	0.113	90.4	68.0-135	
sec-Butylbenzene	0.125	0.107	85.6	74.0-130	
tert-Butylbenzene	0.125	0.111	88.8	75.0-127	
Carbon disulfide	0.125	0.122	97.6	56.0-133	
Carbon tetrachloride	0.125	0.0906	72.5	66.0-128	
Chlorobenzene	0.125	0.114	91.2	76.0-128	
Chlorodibromomethane	0.125	0.113	90.4	74.0-127	
Chloroethane	0.125	0.118	94.4	61.0-134	
Chloroform	0.125	0.0901	72.1	72.0-123	
Chloromethane	0.125	0.144	115	51.0-138	
2-Chlorotoluene	0.125	0.105	84.0	75.0-124	
4-Chlorotoluene	0.125	0.101	80.8	75.0-124	
1,2-Dibromo-3-Chloropropane	0.125	0.0907	72.6	59.0-130	
1,2-Dibromoethane	0.125	0.102	81.6	74.0-128	
Dibromomethane	0.125	0.135	108	75.0-122	
1,2-Dichlorobenzene	0.125	0.0977	78.2	76.0-124	
1,3-Dichlorobenzene	0.125	0.105	84.0	76.0-125	
1,4-Dichlorobenzene	0.125	0.0946	75.7	77.0-121	J4
Dichlorodifluoromethane	0.125	0.138	110	43.0-156	
1,1-Dichloroethane	0.125	0.112	89.6	70.0-127	
1,2-Dichloroethane	0.125	0.107	85.6	65.0-131	
1,1-Dichloroethene	0.125	0.164	131	65.0-131	
cis-1,2-Dichloroethene	0.125	0.101	80.8	73.0-125	
trans-1,2-Dichloroethene	0.125	0.107	85.6	71.0-125	
1,2-Dichloropropane	0.125	0.103	82.4	74.0-125	
1,1-Dichloropropene	0.125	0.101	80.8	73.0-125	
1,3-Dichloropropane	0.125	0.137	110	80.0-125	
cis-1,3-Dichloropropene	0.125	0.0993	79.4	76.0-127	
trans-1,3-Dichloropropene	0.125	0.0984	78.7	73.0-127	
2,2-Dichloropropane	0.125	0.171	137	59.0-135	J4
Di-isopropyl ether	0.125	0.160	128	60.0-136	
Ethylbenzene	0.125	0.110	88.0	74.0-126	
Hexachloro-1,3-butadiene	0.125	0.0807	64.6	57.0-150	
Isopropylbenzene	0.125	0.101	80.8	72.0-127	
p-Isopropyltoluene	0.125	0.101	80.8	72.0-133	
2-Butanone (MEK)	0.625	0.531	85.0	30.0-160	
Methylene Chloride	0.125	0.106	84.8	68.0-123	

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Laboratory Control Sample (LCS)

(LCS) R3465753-1 10/27/19 20:57

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	LCS Qualifier
4-Methyl-2-pentanone (MIBK)	0.625	0.646	103	56.0-143	
Methyl tert-butyl ether	0.125	0.144	115	66.0-132	
Naphthalene	0.125	0.100	80.0	59.0-130	
n-Propylbenzene	0.125	0.0978	78.2	74.0-126	
Styrene	0.125	0.105	84.0	72.0-127	
1,1,1,2-Tetrachloroethane	0.125	0.101	80.8	74.0-129	
1,1,2,2-Tetrachloroethane	0.125	0.123	98.4	68.0-128	
Tetrachloroethene	0.125	0.103	82.4	70.0-136	
Toluene	0.125	0.0895	71.6	75.0-121	J4
1,1,2-Trichlorotrifluoroethane	0.125	0.143	114	61.0-139	
1,2,3-Trichlorobenzene	0.125	0.0867	69.4	59.0-139	
1,2,4-Trichlorobenzene	0.125	0.102	81.6	62.0-137	
1,1,1-Trichloroethane	0.125	0.110	88.0	69.0-126	
1,1,2-Trichloroethane	0.125	0.0971	77.7	78.0-123	J4
Trichloroethene	0.125	0.0995	79.6	76.0-126	
Trichlorofluoromethane	0.125	0.135	108	61.0-142	
1,2,3-Trichloropropane	0.125	0.132	106	67.0-129	
1,2,3-Trimethylbenzene	0.125	0.108	86.4	74.0-124	
1,2,4-Trimethylbenzene	0.125	0.0943	75.4	70.0-126	
1,3,5-Trimethylbenzene	0.125	0.107	85.6	73.0-127	
Vinyl chloride	0.125	0.110	88.0	63.0-134	
Xylenes, Total	0.375	0.337	89.9	72.0-127	
(S) Toluene-d8			*95.9*	*75.0-131*	
(S) 4-Bromofluorobenzene			*97.3*	*67.0-138*	
(S) 1,2-Dichloroethane-d4			*126*	*70.0-130*	

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

(dry)	Results are reported based on the dry weight of the sample. [this will only be present on a dry report basis for soils].
MDL	Method Detection Limit.
MDL (dry)	Method Detection Limit.
RDL	Reported Detection Limit.
RDL (dry)	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
(S)	Surrogate (Surrogate Standard) - Analytes added to every blank, sample, Laboratory Control Sample/Duplicate and Matrix Spike/Duplicate; used to evaluate analytical efficiency by measuring recovery. Surrogates are not expected to be detected in all environmental media.
U	Not detected at the Reporting Limit (or MDL where applicable).
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
B	The same analyte is found in the associated blank.
J	The identification of the analyte is acceptable; the reported value is an estimate.
J4	The associated batch QC was outside the established quality control range for accuracy.

Pace National is the only environmental laboratory accredited/certified to support your work nationwide from one location. One phone call, one point of contact, one laboratory. No other lab is as accessible or prepared to handle your needs throughout the country. Our capacity and capability from our single location laboratory is comparable to the collective totals of the network laboratories in our industry. The most significant benefit to our one location design is the design of our laboratory campus. The model is conducive to accelerated productivity, decreasing turn-around time, and preventing cross contamination, thus protecting sample integrity. Our focus on premium quality and prompt service allows us to be YOUR LAB OF CHOICE.
* Not all certifications held by the laboratory are applicable to the results reported in the attached report.
* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace National.

State Accreditations

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Alaska	17-026	Nevada	TN-03-2002-34
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey–NELAP	TN002
California	2932	New Mexico [1]	n/a
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina [1]	DW21704
Georgia	NELAP	North Carolina [3]	41
Georgia [1]	923	North Dakota	R-140
Idaho	TN00003	Ohio–VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LAO00356
Kentucky [1,6]	90010	South Carolina	84004
Kentucky [2]	16	South Dakota	n/a
Louisiana	AI30792	Tennessee [1,4]	2006
Louisiana [1]	LA180010	Texas	T104704245-18-15
Maine	TN0002	Texas [5]	LAB0152
Maryland	324	Utah	TN00003
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	460132
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	9980939910
Montana	CERT0086	Wyoming	A2LA

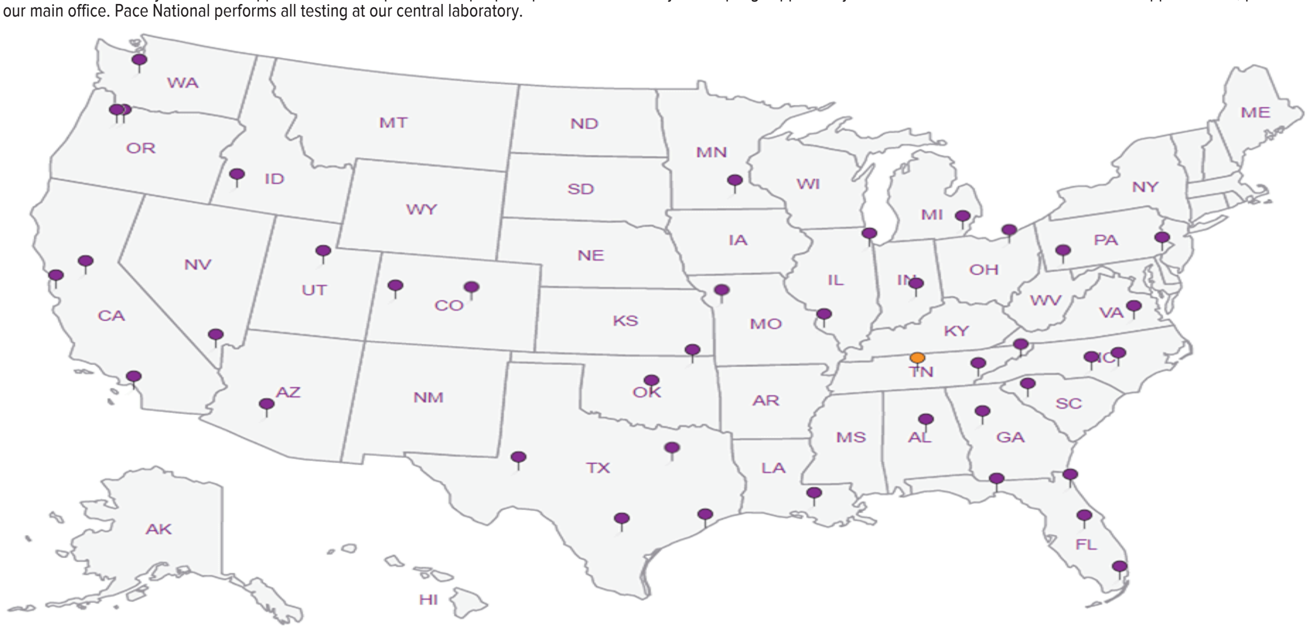
Third Party Federal Accreditations

A2LA – ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA – ISO 17025 [5]	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA–Crypto	TN00003		

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

Our Locations

Pace National has sixty-four client support centers that provide sample pickup and/or the delivery of sampling supplies. If you would like assistance from one of our support offices, please contact our main office. Pace National performs all testing at our central laboratory.



Kleinfelder- San Diego, CA

550 West C St, Suite 1200
San Diego, CA 92101

Billing Information:
Accounts Payable
550 West C St., Ste. 1200
San Diego, CA 92101

Pres Chk

Analysis / Container / Preservative

Chain of Custody Page 1 of 1

Pace Analytical®
National Center for Testing & Innovation

12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

Report to: **Lindsay Ellingson**

Email To: LEllingson@kleinfelder.com

Project Description: CARLSBAD VILLAGE DOUBLE TRACK TRENCH

City/State Collected: CARLSBAD, CA

Please Circle: PT MT CT ET

Phone: 619-831-4600
Fax:

Client Project # 20200172.001A

Lab Project # KLEINSDCA-CARLSBADDT

Collected by (print): STEVE TREADWAY

Site/Facility ID #

P.O. #

Collected by (signature): Steve Treadway

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed: STANDARD

Immediately Packed on Ice N___ Y ✓

SDG # 1150871

G117

Acctnum: KLEINSDCA
Template: T157562
Prelogin: P735827
PM: 110 - Brian Ford
PB:
Shipped Via:

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	soil VOCs 8260 2ozClr-NoPres	soil VOCs 8260 40mlAmb/MeOH5ml/Syr	water VOCs 8260 40mlAmb-HCl								Remarks	Sample # (lab only)
~~ST~~		GW																
1DW-VOC-1		SS	—	10/15/19	1204	1	X	X										01
1DW-VOC-5		SS	—	10/15/19	1230	1	X	X									BOTH	02

SJ

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other_______

Remarks: ONLY NEED VOC 8260 ON SOIL

pH _____ Temp _____
Flow _____ Other _____

Samples returned via:
__ UPS __ FedEx __ Courier ________

Tracking # 4764 8838 5056

Sample Receipt Checklist
COC Seal Present/Intact: NP __Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: ✓Y __N
RAD Screen <0.5 mR/hr: ✓Y __N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Trip Blank Received: Yes / No HCL / MeoH TBR
Steve Treadway	10/15/19	1500	10/16/19 1130	

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: °C	Bottles Received:	If preservation required by Login: Date/Time
	10/16/19	1650		2.1+.1=2.2 AL A6	2	

Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)	Date:	Time:	Hold:	Condition: NCF / OK
			W Taylor	10/17/19	8:45		OK

APPENDIX F

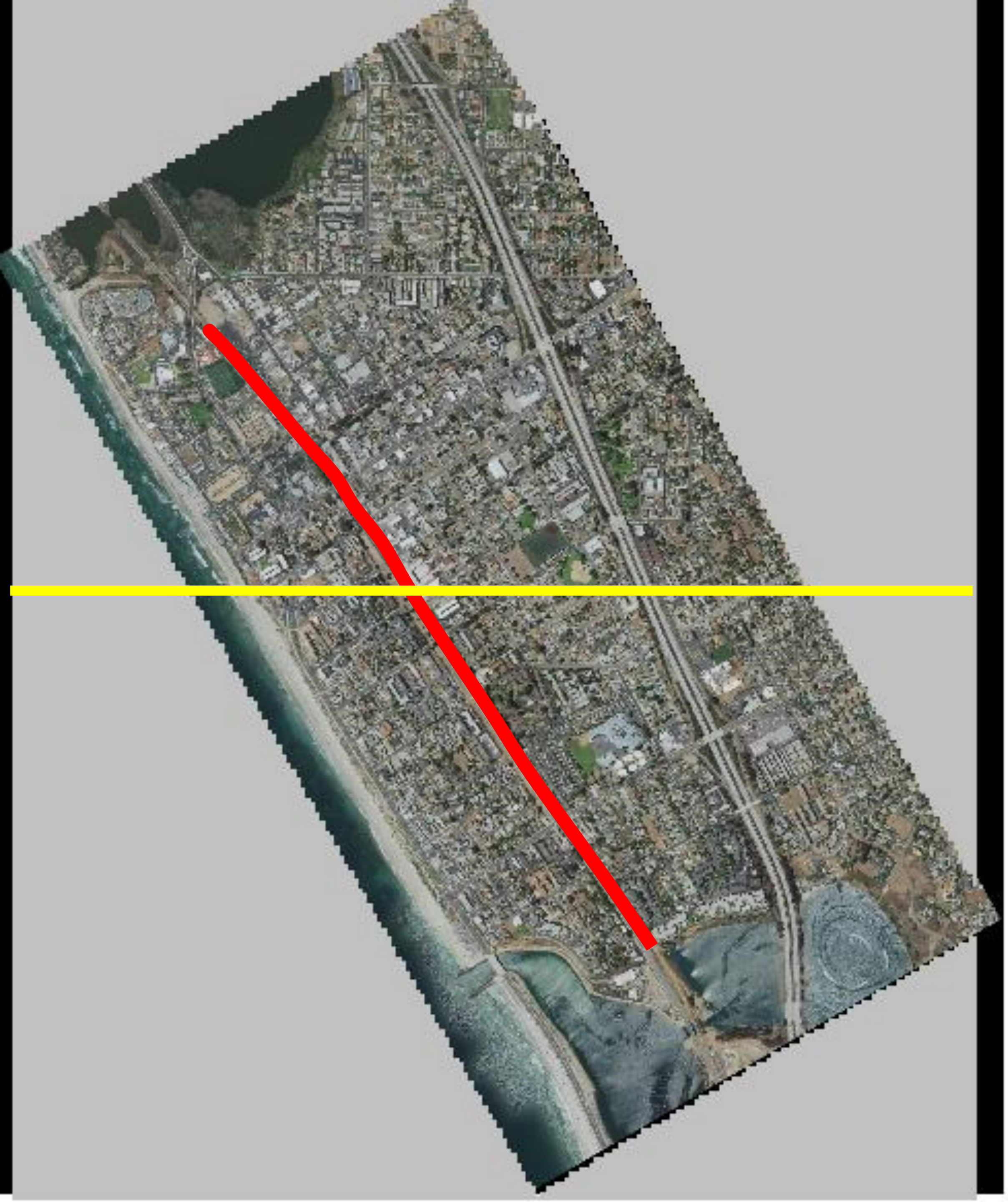
Groundwater Modeling Results

CARLSBAD VILLAGE DOUBLE TRACK TRENCH

Numerical Modeling to Evaluate Potential Groundwater Mounding

February 2020

Appendix F

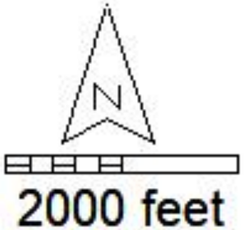


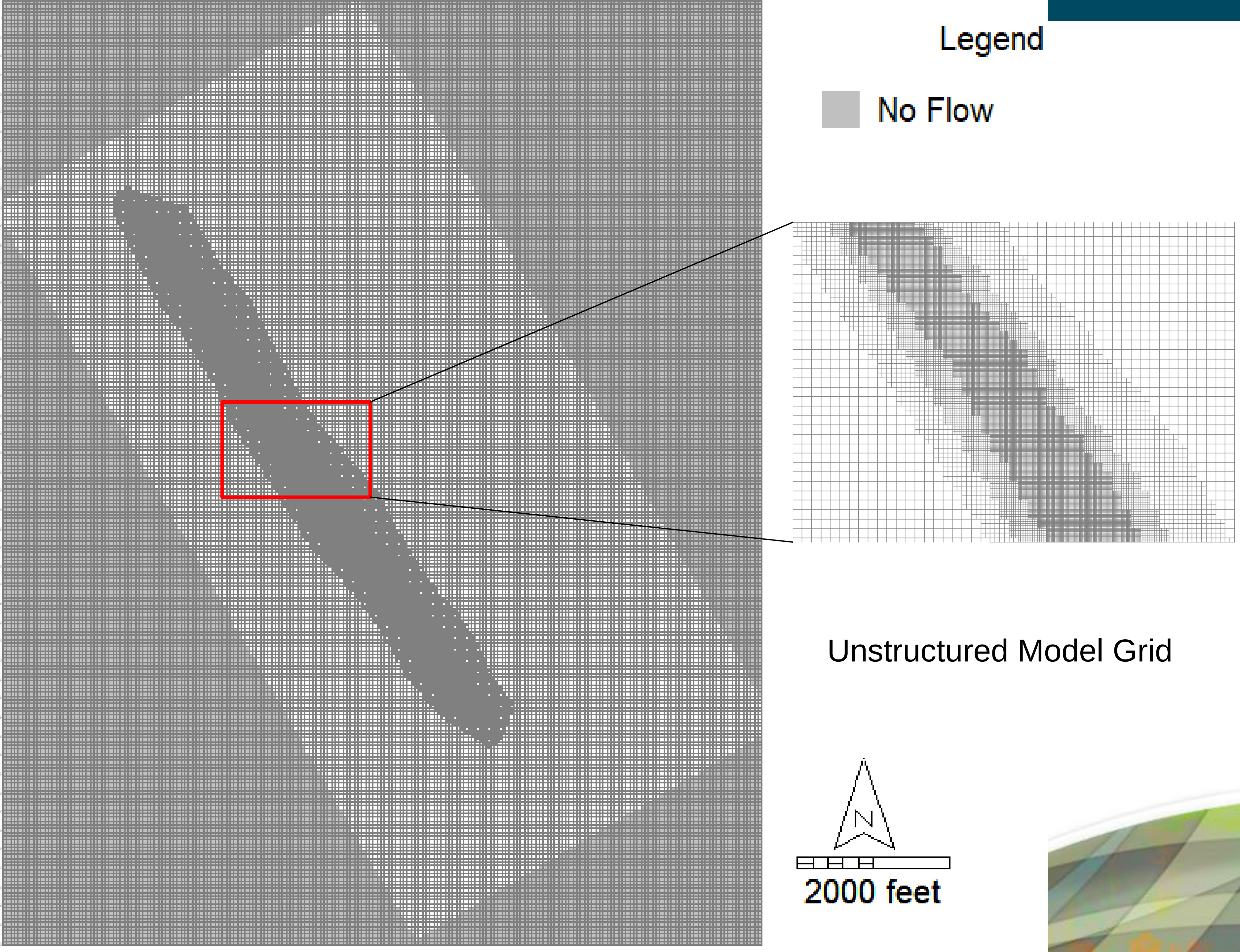
Legend

No Flow

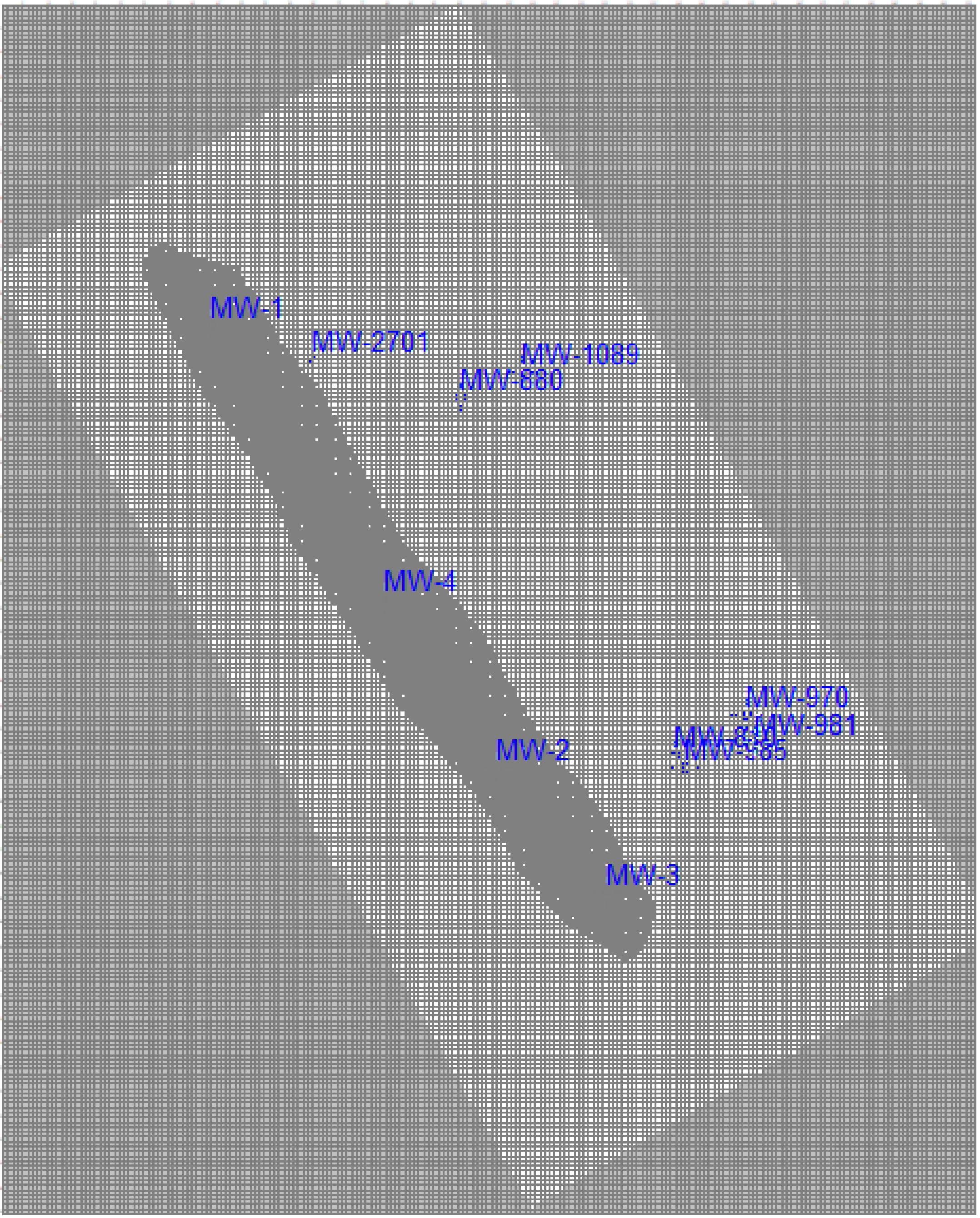
Model Domain

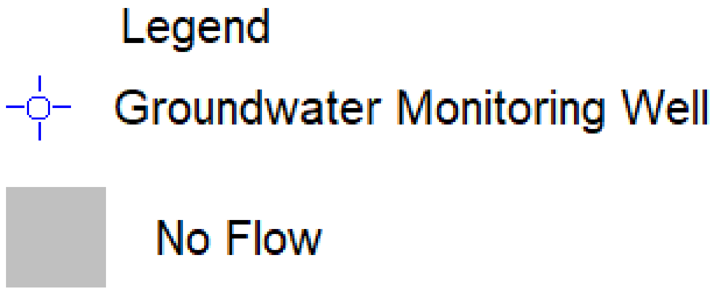
- Red line – Trench Wall
- Yellow line – for cross sectional view



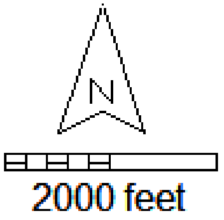


Unstructured Model Grid

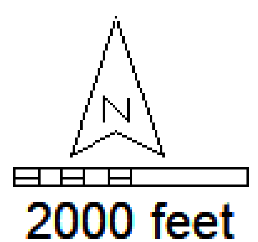




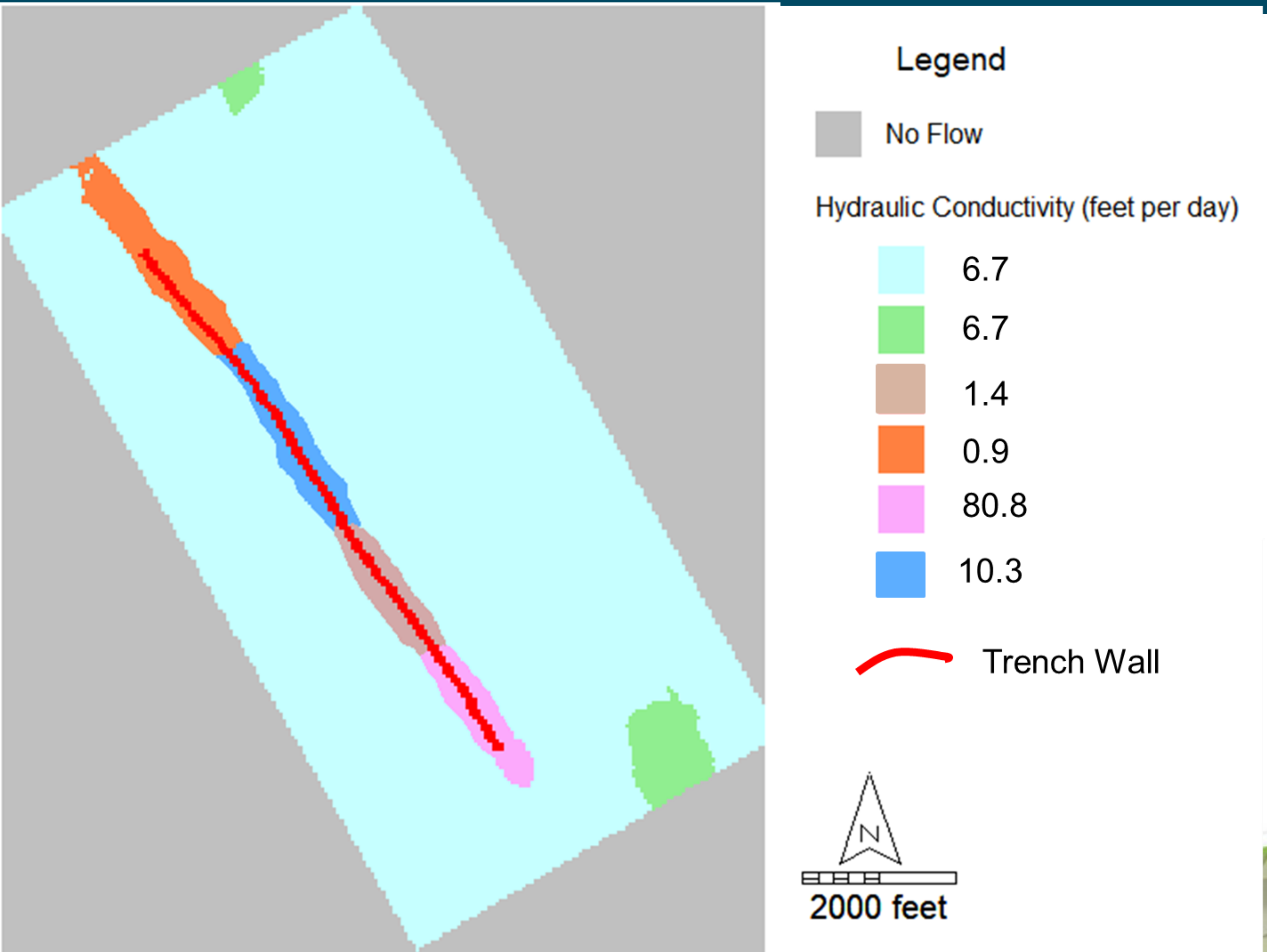
Groundwater Monitoring Wells for Model Calibration



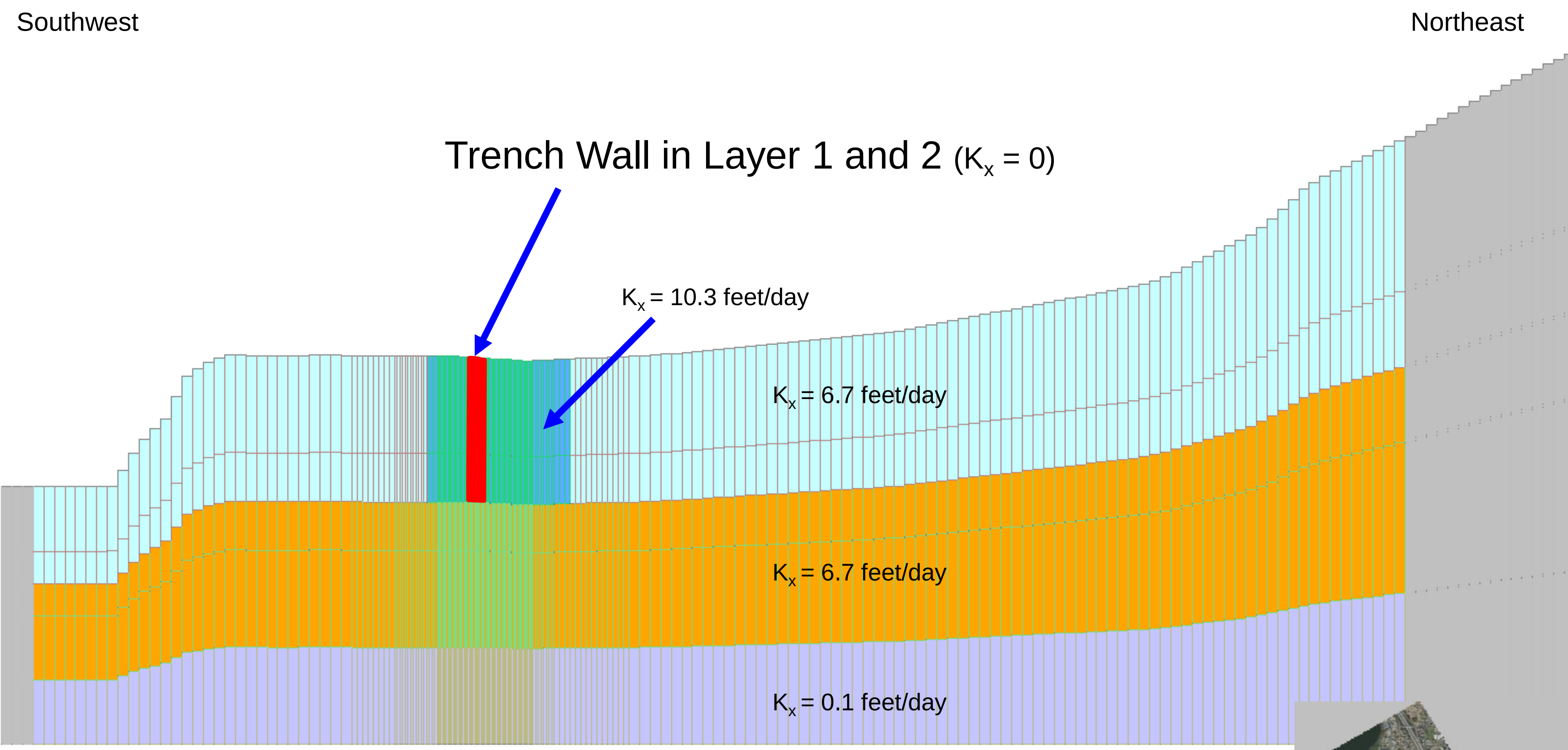
Constant Head Boundary



*feet amsl = feet above mean sea level


Legend
No Flow
Hydraulic Conductivity (feet per day)
6.7
6.7
1.4
0.9
80.8
10.3
Trench Wall
N
2000 feet

Cross-sectional View



KLEINFELDER
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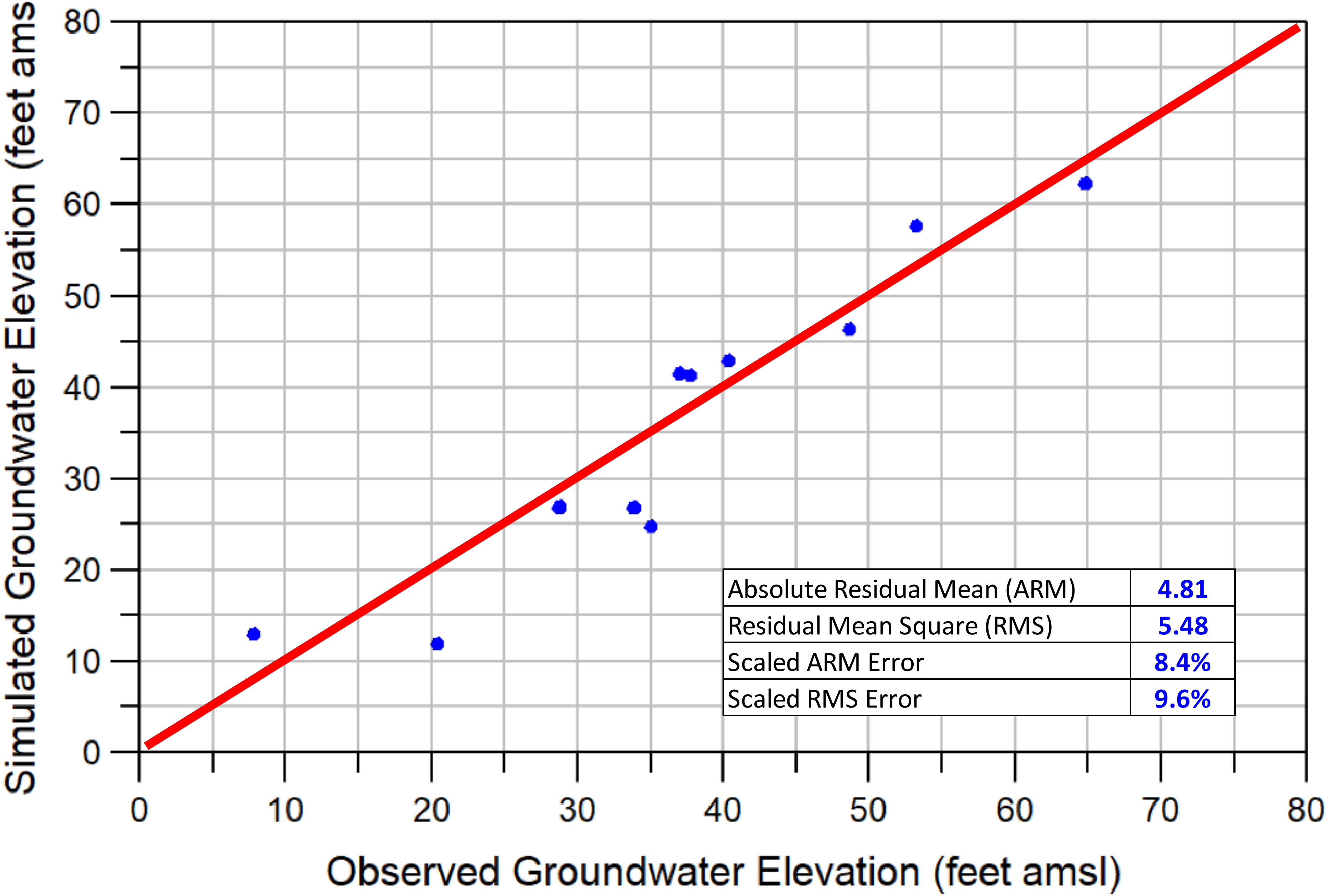
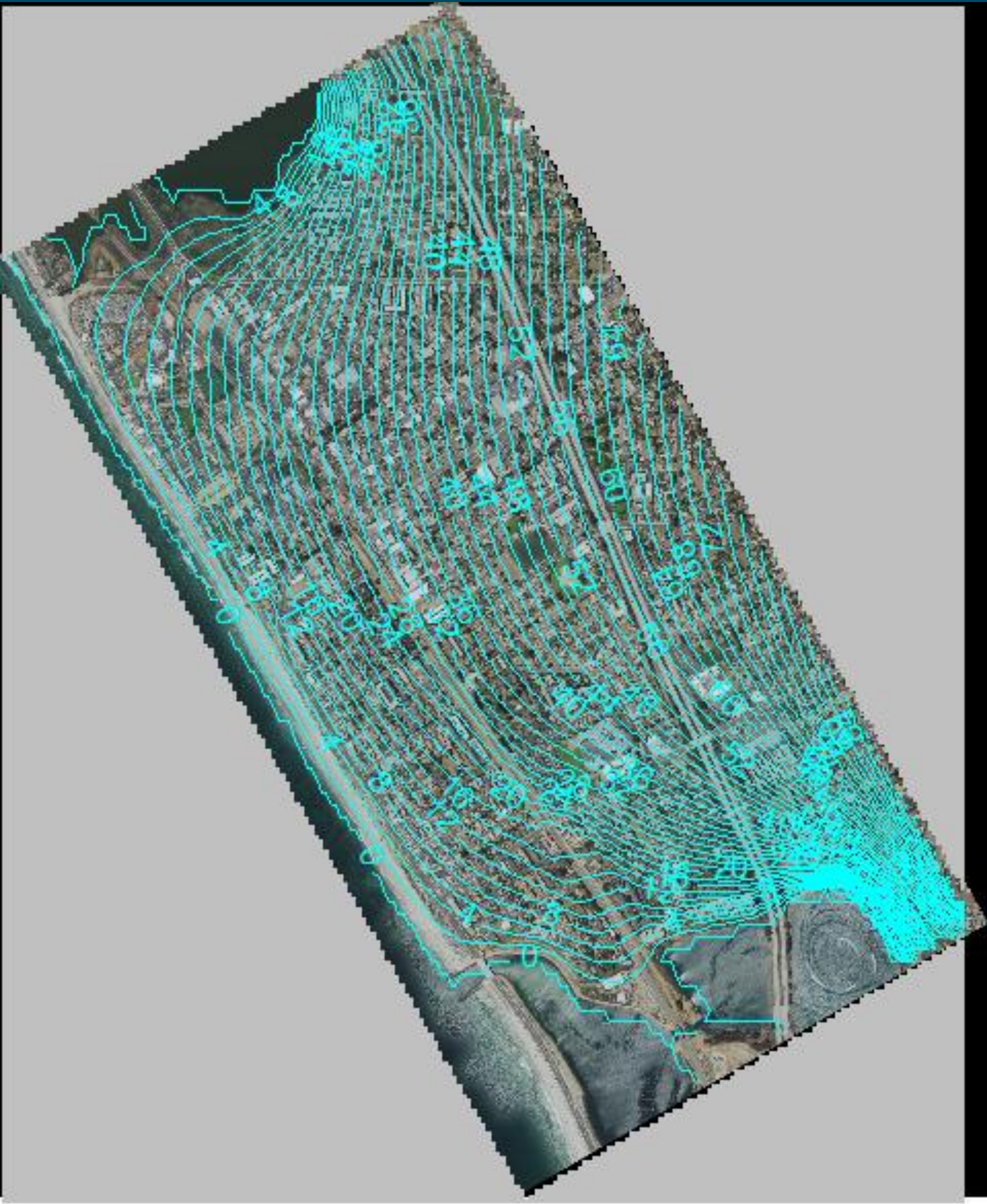
Observed vs. Computed Groundwater Elevation



Absolute Residual Mean (ARM)	4.81
Residual Mean Square (RMS)	5.48
Scaled ARM Error	8.4%
Scaled RMS Error	9.6%

*feet amsl = feet above mean sea level



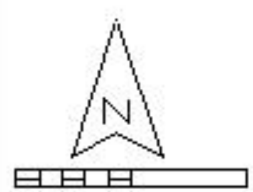
Legend

No Flow

Groundwater Elevation (feet amsl)

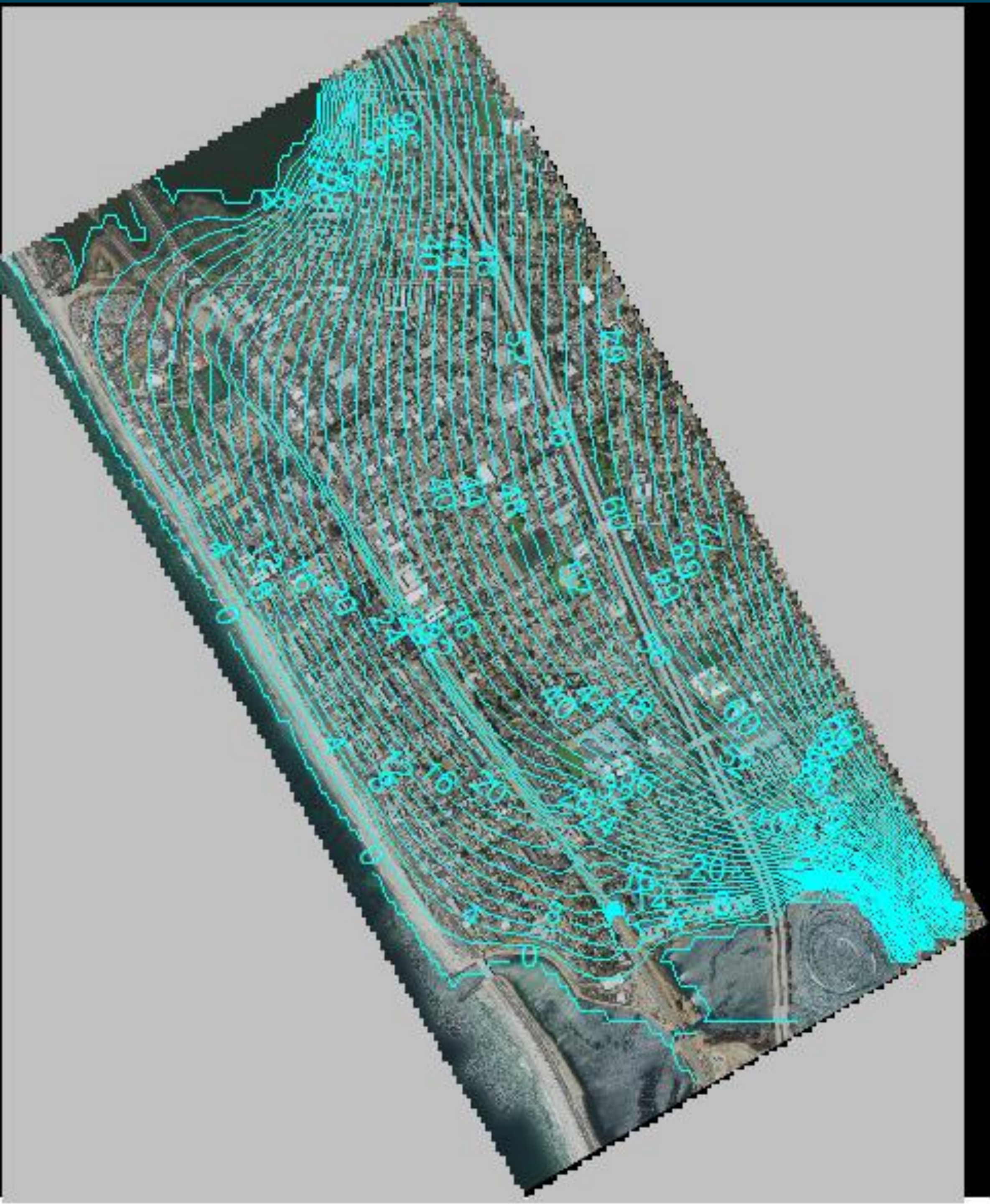
0.0

Potentiometric surface
without a trench wall



2000 feet

*feet amsl = feet above mean sea level



Legend

No Flow

Groundwater Elevation (feet amsl)

0.0

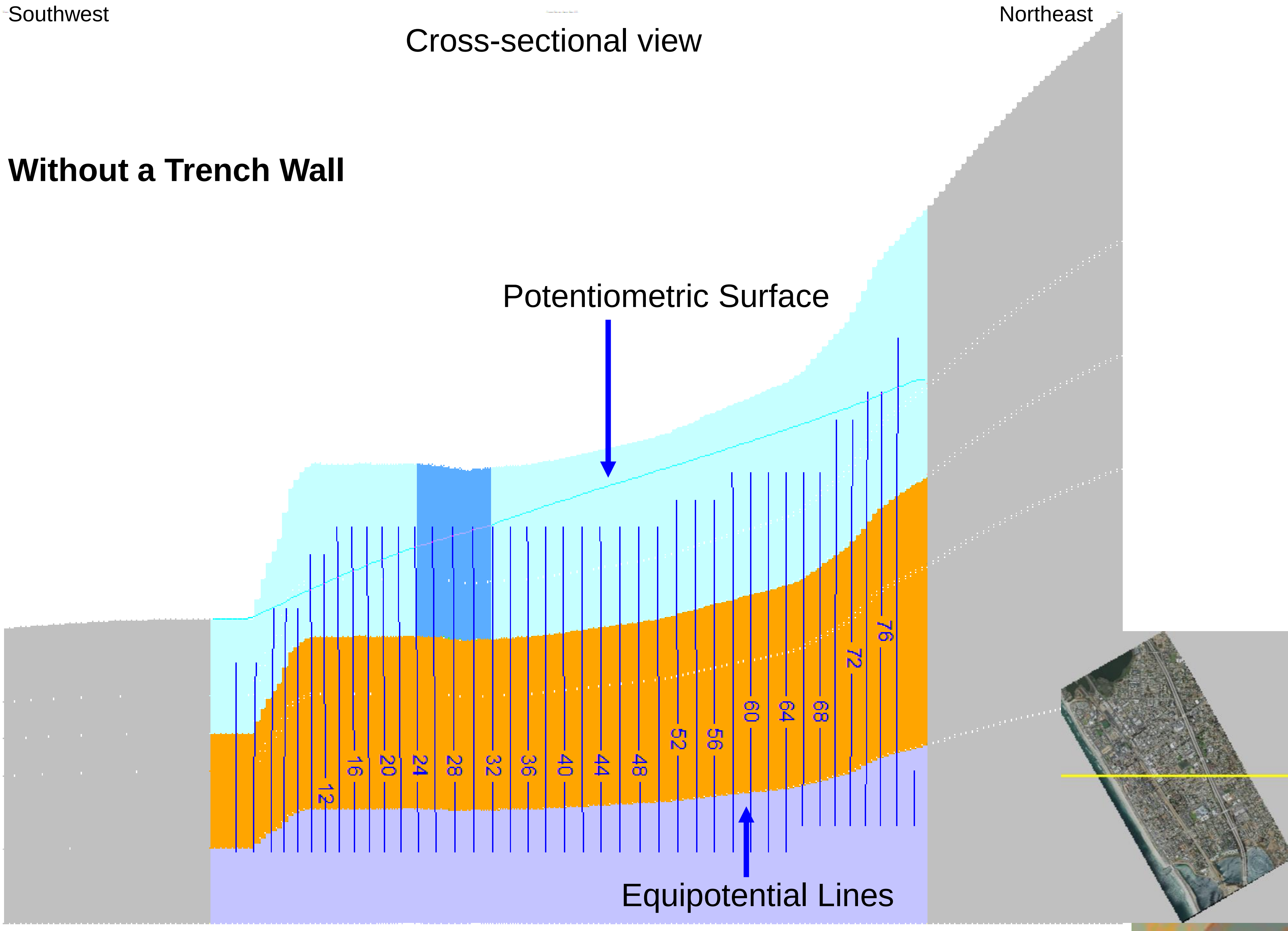
Potentiometric surface with a trench wall

2000 feet

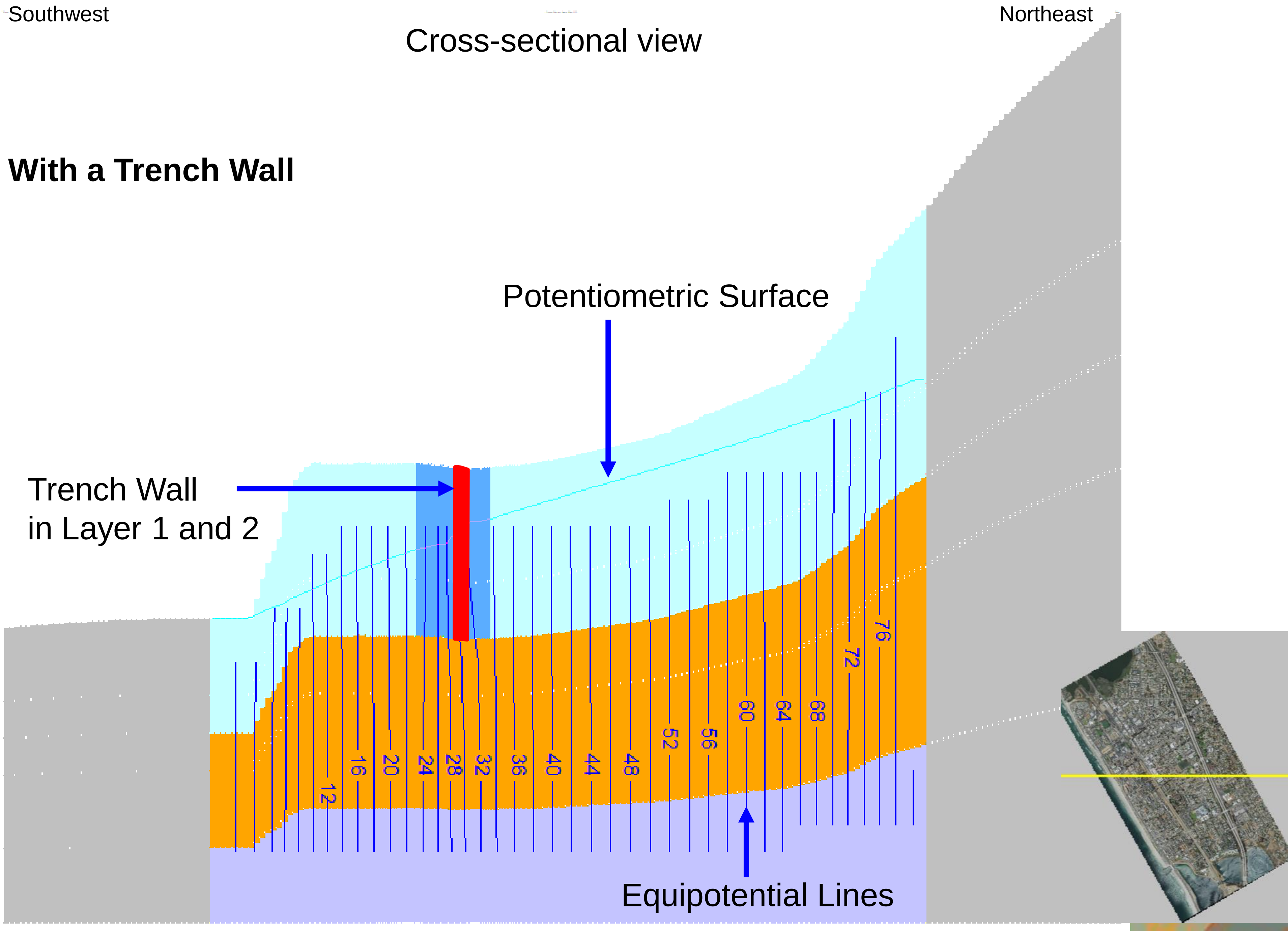
*feet amsl = feet above mean sea level

Cross-sectional view

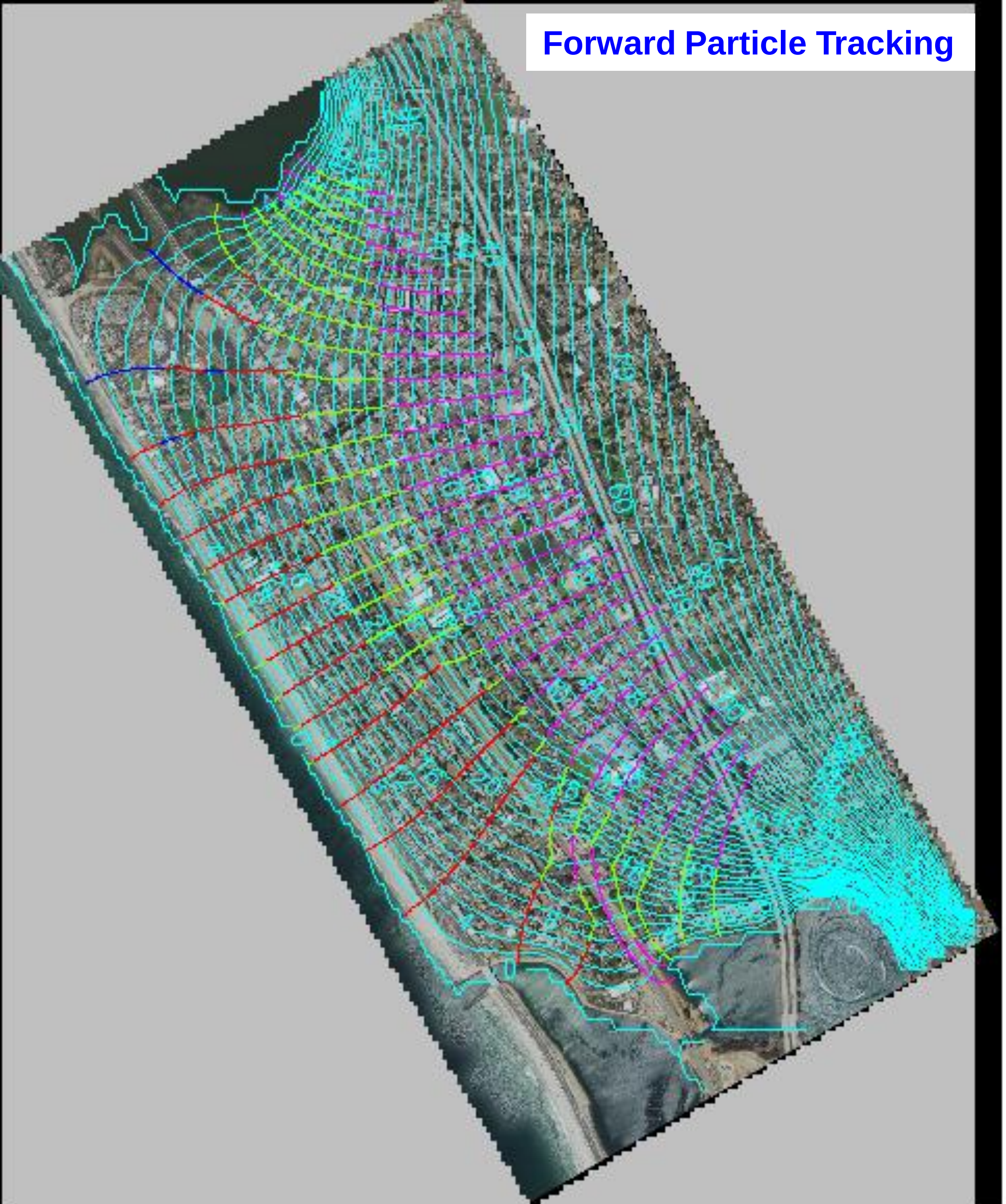
Without a Trench Wall



With a Trench Wall



Forward Particle Tracking



Legend

No Flow

Groundwater Elevation (feet amsl)

0.0 —

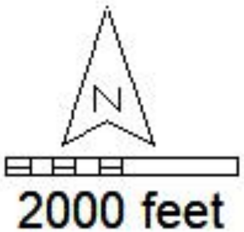
Particle Trace

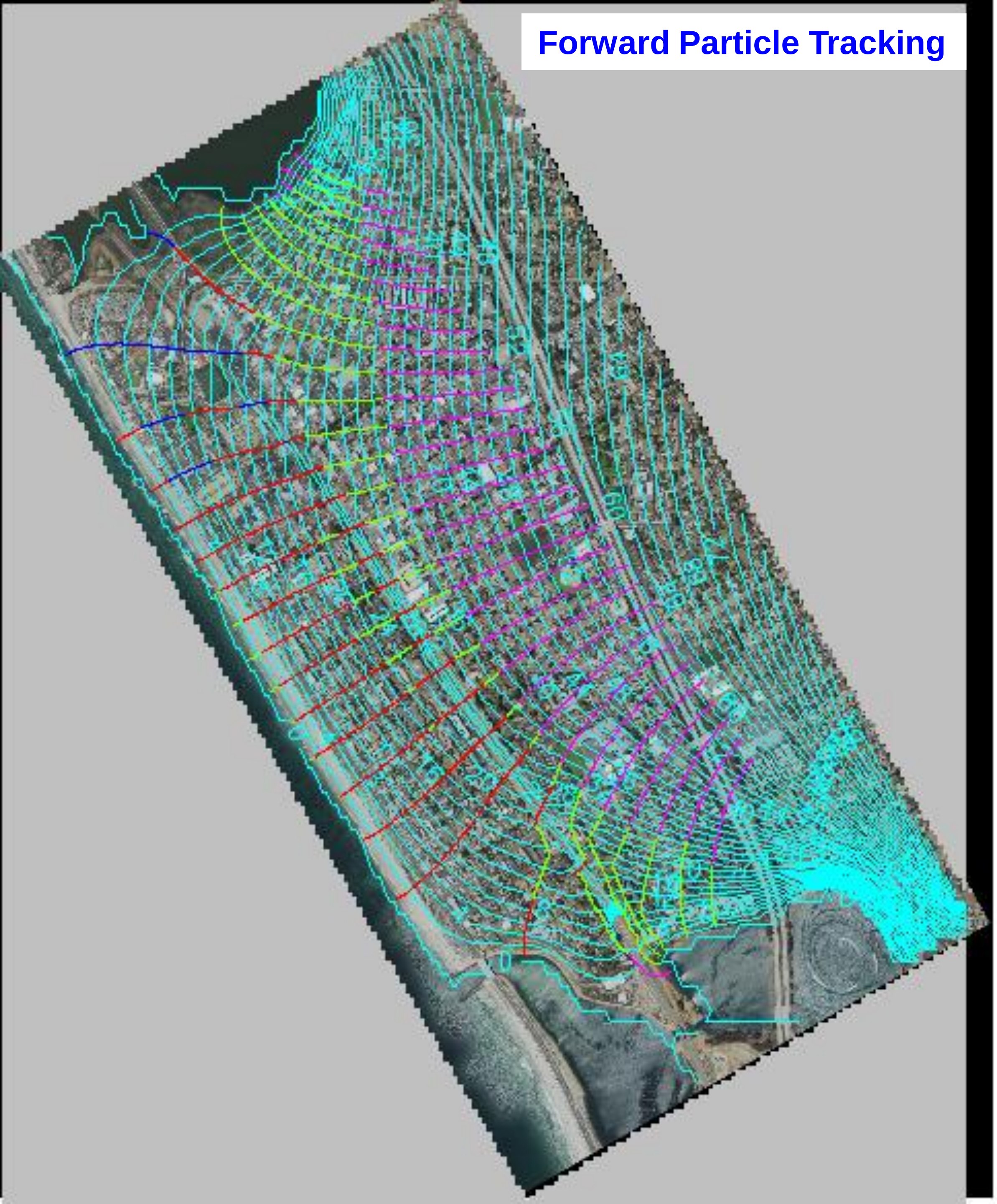
Layer 1 —
Layer 2 —
Layer 3 —
Layer 4 —
Layer 5 —

Without a Trench Wall

(Trench Wall in Layer 1 and 2)

*Feet amsl = Feet above mean sea level





Legend

No Flow

Groundwater Elevation (feet amsl)

0.0 —

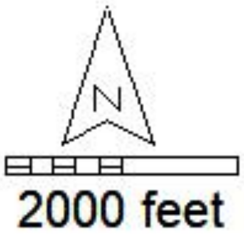
Particle Trace

Layer 1 —
Layer 2 —
Layer 3 —
Layer 4 —
Layer 5 —

With a Trench Wall

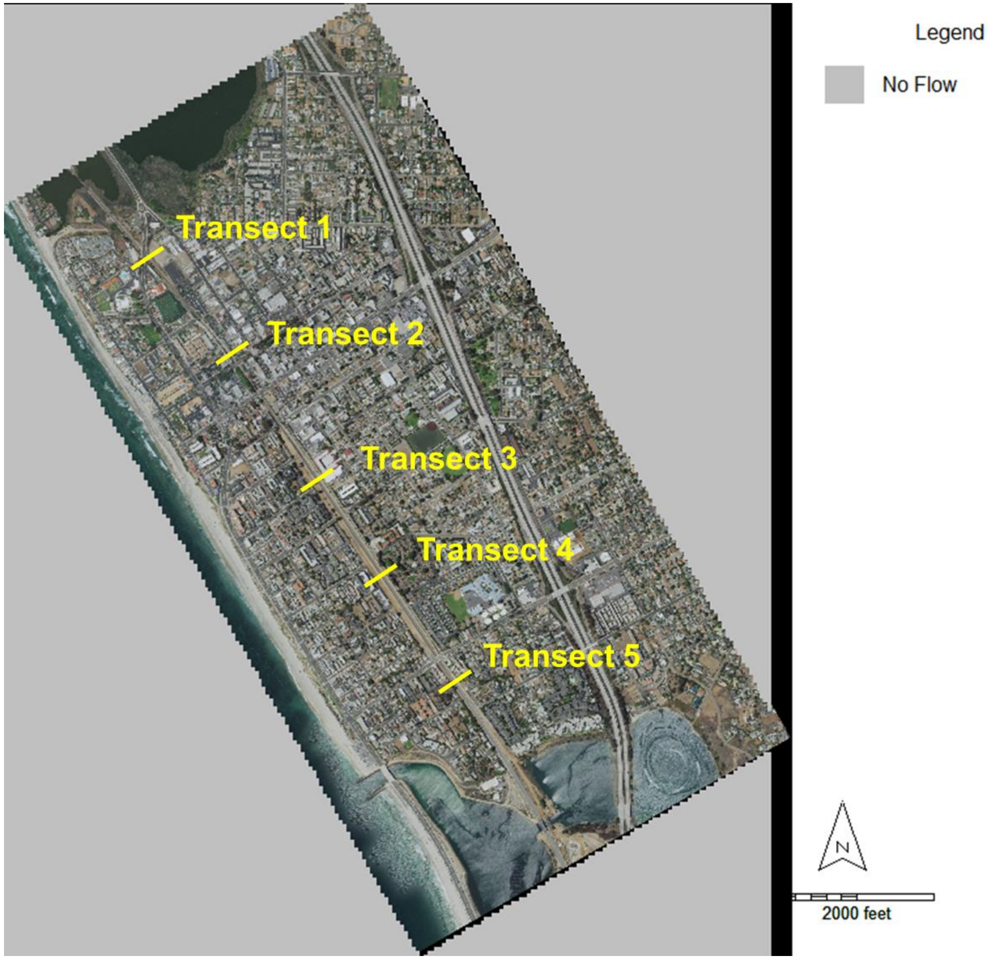
(Trench Wall in Layer 1 and 2)

*Feet amsl = Feet above mean sea level



Transect	Without a wall: Upgradient GWE (feet amsl)	Without a wall: Down gradient GWE (feet amsl)	With a wall: Upgradient GWE (feet amsl)	With a wall: Down gradient GWE (feet amsl)	Groundwater Mounding: Upgradient (feet)
T-1	9.59	8.08	10.10	7.86	0.51
T-2	22.88	20.28	24.76	19.00	1.89
T-3	29.51	27.32	32.31	25.19	2.80
T-4	29.16	26.29	31.99	25.36	2.83
T-5	16.92	16.97	20.58	15.94	3.66

* GWE = Groundwater Elevation
*Feet amsl = Feet above mean sea level



ATTACHMENT F:

PRELIMINARY DRAINAGE REPORT

SANDAG

T·Y·LIN INTERNATIONAL
engineers | planners | scientists

CARLSBAD VILLAGE RAILROAD TRENCH

Preliminary Drainage Report

Oceanside, Ca and Carlsbad, Ca

October 2019

Prepared for:
San Diego Association of Governments
401 B Street #800
San Diego, Ca 92101
(619) 699-1900

Prepared by:
T.Y. Lin International
404 Camino Del Rio South, Suite 700
San Diego, Ca 92108
(619) 692-1920

REGISTERED PROFESSIONAL ENGINEER
SHU-WEN LUMBRERAS
No. C83318
Exp. 3-31-21
CIVIL
STATE OF CALIFORNIA

TABLE OF CONTENTS

LIST OF APPENDICES

ABBREVIATIONS

ac	Acre(s)
ac-ft	Acre feet
cfs	Cubic feet per second
CY	Cubic yard(s)
ft	Feet
in	Inch(es)
in/hr	Inch(es) per hour
min	Minute(s)
SF	Square feet

ACRONYMS

A	Drainage Area
AC	Asphalt Concrete
AREMA	American Railway Engineering and Maintenance-of-Way Association
CP	Control Point
FHWA	Federal Highway Administration
HEC	Hydraulic Engineering Circular
HGL	Hydraulic Grade Line
I	Rainfall Intensity
IDF	Intensity-Duration-Frequency
LOSSAN	Los Angeles-San Luis Obispo-San Diego Rail Corridor
MODRAT	Modified Rational Method
MP	Milepost
NCTD	North County Transit District
P_6	6-Hour Precipitation
Q	Discharge / Runoff
RCP	Reinforced Concrete Pipe
ROW	Right-of-way
SANDAG	San Diego Association of Governments
T_c	Time of Concentration
V	Velocity or Volume

1. INTRODUCTION

The San Diego Association of Governments (SANDAG) has initiated this preliminary drainage study for the Carlsbad Village Double Track Improvements. The project proposes connecting approximately 2.6 miles of secondary track between Mileposts (MP) 228.0 and 230.6 from Agua Hedionda Lagoon in Carlsbad to Cassidy Street in Oceanside.

1.1 Project Location

The Carlsbad Village Double Track Project (Project) is located in the City of Carlsbad and the City of Oceanside, California. Like most regions of Southern California, Carlsbad and Oceanside have a Mediterranean climate with hot, dry summers and cool winters. Carlsbad and Oceanside have an annual rainfall about 10 inches, with most precipitation falling in the months between October and April.

This project is located near the Pacific Ocean and spans across several watersheds within the Carlsbad Hydrologic Unit, including Agua Hedionda and Buena Vista Creek. The northern portion of the project drains to Buena Vista Lagoon and the southern portion drains to Agua Hedionda and both eventually discharge into the Pacific Ocean.

1.2 Project Description

The project consists of the addition of a second railroad track from Cassidy Street in Oceanside south to Tamarack Avenue in Carlsbad. Two trench alternatives are considered for the project to include grade separation of the railroad tracks by constructing a trench beneath the existing street elevations. The first alternative, known as the Short Trench Alternative, would construct the double track railroad lowered in a trench passing under vehicular overpasses at Grand Avenue, Carlsbad Village Drive, and Oak Avenue, with pedestrian overpasses at Beech Ave/Carlsbad Village Station and Chestnut Avenue. The second alternative is the Long Trench Alternative, which would construct a railroad trench passing under vehicular overpasses at Grand Avenue, Carlsbad Village Drive, Oak Avenue, Chestnut Avenue, and Tamarack Avenue, with a pedestrian overpass at Beech Ave/Carlsbad Village Station. Both trench alternatives would require replacement of the Carlsbad Boulevard Overcrossing with a new bridge spanning the tracks.

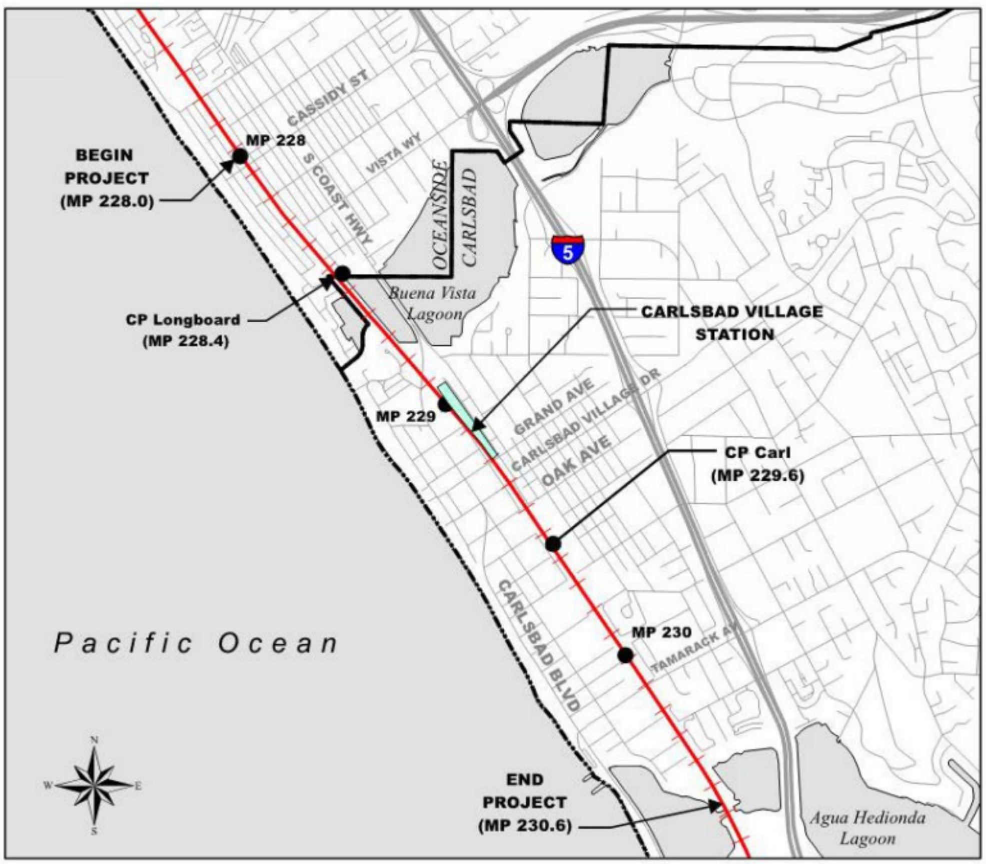
The project includes replacement of the existing single-track Buena Vista Lagoon bridge with a new double-track bridge, improvements and modifications at Carlsbad Village Station (including both the NCTD Coaster Station and Breeze Bus Station), grade crossing modifications, and construction of the new second track (including associated site improvements and signal modifications). SANDAG is directly responsible for funding and implementing of the Project.

Stakeholders involved in review and approval of the project design include NCTD, CPUC, the City of Oceanside, and the City of Carlsbad.

The hydraulics of the Buena Vista Lagoon bridge are analyzed in the *Buena Vista Lagoon Bridge Fluvial Hydraulic Analysis* prepared for the project by Everest International Consultants, Inc. in February 2014. This report provides guidance for the elevation of the Lagoon Bridge soffit and scour depths at the abutments and piers.

Refer to the *Preliminary Water Quality Technical Report for Carlsbad Village Double Track*, concurrently being prepared with this report, for more information on water quality treatment and baseline hydromodification management.

Figure 1: Vicinity Map



2. DRAINAGE CHARACTERISTICS

2.1 Existing Condition

The overall project drains into two major water bodies, Buena Vista Lagoon to the north and Agua Hedionda Lagoon to the south. The general ridge line between the two major watersheds is located at Carlsbad Village Drive. The existing alignment of the track is in a local valley which collects runoff from a significant amount of off-site run-on from both sides of the track. The off-site areas are fully developed and are from predominantly residential and commercial land uses. In some areas, drainage is collected into a storm drain system that runs parallel to the tracks, whereas in many other locations, there are earthen drainage channels parallel to the tracks conveying runoff into either lagoon. The drainage characteristics for each major watershed system will be discussed in greater detail below.

Buena Vista Lagoon

Drainage from the portion of the project located in the City of Oceanside is conveyed on the surface in two shallow earthen channels parallel to the tracks on each side starting from Cassidy Street to the north to Buena Vista Lagoon to the south. The off-site areas draining to the tracks is primarily single-family residential homes.

Within the City of Carlsbad, the major ridge line begins at Carlsbad Village Drive and runoff flows to the north to Buena Vista Lagoon. Since the local valley where the tracks are located is much deeper in this area, the drainage areas tributary to the tracks are much larger. Off-site areas located to the east side of the tracks which are discharging towards the tracks are comprised of various commercial and residential land uses. The drainage flows in a westerly direction towards the tracks and is collected into a 66-inch reinforced concrete pipe (RCP) mainline storm drain system that is located immediately to the east of the existing Carlsbad Village Train Station in an alley. Drainage from the tracks is collected into various inlets along the length of the project site and is conveyed through laterals into the mainline storm drain system. These various connections into the 66-inch RCP are analyzed as part of this project; however, the entire off-site area draining to the 66-inch RCP is not analyzed as part of this project.blvd

Starting from approximately Grand Avenue and to the north, the majority of the off-site areas west of the tracks primarily drain on the surface to reach a trackside earthen drainage channel flowing in a northerly direction before outfalling into Buena Vista Lagoon. This existing earthen channel is constricted as it crosses underneath the Carlsbad Blvd. bridge. A small drainage area between Carlsbad Village Drive and Grand Avenue is collected into a storm drain system which crosses Grand Avenue and connects to the previously discussed 66-inch RCP located on the east side of the tracks.

Agua Hedionda Lagoon

Along the tracks, the ridge line begins at Carlsbad Village Drive and all areas to the south along the tracks discharge into Agua Hedionda Lagoon to the south. Similar to the other major watershed, there is a mainline storm drain system located on the east side of the tracks and earthen channels located along the west side of the tracks conveying flows; however, there are several lateral storm drain systems on the west side of the tracks which tie into the mainline storm drain to the east. This mainline storm drain system, the Santa Fe Storm Drain, is an 84-inch RCP which flows in a southerly direction and discharges into Agua Hedionda Lagoon. In all, there are four (4) lateral storm drain systems which cross the tracks from west to east at Oak Avenue, Chestnut Avenue, Acacia Avenue, and Tamarack Avenue and connect into an 84-inch RCP mainline system. On the east side of the tracks, the drainage areas immediately adjacent to the tracks are analyzed as part of this project at key outlet point connections to the 84-inch RCP. Lastly, on the southwestern portion of this area, the runoff drains on the surface along a trackside drain and discharges directly into the lagoon.

Refer to the Drainage Exhibits provided in Appendix F for watershed delineations.

2.2 Proposed Condition

In both the Short Trench and Long Trench Alternatives, the overall drainage characteristics are the same as the Existing Condition for the areas east of the proposed trench and for all areas within the City of Oceanside. Since the entire length of the proposed trench is within the City of Carlsbad for both the Short and Long Trench Alternatives, the railroad trench just slightly reduces the amount of drainage area on each side of the trench. There are no significant impacts from areas east of the trench as all drainage patterns will remain the same flowing to either existing mainline storm drain systems—66-inch RCP flowing north to Buena Vista Lagoon and 84-inch RCP flowing south to Agua Hedionda Lagoon.

Since the mainline storm drains are located on the east side of the tracks, there are much greater impacts to the drainage flowpath on the west side of the tracks since it is no longer feasible to connect storm drains from west to east at several street crossings. In the Short Trench Alternative, this eliminates the existing storm drain crossings at Grand Avenue, Oak Avenue, Chestnut Avenue, and Acacia Avenue and contains the runoff to the west of the tracks and the first connection that's feasible is at Tamarack Avenue. In the Long Trench Alternative, all five existing storm drain crossings are impacted, thus all drainage from approximately Chestnut Avenue and south the Agua Hedionga Lagoon are restricted to the west side of the tracks. A combination of a trackside channel transitioning connecting to a storm drain system is proposed to collect runoff from these drainage areas and to cross the tracks just south of the trench to connect to the existing 84-inch RCP.

In both alternatives, the drainage area west of the tracks north of approximately Chestnut Avenue is also restricted to the west; thus, a trackside channel connecting to storm drain system design is proposed to bring the runoff all the way north to outfall directly into Buena Vista Lagoon. Given the large peak flow rate and restriction the Carlsbad Blvd. bridge overpass, an underground storm drain solution was determined to be more feasible.

The proposed railroad trench corridors are located deep within the groundwater table, designed to be hydraulically separated from groundwater with the vertical trench walls. However, precipitation that lands in the trench must be addressed. The runoff within the trench must be collected and pumped to the surface to discharge into surface based drainage conveyance systems. Proposed pump stations are located on the west side of the tracks since the temporary shoofly tracks are located on the east side and the pump stations would be in conflict. In the Short Trench Alternative, only one sump is proposed just north of Carlsbad Village Station. In the Long Trench Alternative, a second sump is proposed just south of Hemlock Avenue.

Refer to the Drainage Maps provided in Appendix F for watershed delineations.

3. HYDROLOGIC ANALYSIS

3.1 Design Criteria

All rainfall and storm runoff calculations are designed to comply with the City of Carlsbad Engineering Standards 2016 Edition, and the San Diego County Hydrology Manual (2003) where applicable.

3.1.1 Rainfall Criteria

Design Storm

The design storm analyzed for this study was a 6-hour, 100-year frequency storm event. The rainfall associated with a 100-year storm event used for hydrologic modeling is intended to produce 100-year recurrence interval peak discharges. A 100-year frequency storm event is defined as having a 1.0 percent chance of being equaled or exceeded in any given year.

Precipitation

Rainfall data utilized for this study is from the San Diego County Hydrology Manual (2003). Rainfall depths determined based on Isopluvial Maps (See Appendix D) were as follows:

Table 2: Rainfall Depths

Storm Frequency	***Precipitation***
100-year, 6-hour	2.5 inches
100-year, 24-hour	4.5 inches

3.2 Runoff Computations

Basin Delineation

Drainage basin limits were mapped using photogrammetric topography provided by the surveyor, photogrammetric topography provided by the City of Carlsbad, and SANGIS 2014 2-ft Topography.

Modified Rational Method

Since the drainage areas analyzed as part of this project are less than 1 square mile in size, the Rational Method is the appropriate method for analyzing the 100-year peak flow rates for the project. Since the Rational Method only considers a single drainage area, the Modified Rational Method is used to consider the routing of flows through multiple drainage areas.

100-year flow rates were calculated for both the existing and proposed conditions with the Modified Rational Method, utilizing the Advanced Engineering Software (AES) 2016 software. The equation for the Rational Method is as follows:

$$Q = CIA$$

Where: Q = Peak Flow Rate, cubic feet per second
C = Runoff Coefficient
I = Intensity, inches/hour
A = Drainage Area, acres

To perform a node-link study, the total watershed area is divided into subareas which discharge at designated nodes.

The procedure for the subarea summation model is as follows:

1. Subdivide the watershed into an initial subarea and subsequent subareas, which are generally less than 10 acres in size. Assign upstream and downstream node numbers to each subarea.
2. Estimate an initial Tc by using the appropriate nomograph or overland flow velocity estimation.
3. Using the initial Tc, determine the corresponding values of I. Then Q = C I A.
4. Using Q, estimate the travel time between this node and the next by Manning's equation as applied to the particular channel or conduit linking the two nodes.
5. Then, repeat the calculation for Q based on the revised intensity (which is a function of the revised time of concentration)

The nodes are joined together by links, which may be street gutter flows, drainage swales, drainage ditches, pipe flow, or various channel flows. The AES computer subarea menu is as follows:

SUBAREA HYDROLOGIC PROCESS

Confluence analysis at node.

1. Initial subarea analysis (including time of concentration calculation).
2. Pipeflow travel time (computer estimated).
3. Pipeflow travel time (user specified).
4. Trapezoidal channel travel time.
5. Street flow analysis through subarea.

6. User - specified information at node.
7. Addition of subarea runoff to main line.
8. V-gutter flow through area.
9. Copy main stream data to memory bank
10. Confluence main stream data with a memory bank
11. Clear a memory bank

Runoff Coefficient

Runoff coefficients were in accordance with County of San Diego standards, impervious areas were designated with a runoff coefficient of 0.90, while pervious areas were designated with a runoff coefficient of 0.25 (assumed soil type B). Railroad tracks in the proposed trench were assigned a runoff coefficient of 0.90 since the tracks are located on top of a concrete base and would behave as a fully impervious surface. Most of the off-site developments that are residential or commercial were modeled with a % impervious of 80% to 90% which correlates to a runoff coefficient of 0.77 to 0.84, respectively.

Where a basin contains varying amounts of different cover types, a weighted runoff coefficient was determined per San Diego County Hydrology Manual *Section 3.1.2*s:

$$C = 0.90 * (\%\,Impervious) + C_P * (1 - \%\,Impervious)$$

Where: C_P = 0.25 (Undisturbed natural terrain in Soil Type B)

Pervious and impervious areas were determined from aerial photos. The runoff coefficient calculations are summarized in Appendix D.

Intensity

The intensities utilized in the rational method calculations were determined from Figure 3-1 of the San Diego County Hydrology Manual (See Appendix D). The duration was set equal to the time of concentration (Tc). The duration is set equal to the Tc to ensure that the entire drainage area has time to contribute to the flow.

Time of Concentration

The time of concentration is the time it takes for rain in the most hydrologically remote part of the watershed to reach the outlet. The Tc is made up of two components, the initial time of concentration (Ti) and travel time (Tt).

The initial time of concentration is typically based on sheet flow at the upstream end of a drainage basin. The initial time of concentration is calculated using the methods described in the San Diego County Hydrology Manual Section 3. Figure 3-3 (See Appendix D) of the Hydrology Manual provides the Overland Time of Flow approximated by an equation developed by the Federal Aviation Agency (FAA) for analyzing flow on runways.

The travel time (Tt) is the time required for the runoff to flow in a watercourse (e.g. swale, channel, gutter, or pipe) or series of watercourses from the initial subarea to the point of interest. The Tt is computed by dividing the length of the flow path by the computed velocity. Since the velocity normally changes as a result of each change in flow rate or slope, such as at an inlet or grade break, the total Tt must be computed as the sum of the Tt's for each section of the flow path.

Combining Drainage Systems at a Junction

Where two or more drainage systems approach the same common outlet point, the San Diego County Hydrology Manual (2003) has a procedure for confluencing the peak flow rates. The AES Rational Method software has the calculation built into the program. For reference, refer to Section 3.4.2 of the San Diego County Hydrology Manual (2003) for more specific information.

3.3 Hydrologic Results

AES Modified Rational Method and Rational Method analyses were prepared for the existing condition and proposed condition (Short Trench and Long Trench Alternatives). AES analyses were prepared for most of the project area and supplemental Rational Method calculations were prepared for smaller drainage areas such as the Coastal Rail Trail and the drainage within the railroad trench.

The proposed project will have minimal impacts on drainage patterns in the area except for the drainage within the City of Carlsbad located on the west side of the trench. The drainage ditches along the tracks will be re-graded to provide proper flow capacity and comply with NCTD standards. Storm drains are proposed on the west side of the tracks for conveyance of larger peak flow rates to an appropriate discharge location, either an outfall into a lagoon or a connection into a mainline storm drain system. A summary of the most significantly impacted areas are summarized in Table 2 below.

Table 3: Summary of Key Discharge Locations

Node ID (Trench Alternative)	***Outfall Location***	***Existing 100-YR Flow Rate***	***Proposed 100-YR Flow Rate***	***Net Change***
300 (Short/Long)	Buena Vista Lagoon	88.1 cfs	144.6 cfs	+56.5 cfs
400 (Short/Long)	Buena Vista Lagoon	18.7 cfs	22.2 cfs	+3.5 cfs
2800 (Short)	Existing 84-inch RCP at Tamarack Avenue	222.5 cfs [1] (confluence of Nodes 2000, 2300, 2400, and 2800)	93.3 cfs [2]	-129.2 cfs
3100 (Long)	Existing 84-inch RCP near outfall into Agua Hedionda Lagoon	222.5 cfs [1] (confluence of Nodes 2000, 2300, 2400, and 2800)	114.6 cfs (Node 3100)	-107.9 cfs

Note:

1. A supplemental calculation has been prepared to compare the peak flow contribution of drainage areas located west of the trench to the existing 84-inch on the east side of the tracks. This confluencing calculation represents the peak flow rate at Drainage Node 2800 (Tamarack Avenue) which serves as a comparison of the peak flow rates in the proposed condition. There is a significant decrease in the 100-year peak flow rate discharging into the existing 84-inch RCP in the proposed condition for both alternatives; therefore, there are no negative impacts on the existing 84-inch RCP. Refer to calculations provided in Appendix C.
2. Although there is no increase in the 100-year peak flow rate discharging into the 84-inch RCP, there is an increase in the peak flow rate on the existing 36-inch RCP storm drain crossing at Tamarck Avenue beyond the capacity of the storm drain. To mitigate for this increase, a 54-inch RCP is proposed as a replacement to connect to the existing 84-inch RCP for the Short Trench Alternative only.

In Table 2, the significant change in the 100-year peak flow rate between the existing and proposed conditions for Drainage Nodes 300, 2800, and 3100 are a direct result of the railroad trench redirecting runoff on the west side of the tracks causing 30.5 acres of drainage area (i.e., Drainage Node Series 2000, 2100, and 2200) to now discharge to the north instead of piping under the tracks to the existing 84-inch RCP mainline. As a result, the drainage area now remains on the west side of the tracks and discharges at Drainage Node 300 towards Buena Vista Lagoon.

In the proposed condition, Table 2 above represents a comparison of the discharge of areas from the west side of the tracks between existing and proposed conditions at Drainage Node 2800. In the Short Trench Alternative at Drainage Node 2800, there is a net decrease in the peak flow rate in the proposed condition since the runoff is proposed to be conveyed in a surface trackside channel rather than in a pipe which increases the travel time and reduces the peak flow rate. This surface conveyance is specifically from Drainage Node 2300 (Chestnut Avenue) to Drainage Node 2800 (Tamarck Avenue). Similarly, in the Long Trench Alternative where the trench limits extend to the south of Tamarck Avenue, a proposed storm drain begins at Tamarack Avenue and crosses the tracks just to the southern end of the trench limits. Along the way, additional drainage from Drainage Node Series 2900, 3000, and 3100 are collected into the proposed storm drain. In both alternatives, the contributing peak flow rate from the west side of the tracks is decreased in the proposed condition; therefore, there are no negative impacts on the existing 84-inch RCP.

The results of the hydrologic analyses are described below based on the similar results in both alternatives and the differences between each of the trench alternatives. Refer to Appendix A for detailed existing condition hydrology calculations and Appendix B for proposed condition hydrology calculations and drainage exhibits in Appendix F. A tabular hydrology summary is provided in Appendix C.

<u>Short Trench and Long Trench Alternatives</u>

Buena Vista Lagoon

Drainage from the City of Oceanside to the north of Buena Vista Lagoon will remain the same as compared to existing conditions and the drainage channels parallel to the tracks will remain as the primary drainage conveyance system. Since there is no trench proposed in this segment of the project, then the addition of the second track will not increase the imperviousness along the tracks. Thus, there is no change to the peak flow rate between existing and proposed conditions.

Drainage approaching from the south side of Buena Vista Lagoon from within the City of Carlsbad is impacted more significantly with the addition of the trench by separating the drainage areas located on the west side of the tracks. Runoff on the east side of the tracks will continue to discharge into various connections into the existing 66-inch RCP mainline storm drain system. With the reduction in drainage area on the surface, the proposed condition peak flow rate at each of these locations is less than in the existing condition with the exception of the watershed discharging to Drainage Node 400. Although there is a reduction in drainage areas in the proposed condition as compared to the existing condtion, the longest flow path has now reduced and thus the time of concentration has reduced as well thereby increasing the peak flow rate by 3.5 cfs. Since a biofiltration basin is proposed on the northwest corner of the Carlsbad Village Train Station parking lot, it is anticipated that the increase in peak flow rate can be mitigated within additional detention volume provided in the biofiltration basin.

Runoff from the west side of the tracks will be collected into an earthen channel from Walnut Avenue to Oak Avenue flowing parallel to the track to the north before it is collected into a 48-inch RCP storm drain that continues flowing to the north on the west side of the tracks. Ultimately, more runoff is collected into the storm drain system and will discharge into Buena Vista Lagoon as a 60-inch RCP based on the 100-year peak flow rate of 144.6 cfs at the outfall. This alignment currently assumes the most conservative proposed storm drain alignment in that it flows through areas that are mapped on SANGIS as Environmentally Sensitive Areas (ESA). It may be feasible for the storm drain to cross the tracks just upstream of the Carlsbad Boulevard bridge overpass and outfall into the lagoon through a slightly shorter alignment. This will need to be refined during a future phase of design.

Agua Hedionda Lagoon

On the east side of the trench, drainage areas that are collected into the 84-inch RCP mainline storm drain system start from approximately Carlsbad Village Drive on the north and continues all the way south to Agua Hedionda Lagoon. There is a slight reduction in drainage areas on the surface as a result of the trench, therefore, there are no increases in peak flow rate between the existing and proposed conditions for the local drainage on the surface.

The drainage within the trench is different between the Short and Long Trench alternatives and will be discussed separately below.

<u>Short Trench Alternative Only</u>

Agua Hedionda Lagoon

As mentioned above with Table 2, it is anticipated that there is a net decrease in peak flow rate contibuting to the existing 84-inch RCP for areas west of the tracks, thus there are no negative impacts. However, with the increase in peak flow rate at proposed condition Drainage Node 2800 (Tamarack Avenue), the existing 36-inch RCP storm drain connection into the 84-inch RCP will need to be upsized to a 54-inch RCP to collect and convey the additional runoff.

Trench Drainage

In the Short Trench Alternative, there is a total of 4.2 acres that drain to the sump just north of Carlsbad Village Drive (PS-S1). Based on the shallow groundwater table throughout the project site, drainage within the trench must be pumped to a surface drainage system for discharge. To avoid conflicting with the alignment of the temporary shoofly track, the pump station is located on the west side of the tracks. The 100-year peak flow rate for the full trench is 14.4 cfs (approximately 5,400 gpm). Therefore, the proposed pump station will need to be designed for a least 5,400 gpm.

Long Trench Alternative Only

Agua Hedionda Lagoon

As mentioned above with Table 2, it is anticipated that there is a net decrease in peak flow rate contibuting to the existing 84-inch RCP for areas west of the tracks, thus there are no negative impacts. Runoff from Drainage Node 2800 (Tamarck Avenue) will be collected and conveyed in a proposed 54-inch RCP system on the west side of the tracks which will cross beneath the tracks once past the limits of the trench.

The NCTD right-of-way is very narrow at the Tamarck Avenue crossing; therefore, to accommodate the trench and temporary shoofly track, approximately 3,500-ft of the existing 84-inch RCP needs to be realigned to the east from approximately Chestnut Avenue to Chinquapin Avenue.

Trench Drainage

In the Long Trench Alternative, there are two sump locations—PS-L1 (north of Carlsbad Village Drive) and PS-L2 (south of Hemlock Avenue). There are 4.9 acres draining to PS-S1 with a 100-year peak flow rate of 11.4 cfs (approximately 4,300 gpm). There are 5.8 acres draining to PS-S2 with a 100-year peak flow rate of 13.3 cfs (approximately 5,000 gpm). Each proposed pump station will need to be designed for at a minimum these peak flow rates.

4. HYDRAULIC CALCULATIONS

4.1 Design Criteria

The hydraulic design criteria for the project for the sizing of open channels, inlets, storm drains, and rip rap are designed to comply with the City of Carlsbad Engineering Standards 2016 Edition, and the San Diego County Hydraulic Design Manual (2014) where applicable. The City of Carlsbad Engineering Standards require public drainage facilities to carry the ten-year, six-hour storm underground and the 100-year, six-hour storm between the tops of curbs. Since the storm drain designed for this project runs off the street it must convey the 100-year six-hour storm underground.

Hydraulic calculations can be found in Appendix E. Locations of proposed drainage features are shown on the Proposed Condition Drainage Exhibits in Appendix F.

4.2 Open Channel Calculations

Open channel calculations were determined using FlowMaster (CONNECT Edition) software developed by Haestad Methods. Channels were sized to convey 100-year flows with a minimum freeboard of six inches. For earthen channels, the target maximum permissible velocity is less than 4 feet per second for coarse gravel. Since the existing slopes of the trackside channels are fairly flat, it is anticipated that a coarse gravel lined channel with a maximum flow depth of 2-ft and bottom width ranging from 2-ft to 13-ft is enough for the conveyance of the 100-year peak flow rate.

Within the proposed trenches, a continuous set of 3-ft wide trench grates are proposed on top of a concrete channel on each side of the railroad trench. For ease of construction, the goal was to match the channel slope with the trench slope and standardize the concrete channel depth. A series of rectangular channel capacity calculations were prepared based on the various trench slopes to determine that a uniform 15-inch channel depth would be sufficient to convey the peak flow rate to each sump location. This assumes a flow depth of 9-inches, 3-inches of freeboard, and 3-inches thick of a grate. This is applicable in both the Short Trench and Long Trench Alternatives. However, there is one section of the track where the slope is 0.06% and this section of track requires a deeper channel depth of 18-inches to accommodate the 12-inches needed for conveyance of the flows.

The sizing of the drainage channels will be refined during a future phase of design. Refer to calculations in Appendix E.

4.3 Inlet Capacity and Gutter Flow

Inlet capacity calculations were completed per the City of Carlsbad Engineering Standards. Both inlets designed for this project are sump inlets. According to the City of Carlsbad Engineering Standards curb inlets at a sump condition should be designed for two CFS per lineal foot of opening when headwater may rise to the top of curb.

4.4 Storm Drain Calculations

Storm drain calculations were completed using FlowMaster (CONNECT Edition) software developed by Haestad Methods to determine the flow capacity of various diameters of RCP at an assumed pipe slope of 0.5%. Storm drains were analyzed and sized to convey 100-year flows. Since calculations in FlowMaster only account for frictional pipe losses, an adjustment factor of 30% was added to account for other hydraulic losses (i.e., bend loss, junction losses, etc.). Preliminary storm drain sizes have been identified for each reach of pipe and are summarized in a table located in Appendix F along with the calculations.

4.5 Energy Dissipater Calculations

Energy dissipaters (i.e., riprap) were sized according to the County San Diego County Hydraulic Design Manual (2014). Filter blanket materials were selected per Table 200-1.2(A) in the Standard Specifications for Public Works Construction (Greenbook). Riprap calculations will be prepared during a future phase of design.

4.6 Pump Station Design

Pump stations are designed to be located on the west side of the tracks to avoid conflicting with the temporary shoofly track located on the east side. The proposed pump stations will be required to pump runoff from the 100-year design storm event up to the surface for discharge to the storm drain system. Drainage from the two trench drains located on each side of the track will be conveyed to the west side of the trench before entering a wet vault to be pumped to the surface. At the surface, a cleanout is proposed to split low flow (i.e., water quality flows which require treatment) and high flows so as to not overload the proposed water quality treatment BMP. The proposed high flows will connect directly into the mainline storm drain system for discharge. Refer to pump station schematic provided in Appendix F.

5. CONCLUSION

The proposed project will maintain the existing overall drainage patterns in the area as much as possible. The construction of the railroad trench, reconstruction of the Carlsbad Village Train Station and parking lot will created a small increase in impervious area for the project site in both the Short Trench and Long Trench Alternatives for flows draining to both the Buena Vista Lagoon and Agua Hedionda Lagoon. Each of the increases in flow are not anticipated significantly impact existing drainage facilities with the exception of the drainage of areas located on the west side of the tracks in which two storm drain systems are proposed to safely convey the runoff either directly into the lagoon or to an existing mainline storm drain system. Trackside ditches will be re-constructed to convey the proposed flows without excessive erosion into the lagoon. The project will not increase the peak flows in the existing storm drain system, and thus will not have any adverse impacts to the system.

6. REFERENCES

1. Engineering Standards Volume 1 General Design Standards, City of Carlsbad, 2016 Edition.
2. Standard Specifications for Public Works Construction (Greenbook), 2018 Edition.
3. Hydrology Manual, County of San Diego, August 2003.
4. Hydraulic Design Manual, County of San Diego, July 2014.
5. American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering, 2010 Edition.
6. HydroWIN v. 2016 (AES 2016), Advanced Engineering Software, 2016.
7. FlowMaster CONNECT Edition [10.00.00.02], Haestad Methods Solution Center, July 2018.

APPENDIX A

EXISTING CONDITION
100-YEAR HYDROLOGIC ANALYSIS

- AES Modified Rational Method Analyses

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             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                          2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2016 Advanced Engineering Software (aes)
              Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                           Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)          *
* JN: 701290.15                                                            *
* EXISTING CONDITION; NORTH BASINS, 100-YEAR, 6-HOUR STORM EVENT           *
 **************************************************************************

  FILE NAME: EX100YR.DAT
  TIME/DATE OF STUDY: 08:09 09/25/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

+--------------------------------------------------------------------------+
```

```
| Begin Node Series 100                                                      |
|                                                                            |
|                                                                            |
+----------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     39.00
  DOWNSTREAM ELEVATION(FEET) =     37.60
  ELEVATION DIFFERENCE(FEET) =      1.40
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.708
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.51
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.51

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    100.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     37.60  DOWNSTREAM(FEET) =     12.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  2823.00   CHANNEL SLOPE =  0.0091
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.347
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       8.13
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.23
  AVERAGE FLOW DEPTH(FEET) =   0.68   TRAVEL TIME(MIN.) =  21.06
  Tc(MIN.) =   24.77
  SUBAREA AREA(ACRES) =     7.50       SUBAREA RUNOFF(CFS) =   13.55
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.770
  TOTAL AREA(ACRES) =        7.6         PEAK FLOW RATE(CFS) =      13.73

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.86   FLOW VELOCITY(FEET/SEC.) =   2.55
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    100.00 =    2888.00 FEET.

+----------------------------------------------------------------------------+
```

```
| End Node Series 100                                                    |
| Begin Node Series 200                                                  |
|                                                                        |
+------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    83.00
  UPSTREAM ELEVATION(FEET) =     40.20
  DOWNSTREAM ELEVATION(FEET) =     39.40
  ELEVATION DIFFERENCE(FEET) =      0.80
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.648
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    59.28
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   39.40  DOWNSTREAM ELEVATION(FEET) =   38.20
  STREET LENGTH(FEET) =   372.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.86
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.35
    HALFSTREET FLOOD WIDTH(FEET) =   11.21
```

```
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.35
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.47
  STREET FLOW TRAVEL TIME(MIN.) =   4.59   Tc(MIN.) =    8.24
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.772
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.779
  SUBAREA AREA(ACRES) =    0.69      SUBAREA RUNOFF(CFS) =    2.54
  TOTAL AREA(ACRES) =        0.8        PEAK FLOW RATE(CFS) =       2.94

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.40   HALFSTREET FLOOD WIDTH(FEET) =  13.48
  FLOW VELOCITY(FEET/SEC.) =  1.52   DEPTH*VELOCITY(FT*FT/SEC.) =   0.60
  LONGEST FLOWPATH FROM NODE    201.00 TO NODE    203.00 =     455.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    200.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     38.20  DOWNSTREAM(FEET) =     18.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  2372.00   CHANNEL SLOPE =  0.0085
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.579
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      24.52
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.01
  AVERAGE FLOW DEPTH(FEET) =   1.10   TRAVEL TIME(MIN.) =  13.15
  Tc(MIN.) =   21.39
  SUBAREA AREA(ACRES) =    20.61       SUBAREA RUNOFF(CFS) =   40.93
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.770
  TOTAL AREA(ACRES) =       21.4         PEAK FLOW RATE(CFS) =      42.52

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.41   FLOW VELOCITY(FEET/SEC.) =   3.47
  LONGEST FLOWPATH FROM NODE    201.00 TO NODE    200.00 =    2827.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 200                                                      |
| Begin Node Series 300                                                    |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    91.00
  UPSTREAM ELEVATION(FEET) =     60.00
  DOWNSTREAM ELEVATION(FEET) =     59.59
  ELEVATION DIFFERENCE(FEET) =      0.41
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.169
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    303.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   59.59  DOWNSTREAM ELEVATION(FEET) =   40.00
  STREET LENGTH(FEET) =   850.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       9.91
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.35
    HALFSTREET FLOOD WIDTH(FEET) =   11.21
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.60
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.26
  STREET FLOW TRAVEL TIME(MIN.) =   3.93   Tc(MIN.) =    8.10
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.825
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
```

```
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.771
  SUBAREA AREA(ACRES) =    4.90      SUBAREA RUNOFF(CFS) =   18.21
  TOTAL AREA(ACRES) =        5.0        PEAK FLOW RATE(CFS) =      18.61

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.42   HALFSTREET FLOOD WIDTH(FEET) =  14.49
  FLOW VELOCITY(FEET/SEC.) =  4.19   DEPTH*VELOCITY(FT*FT/SEC.) =   1.75
  LONGEST FLOWPATH FROM NODE    301.00 TO NODE    303.00 =     941.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    303.00 TO NODE    303.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.10
  RAINFALL INTENSITY(INCH/HR) =   4.83
  TOTAL STREAM AREA(ACRES) =     5.00
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     18.61

****************************************************************************
  FLOW PROCESS FROM NODE    304.00 TO NODE    303.00 IS CODE =  22
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  USER SPECIFIED Tc(MIN.) =    5.000
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  SUBAREA RUNOFF(CFS) =      1.01
  TOTAL AREA(ACRES) =      0.20   TOTAL RUNOFF(CFS) =      1.01

****************************************************************************
  FLOW PROCESS FROM NODE    303.00 TO NODE    303.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.00
  RAINFALL INTENSITY(INCH/HR) =   6.59
  TOTAL STREAM AREA(ACRES) =     0.20
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.01

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
```

```
    1       18.61     8.10        4.825          5.00
    2        1.01     5.00        6.587          0.20

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
 STREAM     RUNOFF      Tc      INTENSITY
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
    1       12.50     5.00       6.587
    2       19.35     8.10       4.825

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      19.35   Tc(MIN.) =    8.10
 TOTAL AREA(ACRES) =        5.2
 LONGEST FLOWPATH FROM NODE    301.00 TO NODE    303.00 =     941.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    303.00 TO NODE    307.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =     38.91  DOWNSTREAM(FEET) =     35.07
 CHANNEL LENGTH THRU SUBAREA(FEET) =    97.00   CHANNEL SLOPE =  0.0396
 CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =   4.000
 MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   2.00
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.759
 *USER SPECIFIED(SUBAREA):
 USER-SPECIFIED RUNOFF COEFFICIENT = .7700
 S.C.S. CURVE NUMBER (AMC II) =   0
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      19.54
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   9.17
 AVERAGE FLOW DEPTH(FEET) =   0.45   TRAVEL TIME(MIN.) =   0.18
 Tc(MIN.) =    8.28
 SUBAREA AREA(ACRES) =     0.10       SUBAREA RUNOFF(CFS) =    0.37
 AREA-AVERAGE RUNOFF COEFFICIENT =  0.771
 TOTAL AREA(ACRES) =        5.3         PEAK FLOW RATE(CFS) =      19.45

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.45   FLOW VELOCITY(FEET/SEC.) =   9.14
 LONGEST FLOWPATH FROM NODE    301.00 TO NODE    307.00 =    1038.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    307.00 TO NODE    307.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
```

```
  TIME OF CONCENTRATION(MIN.) =    8.28
  RAINFALL INTENSITY(INCH/HR) =   4.76
  TOTAL STREAM AREA(ACRES) =     5.30
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     19.45

****************************************************************************
  FLOW PROCESS FROM NODE    305.00 TO NODE    306.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    83.00
  UPSTREAM ELEVATION(FEET) =     62.00
  DOWNSTREAM ELEVATION(FEET) =     60.30
  ELEVATION DIFFERENCE(FEET) =      1.70
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.094
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    70.48
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE    306.00 TO NODE    307.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   60.30  DOWNSTREAM ELEVATION(FEET) =   40.00
  STREET LENGTH(FEET) =   663.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.76
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.28
    HALFSTREET FLOOD WIDTH(FEET) =    7.58
```

```
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.44
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.96
  STREET FLOW TRAVEL TIME(MIN.) =   3.21   Tc(MIN.) =    6.31
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.671
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.773
  SUBAREA AREA(ACRES) =    1.90      SUBAREA RUNOFF(CFS) =    8.30
  TOTAL AREA(ACRES) =        2.0       PEAK FLOW RATE(CFS) =       8.77

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.33   HALFSTREET FLOOD WIDTH(FEET) =   9.97
  FLOW VELOCITY(FEET/SEC.) =  3.95   DEPTH*VELOCITY(FT*FT/SEC.) =   1.28
  LONGEST FLOWPATH FROM NODE    305.00 TO NODE    307.00 =     746.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    307.00 TO NODE    307.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.31
  RAINFALL INTENSITY(INCH/HR) =   5.67
  TOTAL STREAM AREA(ACRES) =     2.00
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      8.77

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       19.45     8.28        4.759         5.30
      2        8.77     6.31        5.671         2.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       25.10     6.31       5.671
      2       26.81     8.28       4.759

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      26.81   Tc(MIN.) =    8.28
  TOTAL AREA(ACRES) =        7.3
  LONGEST FLOWPATH FROM NODE    301.00 TO NODE    307.00 =    1038.00 FEET.

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    307.00 TO NODE    308.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     35.07  DOWNSTREAM(FEET) =     31.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   699.00   CHANNEL SLOPE =  0.0058
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   3.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.663
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      31.90
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.81
  AVERAGE FLOW DEPTH(FEET) =   1.45   TRAVEL TIME(MIN.) =   4.14
  Tc(MIN.) =   12.42
  SUBAREA AREA(ACRES) =     3.60       SUBAREA RUNOFF(CFS) =   10.15
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.771
  TOTAL AREA(ACRES) =       10.9         PEAK FLOW RATE(CFS) =      30.79

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.43   FLOW VELOCITY(FEET/SEC.) =   2.79
  LONGEST FLOWPATH FROM NODE    301.00 TO NODE    308.00 =    1737.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    308.00 TO NODE    308.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.42
  RAINFALL INTENSITY(INCH/HR) =   3.66
  TOTAL STREAM AREA(ACRES) =    10.90
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     30.79

****************************************************************************
  FLOW PROCESS FROM NODE   3091.00 TO NODE   3092.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     62.00
  DOWNSTREAM ELEVATION(FEET) =     61.00
  ELEVATION DIFFERENCE(FEET) =      1.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.268
```

```
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
SUBAREA RUNOFF(CFS) =      0.55
TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   3092.00 TO NODE   3093.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   61.00  DOWNSTREAM ELEVATION(FEET) =   43.50
  STREET LENGTH(FEET) =  1186.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      14.76
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.51
    HALFSTREET FLOOD WIDTH(FEET) =   19.20
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.98
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.01
  STREET FLOW TRAVEL TIME(MIN.) =   4.97   Tc(MIN.) =    8.23
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.775
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    7.00      SUBAREA RUNOFF(CFS) =   28.08
  TOTAL AREA(ACRES) =        7.1        PEAK FLOW RATE(CFS) =      28.48

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.53   HALFSTREET FLOOD WIDTH(FEET) =  21.31
  FLOW VELOCITY(FEET/SEC.) =  4.11   DEPTH*VELOCITY(FT*FT/SEC.) =   2.16
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L = 1186.0 FT WITH ELEVATION-DROP =  17.5 FT, IS   38.7 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE   3093.00
  LONGEST FLOWPATH FROM NODE   3091.00 TO NODE   3093.00 =    1251.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   3093.00 TO NODE    309.00 IS CODE =  41
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    43.00  DOWNSTREAM(FEET) =    38.00
  FLOW LENGTH(FEET) =   265.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  19.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.69
  GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      28.48
  PIPE TRAVEL TIME(MIN.) =   0.41    Tc(MIN.) =    8.65
  LONGEST FLOWPATH FROM NODE   3091.00 TO NODE    309.00 =    1516.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    309.00 TO NODE    308.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.65
  RAINFALL INTENSITY(INCH/HR) =   4.63
  TOTAL STREAM AREA(ACRES) =     7.10
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     28.48

****************************************************************************
  FLOW PROCESS FROM NODE   3091.00 TO NODE   3094.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     62.00
  DOWNSTREAM ELEVATION(FEET) =     61.00
  ELEVATION DIFFERENCE(FEET) =      1.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.268
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   3094.00 TO NODE    309.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   61.00  DOWNSTREAM ELEVATION(FEET) =   42.00
  STREET LENGTH(FEET) =  1200.00   CURB HEIGHT(INCHES) =  6.0
```

```
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      14.28
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.50
    HALFSTREET FLOOD WIDTH(FEET) =   18.48
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.04
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.00
  STREET FLOW TRAVEL TIME(MIN.) =   4.95   Tc(MIN.) =    8.22
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.781
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    6.70      SUBAREA RUNOFF(CFS) =   26.91
  TOTAL AREA(ACRES) =        6.8        PEAK FLOW RATE(CFS) =      27.31

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.53   HALFSTREET FLOOD WIDTH(FEET) =  21.31
  FLOW VELOCITY(FEET/SEC.) =  4.26   DEPTH*VELOCITY(FT*FT/SEC.) =   2.24
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L = 1200.0 FT WITH ELEVATION-DROP =  19.0 FT, IS   37.1 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE    309.00
  LONGEST FLOWPATH FROM NODE   3091.00 TO NODE    309.00 =    1265.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    309.00 TO NODE    308.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.22
  RAINFALL INTENSITY(INCH/HR) =   4.78
  TOTAL STREAM AREA(ACRES) =     6.80
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     27.31

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
```

```
    1       30.79    12.42        3.663         10.90
    2       28.48     8.65        4.626          7.10
    3       27.31     8.22        4.781          6.80

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR  3 STREAMS.

** PEAK FLOW RATE TABLE **
STREAM     RUNOFF      Tc      INTENSITY
NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
    1       77.96     8.22       4.781
    2       79.28     8.65       4.626
    3       74.26    12.42       3.663

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =      79.28   Tc(MIN.) =    8.65
TOTAL AREA(ACRES) =       24.8
LONGEST FLOWPATH FROM NODE    301.00 TO NODE    308.00 =    1737.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE    308.00 TO NODE    310.00 IS CODE =  51
----------------------------------------------------------------------------
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
ELEVATION DATA: UPSTREAM(FEET) =     32.45  DOWNSTREAM(FEET) =     27.00
CHANNEL LENGTH THRU SUBAREA(FEET) =   337.00   CHANNEL SLOPE =  0.0162
CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   4.000
MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   3.00
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.289
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .7700
S.C.S. CURVE NUMBER (AMC II) =   0
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      80.27
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   5.21
AVERAGE FLOW DEPTH(FEET) =   1.73   TRAVEL TIME(MIN.) =   1.08
Tc(MIN.) =    9.73
SUBAREA AREA(ACRES) =     0.60       SUBAREA RUNOFF(CFS) =    1.98
AREA-AVERAGE RUNOFF COEFFICIENT =  0.809
TOTAL AREA(ACRES) =       25.4         PEAK FLOW RATE(CFS) =      88.11

END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) =  1.80   FLOW VELOCITY(FEET/SEC.) =   5.33
LONGEST FLOWPATH FROM NODE    301.00 TO NODE    310.00 =    2074.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE    310.00 TO NODE    300.00 IS CODE =  51
----------------------------------------------------------------------------
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
```

```
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     27.00  DOWNSTREAM(FEET) =     18.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   435.00   CHANNEL SLOPE =  0.0207
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   3.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.970
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      89.48
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   5.86
  AVERAGE FLOW DEPTH(FEET) =   1.72   TRAVEL TIME(MIN.) =   1.24
  Tc(MIN.) =   10.96
  SUBAREA AREA(ACRES) =     0.90       SUBAREA RUNOFF(CFS) =    2.75
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.808
  TOTAL AREA(ACRES) =       26.3         PEAK FLOW RATE(CFS) =      88.11

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.71   FLOW VELOCITY(FEET/SEC.) =   5.85
  LONGEST FLOWPATH FROM NODE    301.00 TO NODE    300.00 =    2509.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 300                                                      |
| Begin Node Series 400                                                    |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    402.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    91.00
  UPSTREAM ELEVATION(FEET) =     44.00
  DOWNSTREAM ELEVATION(FEET) =     41.28
  ELEVATION DIFFERENCE(FEET) =      2.72
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.799
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    84.89
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.51
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.51

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    402.00 TO NODE    403.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     41.28  DOWNSTREAM(FEET) =     29.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1375.00   CHANNEL SLOPE =  0.0089
  CHANNEL BASE(FEET) =    1.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.035
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.63
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.79
  AVERAGE FLOW DEPTH(FEET) =   0.47   TRAVEL TIME(MIN.) =  12.82
  Tc(MIN.) =   16.62
  SUBAREA AREA(ACRES) =     0.90       SUBAREA RUNOFF(CFS) =    2.10
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.770
  TOTAL AREA(ACRES) =        1.0         PEAK FLOW RATE(CFS) =       2.34

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.56   FLOW VELOCITY(FEET/SEC.) =   1.96
  LONGEST FLOWPATH FROM NODE    401.00 TO NODE    403.00 =    1466.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    403.00 TO NODE    403.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   16.62
  RAINFALL INTENSITY(INCH/HR) =   3.03
  TOTAL STREAM AREA(ACRES) =     1.00
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.34

****************************************************************************
  FLOW PROCESS FROM NODE    404.00 TO NODE    405.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     37.50
  DOWNSTREAM ELEVATION(FEET) =     37.00
  ELEVATION DIFFERENCE(FEET) =      0.50
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.801
```

```
 WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
          THE MAXIMUM OVERLAND FLOW LENGTH =    55.38
          (Reference: Table 3-1B of Hydrology Manual)
          THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.55
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
 FLOW PROCESS FROM NODE    405.00 TO NODE    403.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =     37.00  DOWNSTREAM(FEET) =     32.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   297.00   CHANNEL SLOPE =  0.0168
 CHANNEL BASE(FEET) =   12.00   "Z" FACTOR =  10.000
 MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   1.00
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.146
 *USER SPECIFIED(SUBAREA):
 USER-SPECIFIED RUNOFF COEFFICIENT = .8400
 S.C.S. CURVE NUMBER (AMC II) =   0
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.52
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.40
 AVERAGE FLOW DEPTH(FEET) =   0.13   TRAVEL TIME(MIN.) =   3.53
 Tc(MIN.) =    7.33
 SUBAREA AREA(ACRES) =     0.90       SUBAREA RUNOFF(CFS) =    3.89
 AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
 TOTAL AREA(ACRES) =        1.0         PEAK FLOW RATE(CFS) =       4.32

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.19   FLOW VELOCITY(FEET/SEC.) =   1.66
 LONGEST FLOWPATH FROM NODE    404.00 TO NODE    403.00 =     362.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    403.00 TO NODE    403.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =    7.33
 RAINFALL INTENSITY(INCH/HR) =   5.15
 TOTAL STREAM AREA(ACRES) =     1.00
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      4.32

 ** CONFLUENCE DATA **
 STREAM     RUNOFF       Tc      INTENSITY      AREA
```

```
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        2.34    16.62        3.035          1.00
      2        4.32     7.33        5.146          1.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1        5.35     7.33       5.146
      2        4.89    16.62       3.035

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       5.35   Tc(MIN.) =    7.33
  TOTAL AREA(ACRES) =        2.0
  LONGEST FLOWPATH FROM NODE    401.00 TO NODE    403.00 =    1466.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    403.00 TO NODE    406.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     30.00  DOWNSTREAM(FEET) =     27.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   243.00   CHANNEL SLOPE =  0.0123
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.588
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      10.99
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.83
  AVERAGE FLOW DEPTH(FEET) =   0.77   TRAVEL TIME(MIN.) =   1.43
  Tc(MIN.) =    8.76
  SUBAREA AREA(ACRES) =     3.20       SUBAREA RUNOFF(CFS) =   11.30
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.783
  TOTAL AREA(ACRES) =        5.2         PEAK FLOW RATE(CFS) =      18.69

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.97   FLOW VELOCITY(FEET/SEC.) =   3.26
  LONGEST FLOWPATH FROM NODE    401.00 TO NODE    406.00 =    1709.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    406.00 TO NODE    400.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =     27.00  DOWNSTREAM(FEET) =     24.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   325.00   CHANNEL SLOPE =  0.0092
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.057
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      19.16
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.94
  AVERAGE FLOW DEPTH(FEET) =   1.05   TRAVEL TIME(MIN.) =   1.84
  Tc(MIN.) =   10.60
  SUBAREA AREA(ACRES) =     0.30       SUBAREA RUNOFF(CFS) =    0.94
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.783
  TOTAL AREA(ACRES) =        5.5         PEAK FLOW RATE(CFS) =      18.69

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.04   FLOW VELOCITY(FEET/SEC.) =   2.92
  LONGEST FLOWPATH FROM NODE    401.00 TO NODE    400.00 =    2034.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 400                                                      |
| Begin Node Series 500                                                    |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    501.00 TO NODE    502.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    67.00
  UPSTREAM ELEVATION(FEET) =     37.50
  DOWNSTREAM ELEVATION(FEET) =     37.00
  ELEVATION DIFFERENCE(FEET) =      0.50
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.824
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    54.93
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    500.00 IS CODE =  91
```

```
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     37.00
  DOWNSTREAM NODE ELEVATION(FEET) =     35.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   469.00
  "V" GUTTER WIDTH(FEET) =   4.00   GUTTER HIKE(FEET) =  0.200
  PAVEMENT LIP(FEET) =  0.033   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   0.50
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.762
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      5.21
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.76
  AVERAGE FLOW DEPTH(FEET) =   0.42   FLOOD WIDTH(FEET) =   22.41
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   4.44   Tc(MIN.) =    8.27
  SUBAREA AREA(ACRES) =    2.30       SUBAREA RUNOFF(CFS) =    9.20
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  TOTAL AREA(ACRES) =        2.4         PEAK FLOW RATE(CFS) =       9.60

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.49   FLOOD WIDTH(FEET) =   30.13
  FLOW VELOCITY(FEET/SEC.) =   1.92   DEPTH*VELOCITY(FT*FT/SEC) =   0.95
  LONGEST FLOWPATH FROM NODE    501.00 TO NODE    500.00 =     536.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 500                                                      |
| Begin Node Series 600                                                    |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    601.00 TO NODE    602.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    92.00
  UPSTREAM ELEVATION(FEET) =     44.00
  DOWNSTREAM ELEVATION(FEET) =     43.00
  ELEVATION DIFFERENCE(FEET) =      1.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.551
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    60.87
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
```

```
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE    600.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     43.00
  DOWNSTREAM NODE ELEVATION(FEET) =     36.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   620.00
  "V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.250
  PAVEMENT LIP(FEET) =  0.020   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.615
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     14.58
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.62
  AVERAGE FLOW DEPTH(FEET) =   0.48   FLOOD WIDTH(FEET) =   26.17
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   2.85   Tc(MIN.) =    6.40
  SUBAREA AREA(ACRES) =    5.90       SUBAREA RUNOFF(CFS) =   27.83
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  TOTAL AREA(ACRES) =        6.0         PEAK FLOW RATE(CFS) =      28.30

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.58   FLOOD WIDTH(FEET) =   35.87
  FLOW VELOCITY(FEET/SEC.) =   4.02   DEPTH*VELOCITY(FT*FT/SEC) =   2.33
  LONGEST FLOWPATH FROM NODE    601.00 TO NODE    600.00 =     712.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 600                                                      |
| Begin Node Series 700                                                    |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    701.00 TO NODE    702.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     44.20
```

```
  DOWNSTREAM ELEVATION(FEET) =     42.80
  ELEVATION DIFFERENCE(FEET) =      1.40
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.708
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.51
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.51

****************************************************************************
  FLOW PROCESS FROM NODE    702.00 TO NODE    700.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   43.80  DOWNSTREAM ELEVATION(FEET) =   41.00
  STREET LENGTH(FEET) =   152.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.17
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.29
    HALFSTREET FLOOD WIDTH(FEET) =    8.17
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.76
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.80
  STREET FLOW TRAVEL TIME(MIN.) =   0.92   Tc(MIN.) =    4.63
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.830
  SUBAREA AREA(ACRES) =    0.60      SUBAREA RUNOFF(CFS) =    3.32
  TOTAL AREA(ACRES) =        0.7        PEAK FLOW RATE(CFS) =       3.83

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.34   HALFSTREET FLOOD WIDTH(FEET) =  10.51
  FLOW VELOCITY(FEET/SEC.) =  3.13   DEPTH*VELOCITY(FT*FT/SEC.) =   1.05
  LONGEST FLOWPATH FROM NODE    701.00 TO NODE    700.00 =     217.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 700                                                      |
```

```
| Begin Node Series 800                                                       |
|                                                                             |
+-----------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    801.00 TO NODE    802.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     44.00
  DOWNSTREAM ELEVATION(FEET) =     39.80
  ELEVATION DIFFERENCE(FEET) =      4.20
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.026
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE    802.00 TO NODE    800.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   43.80  DOWNSTREAM ELEVATION(FEET) =   43.00
  STREET LENGTH(FEET) =    63.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.83
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.24
    HALFSTREET FLOOD WIDTH(FEET) =    5.52
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.96
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.46
  STREET FLOW TRAVEL TIME(MIN.) =   0.53   Tc(MIN.) =    2.56
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
```

```
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    0.10      SUBAREA RUNOFF(CFS) =    0.55
  TOTAL AREA(ACRES) =        0.2        PEAK FLOW RATE(CFS) =      1.11

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.26   HALFSTREET FLOOD WIDTH(FEET) =   6.45
  FLOW VELOCITY(FEET/SEC.) =  2.07   DEPTH*VELOCITY(FT*FT/SEC.) =   0.53
  LONGEST FLOWPATH FROM NODE    801.00 TO NODE    800.00 =     128.00 FEET.

+----------------------------------------------------------------------------+
| End Node Series 800                                                        |
| Begin Node Series 900                                                      |
|                                                                            |
+----------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    901.00 TO NODE    902.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    85.00
  UPSTREAM ELEVATION(FEET) =     44.00
  DOWNSTREAM ELEVATION(FEET) =     43.90
  ELEVATION DIFFERENCE(FEET) =      0.10
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.292
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.350
  SUBAREA RUNOFF(CFS) =      0.49
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.49

****************************************************************************
  FLOW PROCESS FROM NODE    902.00 TO NODE    900.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     44.00  DOWNSTREAM(FEET) =     43.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   368.00   CHANNEL SLOPE =  0.0027
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.626
```

```
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.07
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.84
  AVERAGE FLOW DEPTH(FEET) =   0.30   TRAVEL TIME(MIN.) =   7.33
  Tc(MIN.) =   12.62
  SUBAREA AREA(ACRES) =     0.40       SUBAREA RUNOFF(CFS) =    1.12
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.770
  TOTAL AREA(ACRES) =        0.5         PEAK FLOW RATE(CFS) =       1.40

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.35   FLOW VELOCITY(FEET/SEC.) =   0.91
  LONGEST FLOWPATH FROM NODE    901.00 TO NODE    900.00 =     453.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 900                                                      |
| Begin Node Series 1000                                                   |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE   1001.00 TO NODE   1002.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    77.00
  UPSTREAM ELEVATION(FEET) =     44.00
  DOWNSTREAM ELEVATION(FEET) =     43.80
  ELEVATION DIFFERENCE(FEET) =      0.20
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.169
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   1002.00 TO NODE   1000.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   43.90  DOWNSTREAM ELEVATION(FEET) =   42.00
```

```
  STREET LENGTH(FEET) =    71.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.83
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.21
    HALFSTREET FLOOD WIDTH(FEET) =    4.39
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.67
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.57
  STREET FLOW TRAVEL TIME(MIN.) =   0.44   Tc(MIN.) =    4.61
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    0.10      SUBAREA RUNOFF(CFS) =    0.55
  TOTAL AREA(ACRES) =        0.2        PEAK FLOW RATE(CFS) =       1.11

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.23   HALFSTREET FLOOD WIDTH(FEET) =   5.25
  FLOW VELOCITY(FEET/SEC.) =  2.81   DEPTH*VELOCITY(FT*FT/SEC.) =   0.65
  LONGEST FLOWPATH FROM NODE   1001.00 TO NODE   1000.00 =     148.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 1000                                                     |
| Begin Node Series 1100                                                   |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE   1101.00 TO NODE   1102.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     44.50
  DOWNSTREAM ELEVATION(FEET) =     43.90
```

```
  ELEVATION DIFFERENCE(FEET) =      0.60
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.675
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    58.46
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   1102.00 TO NODE   1100.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   43.90  DOWNSTREAM ELEVATION(FEET) =   42.50
  STREET LENGTH(FEET) =    71.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.11
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.24
    HALFSTREET FLOOD WIDTH(FEET) =    5.78
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.45
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.59
  STREET FLOW TRAVEL TIME(MIN.) =   0.48   Tc(MIN.) =    4.16
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    0.20      SUBAREA RUNOFF(CFS) =    1.11
  TOTAL AREA(ACRES) =        0.3        PEAK FLOW RATE(CFS) =       1.66

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =   7.11
  FLOW VELOCITY(FEET/SEC.) =  2.66   DEPTH*VELOCITY(FT*FT/SEC.) =   0.71
  LONGEST FLOWPATH FROM NODE   1101.00 TO NODE   1100.00 =     136.00 FEET.
```

```
+--------------------------------------------------------------------------+
| End Node Series 1100                                                     |
| Begin Node Series 1200                                                   |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE   1201.00 TO NODE   1202.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    78.00
  UPSTREAM ELEVATION(FEET) =     43.50
  DOWNSTREAM ELEVATION(FEET) =     43.00
  ELEVATION DIFFERENCE(FEET) =      0.50
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.007
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    52.82
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.581
  SUBAREA RUNOFF(CFS) =      0.51
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.51

****************************************************************************
  FLOW PROCESS FROM NODE   1202.00 TO NODE   1200.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     43.00
  DOWNSTREAM NODE ELEVATION(FEET) =     40.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   517.00
  "V" GUTTER WIDTH(FEET) =   4.00   GUTTER HIKE(FEET) =  0.250
  PAVEMENT LIP(FEET) =  0.030   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.724
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     10.72
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.56
  AVERAGE FLOW DEPTH(FEET) =   0.51   FLOOD WIDTH(FEET) =   26.99
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   3.36   Tc(MIN.) =    8.37
  SUBAREA AREA(ACRES) =    5.10       SUBAREA RUNOFF(CFS) =   20.24
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.839
```

```
  TOTAL AREA(ACRES) =        5.2         PEAK FLOW RATE(CFS) =      20.60

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.61   FLOOD WIDTH(FEET) =   36.55
  FLOW VELOCITY(FEET/SEC.) =   2.85   DEPTH*VELOCITY(FT*FT/SEC) =   1.73
  LONGEST FLOWPATH FROM NODE   1201.00 TO NODE   1200.00 =     595.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 1200                                                     |
| Begin Node Series 1300                                                   |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE   1301.00 TO NODE   1302.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    96.00
  UPSTREAM ELEVATION(FEET) =     48.00
  DOWNSTREAM ELEVATION(FEET) =     47.50
  ELEVATION DIFFERENCE(FEET) =      0.50
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.130
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.42
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   1302.00 TO NODE   1300.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   47.50  DOWNSTREAM ELEVATION(FEET) =   43.00
  STREET LENGTH(FEET) =   295.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
```

```
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       9.19
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.44
    HALFSTREET FLOOD WIDTH(FEET) =   15.59
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.61
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.58
  STREET FLOW TRAVEL TIME(MIN.) =   1.36   Tc(MIN.) =    5.49
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.199
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.772
  SUBAREA AREA(ACRES) =    3.60      SUBAREA RUNOFF(CFS) =   17.18
  TOTAL AREA(ACRES) =        3.7        PEAK FLOW RATE(CFS) =      17.70

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.53   HALFSTREET FLOOD WIDTH(FEET) =  21.31
  FLOW VELOCITY(FEET/SEC.) =  4.18   DEPTH*VELOCITY(FT*FT/SEC.) =   2.20
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L =  295.0 FT WITH ELEVATION-DROP =   4.5 FT, IS   18.3 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE   1300.00
  LONGEST FLOWPATH FROM NODE   1301.00 TO NODE   1300.00 =     391.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 1300                                                     |
| Begin Node Series 1400                                                   |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE   1401.00 TO NODE   1402.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     58.50
  DOWNSTREAM ELEVATION(FEET) =     56.50
  ELEVATION DIFFERENCE(FEET) =      2.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.594
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55
```

```
****************************************************************************
  FLOW PROCESS FROM NODE   1402.00 TO NODE   1400.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   56.50  DOWNSTREAM ELEVATION(FEET) =   43.00
  STREET LENGTH(FEET) =   442.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.81
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.35
    HALFSTREET FLOOD WIDTH(FEET) =   11.29
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.17
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.47
  STREET FLOW TRAVEL TIME(MIN.) =   1.77   Tc(MIN.) =    4.36
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    1.90      SUBAREA RUNOFF(CFS) =   10.51
  TOTAL AREA(ACRES) =        2.0        PEAK FLOW RATE(CFS) =      11.07

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.42   HALFSTREET FLOOD WIDTH(FEET) =  14.65
  FLOW VELOCITY(FEET/SEC.) =  4.89   DEPTH*VELOCITY(FT*FT/SEC.) =   2.05
  LONGEST FLOWPATH FROM NODE   1401.00 TO NODE   1400.00 =     507.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 1400                                                     |
| Begin Node Series 1500                                                   |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE   1501.00 TO NODE   1502.00 IS CODE =  21
----------------------------------------------------------------------------
```

```
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     59.00
  DOWNSTREAM ELEVATION(FEET) =     58.20
  ELEVATION DIFFERENCE(FEET) =      0.80
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.447
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    62.31
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   1502.00 TO NODE   1500.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   58.20  DOWNSTREAM ELEVATION(FEET) =   43.00
  STREET LENGTH(FEET) =   464.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       8.20
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.38
    HALFSTREET FLOOD WIDTH(FEET) =   12.77
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.69
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.79
  STREET FLOW TRAVEL TIME(MIN.) =   1.65   Tc(MIN.) =    5.10
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.506
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
```

```
  SUBAREA AREA(ACRES) =    2.80      SUBAREA RUNOFF(CFS) =   15.30
  TOTAL AREA(ACRES) =        2.9        PEAK FLOW RATE(CFS) =      15.85

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.46   HALFSTREET FLOOD WIDTH(FEET) =  16.68
  FLOW VELOCITY(FEET/SEC.) =  5.46   DEPTH*VELOCITY(FT*FT/SEC.) =   2.51
  LONGEST FLOWPATH FROM NODE   1501.00 TO NODE   1500.00 =     529.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 1500                                                     |
| Begin Node Series 1600                                                   |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE   1601.00 TO NODE   1602.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   114.00
  UPSTREAM ELEVATION(FEET) =     58.50
  DOWNSTREAM ELEVATION(FEET) =     56.00
  ELEVATION DIFFERENCE(FEET) =      2.50
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.055
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    71.93
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   1602.00 TO NODE   1600.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   56.00  DOWNSTREAM ELEVATION(FEET) =   43.00
  STREET LENGTH(FEET) =   540.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020
```

```
  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       9.84
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.42
    HALFSTREET FLOOD WIDTH(FEET) =   14.65
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.35
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.82
  STREET FLOW TRAVEL TIME(MIN.) =   2.07   Tc(MIN.) =    5.13
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.482
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.772
  SUBAREA AREA(ACRES) =    3.70      SUBAREA RUNOFF(CFS) =   18.47
  TOTAL AREA(ACRES) =        3.8        PEAK FLOW RATE(CFS) =      19.01

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.51   HALFSTREET FLOOD WIDTH(FEET) =  19.36
  FLOW VELOCITY(FEET/SEC.) =  5.09   DEPTH*VELOCITY(FT*FT/SEC.) =   2.58
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L =  540.0 FT WITH ELEVATION-DROP =  13.0 FT, IS   18.8 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE   1600.00
  LONGEST FLOWPATH FROM NODE   1601.00 TO NODE   1600.00 =     654.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 1600                                                     |
| Begin Node Series 1700                                                   |
|                                                                          |
+--------------------------------------------------------------------------+
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.8  TC(MIN.) =      5.13
  PEAK FLOW RATE(CFS)   =      19.01
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                          2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2016 Advanced Engineering Software (aes)
             Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                           Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)          *
* JN: 701290.15                                                            *
* EXISTING CONDITION; BASIN 2200, 100-YEAR, 6-HOUR STORM EVENT             *
 **************************************************************************

  FILE NAME: CVE22H00.RAT
  TIME/DATE OF STUDY: 09:25 09/25/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   2201.00 TO NODE   2202.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     62.70
  DOWNSTREAM ELEVATION(FEET) =     62.00
  ELEVATION DIFFERENCE(FEET) =      0.70
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.559
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    60.77
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   2202.00 TO NODE   2205.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   62.00  DOWNSTREAM ELEVATION(FEET) =   52.00
  STREET LENGTH(FEET) =   715.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.66
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.41
    HALFSTREET FLOOD WIDTH(FEET) =   13.95
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.23
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.31
  STREET FLOW TRAVEL TIME(MIN.) =   3.69   Tc(MIN.) =    7.25
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.184
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
```

```
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.772
  SUBAREA AREA(ACRES) =    3.00      SUBAREA RUNOFF(CFS) =   11.98
  TOTAL AREA(ACRES) =        3.1        PEAK FLOW RATE(CFS) =      12.41

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.48   HALFSTREET FLOOD WIDTH(FEET) =  17.93
  FLOW VELOCITY(FEET/SEC.) =  3.72   DEPTH*VELOCITY(FT*FT/SEC.) =   1.81
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L =  715.0 FT WITH ELEVATION-DROP =  10.0 FT, IS   15.2 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE   2205.00
  LONGEST FLOWPATH FROM NODE   2201.00 TO NODE   2205.00 =     780.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2203.00 TO NODE   2205.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.184
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7711
  SUBAREA AREA(ACRES) =    3.00   SUBAREA RUNOFF(CFS) =   11.98
  TOTAL AREA(ACRES) =        6.1   TOTAL RUNOFF(CFS) =      24.39
  TC(MIN.) =    7.25

****************************************************************************
  FLOW PROCESS FROM NODE   2207.00 TO NODE   2205.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.184
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7709
  SUBAREA AREA(ACRES) =    1.50   SUBAREA RUNOFF(CFS) =    5.99
  TOTAL AREA(ACRES) =        7.6   TOTAL RUNOFF(CFS) =      30.37
  TC(MIN.) =    7.25

****************************************************************************
  FLOW PROCESS FROM NODE   2205.00 TO NODE   2200.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    49.00  DOWNSTREAM(FEET) =    46.00
  FLOW LENGTH(FEET) =   340.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  30.0 INCH PIPE IS  20.9 INCHES
```

```
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.33
  ESTIMATED PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      30.37
  PIPE TRAVEL TIME(MIN.) =   0.68    Tc(MIN.) =    7.93
  LONGEST FLOWPATH FROM NODE   2201.00 TO NODE   2200.00 =    1120.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2209.00 TO NODE   2200.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.893
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7707
  SUBAREA AREA(ACRES) =    2.50   SUBAREA RUNOFF(CFS) =    9.42
  TOTAL AREA(ACRES) =       10.1   TOTAL RUNOFF(CFS) =      38.09
  TC(MIN.) =    7.93

****************************************************************************
  FLOW PROCESS FROM NODE   2200.00 TO NODE   2100.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     46.00  DOWNSTREAM(FEET) =     41.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   545.00   CHANNEL SLOPE =  0.0092
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      38.09
  FLOW VELOCITY(FEET/SEC.) =   2.73   FLOW DEPTH(FEET) =   0.62
  TRAVEL TIME(MIN.) =   3.33   Tc(MIN.) =   11.26
  LONGEST FLOWPATH FROM NODE   2201.00 TO NODE   2100.00 =    1665.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2100.00 TO NODE   2100.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.902
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7704
  SUBAREA AREA(ACRES) =    6.10   SUBAREA RUNOFF(CFS) =   18.33
  TOTAL AREA(ACRES) =       16.2   TOTAL RUNOFF(CFS) =      48.71
  TC(MIN.) =   11.26

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   2100.00 TO NODE   2000.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     41.00  DOWNSTREAM(FEET) =     36.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   480.00   CHANNEL SLOPE =  0.0104
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      48.71
  FLOW VELOCITY(FEET/SEC.) =   3.10   FLOW DEPTH(FEET) =   0.69
  TRAVEL TIME(MIN.) =   2.58   Tc(MIN.) =   13.83
  LONGEST FLOWPATH FROM NODE   2201.00 TO NODE   2000.00 =    2145.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2000.00 TO NODE   2000.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   13.83
  RAINFALL INTENSITY(INCH/HR) =   3.42
  TOTAL STREAM AREA(ACRES) =    16.20
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     48.71

****************************************************************************
  FLOW PROCESS FROM NODE   2001.00 TO NODE   2002.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     56.70
  DOWNSTREAM ELEVATION(FEET) =     56.00
  ELEVATION DIFFERENCE(FEET) =      0.70
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.559
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    60.77
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   2002.00 TO NODE   2004.00 IS CODE =  62
```

```
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   56.00  DOWNSTREAM ELEVATION(FEET) =   52.00
  STREET LENGTH(FEET) =   500.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      4.92
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.40
    HALFSTREET FLOOD WIDTH(FEET) =   13.87
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.41
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.97
  STREET FLOW TRAVEL TIME(MIN.) =   3.46   Tc(MIN.) =    7.02
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.294
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.773
  SUBAREA AREA(ACRES) =    2.10      SUBAREA RUNOFF(CFS) =    8.56
  TOTAL AREA(ACRES) =        2.2        PEAK FLOW RATE(CFS) =      9.01

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.48   HALFSTREET FLOOD WIDTH(FEET) =  17.62
  FLOW VELOCITY(FEET/SEC.) =  2.80   DEPTH*VELOCITY(FT*FT/SEC.) =   1.34
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L =  500.0 FT WITH ELEVATION-DROP =   4.0 FT, IS   10.7 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE   2004.00
  LONGEST FLOWPATH FROM NODE   2001.00 TO NODE   2004.00 =     565.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2004.00 TO NODE   2000.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    49.00  DOWNSTREAM(FEET) =    33.00
  FLOW LENGTH(FEET) =   610.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   9.6 INCHES
```

```
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.38
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       9.01
  PIPE TRAVEL TIME(MIN.) =   1.08    Tc(MIN.) =    8.10
  LONGEST FLOWPATH FROM NODE   2001.00 TO NODE   2000.00 =    1175.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2006.00 TO NODE   2000.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.826
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7709
  SUBAREA AREA(ACRES) =    5.50   SUBAREA RUNOFF(CFS) =   20.44
  TOTAL AREA(ACRES) =        7.7   TOTAL RUNOFF(CFS) =      28.64
  TC(MIN.) =    8.10

****************************************************************************
  FLOW PROCESS FROM NODE   2008.00 TO NODE   2000.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.826
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7705
  SUBAREA AREA(ACRES) =    6.60   SUBAREA RUNOFF(CFS) =   24.52
  TOTAL AREA(ACRES) =       14.3   TOTAL RUNOFF(CFS) =      53.17
  TC(MIN.) =    8.10

****************************************************************************
  FLOW PROCESS FROM NODE   2000.00 TO NODE   2000.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.10
  RAINFALL INTENSITY(INCH/HR) =   4.83
  TOTAL STREAM AREA(ACRES) =    14.30
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     53.17

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
```

```
    1       48.71    13.83        3.417         16.20
    2       53.17     8.10        4.826         14.30

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
 STREAM     RUNOFF      Tc      INTENSITY
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
    1       81.69     8.10       4.826
    2       86.35    13.83       3.417

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      86.35   Tc(MIN.) =   13.83
 TOTAL AREA(ACRES) =       30.5
 LONGEST FLOWPATH FROM NODE   2201.00 TO NODE   2000.00 =    2145.00 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =       30.5  TC(MIN.) =     13.83
 PEAK FLOW RATE(CFS)   =      86.35
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************

              RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
              Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                           2003,1985,1981 HYDROLOGY MANUAL
           (c) Copyright 1982-2016 Advanced Engineering Software (aes)
               Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                             Analysis prepared by:





 ************************* DESCRIPTION OF STUDY *************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)         *
* JN: 701290.15                                                           *
* EXISTING CONDITION; BASIN 2300, 100-YEAR, 6-HOUR STORM EVENT            *
 **************************************************************************

  FILE NAME: CVE23H00.RAT
  TIME/DATE OF STUDY: 09:43 09/25/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   2301.00 TO NODE   2302.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     61.70
  DOWNSTREAM ELEVATION(FEET) =     61.00
  ELEVATION DIFFERENCE(FEET) =      0.70
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.681
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   2302.00 TO NODE   2304.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   61.00  DOWNSTREAM ELEVATION(FEET) =   53.00
  STREET LENGTH(FEET) =   630.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       7.58
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.43
    HALFSTREET FLOOD WIDTH(FEET) =   15.04
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.18
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.36
  STREET FLOW TRAVEL TIME(MIN.) =   3.30   Tc(MIN.) =    6.98
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.313
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    3.10      SUBAREA RUNOFF(CFS) =   13.83
  TOTAL AREA(ACRES) =        3.2        PEAK FLOW RATE(CFS) =      14.28
```

```
  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.51   HALFSTREET FLOOD WIDTH(FEET) =  19.83
  FLOW VELOCITY(FEET/SEC.) =  3.73   DEPTH*VELOCITY(FT*FT/SEC.) =   1.91
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L =  630.0 FT WITH ELEVATION-DROP =   8.0 FT, IS   17.2 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE   2304.00
  LONGEST FLOWPATH FROM NODE   2301.00 TO NODE   2304.00 =     695.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2306.00 TO NODE   2304.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.313
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8400
  SUBAREA AREA(ACRES) =    3.70   SUBAREA RUNOFF(CFS) =   16.51
  TOTAL AREA(ACRES) =        6.9   TOTAL RUNOFF(CFS) =      30.79
  TC(MIN.) =    6.98

****************************************************************************
  FLOW PROCESS FROM NODE   2304.00 TO NODE   2300.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    50.00  DOWNSTREAM(FEET) =    41.00
  FLOW LENGTH(FEET) =   540.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  27.0 INCH PIPE IS  18.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.63
  ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      30.79
  PIPE TRAVEL TIME(MIN.) =   0.85    Tc(MIN.) =    7.82
  LONGEST FLOWPATH FROM NODE   2301.00 TO NODE   2300.00 =    1235.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2308.00 TO NODE   2300.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.934
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8400
  SUBAREA AREA(ACRES) =    4.40   SUBAREA RUNOFF(CFS) =   18.24
  TOTAL AREA(ACRES) =       11.3   TOTAL RUNOFF(CFS) =      46.84
```

```
  TC(MIN.) =    7.82
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       11.3  TC(MIN.) =      7.82
  PEAK FLOW RATE(CFS)   =      46.84
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
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             Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                          Analysis prepared by:



 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)          *
* JN: 701290.15                                                            *
* EXISTING CONDITION; BASIN 2400, 100-YEAR, 6-HOUR STORM EVENT             *
 **************************************************************************

  FILE NAME: CVE24H00.RAT
  TIME/DATE OF STUDY: 16:22 08/12/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   2401.00 TO NODE   2402.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     61.70
  DOWNSTREAM ELEVATION(FEET) =     61.00
  ELEVATION DIFFERENCE(FEET) =      0.70
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.559
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    60.77
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   2402.00 TO NODE   2404.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   61.00  DOWNSTREAM ELEVATION(FEET) =   49.00
  STREET LENGTH(FEET) =   540.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.54
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.38
    HALFSTREET FLOOD WIDTH(FEET) =   12.62
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.82
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.45
  STREET FLOW TRAVEL TIME(MIN.) =   2.35   Tc(MIN.) =    5.91
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.911
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
```

```
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    2.40      SUBAREA RUNOFF(CFS) =   11.92
  TOTAL AREA(ACRES) =        2.5        PEAK FLOW RATE(CFS) =      12.41

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.45   HALFSTREET FLOOD WIDTH(FEET) =  16.37
  FLOW VELOCITY(FEET/SEC.) =  4.44   DEPTH*VELOCITY(FT*FT/SEC.) =   2.01
  LONGEST FLOWPATH FROM NODE   2401.00 TO NODE   2404.00 =     605.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2406.00 TO NODE   2404.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.911
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8072
  SUBAREA AREA(ACRES) =    2.20   SUBAREA RUNOFF(CFS) =   10.01
  TOTAL AREA(ACRES) =        4.7   TOTAL RUNOFF(CFS) =      22.43
  TC(MIN.) =    5.91

****************************************************************************
  FLOW PROCESS FROM NODE   2408.00 TO NODE   2404.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.911
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7903
  SUBAREA AREA(ACRES) =    3.90   SUBAREA RUNOFF(CFS) =   17.75
  TOTAL AREA(ACRES) =        8.6   TOTAL RUNOFF(CFS) =      40.18
  TC(MIN.) =    5.91

****************************************************************************
  FLOW PROCESS FROM NODE   2404.00 TO NODE   2400.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    46.00  DOWNSTREAM(FEET) =    39.00
  FLOW LENGTH(FEET) =   630.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  30.0 INCH PIPE IS  24.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.52
  ESTIMATED PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      40.18
```

```
  PIPE TRAVEL TIME(MIN.) =   1.10    Tc(MIN.) =    7.02
  LONGEST FLOWPATH FROM NODE   2401.00 TO NODE   2400.00 =    1235.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2410.00 TO NODE   2400.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.294
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7829
  SUBAREA AREA(ACRES) =    5.00   SUBAREA RUNOFF(CFS) =   20.38
  TOTAL AREA(ACRES) =       13.6   TOTAL RUNOFF(CFS) =      56.36
  TC(MIN.) =    7.02
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       13.6  TC(MIN.) =      7.02
  PEAK FLOW RATE(CFS)   =      56.36
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************

             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                          2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2016 Advanced Engineering Software (aes)
              Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                               Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)          *
* JN: 701290.15                                                            *
* EXISTING CONDITION, BASIN 2500, 100-YEAR, 6-HOUR STORM EVENT             *
 **************************************************************************

  FILE NAME: CVE25H00.RAT
  TIME/DATE OF STUDY: 10:28 09/25/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   2501.00 TO NODE   2502.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     63.70
  DOWNSTREAM ELEVATION(FEET) =     63.00
  ELEVATION DIFFERENCE(FEET) =      0.70
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.532
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    61.15
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.51
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.51

****************************************************************************
  FLOW PROCESS FROM NODE   2502.00 TO NODE   2504.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   63.00  DOWNSTREAM ELEVATION(FEET) =   52.50
  STREET LENGTH(FEET) =   560.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.56
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.37
    HALFSTREET FLOOD WIDTH(FEET) =   12.23
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.45
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.28
  STREET FLOW TRAVEL TIME(MIN.) =   2.71   Tc(MIN.) =    7.24
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.188
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
```

```
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.770
  SUBAREA AREA(ACRES) =    2.50      SUBAREA RUNOFF(CFS) =    9.99
  TOTAL AREA(ACRES) =        2.6        PEAK FLOW RATE(CFS) =      10.39

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.44   HALFSTREET FLOOD WIDTH(FEET) =  15.74
  FLOW VELOCITY(FEET/SEC.) =  4.00   DEPTH*VELOCITY(FT*FT/SEC.) =   1.76
  LONGEST FLOWPATH FROM NODE   2501.00 TO NODE   2504.00 =     625.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2506.00 TO NODE   2504.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.188
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7700
  SUBAREA AREA(ACRES) =    3.10   SUBAREA RUNOFF(CFS) =   12.38
  TOTAL AREA(ACRES) =        5.7   TOTAL RUNOFF(CFS) =      22.77
  TC(MIN.) =    7.24

****************************************************************************
  FLOW PROCESS FROM NODE   2504.00 TO NODE   2500.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    50.00  DOWNSTREAM(FEET) =    47.00
  FLOW LENGTH(FEET) =   330.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  27.0 INCH PIPE IS  18.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.85
  ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      22.77
  PIPE TRAVEL TIME(MIN.) =   0.70    Tc(MIN.) =    7.94
  LONGEST FLOWPATH FROM NODE   2501.00 TO NODE   2500.00 =     955.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2508.00 TO NODE   2500.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.888
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7700
  SUBAREA AREA(ACRES) =    1.80   SUBAREA RUNOFF(CFS) =    6.77
```

```
  TOTAL AREA(ACRES) =        7.5   TOTAL RUNOFF(CFS) =      28.23
  TC(MIN.) =    7.94

****************************************************************************
  FLOW PROCESS FROM NODE   2500.00 TO NODE   2600.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     47.00  DOWNSTREAM(FEET) =     42.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   430.00   CHANNEL SLOPE =  0.0105
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      28.23
  FLOW VELOCITY(FEET/SEC.) =   2.57   FLOW DEPTH(FEET) =   0.50
  TRAVEL TIME(MIN.) =   2.79   Tc(MIN.) =   10.73
  LONGEST FLOWPATH FROM NODE   2501.00 TO NODE   2600.00 =    1385.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2600.00 TO NODE   2600.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.026
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7700
  SUBAREA AREA(ACRES) =    5.60   SUBAREA RUNOFF(CFS) =   17.36
  TOTAL AREA(ACRES) =       13.1   TOTAL RUNOFF(CFS) =      40.61
  TC(MIN.) =   10.73

****************************************************************************
  FLOW PROCESS FROM NODE   2600.00 TO NODE   2700.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     42.50  DOWNSTREAM(FEET) =     41.70
  CHANNEL LENGTH THRU SUBAREA(FEET) =   310.00   CHANNEL SLOPE =  0.0026
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      40.61
  FLOW VELOCITY(FEET/SEC.) =   1.85   FLOW DEPTH(FEET) =   0.93
  TRAVEL TIME(MIN.) =   2.79   Tc(MIN.) =   13.52
  LONGEST FLOWPATH FROM NODE   2501.00 TO NODE   2700.00 =    1695.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2700.00 TO NODE   2700.00 IS CODE =  81
----------------------------------------------------------------------------
```

```
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.468
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7902
  SUBAREA AREA(ACRES) =    5.30   SUBAREA RUNOFF(CFS) =   15.44
  TOTAL AREA(ACRES) =       18.4   TOTAL RUNOFF(CFS) =      50.42
  TC(MIN.) =   13.52

****************************************************************************
  FLOW PROCESS FROM NODE   2700.00 TO NODE   2800.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     41.70  DOWNSTREAM(FEET) =     41.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   240.00   CHANNEL SLOPE =  0.0029
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      50.42
  FLOW VELOCITY(FEET/SEC.) =   2.07   FLOW DEPTH(FEET) =   1.01
  TRAVEL TIME(MIN.) =   1.93   Tc(MIN.) =   15.45
  LONGEST FLOWPATH FROM NODE   2501.00 TO NODE   2800.00 =    1935.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2800.00 TO NODE   2800.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   15.45
  RAINFALL INTENSITY(INCH/HR) =   3.18
  TOTAL STREAM AREA(ACRES) =    18.40
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     50.42

****************************************************************************
  FLOW PROCESS FROM NODE   2801.00 TO NODE   2802.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     68.70
  DOWNSTREAM ELEVATION(FEET) =     68.00
  ELEVATION DIFFERENCE(FEET) =      0.70
```

```
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.532
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    61.15
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.51
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.51

****************************************************************************
  FLOW PROCESS FROM NODE   2802.00 TO NODE   2804.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   68.00  DOWNSTREAM ELEVATION(FEET) =   52.00
  STREET LENGTH(FEET) =   735.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.08
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.33
    HALFSTREET FLOOD WIDTH(FEET) =   10.43
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.39
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.13
  STREET FLOW TRAVEL TIME(MIN.) =   3.62   Tc(MIN.) =    8.15
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.806
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.770
  SUBAREA AREA(ACRES) =    1.90      SUBAREA RUNOFF(CFS) =    7.03
  TOTAL AREA(ACRES) =        2.0        PEAK FLOW RATE(CFS) =       7.40

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.39   HALFSTREET FLOOD WIDTH(FEET) =  13.32
  FLOW VELOCITY(FEET/SEC.) =  3.91   DEPTH*VELOCITY(FT*FT/SEC.) =   1.54
  LONGEST FLOWPATH FROM NODE   2801.00 TO NODE   2804.00 =     800.00 FEET.

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   2806.00 TO NODE   2804.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.806
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7700
  SUBAREA AREA(ACRES) =    3.20   SUBAREA RUNOFF(CFS) =   11.84
  TOTAL AREA(ACRES) =        5.2   TOTAL RUNOFF(CFS) =      19.24
  TC(MIN.) =    8.15

****************************************************************************
  FLOW PROCESS FROM NODE   2804.00 TO NODE   2800.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    49.00  DOWNSTREAM(FEET) =    40.90
  FLOW LENGTH(FEET) =   600.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.76
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      19.24
  PIPE TRAVEL TIME(MIN.) =   1.14    Tc(MIN.) =    9.29
  LONGEST FLOWPATH FROM NODE   2801.00 TO NODE   2800.00 =    1400.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2808.00 TO NODE   2800.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.416
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8025
  SUBAREA AREA(ACRES) =    4.50   SUBAREA RUNOFF(CFS) =   16.69
  TOTAL AREA(ACRES) =        9.7   TOTAL RUNOFF(CFS) =      34.38
  TC(MIN.) =    9.29

****************************************************************************
  FLOW PROCESS FROM NODE   2800.00 TO NODE   2800.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
```

```
  TIME OF CONCENTRATION(MIN.) =    9.29
  RAINFALL INTENSITY(INCH/HR) =   4.42
  TOTAL STREAM AREA(ACRES) =     9.70
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     34.38

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
     1        50.42    15.45        3.182        18.40
     2        34.38     9.29        4.416         9.70

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
     1        64.70     9.29       4.416
     2        75.18    15.45       3.182

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      75.18   Tc(MIN.) =   15.45
  TOTAL AREA(ACRES) =       28.1
  LONGEST FLOWPATH FROM NODE   2501.00 TO NODE   2800.00 =    1935.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       28.1  TC(MIN.) =     15.45
  PEAK FLOW RATE(CFS)   =      75.18
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************

             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                          2003,1985,1981 HYDROLOGY MANUAL
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              Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                            Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)          *
* JN: 701290.15                                                            *
* EXISTING CONDITION; BASIN 2900, 100-YEAR, 6-HOUR STORM EVENT             *
 **************************************************************************

  FILE NAME: CVE29H00.RAT
  TIME/DATE OF STUDY: 10:36 09/25/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   2901.00 TO NODE   2092.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     68.00
  DOWNSTREAM ELEVATION(FEET) =     66.00
  ELEVATION DIFFERENCE(FEET) =      2.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.594
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   2902.00 TO NODE   2900.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   66.00  DOWNSTREAM ELEVATION(FEET) =   38.00
  STREET LENGTH(FEET) =   770.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      13.28
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.43
    HALFSTREET FLOOD WIDTH(FEET) =   15.20
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.47
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.35
  STREET FLOW TRAVEL TIME(MIN.) =   2.35   Tc(MIN.) =    4.94
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    4.60      SUBAREA RUNOFF(CFS) =   25.45
```

```
  TOTAL AREA(ACRES) =        4.7        PEAK FLOW RATE(CFS) =      26.00

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.52   HALFSTREET FLOOD WIDTH(FEET) =  20.92
  FLOW VELOCITY(FEET/SEC.) =  6.42   DEPTH*VELOCITY(FT*FT/SEC.) =   3.35
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L =  770.0 FT WITH ELEVATION-DROP =  28.0 FT, IS   25.5 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE   2900.00
  LONGEST FLOWPATH FROM NODE   2901.00 TO NODE   2900.00 =     835.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2904.00 TO NODE   2900.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8010
  SUBAREA AREA(ACRES) =    5.90   SUBAREA RUNOFF(CFS) =   29.92
  TOTAL AREA(ACRES) =       10.6   TOTAL RUNOFF(CFS) =      55.93
  TC(MIN.) =    4.94

****************************************************************************
  FLOW PROCESS FROM NODE   2900.00 TO NODE   3000.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     38.00  DOWNSTREAM(FEET) =     31.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   480.00   CHANNEL SLOPE =  0.0146
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      55.93
  FLOW VELOCITY(FEET/SEC.) =   3.64   FLOW DEPTH(FEET) =   0.68
  TRAVEL TIME(MIN.) =   2.20   Tc(MIN.) =    7.14
  LONGEST FLOWPATH FROM NODE   2901.00 TO NODE   3000.00 =    1315.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   3000.00 TO NODE   3000.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.237
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7930
```

```
  SUBAREA AREA(ACRES) =    3.70   SUBAREA RUNOFF(CFS) =   14.92
  TOTAL AREA(ACRES) =       14.3   TOTAL RUNOFF(CFS) =      59.38
  TC(MIN.) =    7.14

****************************************************************************
  FLOW PROCESS FROM NODE   3000.00 TO NODE   3100.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     31.00  DOWNSTREAM(FEET) =     29.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   610.00   CHANNEL SLOPE =  0.0033
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      59.38
  FLOW VELOCITY(FEET/SEC.) =   2.28   FLOW DEPTH(FEET) =   1.07
  TRAVEL TIME(MIN.) =   4.46   Tc(MIN.) =   11.60
  LONGEST FLOWPATH FROM NODE   2901.00 TO NODE   3100.00 =    1925.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   3100.00 TO NODE   3100.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.828
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7892
  SUBAREA AREA(ACRES) =    2.80   SUBAREA RUNOFF(CFS) =    8.25
  TOTAL AREA(ACRES) =       17.1   TOTAL RUNOFF(CFS) =      59.38
  TC(MIN.) =   11.60
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)      =       17.1  TC(MIN.) =     11.60
  PEAK FLOW RATE(CFS)    =      59.38
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS

↑
```

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                          2003,1985,1981 HYDROLOGY MANUAL
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             Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                              Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)         *
* JN: 701290.15                                                           *
* EXISTING CONDITION; BASIN 3200, 100-YEAR, 6-HOUR STORM EVENT            *
 **************************************************************************

  FILE NAME: CVE32H00.RAT
  TIME/DATE OF STUDY: 08:33 08/13/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   3201.00 TO NODE   3202.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     48.00
  DOWNSTREAM ELEVATION(FEET) =     47.90
  ELEVATION DIFFERENCE(FEET) =      0.10
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.169
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   3202.00 TO NODE   3200.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     47.90  DOWNSTREAM(FEET) =     46.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   390.00   CHANNEL SLOPE =  0.0049
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.214
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.78
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.12
  AVERAGE FLOW DEPTH(FEET) =   0.25   TRAVEL TIME(MIN.) =   5.83
  Tc(MIN.) =   10.00
  SUBAREA AREA(ACRES) =     2.80       SUBAREA RUNOFF(CFS) =    9.91
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  TOTAL AREA(ACRES) =        2.9         PEAK FLOW RATE(CFS) =      10.26

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.35   FLOW VELOCITY(FEET/SEC.) =   1.39
  LONGEST FLOWPATH FROM NODE   3201.00 TO NODE   3200.00 =     455.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.9  TC(MIN.) =     10.00
  PEAK FLOW RATE(CFS)   =      10.26
```

===
===
  END OF RATIONAL METHOD ANALYSIS

```
****************************************************************************

             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                          2003,1985,1981 HYDROLOGY MANUAL
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              Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                            Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)          *
* JN: 701290.15                                                            *
* EXISTING CONDITION; BASIN 3300, 100-YEAR, 6-YEAR EVENT                   *
 **************************************************************************

  FILE NAME: CVE33H00.RAT
  TIME/DATE OF STUDY: 14:51 08/13/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   3301.00 TO NODE   3302.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     64.00
  DOWNSTREAM ELEVATION(FEET) =     63.90
  ELEVATION DIFFERENCE(FEET) =      0.10
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.169
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   3302.00 TO NODE   3304.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   63.90  DOWNSTREAM ELEVATION(FEET) =   50.00
  STREET LENGTH(FEET) =  1880.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.86
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.31
    HALFSTREET FLOOD WIDTH(FEET) =    9.37
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.87
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.59
  STREET FLOW TRAVEL TIME(MIN.) =  16.78   Tc(MIN.) =   20.95
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.614
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
```

```
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    2.42
  TOTAL AREA(ACRES) =        1.2        PEAK FLOW RATE(CFS) =       2.63

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.34   HALFSTREET FLOOD WIDTH(FEET) =  10.90
  FLOW VELOCITY(FEET/SEC.) =  2.02   DEPTH*VELOCITY(FT*FT/SEC.) =   0.69
  LONGEST FLOWPATH FROM NODE   3301.00 TO NODE   3304.00 =    1945.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   3304.00 TO NODE   3300.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   50.00  DOWNSTREAM ELEVATION(FEET) =   46.00
  STREET LENGTH(FEET) =   570.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.58
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.45
    HALFSTREET FLOOD WIDTH(FEET) =   15.98
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.46
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.10
  STREET FLOW TRAVEL TIME(MIN.) =   3.86   Tc(MIN.) =   24.81
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.344
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    4.00      SUBAREA RUNOFF(CFS) =    7.88
  TOTAL AREA(ACRES) =        5.2        PEAK FLOW RATE(CFS) =      10.24

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.51   HALFSTREET FLOOD WIDTH(FEET) =  19.36
  FLOW VELOCITY(FEET/SEC.) =  2.74   DEPTH*VELOCITY(FT*FT/SEC.) =   1.39
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L =  570.0 FT WITH ELEVATION-DROP =   4.0 FT, IS   22.1 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE   3300.00
```

```
  LONGEST FLOWPATH FROM NODE   3301.00 TO NODE   3300.00 =    2515.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   3306.00 TO NODE   3300.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.344
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8028
  SUBAREA AREA(ACRES) =    5.90   SUBAREA RUNOFF(CFS) =   10.65
  TOTAL AREA(ACRES) =       11.1   TOTAL RUNOFF(CFS) =      20.89
  TC(MIN.) =   24.81
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       11.1  TC(MIN.) =     24.81
  PEAK FLOW RATE(CFS)   =      20.89
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************

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                            Analysis prepared by:




 ************************* DESCRIPTION OF STUDY *************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)         *
* JN: 701290.15                                                           *
* EXISTING CONDITION; BASIN 3400, 100-YEAR, 6-HOUR STORM EVENT            *
 **************************************************************************

  FILE NAME: CVE34H00.RAT
  TIME/DATE OF STUDY: 11:13 08/14/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   3401.00 TO NODE   3402.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     51.00
  DOWNSTREAM ELEVATION(FEET) =     50.90
  ELEVATION DIFFERENCE(FEET) =      0.10
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.169
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   3402.00 TO NODE   3400.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     50.90  DOWNSTREAM(FEET) =     44.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   570.00   CHANNEL SLOPE =  0.0121
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.985
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.99
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.41
  AVERAGE FLOW DEPTH(FEET) =   0.17   TRAVEL TIME(MIN.) =   6.73
  Tc(MIN.) =   10.90
  SUBAREA AREA(ACRES) =     2.50       SUBAREA RUNOFF(CFS) =    8.37
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  TOTAL AREA(ACRES) =        2.6         PEAK FLOW RATE(CFS) =       8.70

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.24   FLOW VELOCITY(FEET/SEC.) =   1.73
  LONGEST FLOWPATH FROM NODE   3401.00 TO NODE   3400.00 =     635.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.6  TC(MIN.) =     10.90
  PEAK FLOW RATE(CFS)   =       8.70
```

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==
END OF RATIONAL METHOD ANALYSIS

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                            Analysis prepared by:






 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)          *
* JN: 701290.15                                                            *
* EXISTING CONDITION; BASIN 3800, 100-YEAR, 6-HOUR EVENT                   *
 **************************************************************************

  FILE NAME: CVE38H00.RAT
  TIME/DATE OF STUDY: 10:48 09/25/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   3801.00 TO NODE   3802.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     52.10
  DOWNSTREAM ELEVATION(FEET) =     52.00
  ELEVATION DIFFERENCE(FEET) =      0.10
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.169
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   3802.00 TO NODE   3804.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   52.00  DOWNSTREAM ELEVATION(FEET) =   46.00
  STREET LENGTH(FEET) =   720.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.17
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.36
    HALFSTREET FLOOD WIDTH(FEET) =   11.45
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.22
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.79
  STREET FLOW TRAVEL TIME(MIN.) =   5.41   Tc(MIN.) =    9.58
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.331
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
```

```
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    1.40      SUBAREA RUNOFF(CFS) =    5.09
  TOTAL AREA(ACRES) =        1.5        PEAK FLOW RATE(CFS) =       5.46

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.41   HALFSTREET FLOOD WIDTH(FEET) =  14.34
  FLOW VELOCITY(FEET/SEC.) =  2.51   DEPTH*VELOCITY(FT*FT/SEC.) =   1.04
  LONGEST FLOWPATH FROM NODE   3801.00 TO NODE   3804.00 =     785.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   3806.00 TO NODE   3800.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.331
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8177
  SUBAREA AREA(ACRES) =    0.70   SUBAREA RUNOFF(CFS) =    2.33
  TOTAL AREA(ACRES) =        2.2   TOTAL RUNOFF(CFS) =       7.79
  TC(MIN.) =    9.58

****************************************************************************
  FLOW PROCESS FROM NODE   3808.00 TO NODE   3800.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.331
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7914
  SUBAREA AREA(ACRES) =    2.70   SUBAREA RUNOFF(CFS) =    9.00
  TOTAL AREA(ACRES) =        4.9   TOTAL RUNOFF(CFS) =      16.80
  TC(MIN.) =    9.58
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.9  TC(MIN.) =      9.58
  PEAK FLOW RATE(CFS)   =      16.80
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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                             Analysis prepared by:






 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)          *
* JN: 701290.15                                                            *
* EXISTING CONDITION; BASIN 3900, 100-YEAR, 6-HOUR EVENT                   *
 **************************************************************************

  FILE NAME: CVE39H00.RAT
  TIME/DATE OF STUDY: 10:51 09/25/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   3901.00 TO NODE   3902.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     50.00
  DOWNSTREAM ELEVATION(FEET) =     49.90
  ELEVATION DIFFERENCE(FEET) =      0.10
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.169
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   3902.00 TO NODE   3904.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     49.90  DOWNSTREAM(FEET) =     44.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   160.00   CHANNEL SLOPE =  0.0369
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.741
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.76
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.32
  AVERAGE FLOW DEPTH(FEET) =   0.07   TRAVEL TIME(MIN.) =   2.02
  Tc(MIN.) =    6.19
  SUBAREA AREA(ACRES) =     0.50       SUBAREA RUNOFF(CFS) =    2.41
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       2.89

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.09   FLOW VELOCITY(FEET/SEC.) =   1.60
  LONGEST FLOWPATH FROM NODE   3901.00 TO NODE   3904.00 =     225.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   3904.00 TO NODE   3900.00 IS CODE =  62
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   44.00  DOWNSTREAM ELEVATION(FEET) =   41.30
  STREET LENGTH(FEET) =   390.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.96
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.45
    HALFSTREET FLOOD WIDTH(FEET) =   16.37
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.49
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.13
  STREET FLOW TRAVEL TIME(MIN.) =   2.61   Tc(MIN.) =    8.80
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.574
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    2.10      SUBAREA RUNOFF(CFS) =    8.07
  TOTAL AREA(ACRES) =        2.7        PEAK FLOW RATE(CFS) =      10.37

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.51   HALFSTREET FLOOD WIDTH(FEET) =  19.52
  FLOW VELOCITY(FEET/SEC.) =  2.75   DEPTH*VELOCITY(FT*FT/SEC.) =   1.40
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L =  390.0 FT WITH ELEVATION-DROP =   2.7 FT, IS   11.6 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE   3900.00
  LONGEST FLOWPATH FROM NODE   3901.00 TO NODE   3900.00 =     615.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.7  TC(MIN.) =      8.80
  PEAK FLOW RATE(CFS)   =      10.37
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************

             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                          2003,1985,1981 HYDROLOGY MANUAL
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              Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                            Analysis prepared by:






 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)         *
* JN: 701290.15                                                           *
* EXISTING CONDITION; BASIN 4000, 100-YEAR, 6-HOUR STORM EVENT            *
 **************************************************************************

  FILE NAME: CVE40H00.RAT
  TIME/DATE OF STUDY: 14:44 08/13/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   4001.00 TO NODE   4002.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     49.00
  DOWNSTREAM ELEVATION(FEET) =     48.90
  ELEVATION DIFFERENCE(FEET) =      0.10
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.169
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   4002.00 TO NODE   4004.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     48.90  DOWNSTREAM(FEET) =     47.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   320.00   CHANNEL SLOPE =  0.0059
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.873
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.57
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.74
  AVERAGE FLOW DEPTH(FEET) =   0.10   TRAVEL TIME(MIN.) =   7.22
  Tc(MIN.) =   11.39
  SUBAREA AREA(ACRES) =     0.60       SUBAREA RUNOFF(CFS) =    1.95
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  TOTAL AREA(ACRES) =        0.7         PEAK FLOW RATE(CFS) =       2.28

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.13   FLOW VELOCITY(FEET/SEC.) =   0.84
  LONGEST FLOWPATH FROM NODE   4001.00 TO NODE   4004.00 =     385.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   4004.00 TO NODE   4000.00 IS CODE =  31
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    47.00  DOWNSTREAM(FEET) =    46.90
  FLOW LENGTH(FEET) =   154.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  13.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   1.63
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.28
  PIPE TRAVEL TIME(MIN.) =   1.58    Tc(MIN.) =   12.97
  LONGEST FLOWPATH FROM NODE   4001.00 TO NODE   4000.00 =     539.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   4006.00 TO NODE   4000.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.562
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7820
  SUBAREA AREA(ACRES) =    3.40   SUBAREA RUNOFF(CFS) =    9.33
  TOTAL AREA(ACRES) =        4.1   TOTAL RUNOFF(CFS) =      11.42
  TC(MIN.) =   12.97

****************************************************************************
  FLOW PROCESS FROM NODE   4008.00 TO NODE   4000.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.562
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7791
  SUBAREA AREA(ACRES) =    1.30   SUBAREA RUNOFF(CFS) =    3.57
  TOTAL AREA(ACRES) =        5.4   TOTAL RUNOFF(CFS) =      14.99
  TC(MIN.) =   12.97
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        5.4  TC(MIN.) =     12.97
  PEAK FLOW RATE(CFS)   =      14.99
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************

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                           Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)          *
* JN: 701290.15                                                            *
* EXISTING CONDITION; BASIN 4100, 100-YEAR, 6-HOUR STORM EVENT             *
 **************************************************************************

  FILE NAME: CVE41H00.RAT
  TIME/DATE OF STUDY: 11:04 08/14/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   4101.00 TO NODE   4102.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     46.00
  DOWNSTREAM ELEVATION(FEET) =     42.00
  ELEVATION DIFFERENCE(FEET) =      4.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.059
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   4102.00 TO NODE   4100.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     42.00  DOWNSTREAM(FEET) =     28.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1606.00   CHANNEL SLOPE =  0.0087
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.443
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.92
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.26
  AVERAGE FLOW DEPTH(FEET) =   0.19   TRAVEL TIME(MIN.) =  21.21
  Tc(MIN.) =   23.27
  SUBAREA AREA(ACRES) =     3.60       SUBAREA RUNOFF(CFS) =    7.39
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  TOTAL AREA(ACRES) =        3.7         PEAK FLOW RATE(CFS) =       7.59

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.24   FLOW VELOCITY(FEET/SEC.) =   1.50
  LONGEST FLOWPATH FROM NODE   4101.00 TO NODE   4100.00 =    1671.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.7  TC(MIN.) =     23.27
  PEAK FLOW RATE(CFS)   =       7.59
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

APPENDIX B

PROPOSED CONDITION
100-YEAR HYDROLOGIC ANALYSIS

- AES Modified Rational Method Analyses
- Trench Drainage Modified Rational Method Calculations

```
****************************************************************************

             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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                            Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)          *
* JN: 701290.15                                                            *
* PROPOSED CONDITION; NORTH BASINS, 100-YEAR, 6-HOUR STORM EVENT           *
 **************************************************************************

  FILE NAME: PR100YR.DAT
  TIME/DATE OF STUDY: 09:41 10/09/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================   ======   ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

+--------------------------------------------------------------------------+
```

```
| Begin Node Series 100                                                     |
|                                                                           |
|                                                                           |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     39.00
  DOWNSTREAM ELEVATION(FEET) =     37.60
  ELEVATION DIFFERENCE(FEET) =      1.40
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.708
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.66
  TOTAL AREA(ACRES) =      0.13   TOTAL RUNOFF(CFS) =      0.66

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    100.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     37.60  DOWNSTREAM(FEET) =     12.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  2823.00   CHANNEL SLOPE =  0.0091
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   1.00

         ==>>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
             CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
             ALLOWABLE DEPTH).
             AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
             ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.

   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.348
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       8.25
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.24
  AVERAGE FLOW DEPTH(FEET) =   0.68   TRAVEL TIME(MIN.) =  21.03
  Tc(MIN.) =   24.74
  SUBAREA AREA(ACRES) =     7.45       SUBAREA RUNOFF(CFS) =   13.47
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.770
```

```
  TOTAL AREA(ACRES) =        7.6        PEAK FLOW RATE(CFS) =      13.71

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.86   FLOW VELOCITY(FEET/SEC.) =   2.54
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    100.00 =    2888.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 100                                                      |
| Begin Node Series 200                                                    |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    83.00
  UPSTREAM ELEVATION(FEET) =     40.20
  DOWNSTREAM ELEVATION(FEET) =     39.40
  ELEVATION DIFFERENCE(FEET) =      0.80
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.648
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    59.28
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   39.40  DOWNSTREAM ELEVATION(FEET) =   38.20
  STREET LENGTH(FEET) =   372.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
```

```
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.86
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.35
    HALFSTREET FLOOD WIDTH(FEET) =   11.21
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.35
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.47
  STREET FLOW TRAVEL TIME(MIN.) =   4.59   Tc(MIN.) =    8.24
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.772
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.779
  SUBAREA AREA(ACRES) =    0.69      SUBAREA RUNOFF(CFS) =    2.54
  TOTAL AREA(ACRES) =        0.8        PEAK FLOW RATE(CFS) =       2.94

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.40   HALFSTREET FLOOD WIDTH(FEET) =  13.48
  FLOW VELOCITY(FEET/SEC.) =  1.52   DEPTH*VELOCITY(FT*FT/SEC.) =   0.60
  LONGEST FLOWPATH FROM NODE    201.00 TO NODE    203.00 =     455.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    200.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     38.20  DOWNSTREAM(FEET) =     18.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  2372.00   CHANNEL SLOPE =  0.0085
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.579
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      24.52
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.01
  AVERAGE FLOW DEPTH(FEET) =   1.10   TRAVEL TIME(MIN.) =  13.15
  Tc(MIN.) =   21.39
  SUBAREA AREA(ACRES) =    20.61       SUBAREA RUNOFF(CFS) =   40.93
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.770
  TOTAL AREA(ACRES) =       21.4         PEAK FLOW RATE(CFS) =      42.52

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.41   FLOW VELOCITY(FEET/SEC.) =   3.47
  LONGEST FLOWPATH FROM NODE    201.00 TO NODE    200.00 =    2827.00 FEET.

+--------------------------------------------------------------------------+
```

```
| End Node Series 200                                                          |
| Begin Node Series 400                                                        |
|                                                                              |
+------------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    402.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     44.00
  DOWNSTREAM ELEVATION(FEET) =     41.28
  ELEVATION DIFFERENCE(FEET) =      2.72
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.972
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.51
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.51

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    403.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     41.28  DOWNSTREAM(FEET) =     29.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   177.00   CHANNEL SLOPE =  0.0694
  CHANNEL BASE(FEET) =    1.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.97
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.46
  AVERAGE FLOW DEPTH(FEET) =   0.38   TRAVEL TIME(MIN.) =   0.66
  Tc(MIN.) =    3.63
  SUBAREA AREA(ACRES) =     0.97       SUBAREA RUNOFF(CFS) =    4.92
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.770
  TOTAL AREA(ACRES) =        1.1         PEAK FLOW RATE(CFS) =       5.43

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.51   FLOW VELOCITY(FEET/SEC.) =   5.21
  LONGEST FLOWPATH FROM NODE    401.00 TO NODE    403.00 =     242.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    403.00 TO NODE    404.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     30.00  DOWNSTREAM(FEET) =     27.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   242.00   CHANNEL SLOPE =  0.0124
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      13.80
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.01
  AVERAGE FLOW DEPTH(FEET) =   0.85   TRAVEL TIME(MIN.) =   1.34
  Tc(MIN.) =    4.97
  SUBAREA AREA(ACRES) =     3.30       SUBAREA RUNOFF(CFS) =   16.74
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.770
  TOTAL AREA(ACRES) =        4.4         PEAK FLOW RATE(CFS) =      22.16

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.05   FLOW VELOCITY(FEET/SEC.) =   3.40
  LONGEST FLOWPATH FROM NODE    401.00 TO NODE    404.00 =     484.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    404.00 TO NODE    400.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     27.00  DOWNSTREAM(FEET) =     24.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   242.00   CHANNEL SLOPE =  0.0124
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.764
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      22.83
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.43
  AVERAGE FLOW DEPTH(FEET) =   1.06   TRAVEL TIME(MIN.) =   1.17
  Tc(MIN.) =    6.15
  SUBAREA AREA(ACRES) =     0.30       SUBAREA RUNOFF(CFS) =    1.33
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.770
  TOTAL AREA(ACRES) =        4.7         PEAK FLOW RATE(CFS) =      22.16

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
```

```
  DEPTH(FEET) =  1.05   FLOW VELOCITY(FEET/SEC.) =   3.40
  LONGEST FLOWPATH FROM NODE    401.00 TO NODE    400.00 =     726.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 400                                                      |
| Begin Node Series 500                                                    |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    501.00 TO NODE    502.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     37.50
  DOWNSTREAM ELEVATION(FEET) =     37.00
  ELEVATION DIFFERENCE(FEET) =      0.50
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.801
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    55.38
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    500.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     37.00
  DOWNSTREAM NODE ELEVATION(FEET) =     35.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   469.00
  "V" GUTTER WIDTH(FEET) =   4.00   GUTTER HIKE(FEET) =  0.200
  PAVEMENT LIP(FEET) =  0.033   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   0.50
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.767
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      5.12
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.76
  AVERAGE FLOW DEPTH(FEET) =   0.41   FLOOD WIDTH(FEET) =   22.20
```

```
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   4.45   Tc(MIN.) =    8.25
  SUBAREA AREA(ACRES) =    2.25       SUBAREA RUNOFF(CFS) =    9.01
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  TOTAL AREA(ACRES) =        2.3         PEAK FLOW RATE(CFS) =       9.41

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.49   FLOOD WIDTH(FEET) =   29.81
  FLOW VELOCITY(FEET/SEC.) =   1.92   DEPTH*VELOCITY(FT*FT/SEC) =   0.94
  LONGEST FLOWPATH FROM NODE    501.00 TO NODE    500.00 =     534.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 500                                                      |
| Begin Node Series 600                                                    |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    601.00 TO NODE    602.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    96.00
  UPSTREAM ELEVATION(FEET) =     44.00
  DOWNSTREAM ELEVATION(FEET) =     43.00
  ELEVATION DIFFERENCE(FEET) =      1.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.589
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    60.42
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.61
  TOTAL AREA(ACRES) =      0.11   TOTAL RUNOFF(CFS) =      0.61

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE    600.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     42.00
  DOWNSTREAM NODE ELEVATION(FEET) =     36.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   594.00
  "V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.250
  PAVEMENT LIP(FEET) =  0.020   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.00
```

```
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.565
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     13.09
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.41
  AVERAGE FLOW DEPTH(FEET) =   0.47   FLOOD WIDTH(FEET) =   25.46
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   2.91   Tc(MIN.) =    6.49
  SUBAREA AREA(ACRES) =    5.30       SUBAREA RUNOFF(CFS) =   24.77
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  TOTAL AREA(ACRES) =        5.4         PEAK FLOW RATE(CFS) =      25.29

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.57   FLOOD WIDTH(FEET) =   34.87
  FLOW VELOCITY(FEET/SEC.) =   3.79   DEPTH*VELOCITY(FT*FT/SEC) =   2.15
  LONGEST FLOWPATH FROM NODE    601.00 TO NODE    600.00 =     690.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 600                                                      |
| Begin Node Series 700                                                    |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    701.00 TO NODE    702.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     44.00
  DOWNSTREAM ELEVATION(FEET) =     42.80
  ELEVATION DIFFERENCE(FEET) =      1.20
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.904
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.51
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.51

****************************************************************************
  FLOW PROCESS FROM NODE    702.00 TO NODE    700.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   43.80  DOWNSTREAM ELEVATION(FEET) =   41.00
  STREET LENGTH(FEET) =   134.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00
```

```
  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.56
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.26
    HALFSTREET FLOOD WIDTH(FEET) =    6.78
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.70
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.71
  STREET FLOW TRAVEL TIME(MIN.) =   0.83   Tc(MIN.) =    4.73
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.825
  SUBAREA AREA(ACRES) =    0.38      SUBAREA RUNOFF(CFS) =    2.10
  TOTAL AREA(ACRES) =        0.5        PEAK FLOW RATE(CFS) =       2.61

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.30   HALFSTREET FLOOD WIDTH(FEET) =   8.64
  FLOW VELOCITY(FEET/SEC.) =  3.02   DEPTH*VELOCITY(FT*FT/SEC.) =   0.90
  LONGEST FLOWPATH FROM NODE    701.00 TO NODE    700.00 =     199.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 700                                                      |
| Begin Node Series 800                                                    |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    801.00 TO NODE    802.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     44.00
  DOWNSTREAM ELEVATION(FEET) =     39.80
  ELEVATION DIFFERENCE(FEET) =      4.20
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.026
```

```
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
SUBAREA RUNOFF(CFS) =      0.55
TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE    802.00 TO NODE    800.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   43.80  DOWNSTREAM ELEVATION(FEET) =   43.00
  STREET LENGTH(FEET) =    63.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.72
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.23
    HALFSTREET FLOOD WIDTH(FEET) =    5.12
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.89
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.43
  STREET FLOW TRAVEL TIME(MIN.) =   0.55   Tc(MIN.) =    2.58
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    0.06      SUBAREA RUNOFF(CFS) =    0.33
  TOTAL AREA(ACRES) =       0.2        PEAK FLOW RATE(CFS) =      0.89

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.24   HALFSTREET FLOOD WIDTH(FEET) =   5.72
  FLOW VELOCITY(FEET/SEC.) =  1.99   DEPTH*VELOCITY(FT*FT/SEC.) =   0.48
  LONGEST FLOWPATH FROM NODE    801.00 TO NODE    800.00 =     128.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 800                                                      |
| Begin Node Series 900                                                    |
|                                                                          |
+--------------------------------------------------------------------------+
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    901.00 TO NODE    900.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    96.00
  UPSTREAM ELEVATION(FEET) =     44.00
  DOWNSTREAM ELEVATION(FEET) =     43.50
  ELEVATION DIFFERENCE(FEET) =      0.50
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.242
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.42
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.389
  SUBAREA RUNOFF(CFS) =      1.03
  TOTAL AREA(ACRES) =      0.21   TOTAL RUNOFF(CFS) =      1.03

+--------------------------------------------------------------------------+
| End Node Series 900                                                      |
| Begin Node Series 1000                                                   |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE   1001.00 TO NODE   1002.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     44.00
  DOWNSTREAM ELEVATION(FEET) =     43.00
  ELEVATION DIFFERENCE(FEET) =      1.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.268
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   1002.00 TO NODE   1000.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
```

```
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   43.90  DOWNSTREAM ELEVATION(FEET) =   42.00
  STREET LENGTH(FEET) =    71.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.83
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.21
    HALFSTREET FLOOD WIDTH(FEET) =    4.39
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.67
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.57
  STREET FLOW TRAVEL TIME(MIN.) =   0.44   Tc(MIN.) =    3.71
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    0.10      SUBAREA RUNOFF(CFS) =    0.55
  TOTAL AREA(ACRES) =        0.2        PEAK FLOW RATE(CFS) =       1.11

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.23   HALFSTREET FLOOD WIDTH(FEET) =   5.25
  FLOW VELOCITY(FEET/SEC.) =  2.81   DEPTH*VELOCITY(FT*FT/SEC.) =   0.65
  LONGEST FLOWPATH FROM NODE   1001.00 TO NODE   1000.00 =     136.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 1000                                                     |
| Begin Node Series 1100                                                   |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE   1101.00 TO NODE   1102.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
```

```
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     44.50
  DOWNSTREAM ELEVATION(FEET) =     43.90
  ELEVATION DIFFERENCE(FEET) =      0.60
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.675
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    58.46
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   1102.00 TO NODE   1100.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   43.90  DOWNSTREAM ELEVATION(FEET) =   42.50
  STREET LENGTH(FEET) =    71.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.08
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.24
    HALFSTREET FLOOD WIDTH(FEET) =    5.65
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.47
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.59
  STREET FLOW TRAVEL TIME(MIN.) =   0.48   Tc(MIN.) =    4.15
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    0.19      SUBAREA RUNOFF(CFS) =    1.05
  TOTAL AREA(ACRES) =        0.3        PEAK FLOW RATE(CFS) =       1.60

  END OF SUBAREA STREET FLOW HYDRAULICS:
```

```
  DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =   6.98
  FLOW VELOCITY(FEET/SEC.) =  2.65   DEPTH*VELOCITY(FT*FT/SEC.) =   0.70
  LONGEST FLOWPATH FROM NODE   1101.00 TO NODE   1100.00 =     136.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 1100                                                     |
| Begin Node Series 1200                                                   |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE   1201.00 TO NODE   1202.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    78.00
  UPSTREAM ELEVATION(FEET) =     43.50
  DOWNSTREAM ELEVATION(FEET) =     43.00
  ELEVATION DIFFERENCE(FEET) =      0.50
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.007
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    52.82
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.581
  SUBAREA RUNOFF(CFS) =      0.51
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.51

****************************************************************************
  FLOW PROCESS FROM NODE   1202.00 TO NODE   1200.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     43.00
  DOWNSTREAM NODE ELEVATION(FEET) =     40.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   517.00
  "V" GUTTER WIDTH(FEET) =   4.00   GUTTER HIKE(FEET) =  0.250
  PAVEMENT LIP(FEET) =  0.030   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.715
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      9.79
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.54
  AVERAGE FLOW DEPTH(FEET) =   0.50   FLOOD WIDTH(FEET) =   25.73
```

```
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   3.39   Tc(MIN.) =    8.40
  SUBAREA AREA(ACRES) =    4.65       SUBAREA RUNOFF(CFS) =   18.42
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.839
  TOTAL AREA(ACRES) =        4.8         PEAK FLOW RATE(CFS) =      18.78

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.59   FLOOD WIDTH(FEET) =   35.01
  FLOW VELOCITY(FEET/SEC.) =   2.82   DEPTH*VELOCITY(FT*FT/SEC) =   1.66
  LONGEST FLOWPATH FROM NODE   1201.00 TO NODE   1200.00 =     595.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 1200                                                     |
| Begin Node Series 1300                                                   |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE   1301.00 TO NODE   1302.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    96.00
  UPSTREAM ELEVATION(FEET) =     48.00
  DOWNSTREAM ELEVATION(FEET) =     47.50
  ELEVATION DIFFERENCE(FEET) =      0.50
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.130
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.42
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.61
  TOTAL AREA(ACRES) =      0.11   TOTAL RUNOFF(CFS) =      0.61

****************************************************************************
  FLOW PROCESS FROM NODE   1302.00 TO NODE   1300.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   47.50  DOWNSTREAM ELEVATION(FEET) =   43.00
  STREET LENGTH(FEET) =   282.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
```

```
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       8.87
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.43
    HALFSTREET FLOOD WIDTH(FEET) =   15.27
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.62
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.56
  STREET FLOW TRAVEL TIME(MIN.) =   1.30   Tc(MIN.) =    5.43
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.247
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.772
  SUBAREA AREA(ACRES) =    3.42      SUBAREA RUNOFF(CFS) =   16.45
  TOTAL AREA(ACRES) =        3.5        PEAK FLOW RATE(CFS) =      17.03

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.52   HALFSTREET FLOOD WIDTH(FEET) =  20.77
  FLOW VELOCITY(FEET/SEC.) =  4.24   DEPTH*VELOCITY(FT*FT/SEC.) =   2.21
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L =  282.0 FT WITH ELEVATION-DROP =   4.5 FT, IS   17.3 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE   1300.00
  LONGEST FLOWPATH FROM NODE   1301.00 TO NODE   1300.00 =     378.00 FEET.

+--------------------------------------------------------------------------+
| End Node Series 1300                                                     |
|                                                                          |
|                                                                          |
+--------------------------------------------------------------------------+
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.5  TC(MIN.) =      5.43
  PEAK FLOW RATE(CFS)   =      17.03
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************

             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                          2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2016 Advanced Engineering Software (aes)
              Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                           Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)          *
* JN: 701290.15                                                            *
* PROPOSED CONDITION; BASIN 2200 TO 300, 100-YEAR, 6-HOUR STORM EVENT      *
 **************************************************************************

  FILE NAME: CVP22H00.RAT
  TIME/DATE OF STUDY: 09:57 09/22/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   2201.00 TO NODE   2202.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     62.70
  DOWNSTREAM ELEVATION(FEET) =     62.00
  ELEVATION DIFFERENCE(FEET) =      0.70
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.559
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    60.77
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   2202.00 TO NODE   2205.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   62.00  DOWNSTREAM ELEVATION(FEET) =   52.00
  STREET LENGTH(FEET) =   715.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.66
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.41
    HALFSTREET FLOOD WIDTH(FEET) =   13.95
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.23
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.31
  STREET FLOW TRAVEL TIME(MIN.) =   3.69   Tc(MIN.) =    7.25
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.184
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
```

```
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.772
  SUBAREA AREA(ACRES) =    3.00      SUBAREA RUNOFF(CFS) =   11.98
  TOTAL AREA(ACRES) =        3.1        PEAK FLOW RATE(CFS) =      12.41

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.48   HALFSTREET FLOOD WIDTH(FEET) =  17.93
  FLOW VELOCITY(FEET/SEC.) =  3.72   DEPTH*VELOCITY(FT*FT/SEC.) =   1.81
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L =  715.0 FT WITH ELEVATION-DROP =  10.0 FT, IS   15.2 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE   2205.00
  LONGEST FLOWPATH FROM NODE   2201.00 TO NODE   2205.00 =     780.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2203.00 TO NODE   2205.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.184
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7711
  SUBAREA AREA(ACRES) =    3.00   SUBAREA RUNOFF(CFS) =   11.98
  TOTAL AREA(ACRES) =        6.1   TOTAL RUNOFF(CFS) =      24.39
  TC(MIN.) =    7.25

****************************************************************************
  FLOW PROCESS FROM NODE   2207.00 TO NODE   2205.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.184
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7709
  SUBAREA AREA(ACRES) =    1.50   SUBAREA RUNOFF(CFS) =    5.99
  TOTAL AREA(ACRES) =        7.6   TOTAL RUNOFF(CFS) =      30.37
  TC(MIN.) =    7.25

****************************************************************************
  FLOW PROCESS FROM NODE   2205.00 TO NODE   2200.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    49.00  DOWNSTREAM(FEET) =    46.00
  FLOW LENGTH(FEET) =   340.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  30.0 INCH PIPE IS  20.9 INCHES
```

```
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.33
  ESTIMATED PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      30.37
  PIPE TRAVEL TIME(MIN.) =   0.68    Tc(MIN.) =    7.93
  LONGEST FLOWPATH FROM NODE   2201.00 TO NODE   2200.00 =    1120.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2209.00 TO NODE   2200.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.893
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7707
  SUBAREA AREA(ACRES) =    2.15   SUBAREA RUNOFF(CFS) =    8.10
  TOTAL AREA(ACRES) =        9.8   TOTAL RUNOFF(CFS) =      36.77
  TC(MIN.) =    7.93

****************************************************************************
  FLOW PROCESS FROM NODE   2200.00 TO NODE   2100.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     46.00  DOWNSTREAM(FEET) =     41.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   545.00   CHANNEL SLOPE =  0.0092
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.907
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      37.91
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.74
  AVERAGE FLOW DEPTH(FEET) =   0.62   TRAVEL TIME(MIN.) =   3.31
  Tc(MIN.) =   11.24
  SUBAREA AREA(ACRES) =     0.70       SUBAREA RUNOFF(CFS) =    2.30
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.775
  TOTAL AREA(ACRES) =       10.4         PEAK FLOW RATE(CFS) =      36.77

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.61   FLOW VELOCITY(FEET/SEC.) =   2.71
  LONGEST FLOWPATH FROM NODE   2201.00 TO NODE   2100.00 =    1665.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2100.00 TO NODE   2100.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

```
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.907
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7734
  SUBAREA AREA(ACRES) =    5.80   SUBAREA RUNOFF(CFS) =   17.45
  TOTAL AREA(ACRES) =       16.2   TOTAL RUNOFF(CFS) =      49.10
  TC(MIN.) =   11.24

****************************************************************************
  FLOW PROCESS FROM NODE   2100.00 TO NODE   2000.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     41.00  DOWNSTREAM(FEET) =     36.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   480.00   CHANNEL SLOPE =  0.0104
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      49.10
  FLOW VELOCITY(FEET/SEC.) =   3.12   FLOW DEPTH(FEET) =   0.69
  TRAVEL TIME(MIN.) =   2.56   Tc(MIN.) =   13.80
  LONGEST FLOWPATH FROM NODE   2201.00 TO NODE   2000.00 =    2145.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2000.00 TO NODE   2000.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.422
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7719
  SUBAREA AREA(ACRES) =   13.60   SUBAREA RUNOFF(CFS) =   35.83
  TOTAL AREA(ACRES) =       29.9   TOTAL RUNOFF(CFS) =      78.84
  TC(MIN.) =   13.80

****************************************************************************
  FLOW PROCESS FROM NODE   2000.00 TO NODE   1600.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    35.00  DOWNSTREAM(FEET) =    32.20
  FLOW LENGTH(FEET) =   550.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  45.0 INCH PIPE IS  35.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.44
  ESTIMATED PIPE DIAMETER(INCH) =  45.00    NUMBER OF PIPES =   1
```

```
  PIPE-FLOW(CFS) =      78.84
  PIPE TRAVEL TIME(MIN.) =   1.09    Tc(MIN.) =   14.89
  LONGEST FLOWPATH FROM NODE   2201.00 TO NODE   1600.00 =    2695.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   1600.00 TO NODE   1600.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.259
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7717
  SUBAREA AREA(ACRES) =    3.50   SUBAREA RUNOFF(CFS) =    8.78
  TOTAL AREA(ACRES) =       33.3   TOTAL RUNOFF(CFS) =      83.86
  TC(MIN.) =   14.89

****************************************************************************
  FLOW PROCESS FROM NODE   1600.00 TO NODE   1400.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    32.20  DOWNSTREAM(FEET) =    30.70
  FLOW LENGTH(FEET) =   290.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  48.0 INCH PIPE IS  34.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.76
  ESTIMATED PIPE DIAMETER(INCH) =  48.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      83.86
  PIPE TRAVEL TIME(MIN.) =   0.55    Tc(MIN.) =   15.44
  LONGEST FLOWPATH FROM NODE   2201.00 TO NODE   1400.00 =    2985.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   1500.00 TO NODE   1400.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.183
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7770
  SUBAREA AREA(ACRES) =    2.80   SUBAREA RUNOFF(CFS) =    7.49
  TOTAL AREA(ACRES) =       36.1   TOTAL RUNOFF(CFS) =      89.40
  TC(MIN.) =   15.44

****************************************************************************
  FLOW PROCESS FROM NODE   1400.00 TO NODE   1400.00 IS CODE =  81
----------------------------------------------------------------------------
```

```
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.183
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7809
  SUBAREA AREA(ACRES) =    2.40   SUBAREA RUNOFF(CFS) =    6.42
  TOTAL AREA(ACRES) =       38.5   TOTAL RUNOFF(CFS) =      95.82
  TC(MIN.) =   15.44

****************************************************************************
  FLOW PROCESS FROM NODE   1400.00 TO NODE    307.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    30.70  DOWNSTREAM(FEET) =    26.80
  FLOW LENGTH(FEET) =   780.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  48.0 INCH PIPE IS  39.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.74
  ESTIMATED PIPE DIAMETER(INCH) =  48.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      95.82
  PIPE TRAVEL TIME(MIN.) =   1.49    Tc(MIN.) =   16.93
  LONGEST FLOWPATH FROM NODE   2201.00 TO NODE    307.00 =    3765.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    307.00 TO NODE    307.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.000
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7898
  SUBAREA AREA(ACRES) =    6.80   SUBAREA RUNOFF(CFS) =   17.13
  TOTAL AREA(ACRES) =       45.3   TOTAL RUNOFF(CFS) =     107.44
  TC(MIN.) =   16.93

****************************************************************************
  FLOW PROCESS FROM NODE    307.00 TO NODE    308.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    26.80  DOWNSTREAM(FEET) =    23.40
  FLOW LENGTH(FEET) =   670.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  51.0 INCH PIPE IS  39.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.15
```

```
  ESTIMATED PIPE DIAMETER(INCH) =  51.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     107.44
  PIPE TRAVEL TIME(MIN.) =   1.22    Tc(MIN.) =   18.15
  LONGEST FLOWPATH FROM NODE   2201.00 TO NODE    308.00 =    4435.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    308.00 TO NODE    308.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.868
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8037
  SUBAREA AREA(ACRES) =   17.40   SUBAREA RUNOFF(CFS) =   41.92
  TOTAL AREA(ACRES) =       62.8   TOTAL RUNOFF(CFS) =     144.63
  TC(MIN.) =   18.15

****************************************************************************
  FLOW PROCESS FROM NODE    308.00 TO NODE    300.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    23.40  DOWNSTREAM(FEET) =    18.00
  FLOW LENGTH(FEET) =   780.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  54.0 INCH PIPE IS  41.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.09
  ESTIMATED PIPE DIAMETER(INCH) =  54.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     144.63
  PIPE TRAVEL TIME(MIN.) =   1.17    Tc(MIN.) =   19.32
  LONGEST FLOWPATH FROM NODE   2201.00 TO NODE    300.00 =    5215.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    300.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.754
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8046
  SUBAREA AREA(ACRES) =    1.60   SUBAREA RUNOFF(CFS) =    3.70
  TOTAL AREA(ACRES) =       64.3   TOTAL RUNOFF(CFS) =     144.63
  TC(MIN.) =   19.32
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE
============================================================================
  END OF STUDY SUMMARY:
```

```
  TOTAL AREA(ACRES)     =       64.3  TC(MIN.) =     19.32
  PEAK FLOW RATE(CFS)   =     144.63
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2016 Advanced Engineering Software (aes)
             Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                           Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)          *
* JN: 701290.15 (SHORT TRENCH ONLY)                                        *
* PROPOSED CONDITION; BASIN 2300, 100-YEAR, 6-HOUR STORM EVENT             *
 **************************************************************************

  FILE NAME: CVP23H00.RAT
  TIME/DATE OF STUDY: 10:55 10/10/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   2301.00 TO NODE   2302.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     61.70
  DOWNSTREAM ELEVATION(FEET) =     61.00
  ELEVATION DIFFERENCE(FEET) =      0.70
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.571
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    61.15
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   2302.00 TO NODE   2304.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   61.00  DOWNSTREAM ELEVATION(FEET) =   53.00
  STREET LENGTH(FEET) =   630.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       7.65
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.43
    HALFSTREET FLOOD WIDTH(FEET) =   15.04
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.22
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.37
  STREET FLOW TRAVEL TIME(MIN.) =   3.26   Tc(MIN.) =    6.84
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.384
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
```

```
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    3.10      SUBAREA RUNOFF(CFS) =   14.02
  TOTAL AREA(ACRES) =        3.2        PEAK FLOW RATE(CFS) =      14.47

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.51   HALFSTREET FLOOD WIDTH(FEET) =  19.98
  FLOW VELOCITY(FEET/SEC.) =  3.75   DEPTH*VELOCITY(FT*FT/SEC.) =   1.92
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L =  630.0 FT WITH ELEVATION-DROP =   8.0 FT, IS   17.2 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE   2304.00
  LONGEST FLOWPATH FROM NODE   2301.00 TO NODE   2304.00 =     695.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2306.00 TO NODE   2304.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.384
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8400
  SUBAREA AREA(ACRES) =    3.70   SUBAREA RUNOFF(CFS) =   16.73
  TOTAL AREA(ACRES) =        6.9   TOTAL RUNOFF(CFS) =      31.21
  TC(MIN.) =    6.84

****************************************************************************
  FLOW PROCESS FROM NODE   2304.00 TO NODE   2300.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    50.00  DOWNSTREAM(FEET) =    41.00
  FLOW LENGTH(FEET) =   540.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  27.0 INCH PIPE IS  18.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.65
  ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      31.21
  PIPE TRAVEL TIME(MIN.) =   0.85    Tc(MIN.) =    7.68
  LONGEST FLOWPATH FROM NODE   2301.00 TO NODE   2300.00 =    1235.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2308.00 TO NODE   2300.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.994
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
```

```
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8400
  SUBAREA AREA(ACRES) =    4.70   SUBAREA RUNOFF(CFS) =   19.72
  TOTAL AREA(ACRES) =       11.6   TOTAL RUNOFF(CFS) =      48.66
  TC(MIN.) =    7.68

****************************************************************************
  FLOW PROCESS FROM NODE   2300.00 TO NODE   2400.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     48.00  DOWNSTREAM(FEET) =     46.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   660.00   CHANNEL SLOPE =  0.0023
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      48.66
  FLOW VELOCITY(FEET/SEC.) =   1.88   FLOW DEPTH(FEET) =   1.07
  TRAVEL TIME(MIN.) =   5.84   Tc(MIN.) =   13.52
  LONGEST FLOWPATH FROM NODE   2301.00 TO NODE   2400.00 =    1895.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2400.00 TO NODE   2400.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.467
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8400
  SUBAREA AREA(ACRES) =    9.20   SUBAREA RUNOFF(CFS) =   26.79
  TOTAL AREA(ACRES) =       20.8   TOTAL RUNOFF(CFS) =      60.58
  TC(MIN.) =   13.52

****************************************************************************
  FLOW PROCESS FROM NODE   2400.00 TO NODE   2500.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     46.00  DOWNSTREAM(FEET) =     43.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   700.00   CHANNEL SLOPE =  0.0036
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      60.58
  FLOW VELOCITY(FEET/SEC.) =   2.35   FLOW DEPTH(FEET) =   1.06
  TRAVEL TIME(MIN.) =   4.97   Tc(MIN.) =   18.49
  LONGEST FLOWPATH FROM NODE   2301.00 TO NODE   2500.00 =    2595.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE   2500.00 TO NODE   2500.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.834
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8176
  SUBAREA AREA(ACRES) =    9.80   SUBAREA RUNOFF(CFS) =   21.38
  TOTAL AREA(ACRES) =       30.6   TOTAL RUNOFF(CFS) =      70.89
  TC(MIN.) =   18.49

****************************************************************************
  FLOW PROCESS FROM NODE   2500.00 TO NODE   2600.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     44.00  DOWNSTREAM(FEET) =     42.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   450.00   CHANNEL SLOPE =  0.0033
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      70.89
  FLOW VELOCITY(FEET/SEC.) =   2.42   FLOW DEPTH(FEET) =   1.19
  TRAVEL TIME(MIN.) =   3.10   Tc(MIN.) =   21.59
  LONGEST FLOWPATH FROM NODE   2301.00 TO NODE   2600.00 =    3045.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2600.00 TO NODE   2600.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.564
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8109
  SUBAREA AREA(ACRES) =    5.00   SUBAREA RUNOFF(CFS) =    9.87
  TOTAL AREA(ACRES) =       35.6   TOTAL RUNOFF(CFS) =      74.01
  TC(MIN.) =   21.59

****************************************************************************
  FLOW PROCESS FROM NODE   2600.00 TO NODE   2700.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     42.50  DOWNSTREAM(FEET) =     41.70
```

```
  CHANNEL LENGTH THRU SUBAREA(FEET) =   310.00   CHANNEL SLOPE =  0.0026
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      74.01
  FLOW VELOCITY(FEET/SEC.) =   2.26   FLOW DEPTH(FEET) =   1.30
  TRAVEL TIME(MIN.) =   2.29   Tc(MIN.) =   23.88
  LONGEST FLOWPATH FROM NODE   2301.00 TO NODE   2700.00 =    3355.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2700.00 TO NODE   2700.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.402
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8142
  SUBAREA AREA(ACRES) =    4.60   SUBAREA RUNOFF(CFS) =    9.28
  TOTAL AREA(ACRES) =       40.2   TOTAL RUNOFF(CFS) =      78.64
  TC(MIN.) =   23.88

****************************************************************************
  FLOW PROCESS FROM NODE   2700.00 TO NODE   2800.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     41.70  DOWNSTREAM(FEET) =     41.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   240.00   CHANNEL SLOPE =  0.0029
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      78.64
  FLOW VELOCITY(FEET/SEC.) =   2.40   FLOW DEPTH(FEET) =   1.30
  TRAVEL TIME(MIN.) =   1.67   Tc(MIN.) =   25.55
  LONGEST FLOWPATH FROM NODE   2301.00 TO NODE   2800.00 =    3595.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2800.00 TO NODE   2800.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.300
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8191
  SUBAREA AREA(ACRES) =    9.30   SUBAREA RUNOFF(CFS) =   17.97
  TOTAL AREA(ACRES) =       49.5   TOTAL RUNOFF(CFS) =      93.25
  TC(MIN.) =   25.55
```

```
==============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       49.5  TC(MIN.) =     25.55
  PEAK FLOW RATE(CFS)   =      93.25
==============================================================================
==============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2016 Advanced Engineering Software (aes)
             Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                           Analysis prepared by:





 ************************* DESCRIPTION OF STUDY *************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)         *
* JN: 701290.15 (LONG TRENCH ONLY)                                        *
* PROPOSED CONDITION; BASIN 2300, 100-YEAR, 6-HOUR STORM EVENT            *
 **************************************************************************

  FILE NAME: CVP23H00.RAT
  TIME/DATE OF STUDY: 16:46 10/03/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================= ======   ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   2301.00 TO NODE   2302.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     61.70
  DOWNSTREAM ELEVATION(FEET) =     61.00
  ELEVATION DIFFERENCE(FEET) =      0.70
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.571
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    61.15
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   2302.00 TO NODE   2304.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   61.00  DOWNSTREAM ELEVATION(FEET) =   53.00
  STREET LENGTH(FEET) =   630.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       7.65
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.43
    HALFSTREET FLOOD WIDTH(FEET) =   15.04
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.22
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.37
  STREET FLOW TRAVEL TIME(MIN.) =   3.26   Tc(MIN.) =    6.84
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.384
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
```

```
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    3.10      SUBAREA RUNOFF(CFS) =   14.02
  TOTAL AREA(ACRES) =        3.2        PEAK FLOW RATE(CFS) =      14.47

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.51   HALFSTREET FLOOD WIDTH(FEET) =  19.98
  FLOW VELOCITY(FEET/SEC.) =  3.75   DEPTH*VELOCITY(FT*FT/SEC.) =   1.92
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L =  630.0 FT WITH ELEVATION-DROP =   8.0 FT, IS   17.2 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE   2304.00
  LONGEST FLOWPATH FROM NODE   2301.00 TO NODE   2304.00 =     695.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2306.00 TO NODE   2304.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.384
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8400
  SUBAREA AREA(ACRES) =    3.70   SUBAREA RUNOFF(CFS) =   16.73
  TOTAL AREA(ACRES) =        6.9   TOTAL RUNOFF(CFS) =      31.21
  TC(MIN.) =    6.84

****************************************************************************
  FLOW PROCESS FROM NODE   2304.00 TO NODE   2300.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    50.00  DOWNSTREAM(FEET) =    41.00
  FLOW LENGTH(FEET) =   540.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  27.0 INCH PIPE IS  18.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.65
  ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      31.21
  PIPE TRAVEL TIME(MIN.) =   0.85    Tc(MIN.) =    7.68
  LONGEST FLOWPATH FROM NODE   2301.00 TO NODE   2300.00 =    1235.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2308.00 TO NODE   2300.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.994
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
```

```
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8400
  SUBAREA AREA(ACRES) =    4.70   SUBAREA RUNOFF(CFS) =   19.72
  TOTAL AREA(ACRES) =       11.6   TOTAL RUNOFF(CFS) =      48.66
  TC(MIN.) =    7.68

****************************************************************************
  FLOW PROCESS FROM NODE   2300.00 TO NODE   2400.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     48.00  DOWNSTREAM(FEET) =     46.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   660.00   CHANNEL SLOPE =  0.0023
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      48.66
  FLOW VELOCITY(FEET/SEC.) =   1.88   FLOW DEPTH(FEET) =   1.07
  TRAVEL TIME(MIN.) =   5.84   Tc(MIN.) =   13.52
  LONGEST FLOWPATH FROM NODE   2301.00 TO NODE   2400.00 =    1895.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2400.00 TO NODE   2400.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.467
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8400
  SUBAREA AREA(ACRES) =    9.20   SUBAREA RUNOFF(CFS) =   26.79
  TOTAL AREA(ACRES) =       20.8   TOTAL RUNOFF(CFS) =      60.58
  TC(MIN.) =   13.52

****************************************************************************
  FLOW PROCESS FROM NODE   2400.00 TO NODE   2500.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     46.00  DOWNSTREAM(FEET) =     43.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   700.00   CHANNEL SLOPE =  0.0036
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      60.58
  FLOW VELOCITY(FEET/SEC.) =   2.35   FLOW DEPTH(FEET) =   1.06
  TRAVEL TIME(MIN.) =   4.97   Tc(MIN.) =   18.49
  LONGEST FLOWPATH FROM NODE   2301.00 TO NODE   2500.00 =    2595.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE   2500.00 TO NODE   2500.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.834
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8176
  SUBAREA AREA(ACRES) =    9.80   SUBAREA RUNOFF(CFS) =   21.38
  TOTAL AREA(ACRES) =       30.6   TOTAL RUNOFF(CFS) =      70.89
  TC(MIN.) =   18.49

****************************************************************************
  FLOW PROCESS FROM NODE   2500.00 TO NODE   2600.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     44.00  DOWNSTREAM(FEET) =     42.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   450.00   CHANNEL SLOPE =  0.0033
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      70.89
  FLOW VELOCITY(FEET/SEC.) =   2.42   FLOW DEPTH(FEET) =   1.19
  TRAVEL TIME(MIN.) =   3.10   Tc(MIN.) =   21.59
  LONGEST FLOWPATH FROM NODE   2301.00 TO NODE   2600.00 =    3045.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2600.00 TO NODE   2600.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.564
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8109
  SUBAREA AREA(ACRES) =    5.00   SUBAREA RUNOFF(CFS) =    9.87
  TOTAL AREA(ACRES) =       35.6   TOTAL RUNOFF(CFS) =      74.01
  TC(MIN.) =   21.59

****************************************************************************
  FLOW PROCESS FROM NODE   2600.00 TO NODE   2700.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     42.50  DOWNSTREAM(FEET) =     41.70
```

```
  CHANNEL LENGTH THRU SUBAREA(FEET) =   310.00   CHANNEL SLOPE =  0.0026
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      74.01
  FLOW VELOCITY(FEET/SEC.) =   2.26   FLOW DEPTH(FEET) =   1.30
  TRAVEL TIME(MIN.) =   2.29   Tc(MIN.) =   23.88
  LONGEST FLOWPATH FROM NODE   2301.00 TO NODE   2700.00 =    3355.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2700.00 TO NODE   2700.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.402
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8142
  SUBAREA AREA(ACRES) =    4.60   SUBAREA RUNOFF(CFS) =    9.28
  TOTAL AREA(ACRES) =       40.2   TOTAL RUNOFF(CFS) =      78.64
  TC(MIN.) =   23.88

****************************************************************************
  FLOW PROCESS FROM NODE   2700.00 TO NODE   2800.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     41.70  DOWNSTREAM(FEET) =     41.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   240.00   CHANNEL SLOPE =  0.0029
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      78.64
  FLOW VELOCITY(FEET/SEC.) =   2.40   FLOW DEPTH(FEET) =   1.30
  TRAVEL TIME(MIN.) =   1.67   Tc(MIN.) =   25.55
  LONGEST FLOWPATH FROM NODE   2301.00 TO NODE   2800.00 =    3595.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2800.00 TO NODE   2800.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.300
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8191
  SUBAREA AREA(ACRES) =    9.30   SUBAREA RUNOFF(CFS) =   17.97
  TOTAL AREA(ACRES) =       49.5   TOTAL RUNOFF(CFS) =      93.25
  TC(MIN.) =   25.55
```

```
****************************************************************************
  FLOW PROCESS FROM NODE   2800.00 TO NODE   2900.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    29.20  DOWNSTREAM(FEET) =    25.90
  FLOW LENGTH(FEET) =   660.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  48.0 INCH PIPE IS  38.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.74
  ESTIMATED PIPE DIAMETER(INCH) =  48.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      93.25
  PIPE TRAVEL TIME(MIN.) =   1.26    Tc(MIN.) =   26.81
  LONGEST FLOWPATH FROM NODE   2301.00 TO NODE   2900.00 =    4255.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2900.00 TO NODE   2900.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.230
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8104
  SUBAREA AREA(ACRES) =   10.60   SUBAREA RUNOFF(CFS) =   18.20
  TOTAL AREA(ACRES) =       60.1   TOTAL RUNOFF(CFS) =     108.60
  TC(MIN.) =   26.81

****************************************************************************
  FLOW PROCESS FROM NODE   2900.00 TO NODE   3000.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    25.90  DOWNSTREAM(FEET) =    23.50
  FLOW LENGTH(FEET) =   470.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  51.0 INCH PIPE IS  39.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.18
  ESTIMATED PIPE DIAMETER(INCH) =  51.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     108.60
  PIPE TRAVEL TIME(MIN.) =   0.85    Tc(MIN.) =   27.66
  LONGEST FLOWPATH FROM NODE   2301.00 TO NODE   3000.00 =    4725.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   3000.00 TO NODE   3000.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
```

```
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.185
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8083
  SUBAREA AREA(ACRES) =    3.40   SUBAREA RUNOFF(CFS) =    5.72
  TOTAL AREA(ACRES) =       63.5   TOTAL RUNOFF(CFS) =     112.15
  TC(MIN.) =   27.66

****************************************************************************
  FLOW PROCESS FROM NODE   3000.00 TO NODE   3100.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    23.50  DOWNSTREAM(FEET) =    12.00
  FLOW LENGTH(FEET) =   555.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  39.0 INCH PIPE IS  31.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  15.49
  ESTIMATED PIPE DIAMETER(INCH) =  39.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     112.15
  PIPE TRAVEL TIME(MIN.) =   0.60    Tc(MIN.) =   28.26
  LONGEST FLOWPATH FROM NODE   2301.00 TO NODE   3100.00 =    5280.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   3100.00 TO NODE   3100.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.155
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8069
  SUBAREA AREA(ACRES) =    2.40   SUBAREA RUNOFF(CFS) =    3.98
  TOTAL AREA(ACRES) =       65.9   TOTAL RUNOFF(CFS) =     114.60
  TC(MIN.) =   28.26
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       65.9  TC(MIN.) =     28.26
  PEAK FLOW RATE(CFS)   =     114.60
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2016 Advanced Engineering Software (aes)
             Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                           Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)         *
* JN: 701290.15                                                           *
* PROPOSED CONDITION; BASIN 3200, 100-YEAR, 6-HOUR STORM EVENT            *
 **************************************************************************

  FILE NAME: CVP32H00.RAT
  TIME/DATE OF STUDY: 10:43 08/14/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   3201.00 TO NODE   3202.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     48.00
  DOWNSTREAM ELEVATION(FEET) =     47.90
  ELEVATION DIFFERENCE(FEET) =      0.10
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.169
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   3202.00 TO NODE   3200.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     47.90  DOWNSTREAM(FEET) =     46.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   390.00   CHANNEL SLOPE =  0.0049
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.136
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.15
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.06
  AVERAGE FLOW DEPTH(FEET) =   0.23   TRAVEL TIME(MIN.) =   6.12
  Tc(MIN.) =   10.29
  SUBAREA AREA(ACRES) =     2.50       SUBAREA RUNOFF(CFS) =    8.68
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  TOTAL AREA(ACRES) =        2.6         PEAK FLOW RATE(CFS) =       9.03

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.32   FLOW VELOCITY(FEET/SEC.) =   1.34
  LONGEST FLOWPATH FROM NODE   3201.00 TO NODE   3200.00 =     455.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.6  TC(MIN.) =     10.29
  PEAK FLOW RATE(CFS)   =       9.03
```

==
==
END OF RATIONAL METHOD ANALYSIS

```
****************************************************************************

             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                          2003,1985,1981 HYDROLOGY MANUAL
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              Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                             Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)         *
* JN: 701290.15 (SHORT TRENCH ONLY)                                       *
* PROPOSED CONDITION; BASIN 2900, 100-YEAR, 6-HOUR STORM EVENT            *
 **************************************************************************

  FILE NAME: CVP29H00.RAT
  TIME/DATE OF STUDY: 10:46 10/10/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   2901.00 TO NODE   2092.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     68.00
  DOWNSTREAM ELEVATION(FEET) =     66.00
  ELEVATION DIFFERENCE(FEET) =      2.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.594
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   2902.00 TO NODE   2900.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   66.00  DOWNSTREAM ELEVATION(FEET) =   38.00
  STREET LENGTH(FEET) =   770.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      13.28
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.43
    HALFSTREET FLOOD WIDTH(FEET) =   15.20
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.47
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.35
  STREET FLOW TRAVEL TIME(MIN.) =   2.35   Tc(MIN.) =    4.94
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    4.60      SUBAREA RUNOFF(CFS) =   25.45
```

```
  TOTAL AREA(ACRES) =        4.7        PEAK FLOW RATE(CFS) =      26.00

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.52   HALFSTREET FLOOD WIDTH(FEET) =  20.92
  FLOW VELOCITY(FEET/SEC.) =  6.42   DEPTH*VELOCITY(FT*FT/SEC.) =   3.35
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L =  770.0 FT WITH ELEVATION-DROP =  28.0 FT, IS   25.5 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE   2900.00
  LONGEST FLOWPATH FROM NODE   2901.00 TO NODE   2900.00 =     835.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2904.00 TO NODE   2900.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8010
  SUBAREA AREA(ACRES) =    5.90   SUBAREA RUNOFF(CFS) =   29.92
  TOTAL AREA(ACRES) =       10.6   TOTAL RUNOFF(CFS) =      55.93
  TC(MIN.) =    4.94

****************************************************************************
  FLOW PROCESS FROM NODE   2900.00 TO NODE   3000.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     38.00  DOWNSTREAM(FEET) =     31.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   480.00   CHANNEL SLOPE =  0.0146
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      55.93
  FLOW VELOCITY(FEET/SEC.) =   3.64   FLOW DEPTH(FEET) =   0.68
  TRAVEL TIME(MIN.) =   2.20   Tc(MIN.) =    7.14
  LONGEST FLOWPATH FROM NODE   2901.00 TO NODE   3000.00 =    1315.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   3000.00 TO NODE   3000.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.237
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7930
```

```
  SUBAREA AREA(ACRES) =    3.70   SUBAREA RUNOFF(CFS) =   14.92
  TOTAL AREA(ACRES) =       14.3   TOTAL RUNOFF(CFS) =      59.38
  TC(MIN.) =    7.14

****************************************************************************
  FLOW PROCESS FROM NODE   3000.00 TO NODE   3100.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     31.00  DOWNSTREAM(FEET) =     29.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   610.00   CHANNEL SLOPE =  0.0033
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      59.38
  FLOW VELOCITY(FEET/SEC.) =   2.28   FLOW DEPTH(FEET) =   1.07
  TRAVEL TIME(MIN.) =   4.46   Tc(MIN.) =   11.60
  LONGEST FLOWPATH FROM NODE   2901.00 TO NODE   3100.00 =    1925.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   3100.00 TO NODE   3100.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.828
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7892
  SUBAREA AREA(ACRES) =    2.80   SUBAREA RUNOFF(CFS) =    8.25
  TOTAL AREA(ACRES) =       17.1   TOTAL RUNOFF(CFS) =      59.38
  TC(MIN.) =   11.60
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       17.1  TC(MIN.) =     11.60
  PEAK FLOW RATE(CFS)   =      59.38
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************

             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                          2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2016 Advanced Engineering Software (aes)
              Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                           Analysis prepared by:






 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)         *
* JN: 701290.15                                                           *
* PROPOSED CONDITION; BASIN 3300, 100-YEAR, 6-HOUR EVENT                  *
 **************************************************************************

  FILE NAME: CVP33H00.RAT
  TIME/DATE OF STUDY: 10:45 08/14/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   3301.00 TO NODE   3302.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     64.00
  DOWNSTREAM ELEVATION(FEET) =     63.90
  ELEVATION DIFFERENCE(FEET) =      0.10
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.169
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   3302.00 TO NODE   3304.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   63.90  DOWNSTREAM ELEVATION(FEET) =   50.00
  STREET LENGTH(FEET) =  1880.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.86
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.31
    HALFSTREET FLOOD WIDTH(FEET) =    9.37
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.87
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.59
  STREET FLOW TRAVEL TIME(MIN.) =  16.78   Tc(MIN.) =   20.95
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.614
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
```

```
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    2.42
  TOTAL AREA(ACRES) =        1.2        PEAK FLOW RATE(CFS) =       2.63

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.34   HALFSTREET FLOOD WIDTH(FEET) =  10.90
  FLOW VELOCITY(FEET/SEC.) =  2.02   DEPTH*VELOCITY(FT*FT/SEC.) =   0.69
  LONGEST FLOWPATH FROM NODE   3301.00 TO NODE   3304.00 =    1945.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   3304.00 TO NODE   3300.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   50.00  DOWNSTREAM ELEVATION(FEET) =   46.00
  STREET LENGTH(FEET) =   570.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.28
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.44
    HALFSTREET FLOOD WIDTH(FEET) =   15.66
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.44
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.07
  STREET FLOW TRAVEL TIME(MIN.) =   3.89   Tc(MIN.) =   24.84
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.342
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    3.70      SUBAREA RUNOFF(CFS) =    7.28
  TOTAL AREA(ACRES) =        4.9        PEAK FLOW RATE(CFS) =       9.64

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.50   HALFSTREET FLOOD WIDTH(FEET) =  18.55
  FLOW VELOCITY(FEET/SEC.) =  2.71   DEPTH*VELOCITY(FT*FT/SEC.) =   1.35
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L =  570.0 FT WITH ELEVATION-DROP =   4.0 FT, IS   20.5 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE   3300.00
```

```
  LONGEST FLOWPATH FROM NODE   3301.00 TO NODE   3300.00 =    2515.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   3306.00 TO NODE   3300.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.342
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8018
  SUBAREA AREA(ACRES) =    5.90   SUBAREA RUNOFF(CFS) =   10.64
  TOTAL AREA(ACRES) =       10.8   TOTAL RUNOFF(CFS) =      20.28
  TC(MIN.) =   24.84
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       10.8  TC(MIN.) =     24.84
  PEAK FLOW RATE(CFS)   =      20.28
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2016 Advanced Engineering Software (aes)
             Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                           Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)         *
* JN: 701290.15                                                           *
* PROPOSED CONDITION; BASIN 3400, 100-YEAR, 6-HOUR STORM EVENT            *
 **************************************************************************

  FILE NAME: CVP34H00.RAT
  TIME/DATE OF STUDY: 10:48 08/14/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   3401.00 TO NODE   3402.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     51.00
  DOWNSTREAM ELEVATION(FEET) =     50.90
  ELEVATION DIFFERENCE(FEET) =      0.10
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.169
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   3402.00 TO NODE   3400.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     50.90  DOWNSTREAM(FEET) =     44.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   570.00   CHANNEL SLOPE =  0.0121
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.985
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.99
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.41
  AVERAGE FLOW DEPTH(FEET) =   0.17   TRAVEL TIME(MIN.) =   6.73
  Tc(MIN.) =   10.90
  SUBAREA AREA(ACRES) =     2.50       SUBAREA RUNOFF(CFS) =    8.37
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  TOTAL AREA(ACRES) =        2.6         PEAK FLOW RATE(CFS) =       8.70

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.24   FLOW VELOCITY(FEET/SEC.) =   1.73
  LONGEST FLOWPATH FROM NODE   3401.00 TO NODE   3400.00 =     635.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.6  TC(MIN.) =     10.90
  PEAK FLOW RATE(CFS)   =       8.70
```

===
===
END OF RATIONAL METHOD ANALYSIS

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2016 Advanced Engineering Software (aes)
             Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                           Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)         *
* JN: 701290.15                                                           *
* PROPOSED CONDITION; BASIN3800, 100-YEAR, 6-HOUR STORM EVENT             *
 **************************************************************************

  FILE NAME: CVP38H00.RAT
  TIME/DATE OF STUDY: 13:19 08/19/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   3801.00 TO NODE   3802.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     52.10
  DOWNSTREAM ELEVATION(FEET) =     52.00
  ELEVATION DIFFERENCE(FEET) =      0.10
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.169
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   3802.00 TO NODE   3804.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   52.00  DOWNSTREAM ELEVATION(FEET) =   46.00
  STREET LENGTH(FEET) =   720.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.17
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.36
    HALFSTREET FLOOD WIDTH(FEET) =   11.45
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.22
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.79
  STREET FLOW TRAVEL TIME(MIN.) =   5.41   Tc(MIN.) =    9.58
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.331
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
```

```
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    1.40      SUBAREA RUNOFF(CFS) =    5.09
  TOTAL AREA(ACRES) =        1.5        PEAK FLOW RATE(CFS) =       5.46

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.41   HALFSTREET FLOOD WIDTH(FEET) =  14.34
  FLOW VELOCITY(FEET/SEC.) =  2.51   DEPTH*VELOCITY(FT*FT/SEC.) =   1.04
  LONGEST FLOWPATH FROM NODE   3801.00 TO NODE   3804.00 =     785.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   3806.00 TO NODE   3800.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.331
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8195
  SUBAREA AREA(ACRES) =    0.62   SUBAREA RUNOFF(CFS) =    2.07
  TOTAL AREA(ACRES) =        2.1   TOTAL RUNOFF(CFS) =       7.53
  TC(MIN.) =    9.58

****************************************************************************
  FLOW PROCESS FROM NODE   3808.00 TO NODE   3800.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.331
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7918
  SUBAREA AREA(ACRES) =    2.70   SUBAREA RUNOFF(CFS) =    9.00
  TOTAL AREA(ACRES) =        4.8   TOTAL RUNOFF(CFS) =      16.53
  TC(MIN.) =    9.58
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.8  TC(MIN.) =      9.58
  PEAK FLOW RATE(CFS)   =      16.53
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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              Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                           Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)          *
* JN: 701290.15                                                            *
* PROPOSED CONDITION; BASIN 3900, 100-YEAR, 6-HOUR STORM EVENT             *
 **************************************************************************

  FILE NAME: CVP39H00.RAT
  TIME/DATE OF STUDY: 10:53 08/14/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   3901.00 TO NODE   3902.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     50.00
  DOWNSTREAM ELEVATION(FEET) =     49.90
  ELEVATION DIFFERENCE(FEET) =      0.10
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.169
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   3902.00 TO NODE   3904.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     49.90  DOWNSTREAM(FEET) =     44.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   160.00   CHANNEL SLOPE =  0.0369
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.741
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.76
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.32
  AVERAGE FLOW DEPTH(FEET) =   0.07   TRAVEL TIME(MIN.) =   2.02
  Tc(MIN.) =    6.19
  SUBAREA AREA(ACRES) =     0.50       SUBAREA RUNOFF(CFS) =    2.41
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       2.89

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.09   FLOW VELOCITY(FEET/SEC.) =   1.60
  LONGEST FLOWPATH FROM NODE   3901.00 TO NODE   3904.00 =     225.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   3904.00 TO NODE   3900.00 IS CODE =  62
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
==============================================================================
  UPSTREAM ELEVATION(FEET) =   44.00  DOWNSTREAM ELEVATION(FEET) =   41.30
  STREET LENGTH(FEET) =   390.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.75
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.45
    HALFSTREET FLOOD WIDTH(FEET) =   16.13
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.48
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.11
  STREET FLOW TRAVEL TIME(MIN.) =   2.62   Tc(MIN.) =    8.81
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.572
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  SUBAREA AREA(ACRES) =    2.00      SUBAREA RUNOFF(CFS) =    7.68
  TOTAL AREA(ACRES) =        2.6        PEAK FLOW RATE(CFS) =       9.98

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.50   HALFSTREET FLOOD WIDTH(FEET) =  19.05
  FLOW VELOCITY(FEET/SEC.) =  2.71   DEPTH*VELOCITY(FT*FT/SEC.) =   1.37
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L =  390.0 FT WITH ELEVATION-DROP =   2.7 FT, IS   11.1 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE   3900.00
  LONGEST FLOWPATH FROM NODE   3901.00 TO NODE   3900.00 =     615.00 FEET.
==============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.6  TC(MIN.) =      8.81
  PEAK FLOW RATE(CFS)   =       9.98
==============================================================================
==============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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             Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                          2003,1985,1981 HYDROLOGY MANUAL
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              Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                           Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)          *
* JN: 701290.15                                                            *
* PROPOSED CONDITION; BASIN 4000, 100-YEAR, 6-HOUR STORM EVENT             *
 **************************************************************************

  FILE NAME: CVP40H00.RAT
  TIME/DATE OF STUDY: 10:55 08/14/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   4001.00 TO NODE   4002.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     49.00
  DOWNSTREAM ELEVATION(FEET) =     48.90
  ELEVATION DIFFERENCE(FEET) =      0.10
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.169
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   4002.00 TO NODE   4004.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     48.90  DOWNSTREAM(FEET) =     47.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   320.00   CHANNEL SLOPE =  0.0059
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.873
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.57
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.74
  AVERAGE FLOW DEPTH(FEET) =   0.10   TRAVEL TIME(MIN.) =   7.22
  Tc(MIN.) =   11.39
  SUBAREA AREA(ACRES) =     0.60       SUBAREA RUNOFF(CFS) =    1.95
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  TOTAL AREA(ACRES) =        0.7         PEAK FLOW RATE(CFS) =       2.28

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.13   FLOW VELOCITY(FEET/SEC.) =   0.84
  LONGEST FLOWPATH FROM NODE   4001.00 TO NODE   4004.00 =     385.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   4004.00 TO NODE   4000.00 IS CODE =  31
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    47.00  DOWNSTREAM(FEET) =    46.90
  FLOW LENGTH(FEET) =   154.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  13.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   1.63
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.28
  PIPE TRAVEL TIME(MIN.) =   1.58    Tc(MIN.) =   12.97
  LONGEST FLOWPATH FROM NODE   4001.00 TO NODE   4000.00 =     539.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   4006.00 TO NODE   4000.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.562
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7820
  SUBAREA AREA(ACRES) =    3.40   SUBAREA RUNOFF(CFS) =    9.33
  TOTAL AREA(ACRES) =        4.1   TOTAL RUNOFF(CFS) =      11.42
  TC(MIN.) =   12.97

****************************************************************************
  FLOW PROCESS FROM NODE   4008.00 TO NODE   4000.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.562
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7791
  SUBAREA AREA(ACRES) =    1.30   SUBAREA RUNOFF(CFS) =    3.57
  TOTAL AREA(ACRES) =        5.4   TOTAL RUNOFF(CFS) =      14.99
  TC(MIN.) =   12.97
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        5.4  TC(MIN.) =     12.97
  PEAK FLOW RATE(CFS)   =      14.99
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2016 Advanced Engineering Software (aes)
             Ver. 23.0 Release Date: 07/01/2016  License ID 1649

                              Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* CARLSBAD VILLAGE DOUBLE TRACK PROJECT (PRELIMINARY ENGINEERING)         *
* JN: 701290.15                                                           *
* PROPOSED CONDITION; BASIN 4100, 100-YEAR, 6-HOUR STORM EVENT            *
 **************************************************************************

  FILE NAME: CVP41H00.RAT
  TIME/DATE OF STUDY: 09:43 10/09/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE   4101.00 TO NODE   4102.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     46.00
  DOWNSTREAM ELEVATION(FEET) =     42.00
  ELEVATION DIFFERENCE(FEET) =      4.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.059
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE   4102.00 TO NODE   4100.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     42.00  DOWNSTREAM(FEET) =     28.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1606.00   CHANNEL SLOPE =  0.0087
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.166
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.97
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.03
  AVERAGE FLOW DEPTH(FEET) =   0.14   TRAVEL TIME(MIN.) =  25.98
  Tc(MIN.) =   28.04
  SUBAREA AREA(ACRES) =     2.20       SUBAREA RUNOFF(CFS) =    4.00
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.840
  TOTAL AREA(ACRES) =        2.3         PEAK FLOW RATE(CFS) =       4.19

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.17   FLOW VELOCITY(FEET/SEC.) =   1.19
  LONGEST FLOWPATH FROM NODE   4101.00 TO NODE   4100.00 =    1671.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.3  TC(MIN.) =     28.04
  PEAK FLOW RATE(CFS)   =       4.19
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Carlsbad Vilage Double Track
JN: 701290.15
10/30/19

Trench Drain Design - Rational Method Calculations

100-yr, 6-hr Precipitation (in) = ***2.5***

						Rational Method Parameters							
Trench Alternative	**Pump Station ID**	**Rail Upstation**	**Rail Downstation**	**Flow Length (ft)**	**Trench Half-Width (ft)**	**Drainage Area (acres)**	**% Impervious**	**Runoff Coefficient (0% Impervious, Type B Soils)[1]**	**Runoff Coefficient (100% Impervious)[1]**	**Weighted Runoff Coefficient[1]**	**Proposed Rail Longitudinal Slope (%)**	**Modeled Channel Longitudinal Slope (%)[2]**	**Maximum Overland Flow Length (L_M) (ft)**
Short Trench	**PS-S1**	235903.18	233482.78	2,420	27.5	1.6	100%	0.25	0.9	0.9	0.39%	0.5%	50
		233482.78	232060.51	1,422	27.5	0.9	100%	0.25	0.9	0.9	0.06%	0.5%	50
		232060.51	229500.00	2,561	27.5	1.7	100%	0.25	0.9	0.9	1.15%	1.2%	60
						4.2							
Long Trench	**PS-L1**	235903.91	235521.12	383	27.5	0.3	100%	0.25	0.9	0.9	0.39%	0.5%	50
		235521.12	231369.24	4,152	27.5	2.7	100%	0.25	0.9	0.9	0.06%	0.5%	50
						3.0							
	PS-L2	231369.24	229727.12	1,642	27.5	1.1	100%	0.25	0.9	0.9	0.17%	0.5%	50
		229727.12	227494.16	2,233	27.5	1.5	100%	0.25	0.9	0.9	1.09%	1.2%	60
						2.6							

Notes:
1. Runoff Coefficients are based on guidance in the County of San Diego Hydrology Manual (2003), Table 3-1.
2. For the purposes of the hydrology calculations, the channel slope has been modeled as slightly steeper to reduce the time of concentration. In actuality, it is assumed that the drainage channel slope is limited to rail profile slopes.
3. The Initial Time of Concentration and Travel Time are calculated based on Section 3.1.4 of the County of San Diego Hydrology Manual (2003).
4. Reference Flowmaster calculations for calculation of channel velocity within trench drain.
5. The Precipitation Intensity if calculated based on equation provided in Section 3.1.3 of the County of San Diego Hydrology Manual (2003).
6. The confluencing of flows from each half of the trench is based on Section 3.4.2 of the County of San Diego Hydrology Manual (2003).

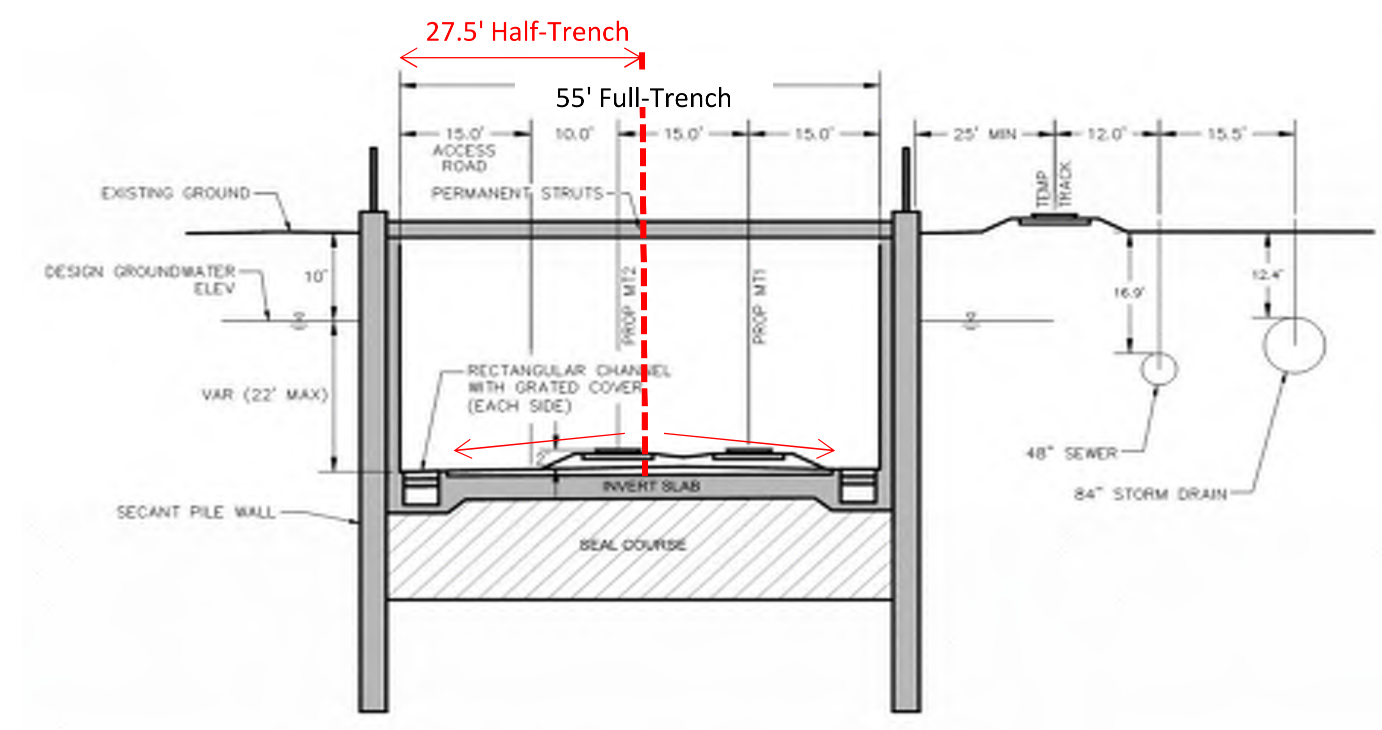
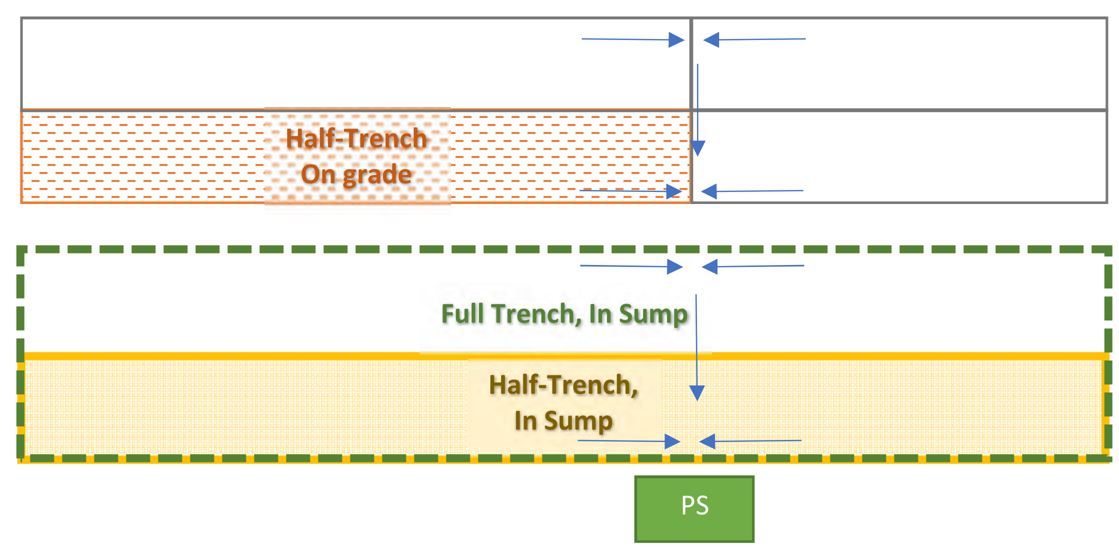


Figure 6.1: Typical Section of Trench (Looking North)

Rational Method Parameters (Contd.)					Trench Drain Design	Emergency Overflow Design		Pump Station Design	
Initial Time of Concentration, T_i[3] (min.)	Average Velocity[4] (ft/sec)	Travel Time, T_t[3] (min.)	Time of Concentration (min.)[3]	100-year Precipitation Intensity (in/hr)[5]	100-year Peak Flow Rate, Q_{100} (Half-Trench, On-grade) (cfs)	Time of Concentration (Confluenced) (min.)	100-year Peak Flow Rate, Q_{100} (Half-Trench, In Sump, Confluenced)[6] (cfs)	100-year Peak Flow Rate, Q_{100} (Full-Trench, In Sump, Confluenced) (cfs)	100-year Peak Flow Rate, Q_{100} (Full-Trench, In Sump, Confluenced) (gpm)
3.2	2.1	18.8	22.0	2.5	3.6	34.2	7.2	14.4	5,400
3.2	2.1	10.9	17.1	1.9	4.5				
2.6	2.7	15.4	17.1						
3.2	2.1	2.6	8.9	4.5	1.2	29.2	5.7	11.4	4,300
3.2	2.1	32.6	29.2	2.1	5.1				
3.2	2.1	12.6	18.4	2.8	2.8	18.4	6.7	13.3	5,000
2.6	2.7	13.4	16.0	3.1	4.2				



**** The color scheme in the schematic above matches the column headings above for ease of reference.***

Rational Method Calculations - Coastal Rail Trail

100-year, 6-hour Precipittion | ***2.5 inches***

	Existing Condition					Proposed Condition					
Drainage Outlet	**Drainage Area (ac.)**	**Runoff Coefficient, C**	**Time of Concentration, Tc (min.)**	**Precipitation Intensity (in/hr)**	**100-year Peak Flow Rate, Q100 (cfs)**	**Drainage Area (ac.)**	**Runoff Coefficient, C**	**Time of Concentration, Tc (min.)**	**Precipitation Intensity (in/hr)**	**100-year Peak Flow Rate, Q100 (cfs)**	**Increase?**
3500	1.7	0.77	5	6.59	8.6	1.1	0.77	5	6.59	5.6	No
3600	1.4	0.77	5	6.59	7.1	0.8	0.77	5	6.59	4.1	No
3700	0.9	0.77	5	6.59	4.6	0.5	0.77	5	6.59	2.5	No

Notes:
1. A minimum time of concentration of 5 minutes is assumed.
2. Runoff Coefficients and precipitation intensities are based on the County of San Diego Hydrolog Manual (2003).

APPENDIX C

HYDROLOGY SUMMARY

- Hydrology Summary Table
- Confluencing Calculation for Drainage Areas West of the Trench contributing to the existing 84-inch RCP

Hydrology Summary - 100-year Peak Flow Rates

Drainage Node		Existing Condition			Proposed Condition (Long Trench)					Proposed Condition (Short Trench)				
(Outlet)	Outlet Description	Q100 (cfs)	A (acres)	Tc (min.)	Q100 (cfs)	A (acres)	Tc (min.)	Increase?	Notes	Q100 (cfs)	A (acres)	Tc (min.)	Increase?	Notes
100	Buena Vista Lagoon	13.7	7.6	24.8	13.7	7.6	24.7	-						
200	Buena Vista Lagoon	42.5	21.4	21.4	42.5	21.4	21.4	-						
300	Buena Vista Lagoon	88.1	26.3	11.0	144.6	64.3	19.3	Yes	*new storm drain proposed					
400	Buena Vista Lagoon	18.7	5.5	10.6	22.2	4.7	6.2	Yes	It's anticipated that the proposed biofiltration BMP can be sized to provide incidental flood control detention benefit. (BMP TS1)					
500	Grated Inlet at the cul-de-sac north of the Station connected to the 66-inch Storm Drain	9.6	2.4	8.3	9.4	2.3	8.3	-						
600	Inlets in the Station parking lot and in the adjacent alley that are connected to the 66-inch Storm Drain	28.3	6.0	6.4	25.3	5.4	6.5	-						
700	Inlet located on the Station driveway east of the Station Building that connects to the 66-inch Storm Drain	3.8	0.7	5.0	2.6	0.5	5.0	-						
800	Inlet located on the westerly corner of the Grand Ave Station entrance that connects to the 66-inch Storm Drain	1.1	0.2	5.0	0.9	0.2	5.0	-						
900	Inlet located on Grand Ave across the street from the Station Entrance	1.4	0.5	12.6	1.0	0.2	5.0	-						
1000	Inlet located on Carlsbad Village Dr. east of the Historic Depot parking lot entrance	1.1	0.2	5.0	1.1	0.2	5.0	-						
1100	Inlet located on the south side of Carlsbad Village Dr. across the street from the Historic Depot parking lot entrance	1.7	0.3	5.0	1.6	0.3	5.0	-		Same as Proposed Condition (Long Trench)				
1200	Inlet located on the east side of the railroad tracks at the end of Oak Ave that is connected to the Santa Fe Storm Drain	20.6	5.2	8.4	18.8	4.8	8.4	-						
1300	Several Inlets located along the Coastal Rail Trail from Oak Ave south to the end of the project that are connected to the Santa Fe Storm Drain	17.7	3.7	5.5	17.0	3.5	5.4	-						
1400	Inlet located on the northeast corner of Grand Ave and Washington St that leads to the 66-inch Storm Drain	11.1	2.0	5.0	Flows to Outlet at Drainage Node 300 (proposed SD)									
1500	Inlet located on the southwest corner of Grand Ave and Washington St that leads to the 66-inch Storm Drain	15.9	2.9	5.1	Flows to Outlet at Drainage Node 300 (proposed SD)									
1600	Inlet located on the northwest corner of Carlsbad Village Dr and Washington St that leads to the 66-inch Storm Drain	19.0	3.8	5.1	Flows to Outlet at Drainage Node 300 (proposed SD)									
2000	Headwall located on the west side of the tracks at the end of Oak Ave that leads to the Santa Fe Storm Drain	86.4	30.5	13.8	Flows to Outlet at Drainage Node 3100 (proposed SD)									
2300	Existing 24-inch PVC at Chestnut Avenue connecting to the existing 84-inch RCP mainline east of the tracks.	46.8	11.3	7.8	Flows to Outlet at Drainage Node 3100 (proposed SD)									
2400	Existing 24-inch RCP at Acacia Avenue connecting to the existing 84-inch RCP mainline east of the tracks.	56.4	13.6	7.0	Flows to Outlet at Drainage Node 3100 (proposed SD)									
2800	Existing 36-inch RCP at Tamarck Avenue connecting to the existing 84-inch RCP mainline east of the tracks.	75.2	28.1	15.5	Flows to Outlet at Drainage Node 3100 (proposed SD)					93.3	49.5	25.6	Yes	* new storm drain connection to 84-inch RCP

Hydrology Summary - 100-year Peak Flow Rates

Drainage Node (Outlet)	Outlet Description	Existing Condition			Proposed Condition (Long Trench)					Proposed Condition (Short Trench)				
		Q100 (cfs)	A (acres)	Tc (min.)	Q100 (cfs)	A (acres)	Tc (min.)	Increase?	Notes	Q100 (cfs)	A (acres)	Tc (min.)	Increase?	Notes
3100	Existing / Proposed (Short) - Agua Hedionda Lagoon Proposed (Long) - Connection to Existing 84-inch RCP	59.4	17.1	11.6	114.6	65.9	28.3	Yes	* new storm drain connection to 84-inch RCP	59.4	17.1	11.6	-	
3200	Inlet located on the southwest corner of commerical development near Walnut Av and Tyler St that leads to 84-inch Storm Drain	10.3	2.9	10.0	9.0	2.5	10.3	-		Same as Proposed Condition (Long Trench)				
3300	Inlet on Chestnut Av at the end of the cul-de-sac which leads to 84-inch Storm Drain	20.9	11.1	24.8	20.3	10.8	24.8	-						
3400	Inlet in a residential complex south of Chestnut Av which leads to 84-inch Storm Drain	8.7	2.6	10.9	8.7	2.6	10.9	-						
3500*	Portion of Coastal Rail Trail discharging to Existing 84-inch RCP	8.6	1.7	5.0	5.6	1.1	5.0	-						
3600*	Portion of Coastal Rail Trail discharging to Existing 84-inch RCP	7.1	1.4	5.0	4.1	0.8	5.0	-						
3700*	Portion of Coastal Rail Trail discharging to Existing 84-inch RCP	4.6	0.9	5.0	2.5	0.5	5.0	-						
3800	Pair of inlets on Tamarack Av which leads to a lateral that connects to the 84-inch Storm Drain	16.8	4.9	9.6	16.5	4.8	9.6	-						
3900	Inlet at the northwest corner of Long Pl and Chinquapin Av which leads to 84-inch Storm Drain	10.4	2.7	8.8	10.0	2.6	8.8	-						
4000	Inlet at the southwest corner of Long Pl and Chinquapin Av which leads to 84-inch Storm Drain	15.0	5.4	13.0	15.0	5.4	13.0	-						
4100	Inlet within a residential complex south of Chinquapin Av which leads to 84-inch Storm Drain	7.6	3.7	23.3	4.2	2.3	28.0	-						

Notes:
1. Coastal Rail Trail Rational Method calculations were completed in Excel in both existing and proposed conditions. Refer to Appendix B.
2. Drainage calculations for areas within the trench are not included in this table. Refer to Appendix B.

Comparison of Q100 Contribution to Existing 84-inch RCP (Areas West of Trench Only)

Drainage Node (Outlet)	Outlet Description	Existing Condition				Shortest Tc Index (i)	Q_{Ti} (cfs)	Approximate Confluenced Q100 (cfs)	Approximate Confluenced Tc (min.)
		Q100 (cfs)	A (acres)	Tc (min.)	Precipitation Intensity (in/hr)				
2000	Headwall located on the west side of the tracks at the end of Oak Ave that leads to the Santa Fe Storm Drain	86.4	30.5	13.8	3.4	3	222.5	222.5	13.8
2300	Existing 24-inch PVC at Chestnut Avenue connecting to the existing 84-inch RCP mainline east of the tracks.	46.8	11.3	7.8	4.9	2	186.3		
2400	Existing 24-inch RCP at Acacia Avenue connecting to the existing 84-inch RCP mainline east of the tracks.	56.4	13.6	7.0	5.3	1	176.4		
2800	Existing 36-inch RCP at Tamarck Avenue connecting to the existing 84-inch RCP mainline east of the tracks.	75.2	28.1	15.5	3.2	4	219.7		

Notes:
1. The confluencing of four streams is calculated using the procedure outlined in Section 3.4.2 of the County of San Diego Hydrology Manual (2003).
2. The confleunced Q100 can be used for comparison against the proposed condition connections into the existing 84-inch RCP to see if there are any impacts. Refer to Drainage Study text for more information.

APPENDIX D

HYDROLOGY BACK-UP

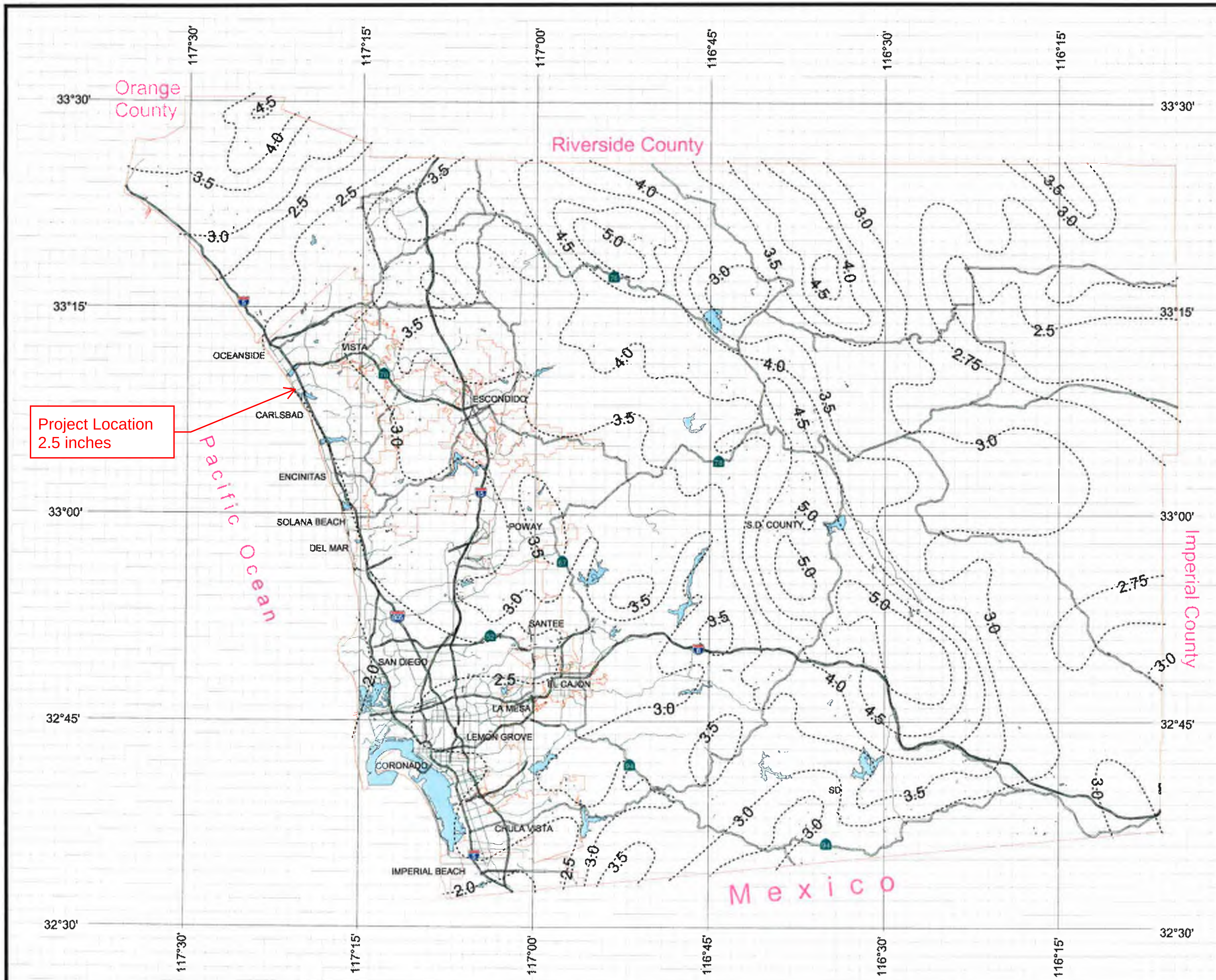
- Runoff Coefficient
- Intensity-Duration-Frequency Chart
- Time of Concentration
- Isopluvial Map Precipitation Data
- NRCS Hydrologic Soil Group

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

NOTES: *The majority of the developed drainage areas within the project study area are approximately be 80% to 90% impervious and the dominant Hydrologic Soil Group is Type B; therefore, a runoff coefficient of 0.77 or 0.84 is utilized. For remaining areas which are less developed, the runoff coefficient can be calculated by weighting a 0% impervious C = 0.25 with an 100% impervious C = 0.90. Refer to the hydrologic calculations in Appendix A and B.*



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

....	Isopluvial (inches)

DPW GIS

Department of Public Works Geographic Information Services

SanGIS

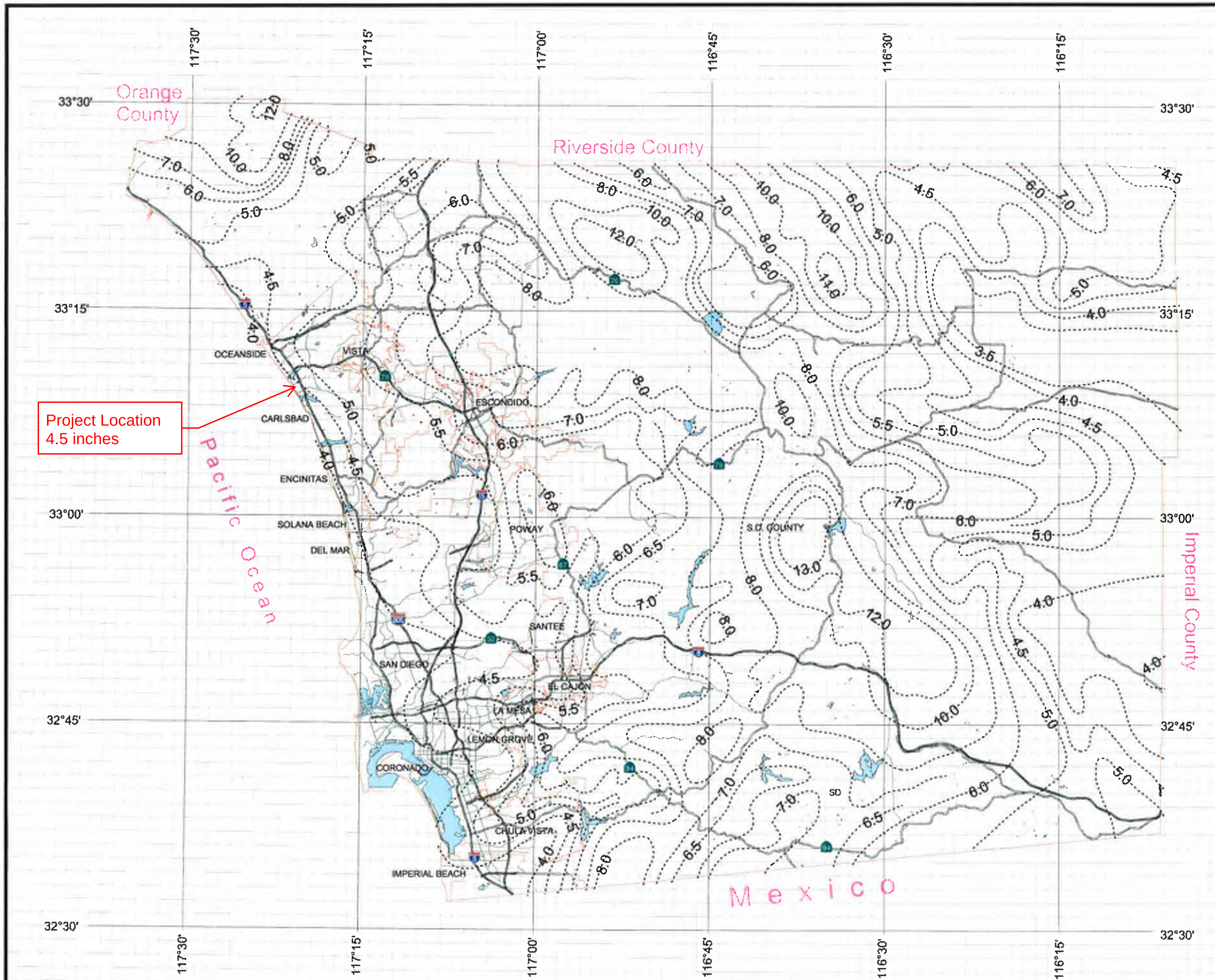
We Have San Diego Covered!

N S E W

3 0 3 Miles

County of San Diego Hydrology Manual

Rainfall Isopluviala



100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

DPW GIS

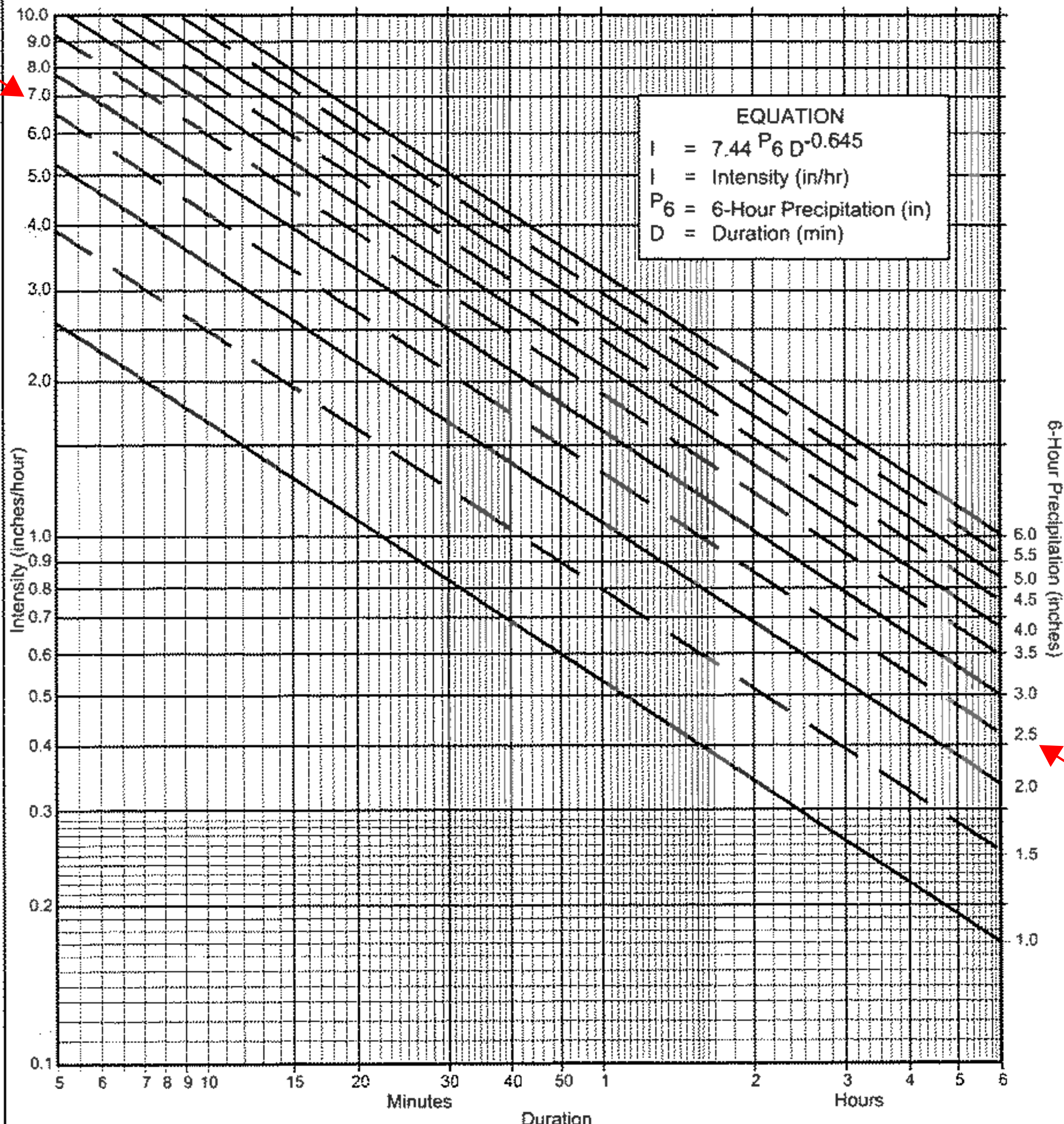
Department of Public Works
Geographic Information Services

SanGIS

We Have San Diego Covered!

N
W
E
S

3 0 3 Miles



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicapie to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 2.5 in., P_{24} = 4.5, $\frac{P_6}{P_{24}}$ = 56 %(2)

(c) Adjusted $P_6^{(2)}$ = 2.5 in.

(d) t_x = ______ min. see AES analyses

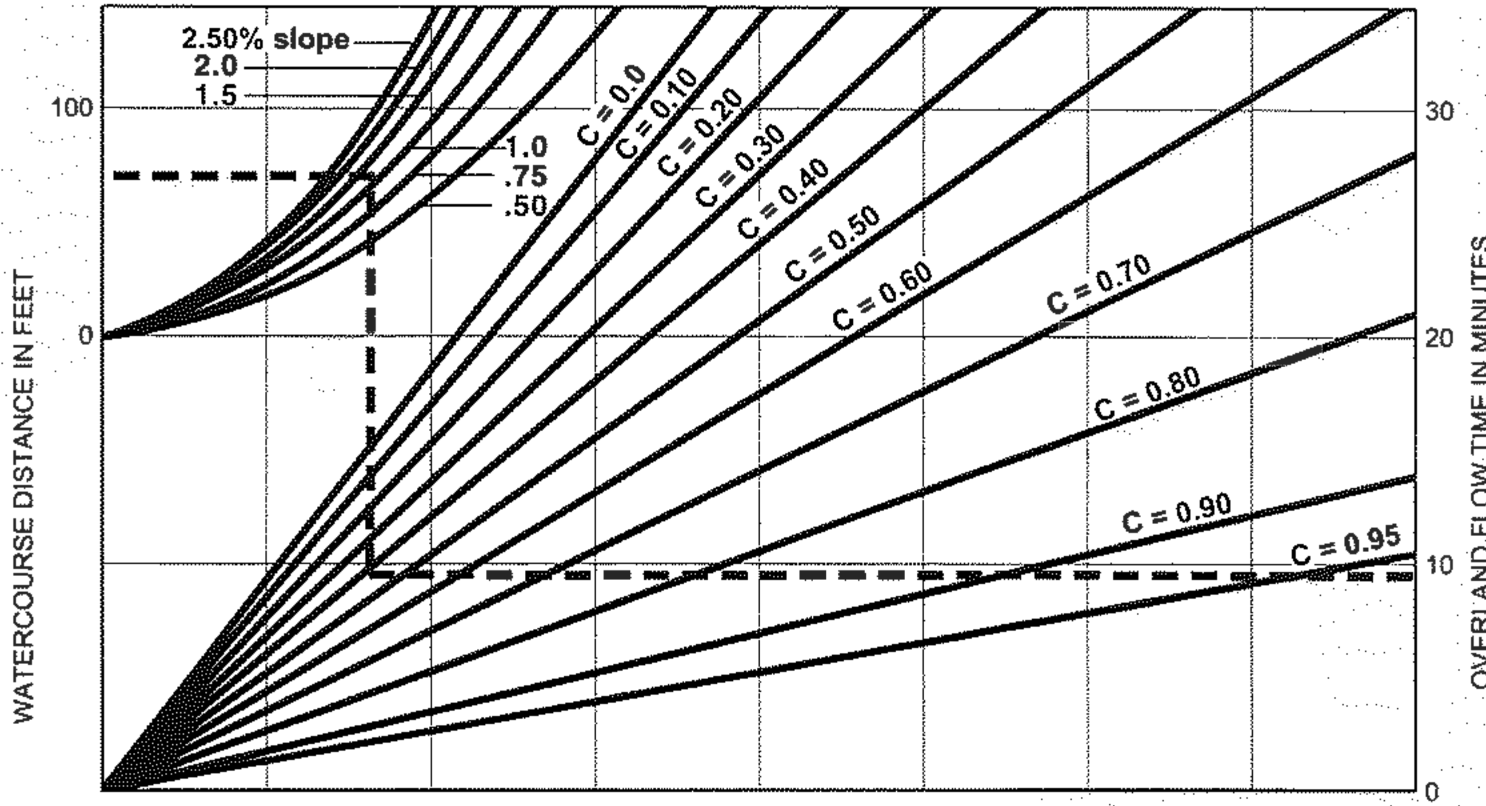
(e) I = ______ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6 / Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE 3-1



EXAMPLE:

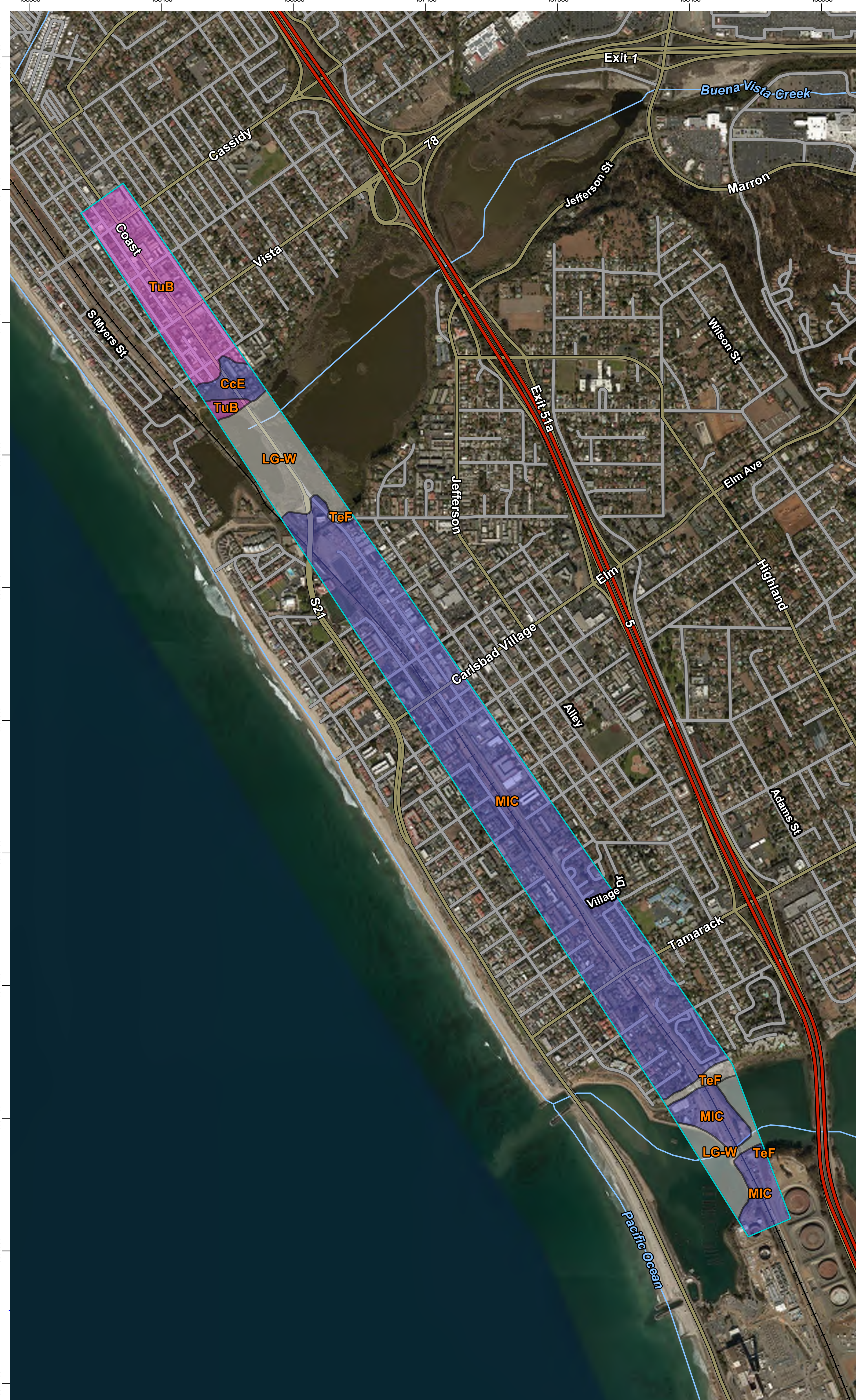
Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE **3-3**

Rational Formula - Overland Time of Flow Nomograph



Map Scale: 1:14,800 if printed on B portrait (11" x 17") sheet.

N

Meters: 0, 200, 400, 800, 1200

Feet: 0, 500, 1000, 2000, 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Diego County Area, California
Survey Area Data: Version 13, Sep 12, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jan 1, 1999—Oct 22, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
CcE	Carlsbad-Urban land complex, 9 to 30 percent slopes	B	6.6	2.4%
LG-W	Lagoon water		39.1	13.9%
MlC	Marina loamy coarse sand, 2 to 9 percent slopes	B	188.5	67.2%
TeF	Terrace escarpments		4.1	1.5%
TuB	Tujunga sand, 0 to 5 percent slopes	A	42.4	15.1%
Totals for Area of Interest			**280.7**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX E

HYDRAULIC CALCULATIONS

- Open Channel Sizing Calculations
- Inlet Sizing
- Storm Drain Sizing Calculations
- Trench Pump Station Schematic

Trapezoidal Channel (70129015_AdjacentTrackChannelCalculations.fm8)

Label	Solve For	Friction Method	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)
Trapezoidal Channel - Node 2200 to 2100	Bottom Width	Manning Formula	0.030	0.005	12.0
Trapezoidal Channel - Node 2100 to 2000	Bottom Width	Manning Formula	0.030	0.005	12.0
Trapezoidal Channel - Node 2300 to 2400	Bottom Width	Manning Formula	0.030	0.003	24.0
Trapezoidal Channel - Node 2400 to 2500	Bottom Width	Manning Formula	0.030	0.003	24.0
Trapezoidal Channel - Node 2500 to 2600	Bottom Width	Manning Formula	0.030	0.003	24.0
Trapezoidal Channel - Node 2600 to 2700	Bottom Width	Manning Formula	0.030	0.003	24.0
Trapezoidal Channel - Node 2700 to 2800	Bottom Width	Manning Formula	0.030	0.003	24.0

Left Side Slope (H:V)	Right Side Slope (H:V)	Bottom Width (ft)	Discharge (cfs)	Flow Area (ft^2)	Wetted Perimeter (ft)
4.000	4.000	8.73	36.80	12.7	17.0
4.000	4.000	12.35	49.10	16.4	20.6
4.000	4.000	1.95	48.70	19.9	18.4
4.000	4.000	3.79	60.60	23.6	20.3
4.000	4.000	5.34	70.90	26.7	21.8
4.000	4.000	5.80	74.00	27.6	22.3
4.000	4.000	6.48	78.60	29.0	23.0

Hydraulic Radius (in)	Top Width (ft)	Critical Depth (in)	Critical Slope (ft/ft)	Velocity (ft/s)	Velocity Head (ft)
9.0	16.73	8.8	0.016	2.89	0.13
9.5	20.35	8.7	0.016	3.00	0.14
13.0	17.95	16.1	0.020	2.45	0.09
13.9	19.79	15.7	0.020	2.57	0.10
14.7	21.34	15.4	0.019	2.66	0.11
14.9	21.80	15.4	0.019	2.68	0.11
15.1	22.48	15.3	0.019	2.71	0.11

Specific Energy (ft)	Froude Number	Flow Type	Notes	Messages
1.13	0.584	Subcritical		
1.14	0.591	Subcritical		
2.09	0.410	Subcritical		
2.10	0.415	Subcritical		
2.11	0.419	Subcritical		
2.11	0.420	Subcritical		
2.11	0.422	Subcritical		

Target Permissible Velocity for coarse gravel < 4 fps

Rectangular Channel (70129015_TrenchDrainChannelCalculations.fm8)

Label	Solve For	Friction Method	Roughness Coefficient	Channel Slope (%)	Normal Depth (in)
Rectangular Channel - Capacity Calc - 0.2%, 3-ft (W) x 1.0-ft (D)	Normal Depth	Manning Formula	0.015	0.20	9.0
Rectangular Channel - Capacity Calc - 0.4%, 3-ft (W) x 1.0-ft (D)	Normal Depth	Manning Formula	0.015	0.40	9.0
Rectangular Channel - Capacity Calc - 1.2%, 3-ft (W) x 1.0-ft (D)	Normal Depth	Manning Formula	0.015	1.20	9.0
Rectangular Channel - Capacity Calc - 0.06%, 3-ft (W) x 1.25-ft (D)	Normal Depth	Manning Formula	0.015	0.06	12.0

Bottom Width (ft)	Discharge (cfs)	Flow Area (ft²)	Wetted Perimeter (ft)	Hydraulic Radius (in)	Top Width (ft)
3.00	6.30	2.3	4.5	6.0	3.00
3.00	8.90	2.3	4.5	6.0	3.00
3.00	15.40	2.3	4.5	6.0	3.00
3.00	5.20	3.0	5.0	7.2	3.00

Critical Depth (in)	Critical Slope (%)	Velocity (ft/s)	Velocity Head (ft)	Specific Energy (ft)	Froude Number
6.2	0.61	2.79	0.12	0.87	0.568
7.8	0.61	3.95	0.24	0.99	0.803
11.2	0.64	6.84	0.73	1.48	1.392
5.4	0.61	1.73	0.05	1.05	0.304

Flow Type	Notes	Messages
Subcritical		
Subcritical		
Supercritical		
Subcritical		

Discharge Capacities based on slope

Notes:
1. For ease of construction, a uniform trench drain channel cross-section is desired. Therefore, these capacity calculations have been prepared to demonstrate the Q capacity of these channels. As a result, a trench drain channel geometry of 3-ft wide (to match the trench grate) x 15-inches deep is proposed throughout with the exception of the reaches of the trench which are sloped at 0.06%. These areas require a deeper cross-section of 18-inches to convey the peak flow rate tributary to the trench.
2. The depth of each trench is set based on the flow depth + 3-inches of freeboard + 3-inch (+/-) trench grate thickness.

Inlet Sizing Calculations

Inlet sizing is calculated per Chapter 5 of the City of Carlsbad General Design Standards, Drainage and Storm Drain Standards.

Node	**Sump/ Flow-by**	**Q (cfs)**	**Inlet Size, Calculated (ft)**	**Inlet Size, Actual (ft)**
303	Sump	22.33	11.17	12.00
307	Sump	10.42	5.21	6.00

Where:

Node = Drainage node number per Proposed Condition Hydrology Map

Q = Peak 100-year runoff in cubic feet per second

Inlet Size, Calculated = Q/2 in feet

> -Section 4A -Curb inlets at a sump condition should be designated for two CFS per linear foot of opening when headwater may rise to the top of the curb.

Inlet Size, Actual = Inlet Size, Calculated rounded up to nearest 2' increment for constructability

Circular Pipe (70129015_PipeSizing.fm8)

Label	Solve For	Friction Method	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)
Circular Pipe - Capacity - 36" RCP	Full Flow Capacity	Manning Formula	0.013	0.005	36.0
Circular Pipe - Capacity - 42" RCP	Full Flow Capacity	Manning Formula	0.013	0.005	42.0
Circular Pipe - Capacity - 48" RCP	Full Flow Capacity	Manning Formula	0.013	0.005	48.0
Circular Pipe - Capacity - 54" RCP	Full Flow Capacity	Manning Formula	0.013	0.005	54.0
Circular Pipe - Capacity - 60" RCP	Full Flow Capacity	Manning Formula	0.013	0.005	60.0

Diameter (in)	Discharge (cfs)	Flow Area (ft²)	Wetted Perimeter (ft)	Hydraulic Radius (in)	Top Width (ft)
36	47.2	7.1	9.4	9.0	0.00
42	71.1	9.6	11.0	10.5	0.00
48	101.6	12.6	12.6	12.0	0.00
54	139.0	15.9	14.1	13.5	0.00
60	184.2	19.6	15.7	15.0	0.00

Critical Depth (in)	Percent Full (%)	Critical Slope (ft/ft)	Velocity (ft/s)	Velocity Head (ft)	Specific Energy (ft)
26.8	100.0	0.006	6.67	0.69	3.69
31.7	100.0	0.006	7.39	0.85	4.35
36.6	100.0	0.006	8.08	1.02	5.02
41.6	100.0	0.006	8.74	1.19	5.69
46.6	100.0	0.006	9.38	1.37	6.37

Froude Number	Maximum Discharge (cfs)	Discharge Full (cfs)	Slope Full (ft/ft)	Flow Type	Notes
(N/A)	50.7	47.2	0.005	Undefined	
(N/A)	76.5	71.1	0.005	Undefined	
(N/A)	109.3	101.6	0.005	Undefined	
(N/A)	149.6	139.0	0.005	Undefined	
(N/A)	198.1	184.2	0.005	Undefined	

Messages

Diameter (in)	**Adjusted Discharge* (cfs)**
36	36.3
42	54.7
48	78.2
54	106.9
60	141.7

*To account for junction losses, minor bend losses, etc., a 30% scaling factor has been applied to the FlowMaster calculated storm drain flow capacity. The 'Adjusted Discharge' rates to the left have been used for sizing the proposed storm drains.

Preliminary Pipe Sizing Summary

Short Trench and Long Trench Alternatives ***Storm Drain Flowing North to Buena Vista Lagoon***			
AES Drainage Node	**Storm Drain Length (ft)**	**100-year Peak Flow Rate Q_{100} (cfs)**	**Proposed Storm Drain Diameter (in.)**
300 (Outfall into Buena Vista Lagoon)			
↑	780	144.6	60
308			
↑	670	107.4	54
307			
↑	780	95.8	54
1500			
↑	290	83.9	48
1600			
↑	550	78.8	48
2000 (Oak Avenue)			

Short Trench Alternative ***Storm Drain Flowing South to Agua Hedionda Lagoon***			
AES Drainage Node	**Storm Drain Length (ft)**	**100-year Peak Flow Rate Q_{100} (cfs)**	**Proposed Storm Drain Diameter (in.)**
2800 (Tamarack Avenue)			
↓	80	93.3	54
84-inch RCP @ Tamarack Avenue			

Long Trench Alternative ***Storm Drain Flowing South to Agua Hedionda Lagoon***			
AES Drainage Node	**Storm Drain Length (ft)**	**100-year Peak Flow Rate Q_{100} (cfs)**	**Proposed Storm Drain Diameter (in.)**
2800 (Tamarack Avenue)			
↓	660	93.3	54
2900			
↓	470	108.6	54
3000			
↓	555	114.6	54
3100 (Confluence with Existing 84-inch RCP)			

Notes:
1. The proposed storm drain diameters have been sized based on the anticipate pipe conveyance capacity. See Flowmaster calculations for back-up.

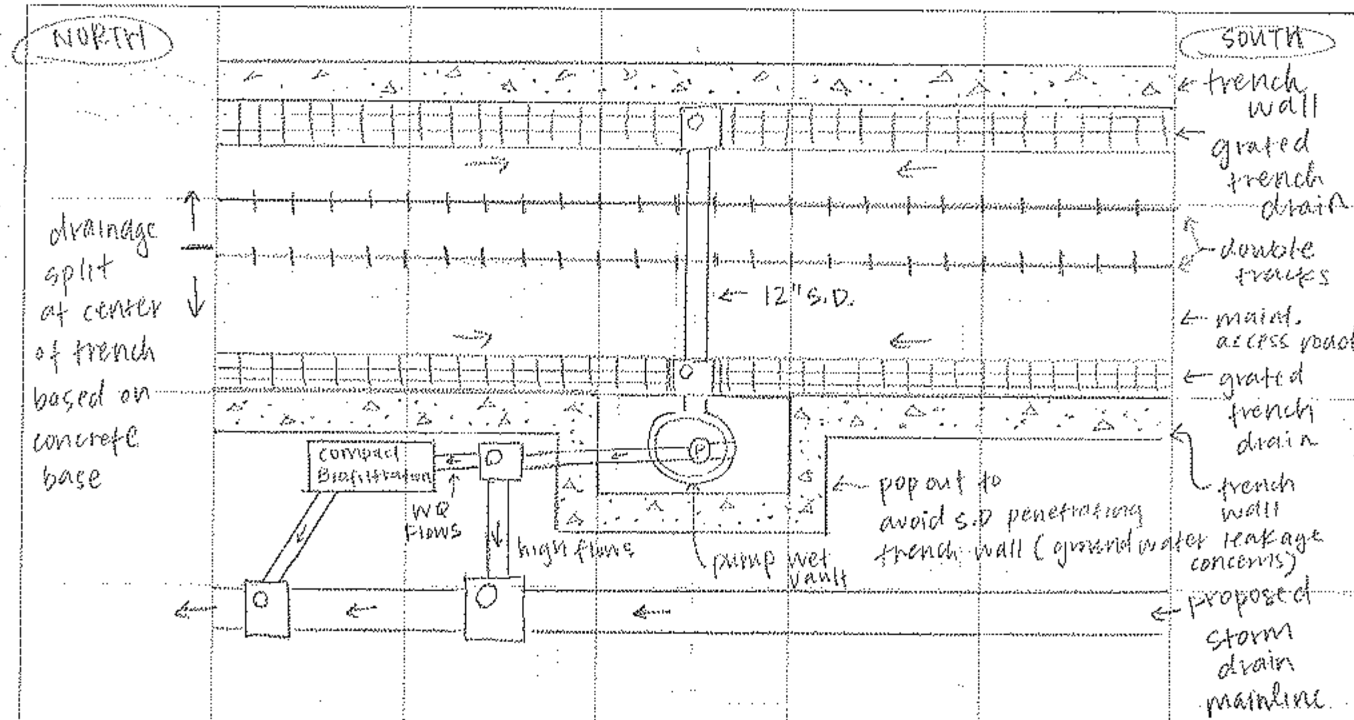
T·Y·LIN INTERNATIONAL

Project: Carlsbad Village Double Track | Job No. 701290.15 | Sheet: 1 of 1

Item: Preliminary pump station & water quality treatment concept for drainage within proposed trench | Designer: SLL | Date: 10/6/19

Checker: | Date:

Grid: 1/10"



Notes:

1. All drainage within the trench will be collected within trench drains on the East and West sides of the trench using a continuous linear trench drain system anticipated to be approximately 3-ft wide. Once flows enter the trench, the drainage flows within a concrete rectangular channel until it reaches the sump.
2. Once the drainage reaches the sump, the flows will be piped to the west to a proposed pump station designed to bring at least the Q_{100} to the surface for discharge. This is necessary because the trench is within groundwater.
3. A cleanout is proposed at the surface to split water quality flows and larger flows to reduce the Q to the compact biofiltration BMP to only what is required. Larger flows can be discharged directly into the mainline storm drain system.

APPENDIX F

DRAINAGE EXHIBITS

- Existing Condtion Drainage Exhibits (3 Sheets)
- Proposed Condition Drainage Exhibits -Short Trench Alternative (3 Sheets)
- Proposed Condition Drainage Exhibits – Long Trench Alternative (3 Sheets)

SOURCE OF TOPOGRAPHY:
NORTH–20130418; SOUTH–20190515
VERTICAL DATUM: NGVD29
HORIZONTAL DATUM: CCS83 (1991.35), ZONE 6

CARLSBAD VILLAGE DOUBLE TRACK
SHORT/LONG TRENCH ALTERNATIVE
EXISTING CONDITION HYDROLOGY MAP - SHEET 1 of 3
Date: 10/10/2019

100 50 0 100 200

SCALE 1"= 100'

SOURCE OF TOPOGRAPHY:
NORTH-20130418; SOUTH-20190515
VERTICAL DATUM: NGVD29
HORIZONTAL DATUM: CCS83 (1991.35), ZONE 6

CARLSBAD VILLAGE DOUBLE TRACK
SHORT/LONG TRENCH ALTERNATIVE
EXISTING CONDITION HYDROLOGY MAP - SHEET 2 of 3
Date: 10/10/2019

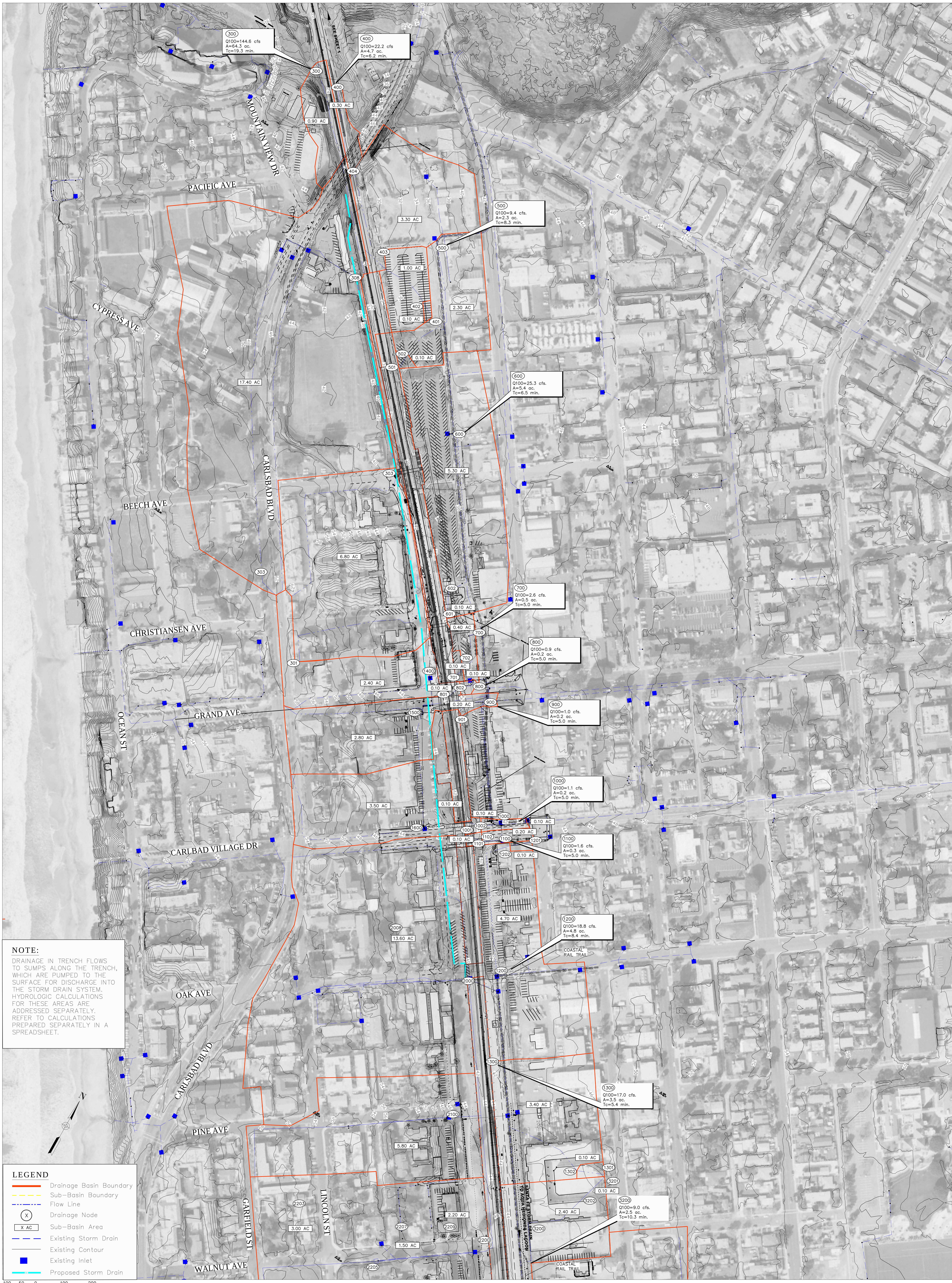
SOURCE OF TOPOGRAPHY:
NORTH–20130418; SOUTH–20190515
VERTICAL DATUM: NGVD29
HORIZONTAL DATUM: CCS83 (1991.35), ZONE 6

CARLSBAD VILLAGE DOUBLE TRACK
SHORT/LONG TRENCH ALTERNATIVE
EXISTING CONDITION HYDROLOGY MAP - SHEET 3 of 3
Date: 10/10/2019

100 50 0 100 200
SCALE 1"= 100'

SOURCE OF TOPOGRAPHY:
NORTH-20130418; SOUTH-20190515
VERTICAL DATUM: NGVD29
HORIZONTAL DATUM: CCS83 (1991.35), ZONE 6

CARLSBAD VILLAGE DOUBLE TRACK
SHORT TRENCH ALTERNATIVE
PROPOSED CONDITION HYDROLOGY MAP - SHEET 1 of 3
Date: 10/10/2019



SOURCE OF TOPOGRAPHY:
NORTH–20130418; SOUTH–20190515
VERTICAL DATUM: NGVD29
HORIZONTAL DATUM: CCS83 (1991.35), ZONE 6

CARLSBAD VILLAGE DOUBLE TRACK
SHORT TRENCH ALTERNATIVE
PROPOSED CONDITION HYDROLOGY MAP - SHEET 2 of 3
Date: 10/10/2019

NOTE:

DRAINAGE IN TRENCH FLOWS TO SUMPS ALONG THE TRENCH, WHICH ARE PUMPED TO THE SURFACE FOR DISCHARGE INTO THE STORM DRAIN SYSTEM. HYDROLOGIC CALCULATIONS FOR THESE AREAS ARE ADDRESSED SEPARATELY. REFER TO CALCULATIONS PREPARED SEPARATELY IN A SPREADSHEET.

LEGEND

- Drainage Basin Boundary
- Sub-Basin Boundary
- Flow Line
- (X) Drainage Node
- X AC Sub-Basin Area
- Existing Storm Drain
- Existing Contour
- Existing Inlet
- Proposed Storm Drain

100 50 0 100 200

SCALE 1"= 100'

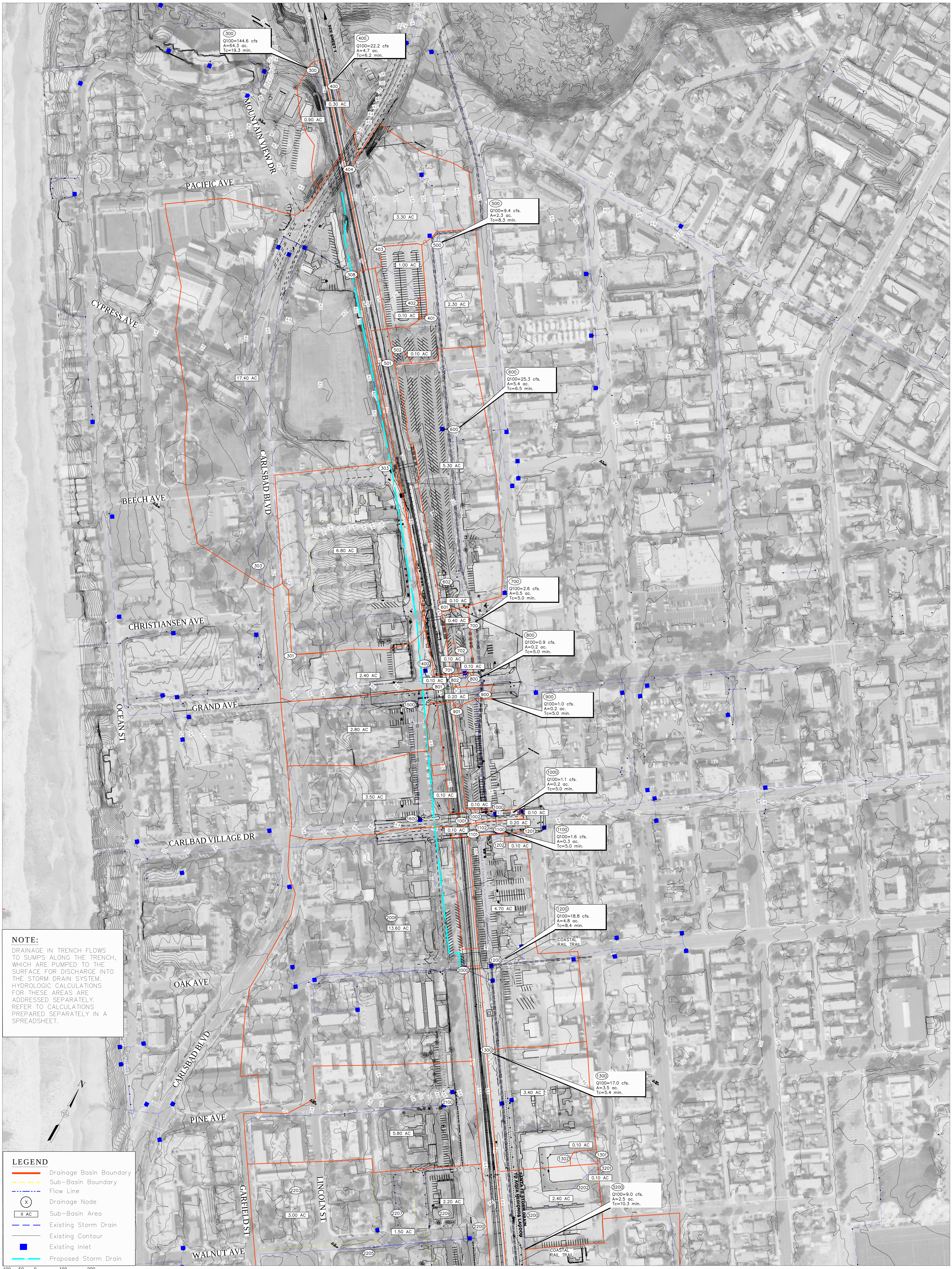
SOURCE OF TOPOGRAPHY:
NORTH–20130418; SOUTH–20190515
VERTICAL DATUM: NGVD29
HORIZONTAL DATUM: CCS83 (1991.35), ZONE 6

CARLSBAD VILLAGE DOUBLE TRACK
SHORT TRENCH ALTERNATIVE
PROPOSED CONDITION HYDROLOGY MAP - SHEET 3 of 3
Date: 10/10/2019

100 50 0 100 200
SCALE 1"= 100'

SOURCE OF TOPOGRAPHY:
NORTH–20130418; SOUTH–20190515
VERTICAL DATUM: NGVD29
HORIZONTAL DATUM: CCS83 (1991.35), ZONE 6

CARLSBAD VILLAGE DOUBLE TRACK
LONG TRENCH ALTERNATIVE
PROPOSED CONDITION HYDROLOGY MAP - SHEET 1 of 3
Date: 10/10/2019



SOURCE OF TOPOGRAPHY:
NORTH–20130418; SOUTH–20190515
VERTICAL DATUM: NGVD29
HORIZONTAL DATUM: CCS83 (1991.35), ZONE 6

CARLSBAD VILLAGE DOUBLE TRACK
LONG TRENCH ALTERNATIVE
PROPOSED CONDITION HYDROLOGY MAP - SHEET 2 of 3
Date: 10/10/2019

100 50 0 100 200

SCALE 1"= 100'

SOURCE OF TOPOGRAPHY:
NORTH–20130418; SOUTH–20190515
VERTICAL DATUM: NGVD29
HORIZONTAL DATUM: CCS83 (1991.35), ZONE 6

CARLSBAD VILLAGE DOUBLE TRACK
LONG TRENCH ALTERNATIVE
PROPOSED CONDITION HYDROLOGY MAP - SHEET 3 of 3
Date: 10/10/2019

ATTACHMENT G:

PRELIMINARY WATER QUALITY TECHNICAL REPORT

T·Y·LIN INTERNATIONAL
engineers | planners | scientists

CARLSBAD VILLAGE RAILROAD TRENCH

Preliminary Water Quality Technical Report (WQTR)

Oceanside, Ca and Carlsbad, Ca

October 2019

Prepared for:

SANDAG

Prepared by:

T.Y. Lin International
404 Camino Del Rio South, Suite 700
San Diego, Ca 92108
(619) 692-1920

REGISTERED PROFESSIONAL ENGINEER
SHU-WEN LUMBRERAS
No. C83318
Exp. 3-31-21
CIVIL
STATE OF CALIFORNIA

Table of Contents

LIST OF APPENDICES

ABBREVIATIONS

ac	Acre(s)
ac-ft	Acre feet
cfs	Cubic feet per second
CY	Cubic yard(s)
CF	Cubic feet
ft	Feet
in	Inch(es)
in/hr	Inch(es) per hour
min	Minute(s)
SF	Square feet

ACRONYMS

A	Drainage Area
AC	Asphalt Concrete
BMP	Best Management Practices
CASQA	California Stormwater Quality Association
DMA	Drainage Management Area
FHWA	Federal Highway Administration
FS	Finished Surface
HEC	Hydraulic Engineering Circular
HGL	Hydraulic Grade Line
I	Rainfall Intensity
IDF	Intensity-Duration-Frequency
LID	Low Impact Development
LOSSAN	Los Angeles-San Luis Obispo-San Diego Rail Corridor
MP	Milepost
NCTD	North County Transit District
NOAA	Administration
NPDES	National Pollution Discharge Elimination System
P_6	6-Hour Precipitation
PFDS	Precipitation Frequency Data Server
Q	Discharge / Runoff
RCP	Reinforced Concrete Pipe
ROW	Right-of-way
SANDAG	San Diego Association of Governments
T_c	Time of Concentration
V	Volume
WDR	Waste Discharge Requirements
WQTR	Water Quality Technical Report

1. PROJECT LOCATION

The Carlsbad Village Railroad Trench Project (Project) is located in the City of Carlsbad and the City of Oceanside, Ca. Like most regions of Southern California, Carlsbad and Oceanside have a Mediterranean climate with hot, dry summers and cool winters. Carlsbad and Oceanside have an annual rainfall about 10 inches, with most precipitation falling in the months between October and April.

The Project site is across the existing NCTD railroad tracks approximately between Mileposts (MP) 228.0 to 230.6, along 2.6 miles of railroad corridor from Agua Hedionda Lagoon in Carlsbad to Cassidy Street in Oceanside. See Location Map on page 2.

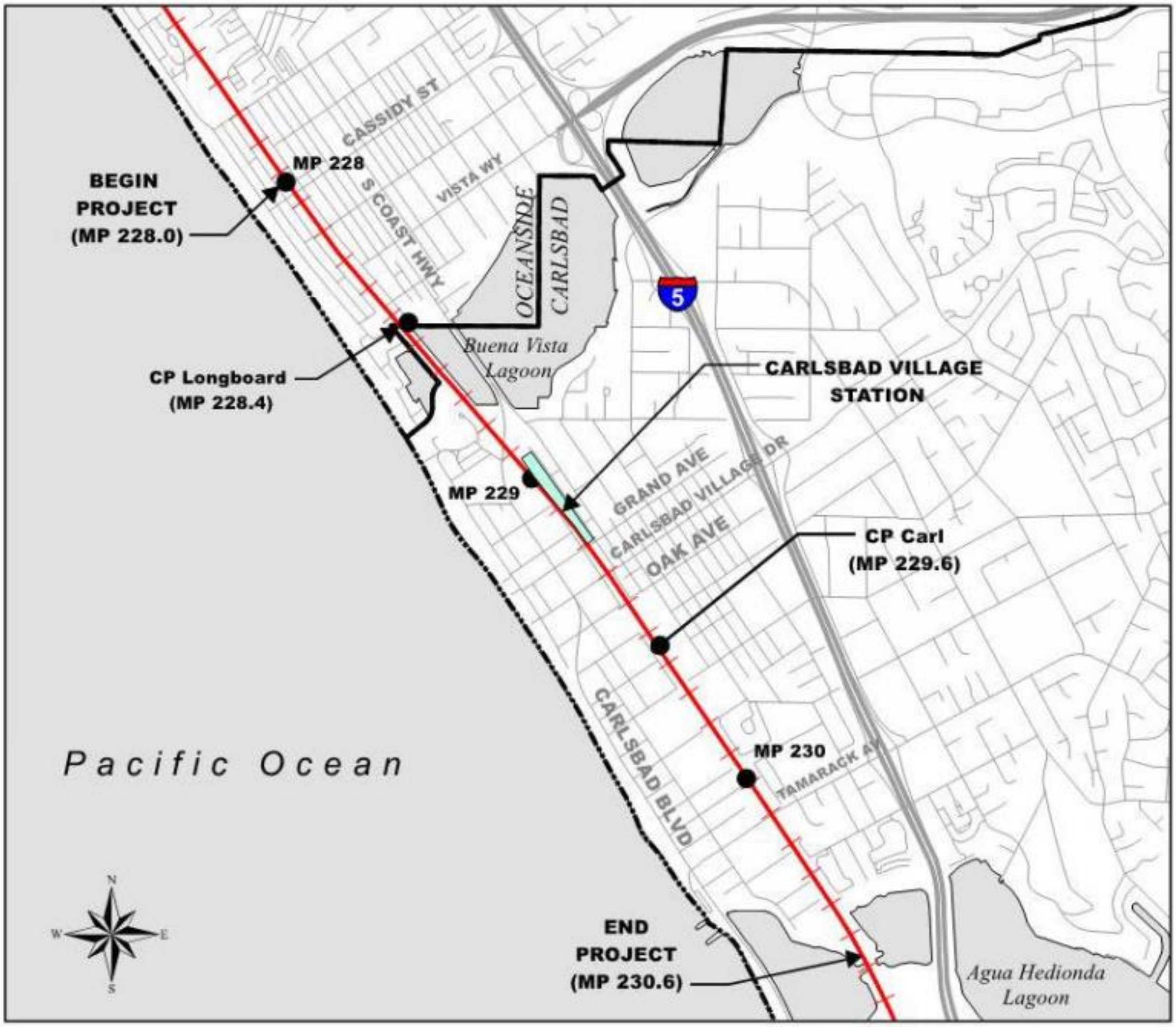
This project is located near the Pacific Ocean and spans across several watersheds within the Carlsbad Hydrologic Unit, including Agua Hedionda and Buena Vista Creek. The northern portion of the project drains to Buena Vista Lagoon and the southern portion drains to Agua Hedionda and both eventually discharge into the Pacific Ocean.

2. PROJECT DESCRIPTION

The project consists of the addition of a second railroad track from Cassidy Street in Oceanside south to Tamarack Avenue in Carlsbad. Two trench alternatives are considered for the project to include grade separation of the railroad tracks by constructing a trench beneath the existing street elevations. The first alternative, known as the Short Trench Alternative, would construct the double track railroad, lowered in a trench, passing under vehicular overpasses at Grand Avenue, Carlsbad Village Drive, and Oak Avenue, with pedestrian overpasses at Beech Ave/Carlsbad Village Station and Chestnut Avenue. The second alternative is the Long Trench Alternative, which would construct a railroad trench passing under vehicular overpasses at Grand Avenue, Carlsbad Village Drive, Oak Avenue, Chestnut Avenue, and Tamarack Avenue, with a pedestrian overpass at Beech Ave/Carlsbad Village Station. Both trench alternatives would require replacement of the Carlsbad Boulevard Overcrossing with a new bridge spanning the tracks.

Refer to the Preliminary Drainage Study for Carlsbad Village Double Track, concurrently being prepared with this report, for more information on flood control drainage.

Figure 1: Location Map



3. PRELIMINARY DESIGN CONSTRAINTS AND OPPORTUNITIES

As shown on the Drainage Management Area Exhibit in Appendix A, the proposed improvements will occur within NCTD right-of-way. The proposed impervious surfaces are located within the redeveloped train station and through the proposed limits of the trench. The remainder of the project is located within pervious areas and therefore is not subject to the water quality treatment reqirements.

Since the proposed trench is set below grade, off-site drainage from the City of Carlsbad is directed away from the proposed trench; however, direct rainfall into the trench needs to be addressed. Based on the two proposed track alternatives, the drainage within the track is directed into sumps and is collected into a wet vault for pumping to the surface, treatment and discharge. Based on the proposed track alignment, the pump stations are located on the west side of the tracks out of the way of the temporary shoofly track. Once low flows are pumped to the surface, there is limited space available to install a conventional biofiltration basin; therefore, compact biofiltration BMPs are more feasible for water quality treatment of the trench drainage.

The proposed trench traps drainage located west of the tracks that would otherwise connect to the mainline storm drain systems east of the tracks, thus necessitating the addition of two separate drainage systems each comprising of an open channel and storm drain system running parallel to the trench. For the portion that drains to the north, this will require a new storm drain outfall into Buena Vista Lagoon where the existing track ditch outfalls now. This could potentially present challenges with obtaining environmental permits.

Another constraint is the elevated groundwater table throughout the limits of the project, thus infiltration type BMPs are infeasible for this project.

The limits of the NCTD right-of-way is the narrowest where the tracks are crossing Tamarack Avenue; therefore it is necessary as part of the Long Trench Alternative to acquire three parcels on the southeast side of the crossing. The acquisition of this land presents an opportunity to incorporate a regional, multi-benefit storm water basin for serving a range of potential purposes such as water quality treatment, Trash Amendment compliance, and flood control detention. Additionally, the land could serve as a pocket park which would serve as a community amenity and rest stop for those traveling along the Coastal Rail Trail. Refer to Appendix E for an exhibit identifying the watershed area.

Another impact resulting from the project is the conflict of the new trench with an existing 84-inch storm drain system located within the City of Carlsbad which is located on the east side of the tracks and flows in a southerly direction towards Agua Hedionda. Since the proposed trench requires the realignment of the storm drain system further to the east, then there is an opportunity to install an offline full trash capture BMP to comply with the Trash Amendment requirements.

Ideally, the BMP would be elevated above the tidally influenced lagoon and would also account for the future impacts resulting from sea level rise. The new alignment of the 84-inch RCP would be within the existing Coastal Rail Trail and it is anticipated that the entire length of the trail would need to be reconstructed. The impervious portions of the trail would be subject to the water quality treatment requirements and it is anticipated that linear biofiltration BMPs would be implemented. This presents an opportunity to improve water quality.

4. WATER QUALITY ENVIRONMENT

4.1 Water Quality Regulations

NCTD is designated as a non-traditional permitee under the Phase II Small MS4 statewide general storm water permit and generates more than 1 acre of disturbance during construction. The project is located within NCTD Right-of-Way, therefore the applicable regulations include the following:

- State Water Resources Control Board Water Quality Order No. 2013-0001-DWQ National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000004 – Waste Discharge Requirements (WDRs) for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems (MS4s) (General Permit) [Also called Phase II Small MS4 Permit]
- State Water Resources Control Board Water Quality Order No. 2009-0009-DWQ (as amended by 2010-0014-DWQ and 2012-0006-DWQ) National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000002 for Storm Water Discharges Associated with Construction and Land Disturbance Activities [Also called Construction General Permit]

This report addresses the post-construction permanent storm water BMP requirements associated with the Phase II Small MS4 Permit.

4.2 TMDLs and 303(d) Listed Water Bodies

There are three receiving waters for the project site including Buena Vista Creek, Buena Vista Lagoon, and Agua Hedionda Lagoon.

Buena Vista Creek is 303(d) listed for the following pollutants:

- Benthic Community Effects
- Bifenthrin

Buena Vista Lagoon is 303(d) listed for the following pollutants:

- Indicator Bacteria
- Nutrients
- Sedimentation/Siltation
- Toxicity

Agua Hedionda Lagoon is 303(d) listed for the following pollutants:

- Toxicity

5. POLLUTANTS AND CONDITIONS OF CONCERN

5.1 Pollutants from Project Area

The project's expected pollutants of concern according to the NCTD Storm Water Management Plan (July 2019) include the following:

- Suspended Solids/Sediment – Sediment could be discharged due to erosion of pervious areas and suspended solids could come from the parking lot.
- Nutrients – Nitrogen and phosphorus from over fertilizing landscaped areas could potentially result in the discharge of nutrients.
- Heavy Metals – The parking lot could be a source of heavy metals coming off of brake pads.
- Pathogens – Litter from the train station areas could result in the addition of pathogens.
- Pesticides – The maintenance of landscaped areas oftentimes involves the use of pesticides for weed suppression.
- Oil and Grease – Parking lot runoff may included oils.
- Trash and Debris – The train station may contribute trash and debris due to littering by pedestrians.

6. POST CONSTRUCTION STORM WATER MANAGEMENT PRACTICES

The Project will create more than 5,000 square feet of impervious surface and is considered a Regulated Project according to the NCTD Storm Water Management Plan. Regulated Projects are required to implement measures for site design, source control, runoff reduction, storm water treatment, and baseline hydromodification management.

6.1 Site Design BMPs

The project will utilize the following standard site design BMPs, which are listed in the Phase II Small General Permit:

Impervious Area Disconnection: Runoff from the proposed Carlsbad Village Train Station parking lot will discharge into biofiltration basins for treatment. Similarly, the runoff from the reconstructed Coastal Rail Trail in the Long Trench Alternative will sheet flow into the adjacent pervious areas.

Soil Quality Improvement: Biofiltration basins are proposed for water quality treatment.

Refer to Site Design BMP fact sheets in Appendix D for more information.

6.2 Source Control BMPs

Source control BMPs will consist of measures to prevent pollutants from enterring stormwater runoff. Table 1 below provides the proposed permanent and operational source control measures.

Table 1: Permanent and Operational Source Control Measures

Potential source of runoff pollutants	*Permanent source control BMPs*	*Operational source control BMPs*
Erosion & sediment	• Design & Landscape Planning • Efficient Irrigation	
On-site Storm Drain Inlets	• Storm Drain Signage and Stenciling	
Trash Storage Areas	• Covered trash cans and large trash enclosures shielded from wind	
Landscape fertilizer and pesticide		• Minimize the use of fertilizers and pesticides to the extent practicable.

Pollutant generating activities associated with the project include:

- Parking/storage areas and maintenance
- Landscape/outdoor pesticide use
- Refuse areas

Refer to Source Control BMP fact sheets in Appendix D for more information.

6.3 Low Impact Development Site Design BMPs

Low Impact Development (LID) BMPs must be incorporated into the site design to meet the requirements of the Phase II Small MS4. The integrated LID outlines three strategies:

1. Optimize the site layout by preserving natural drainage features and design buildings and circulation to minimize the amount of roofs and paving.

2. Disperse runoff from impervious surfaces on the adjacent pervious surfaces (e.g., direct impervious runoff to pervious retention areas).

3. Drain impervious surfaces to engineered Treatment Control BMP’s, such as a bioretention basin.

The project design has implemented the above strategies. The site layout has been designed to preserve the existing vegetation where possible.

6.4 Water Quality Treatment and Baseline Hydromodification Management

Since this project is a Regulated Project then it is required to include water quality treatment and baseline hydromodification management measures. These measures shall infiltrate, evapotranspire, and/or bioretain the 85th percentile 24-hour storm. A hierarchy of BMP types were evaluated for feasibility based on project constraints and based on the project's target pollutants of concern. This hierarchy of BMPs to consider include facilities designed to evapotranspire, infiltrate, harvest/use, and biotreat storm water. Harvest and use BMPs were considered, but were not proposed given the limited water demand within the vicinity of the proposed BMPs. The high groundwater table throughout the length of the project site makes infiltration BMPs infeasible since there isn't sufficient separation from groundwater. Therefore, biofiltration BMPs were then considered next for water quality treatment.

Conventional biofiltration BMPs are proposed to address the improvements in the Carlsbad Village Train Station (both Short and Long Trench Alternatives) and Coastal Rail Trail (Long Trench Alternative only). However, in both alternatives, treatment of the trench area is difficult given the space constraints within the trench, thus, drainage will be collected at the proposed sump locations and will be pumped up to BMPs at the surface for treatment. Based on the proposed sump locations in both alternatives, there is limited space on the surface to accommodate a conventional biofiltration BMP; therefore, compact biofiltration BMPs (such as Modular Wetland Systems) are proposed. These compact biofiltration BMPs are comprised of a concrete vault with a pretreatment filter system which first filters out sediment, trash, and debris before the flows enter a second chamber for filtering through a high rate filtration media before discharging. To reduce maintenance needs in the sump pump, a pretreatment device is recommended within or adjacent to the sump pump.

In addition to water quality treatment, the baseline hydromodification management compliance is also required. Based on Provision F.5.g.2.d of the Small MS4 Permit, the numeric sizing requirements for achieving baseline hydromodification management compliance is correlated with a providing the water quality treatment volume of a bioretention system based on specific cross-sectional parameters. This is achievable when proposing a conventional biofiltration basin per the cross-sectional requirements speciefied in the Permit. In cases where the project is directly discharging to a large water body, such as a lagoon, hydromodification is typically not of a concern. This is applicable in the case of both the Short and Long Trench Alternatives where the project's proposed impervious areas are discharging directly to both the Buena Vista Lagoon and Agua Hedionda Lagoon.

There are two methods to design BMPs which meet the treatment requirements of the 85th percentile, 24-hour storm event—volume-based and flow-based. Each method is summarized below.

Volume Based Sizing Criteria

$$WQV = C * P_{85} * A * \text{(unit conversion)}$$

Where: WQV = Water Quality Volume (CF)
C = Weighted Runoff Factor (unitless)
P85 = 85th Percentile, 24-hour Precipitation (inches)
A = Drainage area (acres)

Flow-Based Sizing Criteria

$$Q_T = C * i_{WQ} * A * \text{(unit conversion)}$$

Where: Q_T = Treatment Flow Rate (cfs)
C = Weighted Runoff Factor (unitless)
i_{WQ} = Precipitation Intensity (in/hr) (0.2 in/hr)
A = Drainage area (acres)

Conventional biofiltration BMPs have been sized as volume-based BMPs whereas compact biofiltration BMPs have been sized as flow-based BMPs. Refer to the water quality calculations provided in Appendix B and the typical BMP sections provided in Appendix C for both the Short Trench and Long Trench Alternatives.

6.5 State Trash Amendment

Drainage from proposed improvements to the *existing* train station are subject to the State Trash Amendment requirements since the existing train station is classified as a transportation center, one of the five Priority Land Uses (PLUs) for high trash generation. Therefore, this project aimed to address the trash capture requirements for drainage areas which comingle existing improvements with the proposed improvements to help NCTD meet their implementation goals set forth in the State Trash Amendment.

Full trash capture is defined as the capture of particles that are 5 mm or larger for a 1-year, 1-hour storm event. For the train station (DMA TS1 through TS5), the precipitation depth associated with a 1-year, 1-hour storm event is 0.442 in. As compared to the water quality storm event, the 85th percentile precipitation depth of 0.55 in. is less than the Trash Amendment storm event; therefore, 0.55 in. is used for designing BMPs located in the vicinity of the existing train station.

Refer to NOAA Atlas 14 precipitation back-up provided in Appendix B.

7. STORM WATER BMP MAINTENANCE

NCTD will be responsible for funding and implementing the operations and maintenance of the project BMPs since the proposed BMPs are treating drainage areas within NCTD right-of-way only.

Bioretention Basin
In addition to routine landscape maintenance, the bioretention basin should be inspected biannually to evaluate the health of the plants and check for ponding water. Any dead or diseased vegetation should be removed and replaced. If standing water is observed, implement corrective measures to restore proper infiltration rates. This applies to compact biofiltration BMPs (e.g., Modular Wetland Systems) as well. In addition, compact biofiltration BMPs typically have a pre-treatment chamber and filtration device which will need to be inspected for sediment and debris accumulation. The filtration device may have filter cartridges which need to be replaced occassionally when maintenance indicaters show that replacement is necessary.

Landscaping
Maintenance will be performed by landscaping personnel. The vegetation will be maintained and inspected on a monthly or more frequently basis by landscaping maintenance staff and will be replaced or replanted, as necessary, to maintain a dense, healthy cover. The vegetation will also be inspected after major storm events. Maintenance shall include weed control, irrigation, reseeding/replanting of bare areas, and cleaning of debris. The drainage system shall be kept clear of debris and inspected prior to and during the rainy season to ensure it is free flowing.

Hazardous Waste
Suspected hazardous waste will be analyzed to determine disposal options. Hazardous materials are not expected to be generated on-site; however, if discovered, hazardous materials will be handled and disposed of according to local, state, and federal regulations. A solid or liquid waste is considered a hazardous waste if it exceeds the criteria listed in the California Code of Federal Regulations, Title 22, Article 11 (State of California, 1985).

Refer to the NCTD Storm Water Management Plan (July 2019) for more detailed guidance.

CONCLUSION

This WQTR has been prepared in accordance with the Non-traditional Phase II Small MS4 permit, and has evaluated and addressed potential pollutants associated with the Project and its effects on water quality. A summary of facts and findings associated with the project and the measure addressed by this WQTR are as follows:

- The beneficial uses for the receiving waters have been identified. BMPs will be used to protect the beneficial uses. The proposed BMPs address mitigation measures to protect water quality and beneficial uses to the maximum extent practicable.
- The project will collect the 85th percentile, 24 hour volume or flow rate of runoff allowing it to biofilter and evapotranspire.
- Permanent BMPs will be incorporated into the project design in the form of site design, source control, and LID treatment control.

8. REFERENCES

1. Storm Water Management Plan, North County Transit District, July 2019.
2. Volume 5 – BMP Design Manual (Post-Construction BMPs), City of Carlsbad, 2016 Edition.
3. Storm Drain GIS Data, City of Carlsbad, Received July 2019.
4. 2014 2-ft Topographic Contours, SANGIS, 2015.
5. Final 2014/2016 California Integrated Report (Clean Water Act Section 303(d) List / 305(b) Report) Website, California State Water Resources Control Board, April 2018. (https://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2014_2016.shtml)
6. Final Staff Report, Amendment to the Water Quality Control Plan for the Ocean Waters of California to Control Trash and Part 1 Trash Provisions of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California, California State Water Resources Control Board, April 2015.
7. California Stormwater Quality Association (CASQA) Stormwater Best Management Practices Handbooks, 2009 Edition

APPENDIX A

Drainage Management Area (DMA) Exhibit

- Drainage Management Area Exhibit – Short Trench Alternative (2 Sheets)
- Drainage Management Area Exhibit – Long Trench Alternative (2 Sheets)

LEGEND

PROPOSED TRACK CENTERLINE	
PROPERTY LINE	
DRAINAGE MANAGEMENT AREA (DMA)	
BIOFILTRATION BMP	
PERVIOUS AREA	
IMPERVIOUS AREA	
TRENCH AREA	

T·Y·LIN INTERNATIONAL

CARLSBAD VILLAGE RAILROAD TRENCH
PRELIMINARY DRAINAGE MANAGEMENT AREA EXHIBIT
SHORT TRENCH ALTERNATIVE
SHEET □OF 2

10/31/2019

LEGEND

PROPOSED TRACK CENTERLINE	
PROPERTY LINE	
DRAINAGE MANAGEMENT AREA (DMA)	
PERVIOUS AREA	
IMPERVIOUS AREA	
TRENCH AREA	

T·Y·LIN INTERNATIONAL

CARLSBAD VILLAGE RAILROAD TRENCH
PRELIMINARY DRAINAGE MANAGEMENT AREA EXHIBIT
SHORT TRENCH ALTERNATIVE
SHEET 2 OF 2

10/31/2019

LEGEND

PROPOSED TRACK CENTERLINE	
PROPERTY LINE	
DRAINAGE MANAGEMENT AREA (DMA)	
BIOFILTRATION BMP	
PERVIOUS AREA	
IMPERVIOUS AREA	
TRENCH AREA	

CARLSBAD VILLAGE RAILROAD TRENCH

PRELIMINARY DRAINAGE MANAGEMENT AREA EXHIBIT

LONG TRENCH ALTERNATIVE

SHEET □OF 2

10/31/2019

T·Y·LIN INTERNATIONAL

CARLSBAD VILLAGE RAILROAD TRENCH

PRELIMINARY DRAINAGE MANAGEMENT AREA EXHIBIT
LONG TRENCH ALTERNATIVE
SHEET 2 OF 2

10/31/2019

T·Y·LIN INTERNATIONAL

APPENDIX B

Water Quality Calculations

- Water Quality Calculations
- 85th Percentile, 24-hour Precipitation Back-up
- NOAA Atlas 14 Precipitation Back-up

Carlsbad Village Double Track
JN: 701290.15
10/8/19

Water Quality Treatment Calculations

85th Percentile Precipitation [1] (in.)	0.55	*governs
NOAA Atlas 14 1-year, 1-hour Precipitation [2] (in.)	0.442	

***Flow-Based Design**

								Flow-Based		Proposed Permanent Stormwater BMP			
Trench Alternative	**Pump Station ID**	**Drainage Management Area (DMA) ID**	**Drainage Area (acres)**	**% Impervious**	**Runoff Factor (Pervious)[1]**	**Runoff Factor (Impervious)[1]**	**Weighted Runoff Factor**	**Water Quality Precipitation Intensity (in/hr)**	**Required Water Quality Treatment Flow Rate (Q_T) (cfs)**	**BMP Type**	**Model Number**	**Treatment Capacity (cfs)**	**Is Design Adequate?**
Trench Improvements													
Short Trench	PS-S1	DMA S1	8.1	100%	0.3	0.9	0.9	0.2	1.458	Compact Biofiltration	Two (2) MWS-L-8-24-V One (1) MWS-L-4-6-V	2 x 0.693 + 1 x 0.073 = 1.459	Yes
Long Trench	PS-L1	DMA L1	5.8	100%	0.3	0.9	0.9	0.2	1.044	Compact Biofiltration	Two (2) MWS-L-8-20-V	2 x 0.577= 1.154	Yes
Long Trench	PS-L2	DMA L2	4.9	100%	0.3	0.9	0.9	0.2	0.882	Compact Biofiltration	Two (2) MWS-L-8-16-V	2 x 0.462 = 0.924	Yes

***Volume-Based Design**

								Volume-Based	Proposed Permanent Stormwater BMP								
Trench Alternative	**Pump Station ID**	**Drainage Management Area (DMA) ID**	**Drainage Area (acres)**	**% Impervious**	**Runoff Factor (Pervious)[1]**	**Runoff Factor (Impervious)[1]**	**Weighted Runoff Factor**	**Required Water Quality Volume (WQV) (CF)**	**BMP Type**	**Gravel Depth (ft)**	**Mulch + Biofiltration Media Depth (ft)**	**Water Quality Ponding Depth (ft)**	**Effective Ponding Depth (ft)**	**Conveyance + Freeboard (ft)**	**Provided Surface Area (SF)**	**Provided Water Quality Volume (CF)**	**Is Design Adequate?**
Carlsbad Village Train Station Improvements[2]																	
Short and Long Trench	N/A	DMA TS1	1.06	90%	0.3	0.9	0.84	1,778	Biofiltration Basin (Offline)	0.75	1.75	0.5	1.15	0.5	1800	2,070	Yes
Short and Long Trench	N/A	DMA TS2	0.67	90%	0.3	0.9	0.84	1,124	Biofiltration Basin (Offline)	0.75	1.75	0.5	1.15	0.5	1000	1,150	Yes
Short and Long Trench	N/A	DMA TS3	2.42	90%	0.3	0.9	0.84	4,058	Biofiltration Basin (Offline)	0.75	1.75	0.5	1.15	0.5	3600	4,140	Yes
Short and Long Trench	N/A	DMA TS4	1.06	90%	0.3	0.9	0.84	1,778	Biofiltration Basin (Offline)	0.75	1.75	0.5	1.15	0.5	1600	1,840	Yes
Short and Long Trench	N/A	DMA TS5	0.33	90%	0.3	0.9	0.84	553	Biofiltration Basin (Offline)	0.75	1.75	0.5	1.15	0.5	500	575	Yes
Coastal Rail Trail Surface Improvements[3]																	
Long Trench	N/A	DMA CRT1	0.4	64%	0.3	0.9	0.684	546	Biofiltration Basin (In-line)	0.75	1.75	0.5	1.15	0.5	1400	1,610	Yes
Long Trench	N/A	DMA CRT2	0.52	70%	0.3	0.9	0.72	747	Biofiltration Basin (In-line)	0.75	1.75	0.5	1.15	0.5	2100	2,415	Yes
Long Trench	N/A	DMA CRT3	0.36	78%	0.3	0.9	0.768	552	Biofiltration Basin (In-line)	0.75	1.75	0.5	1.15	0.5	860	989	Yes
Long Trench	N/A	DMA CRT4	0.21	81%	0.3	0.9	0.786	330	Biofiltration Basin (In-line)	0.75	1.75	0.5	1.15	0.5	500	575	Yes

Porosity Assumptions

Gravel	40%
Biofiltration Soil Media	20%

Notes:

1. The 85th percentile, 24-hour precipitation depth and runoff factors have been referenced from the City of Carlsbad BMP Design Manual (2016).
2. The State Trash Amendment requirements are only applicable to the Carlsbad Village Train station area since it is an existing transportation station, one of the five priority land uses. Since the 85th percentile precipitation depth is greater than the NOAA Atlas 14 Precipitation depth, the 85th percentile precipitation governs for design in addressing both water quality and State Trash Amendment requirements.
3. In the Long Trench Alternative, the realignment of an existing 84-inch RCP will encroach into the Coastal Rail Trail; therefore, it is anticipated that the realignment will necessitate the resconstruction of Coastal Rail Trail, a paved path. DMAs CRT1, CRT2, CRT3, and CRT4 represent the four drainage areas impacted. Based on the geometry of the site, it is anticipated that linear biofiltration BMPs will be proposed to address water quality treatment.
4. In both the Short and Long Trench Alternatives, the discharge from the proposed BMPs are discharging directly into either Buena Vista Lagoon or Agua Hedionda Lagoon; therefore, it is anticipated that the project will be exempt from hydromodification management requirements.

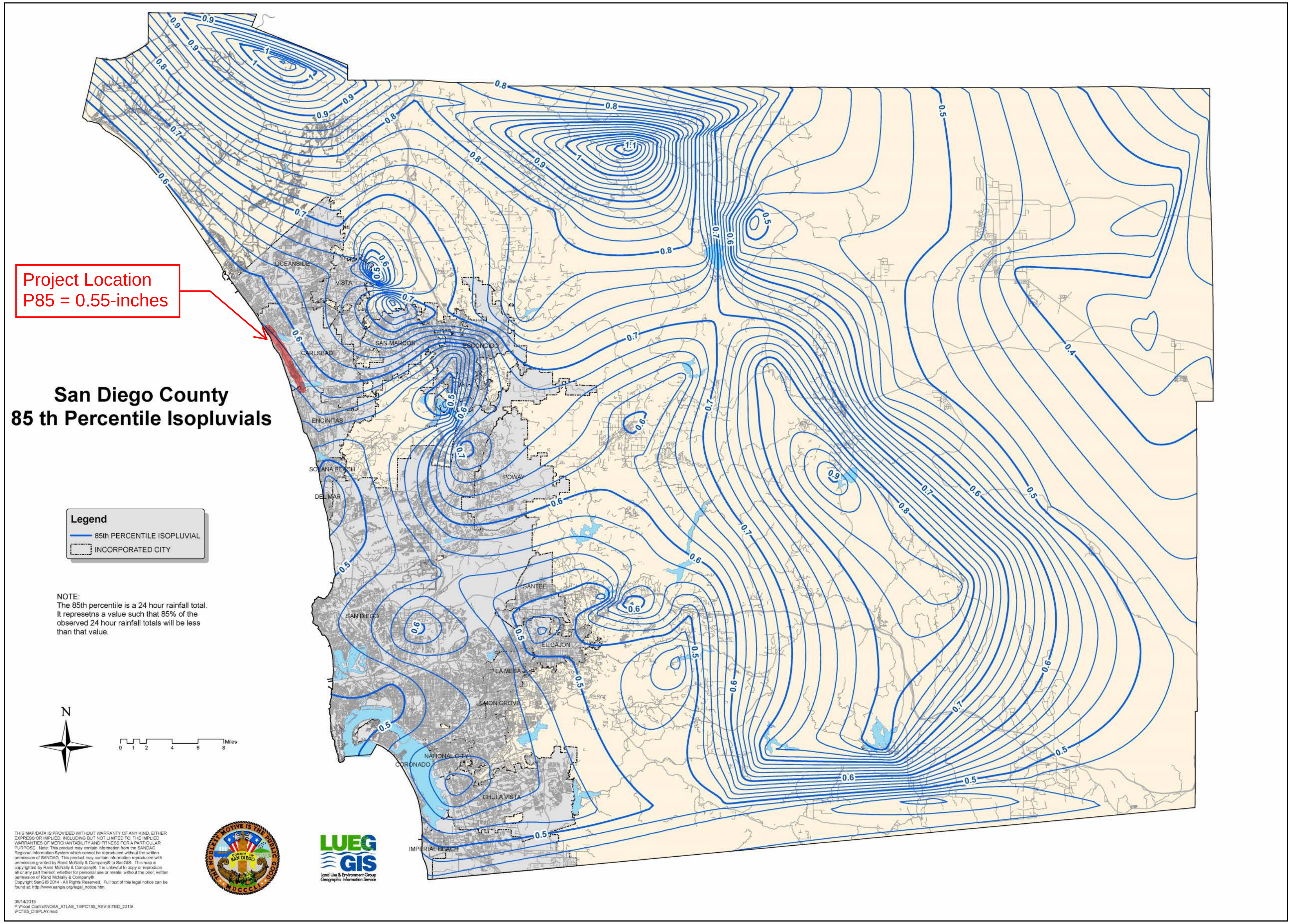


Figure B.1-1: 85th Percentile 24-hour Isopluvial Map

NOAA Atlas 14, Volume 6, Version 2
Location name: Carlsbad, California, USA*
Latitude: 33.159°, Longitude: -117.3494°
Elevation: 44.48 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

Trash Amendment:
1-year, 1-hour Design Storm
0.442 in/hr OR 0.442 in.

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.61 (1.36-1.93)	2.04 (1.72-2.45)	2.64 (2.21-3.18)	3.16 (2.62-3.83)	3.90 (3.12-4.91)	4.51 (3.54-5.82)	5.17 (3.95-6.84)	5.89 (4.37-8.04)	6.95 (4.92-9.90)	7.82 (5.34-11.6)
10-min	1.15 (0.972-1.39)	1.46 (1.23-1.76)	1.89 (1.58-2.28)	2.26 (1.88-2.75)	2.80 (2.24-3.52)	3.23 (2.53-4.17)	3.71 (2.83-4.90)	4.22 (3.13-5.76)	4.97 (3.53-7.09)	5.60 (3.83-8.29)
15-min	0.932 (0.784-1.12)	1.18 (0.992-1.42)	1.52 (1.28-1.84)	1.82 (1.51-2.22)	2.25 (1.80-2.84)	2.61 (2.04-3.36)	2.99 (2.28-3.95)	3.40 (2.52-4.64)	4.01 (2.84-5.72)	4.52 (3.09-6.68)
30-min	0.658 (0.554-0.790)	0.834 (0.702-1.00)	1.08 (0.904-1.30)	1.29 (1.07-1.57)	1.59 (1.28-2.01)	1.85 (1.45-2.38)	2.12 (1.61-2.80)	2.41 (1.79-3.29)	2.84 (2.01-4.05)	3.20 (2.18-4.73)
60-min	0.442 (0.372-0.531)	0.560 (0.471-0.673)	0.724 (0.606-0.872)	0.865 (0.719-1.05)	1.07 (0.857-1.35)	1.24 (0.970-1.60)	1.42 (1.08-1.88)	1.62 (1.20-2.21)	1.91 (1.35-2.72)	2.15 (1.47-3.18)
2-hr	0.298 (0.250-0.358)	0.371 (0.312-0.446)	0.472 (0.396-0.570)	0.560 (0.464-0.680)	0.685 (0.549-0.864)	0.788 (0.618-1.02)	0.898 (0.686-1.19)	1.02 (0.754-1.39)	1.19 (0.846-1.70)	1.34 (0.914-1.98)
3-hr	0.232 (0.196-0.279)	0.289 (0.243-0.347)	0.367 (0.307-0.442)	0.433 (0.360-0.527)	0.528 (0.424-0.666)	0.606 (0.475-0.781)	0.688 (0.525-0.911)	0.778 (0.576-1.06)	0.906 (0.642-1.29)	1.01 (0.692-1.50)
6-hr	0.150 (0.126-0.180)	0.187 (0.157-0.225)	0.237 (0.199-0.286)	0.280 (0.232-0.340)	0.339 (0.272-0.428)	0.387 (0.303-0.499)	0.437 (0.333-0.578)	0.490 (0.363-0.669)	0.565 (0.401-0.806)	0.626 (0.428-0.926)
12-hr	0.093 (0.078-0.112)	0.119 (0.100-0.143)	0.152 (0.128-0.184)	0.180 (0.149-0.219)	0.218 (0.175-0.275)	0.248 (0.194-0.319)	0.278 (0.212-0.368)	0.310 (0.229-0.422)	0.353 (0.250-0.503)	0.387 (0.264-0.572)
24-hr	0.057 (0.050-0.066)	0.074 (0.065-0.086)	0.096 (0.085-0.112)	0.115 (0.100-0.134)	0.139 (0.117-0.168)	0.157 (0.131-0.194)	0.176 (0.143-0.222)	0.196 (0.154-0.253)	0.222 (0.168-0.298)	0.242 (0.178-0.337)
2-day	0.035 (0.031-0.040)	0.045 (0.040-0.053)	0.060 (0.052-0.069)	0.071 (0.062-0.083)	0.086 (0.073-0.104)	0.098 (0.081-0.121)	0.110 (0.089-0.138)	0.122 (0.096-0.158)	0.138 (0.105-0.186)	0.151 (0.111-0.210)
3-day	0.026 (0.023-0.030)	0.034 (0.030-0.039)	0.045 (0.039-0.052)	0.053 (0.047-0.062)	0.065 (0.055-0.079)	0.074 (0.061-0.091)	0.083 (0.067-0.105)	0.093 (0.073-0.120)	0.106 (0.080-0.142)	0.115 (0.085-0.161)
4-day	0.021 (0.019-0.024)	0.028 (0.024-0.032)	0.037 (0.032-0.042)	0.044 (0.038-0.051)	0.054 (0.045-0.065)	0.061 (0.051-0.075)	0.069 (0.056-0.087)	0.077 (0.061-0.099)	0.088 (0.066-0.118)	0.096 (0.070-0.133)
7-day	0.014 (0.012-0.016)	0.018 (0.016-0.021)	0.025 (0.022-0.028)	0.029 (0.026-0.034)	0.036 (0.031-0.044)	0.042 (0.034-0.051)	0.047 (0.038-0.059)	0.053 (0.042-0.068)	0.060 (0.046-0.081)	0.066 (0.049-0.092)
10-day	0.011 (0.010-0.012)	0.014 (0.013-0.017)	0.019 (0.017-0.022)	0.023 (0.020-0.027)	0.029 (0.024-0.035)	0.033 (0.027-0.041)	0.037 (0.030-0.047)	0.042 (0.033-0.054)	0.048 (0.037-0.065)	0.053 (0.039-0.074)
20-day	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.012 (0.011-0.014)	0.015 (0.013-0.017)	0.018 (0.015-0.022)	0.021 (0.017-0.026)	0.024 (0.019-0.030)	0.027 (0.021-0.035)	0.032 (0.024-0.043)	0.035 (0.026-0.049)
30-day	0.005 (0.005-0.006)	0.007 (0.006-0.008)	0.009 (0.008-0.011)	0.012 (0.010-0.014)	0.015 (0.012-0.018)	0.017 (0.014-0.021)	0.020 (0.016-0.025)	0.022 (0.017-0.029)	0.026 (0.020-0.035)	0.029 (0.021-0.040)
45-day	0.004 (0.004-0.005)	0.006 (0.005-0.006)	0.007 (0.007-0.009)	0.009 (0.008-0.011)	0.012 (0.010-0.014)	0.014 (0.011-0.017)	0.016 (0.013-0.020)	0.018 (0.014-0.023)	0.021 (0.016-0.028)	0.024 (0.017-0.033)
60-day	0.004 (0.003-0.004)	0.005 (0.004-0.005)	0.006 (0.006-0.007)	0.008 (0.007-0.009)	0.010 (0.008-0.012)	0.012 (0.010-0.015)	0.014 (0.011-0.017)	0.016 (0.012-0.020)	0.019 (0.014-0.025)	0.021 (0.015-0.029)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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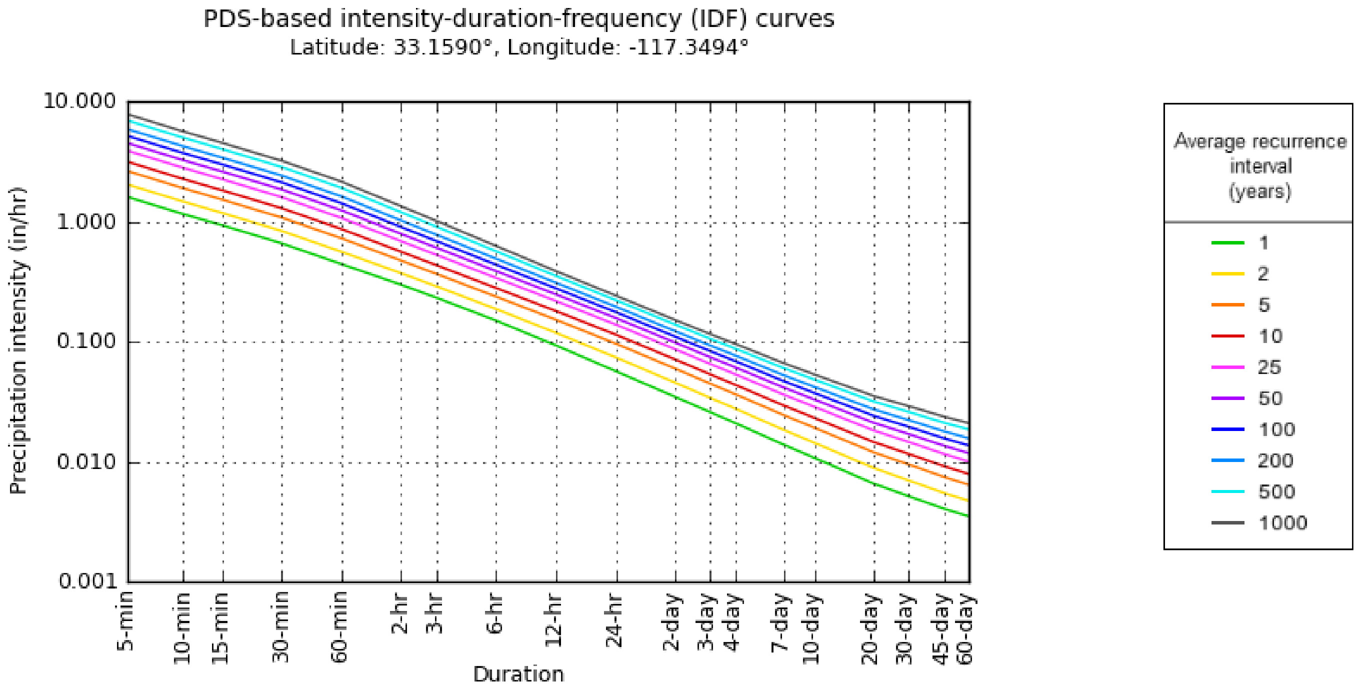
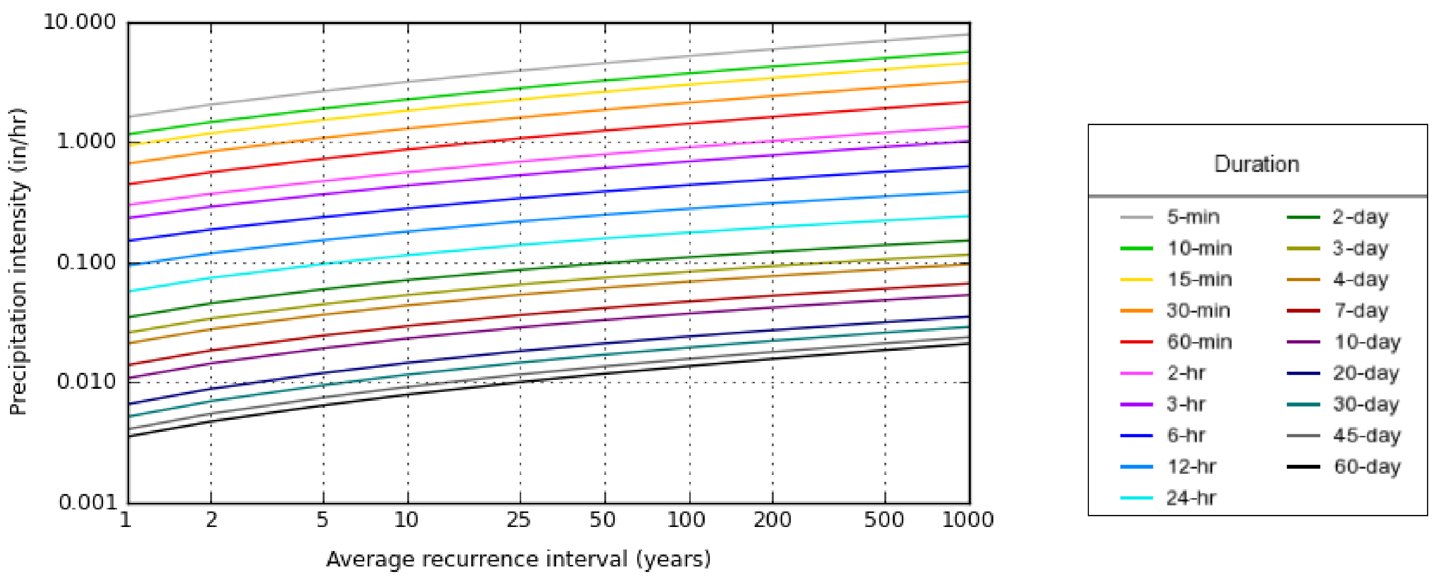
PF graphical





NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Tue Jul 9 23:25:27 2019

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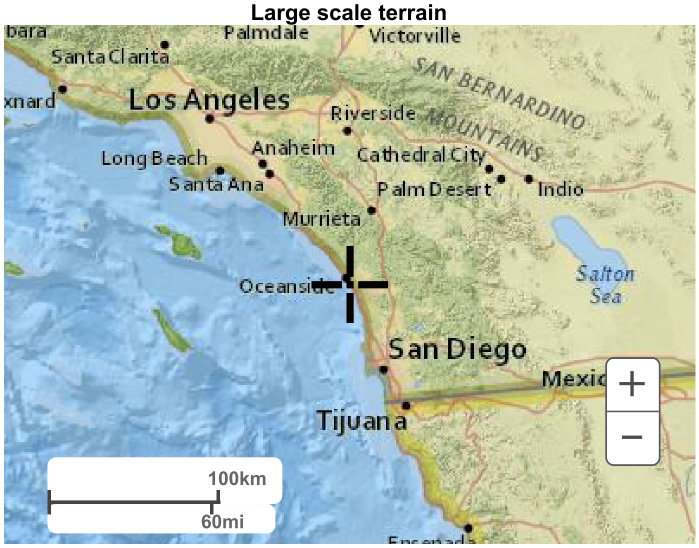
Maps & aerials

Small scale terrain

Large scale terrain



Large scale map

Large scale aerial

Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

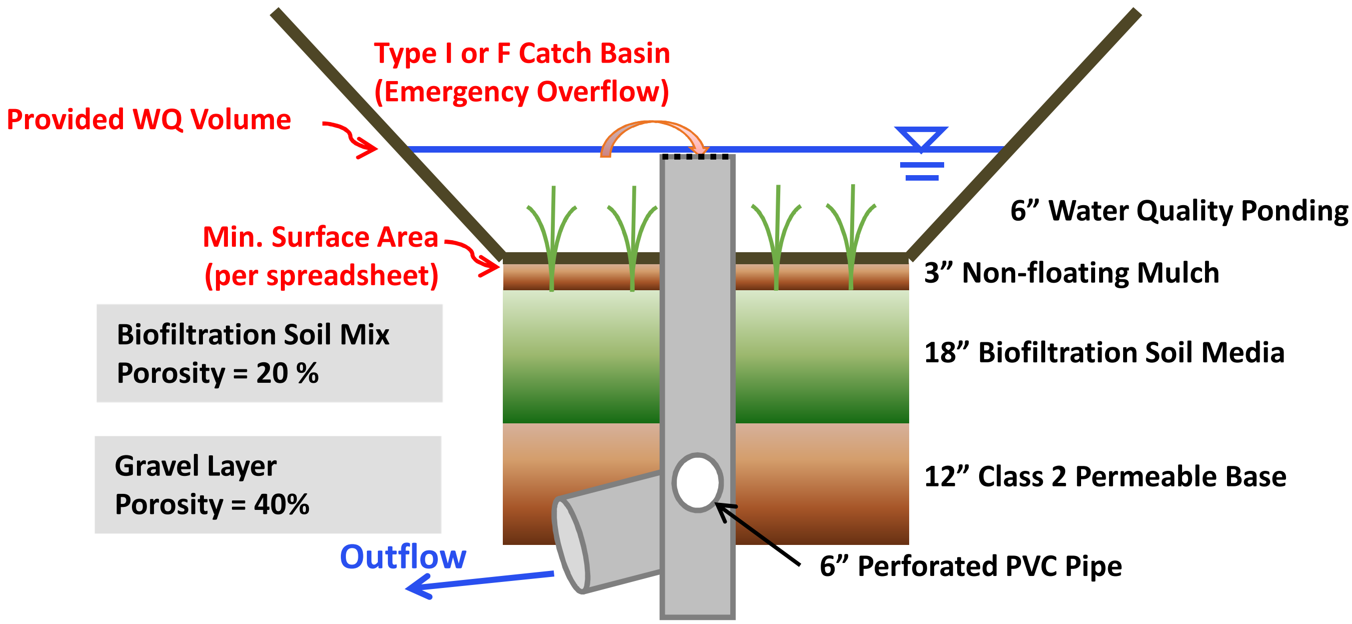
Disclaimer

APPENDIX C

Post-Construction BMP Details

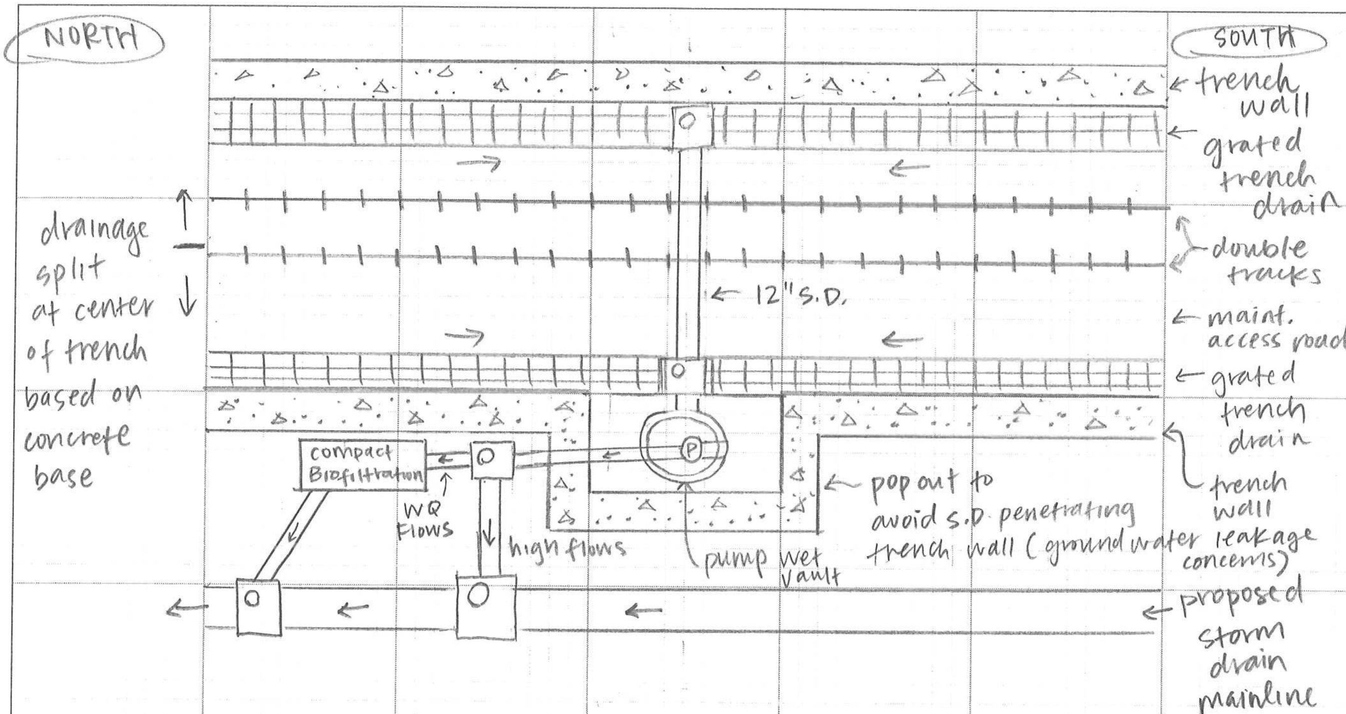
- Biofiltration Basin Schematic
- Pump Station Schematic
- Compact Biofiltration BMPs (e.g., Modular Wetland System) Details
- Biofiltration BMP Fact Sheet

TYP. Biofiltration Basin Section



T·Y·LIN INTERNATIONAL

Project:	Carlsbad Village Double Track	Job No.	701290.15	Sheet:	1 of 1
Item:	preliminary pump station & water quality treatment concept for drainage within proposed trench	Designer:	SLL	Date:	10/6/19
		Checker:		Date:	
				Grid:	1/10"



Notes:

1. All drainage within the trench will be collected within trench drains on the East and West sides of the trench using a continuous linear trench drain system anticipated to be approximately 3-ft wide. Once flows enter the trench, the drainage flows within a concrete rectangular channel until it reaches the sump.
2. Once the drainage reaches the sump, the flows will be piped to the west to a proposed pump station designed to bring at least the Q_{100} to the surface for discharge. This is necessary because the trench is within groundwater.
3. A cleanout is proposed at the surface to split water quality flows and larger flows to reduce the Q to the compact biofiltration BMP to only what is required. Larger flows can be discharged directly into the mainline storm drain system.

SITE SPECIFIC DATA

PROJECT NUMBER			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
TREATMENT HGL AVAILABLE (FT)			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PARKWAY	OPEN PLANTER	PARKWAY
FRAME & COVER	30" x 36"	N/A	N/A
WETLANDMEDIA VOLUME (CY)			1.68
WETLANDMEDIA DELIVERY METHOD			TBD
ORIFICE SIZE (DIA. INCHES)			ø1.22"
MAXIMUM PICK WEIGHT (LBS)			12700
NOTES:			

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GENERAL NOTES

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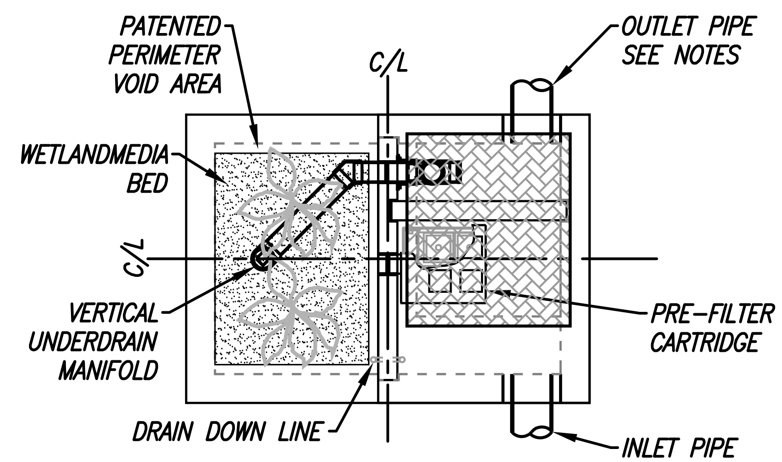
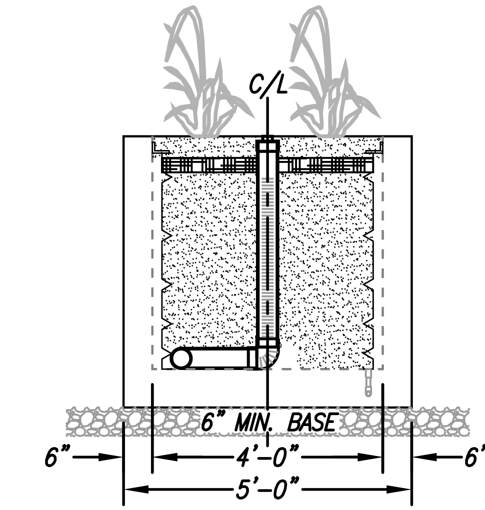
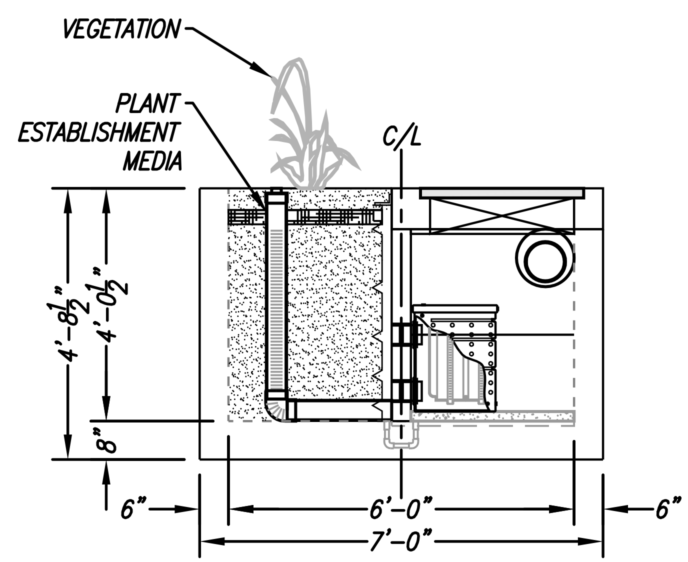
5/1/15/JOHN



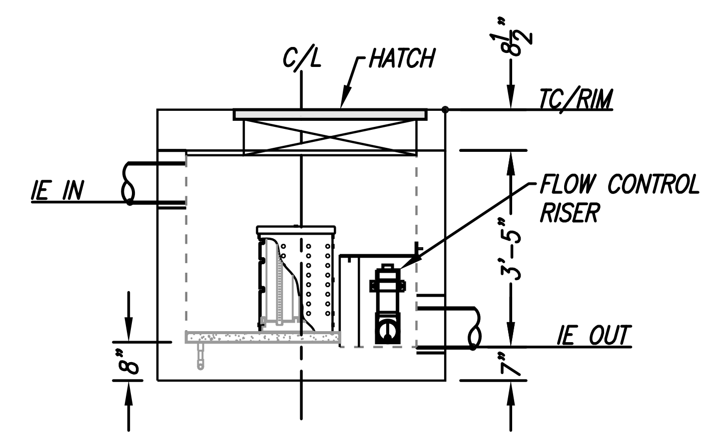
PLAN VIEW



LEFT END VIEW
BIOFILTRATION



ELEVATION VIEW



RIGHT END VIEW
PRETREATMENT/DISCHARGE

TREATMENT FLOW (CFS)	0.073
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	TBD
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

MODULAR WETLANDS
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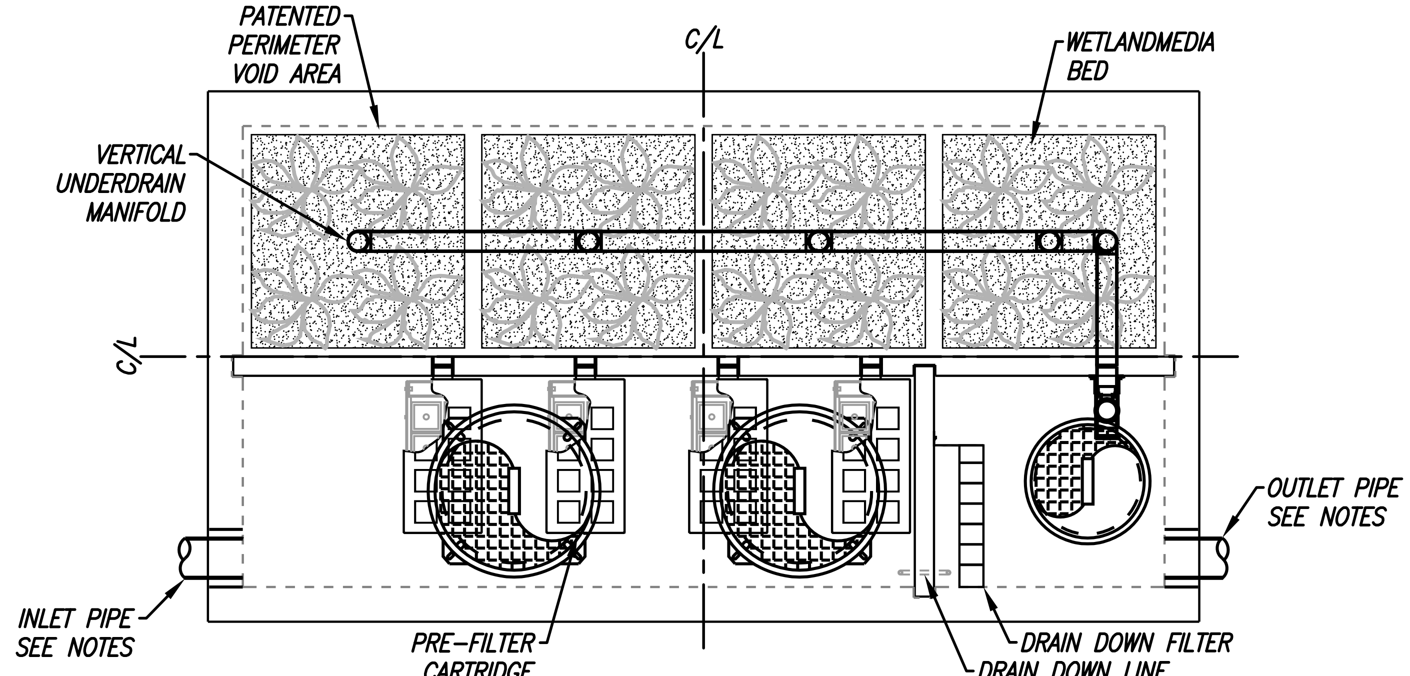
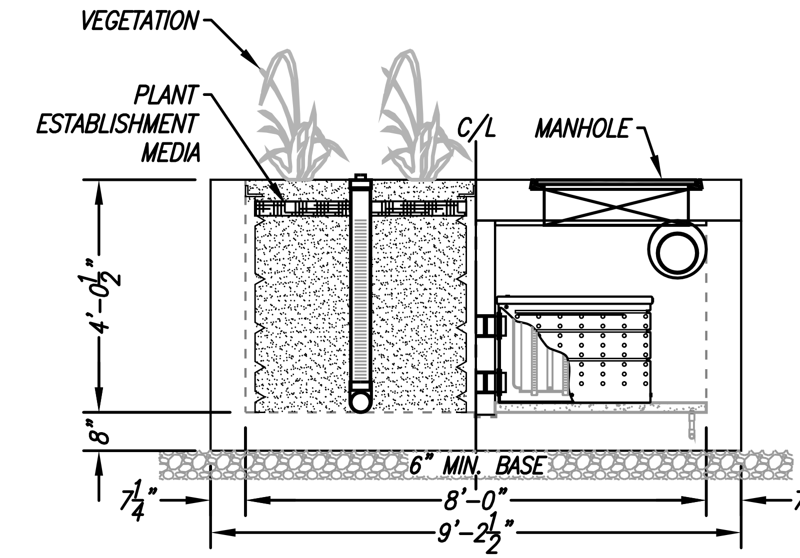
MWS-L-4-6-V
STORMWATER BIOFILTRATION SYSTEM STANDARD DETAIL

SITE SPECIFIC DATA			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
TREATMENT HGL AVAILABLE (FT)			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PARKWAY	OPEN PLANTER	PARKWAY
FRAME & COVER	ø30"	N/A	ø24"
WETLANDMEDIA VOLUME (CY)			9.50
WETLANDMEDIA DELIVERY METHOD			TBD
ORIFICE SIZE (DIA. INCHES)			ø3.07"
MAXIMUM PICK WEIGHT (LBS)			TBD
NOTES:			

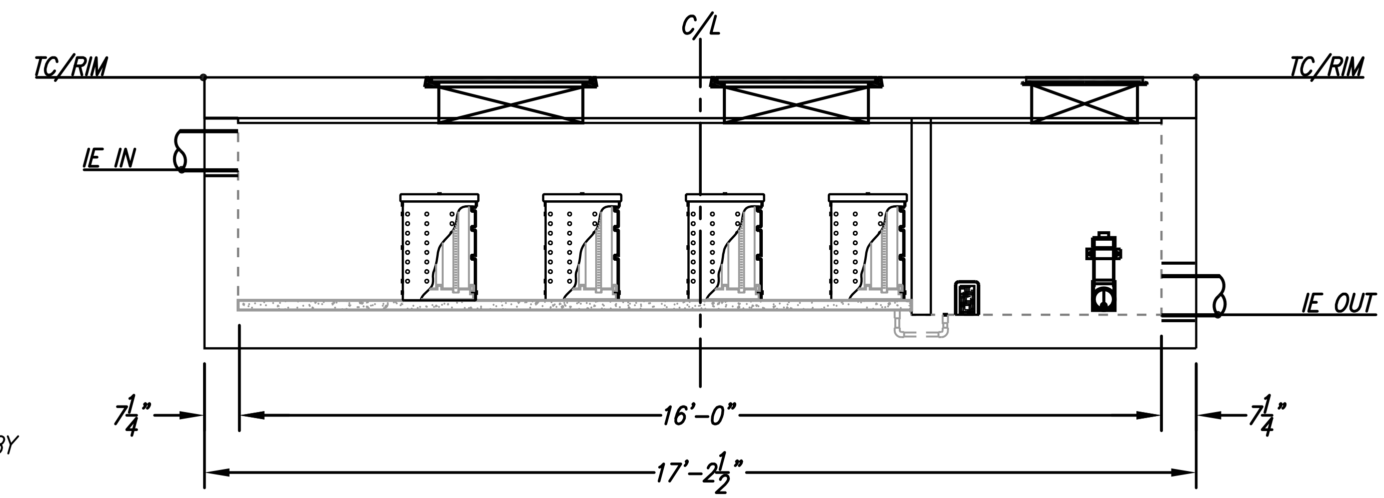


PLAN VIEW

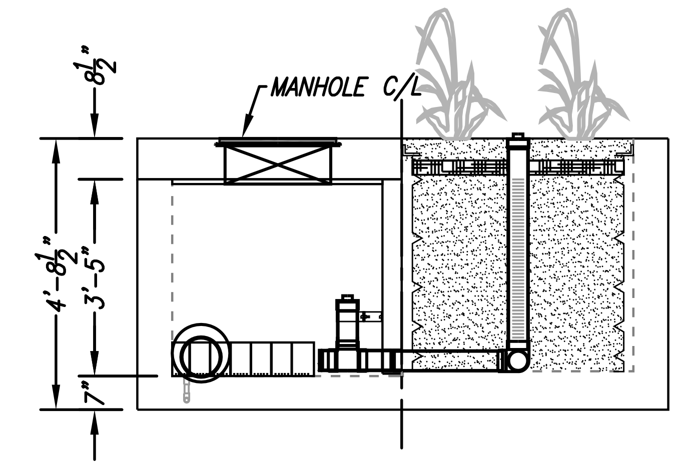


LEFT END VIEW

BIOFILTRATION/PRETREATMENT



ELEVATION VIEW



RIGHT END VIEW

DISCHARGE/BIOFILTRATION

INSTALLATION NOTES

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TREATMENT FLOW (CFS)	0.462
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	TBD
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

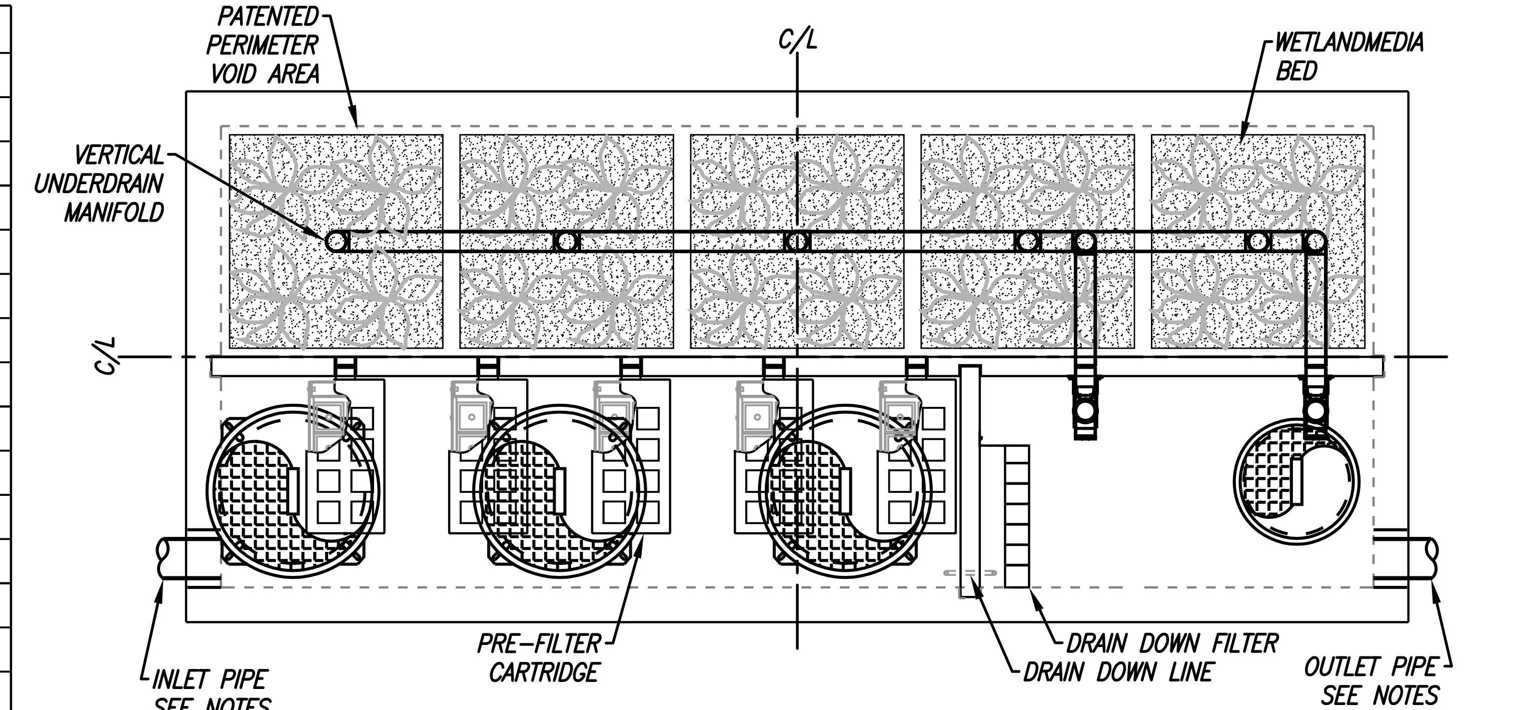
MWS-L-8-16-V

STORMWATER BIOFILTRATION SYSTEM

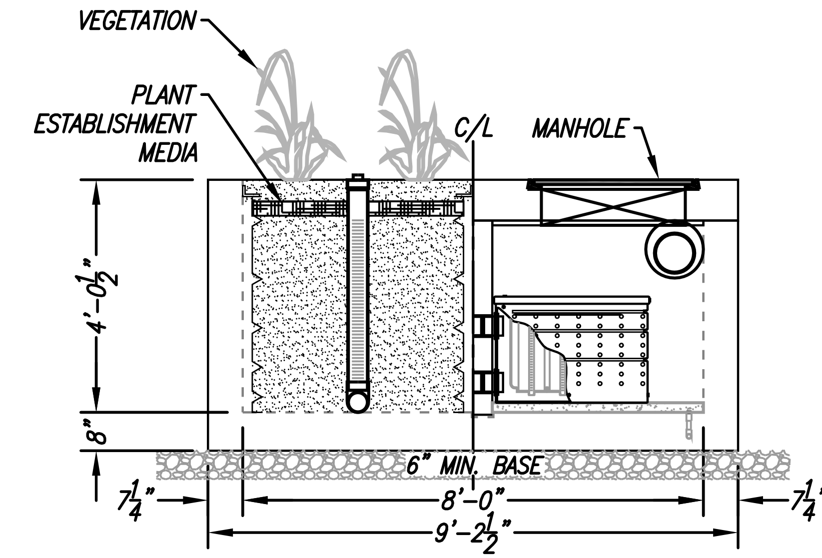
STANDARD DETAIL

3/11/15 JOHN

SITE SPECIFIC DATA			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
TREATMENT HGL AVAILABLE (FT)			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PARKWAY	OPEN PLANTER	PARKWAY
FRAME & COVER	ø30"	N/A	ø24"
WETLANDMEDIA VOLUME (CY)			11.85
WETLANDMEDIA DELIVERY METHOD			TBD
ORIFICE SIZE (DIA. INCHES)			ø2.43"
MAXIMUM PICK WEIGHT (LBS)			TBD
NOTES:			

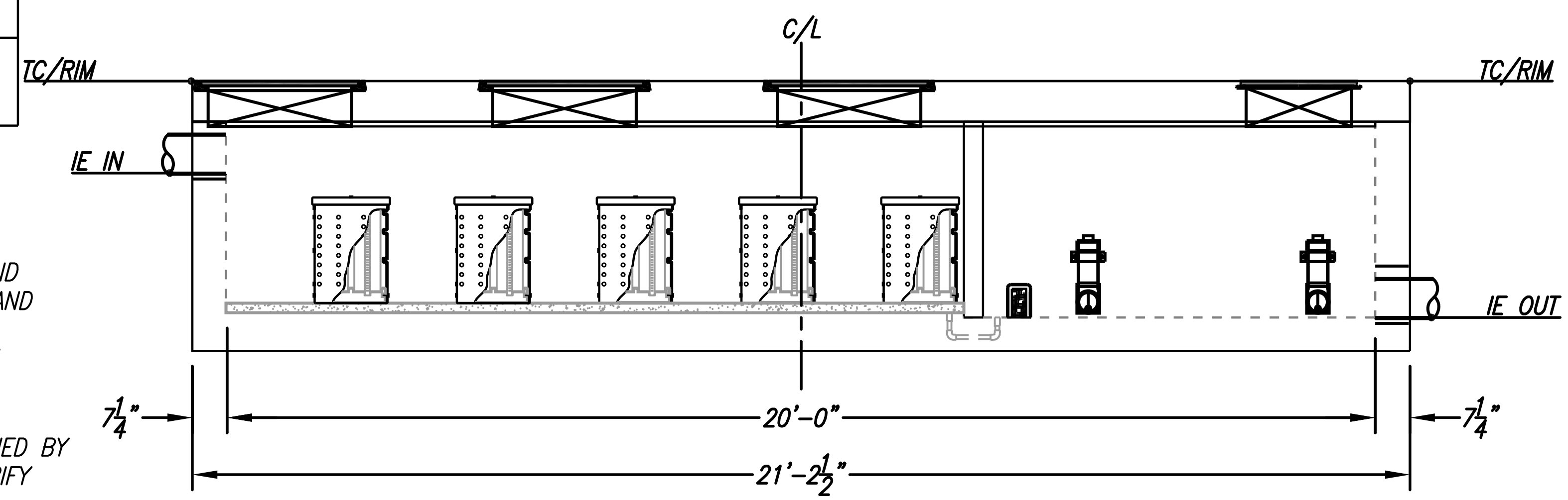


PLAN VIEW

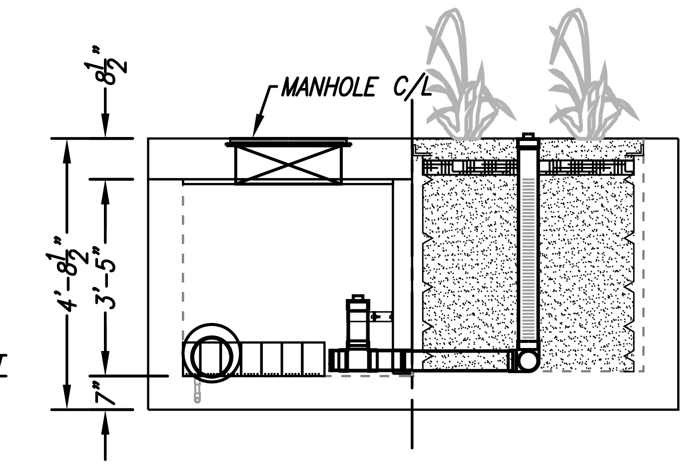


LEFT END VIEW

BIOFILTRATION/PRETREATMENT



ELEVATION VIEW



RIGHT END VIEW

DISCHARGE/BIOFILTRATION

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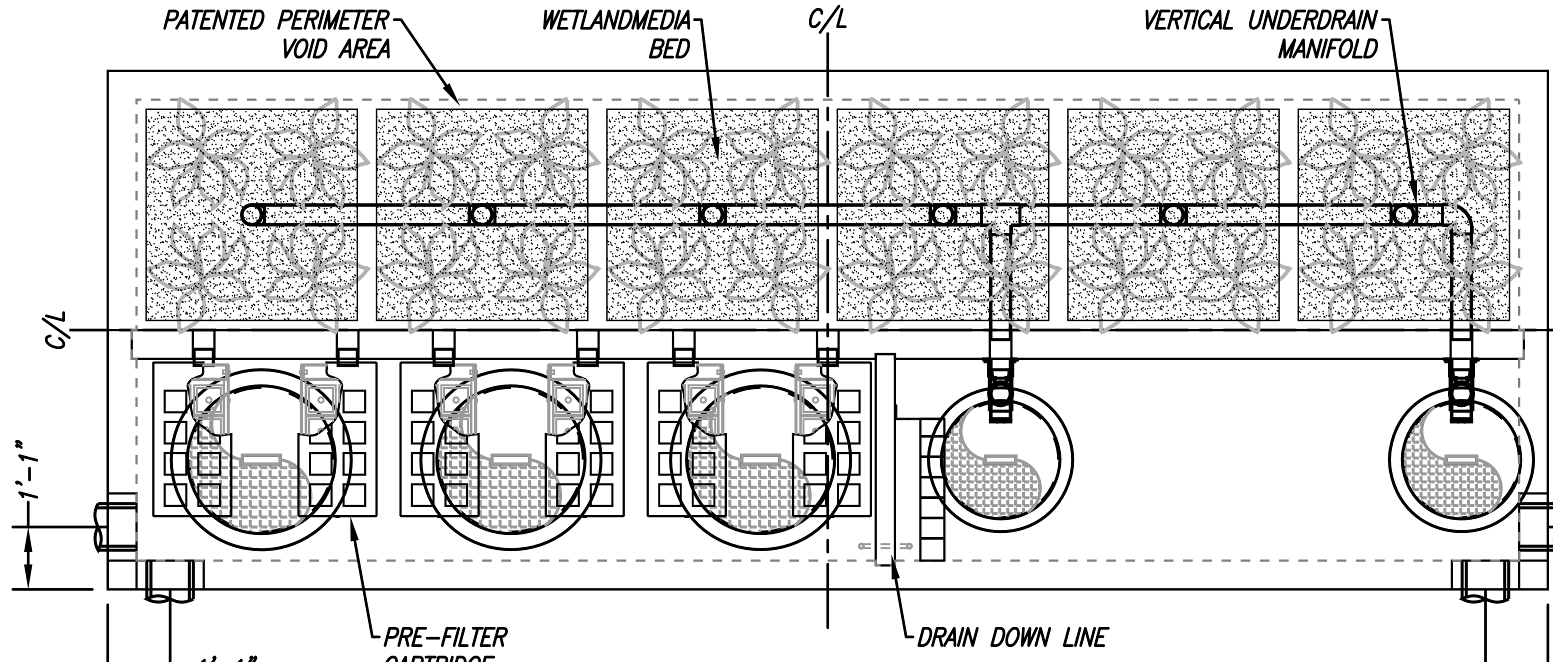
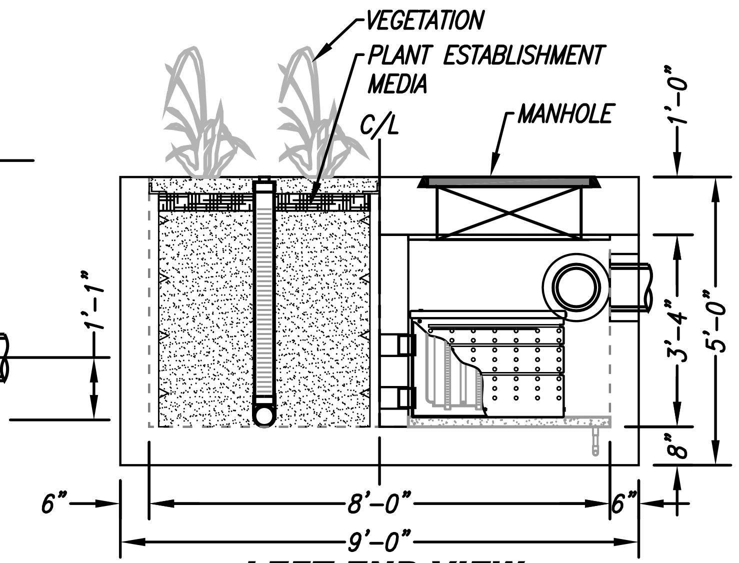
TREATMENT FLOW (CFS)	0.577
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	TBD
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

MWS-L-8-20-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

SITE SPECIFIC DATA			
PROJECT NUMBER		----	
PROJECT NAME		----	
PROJECT LOCATION		----	
STRUCTURE ID		----	
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
TREATMENT HGL AVAILABLE (FT)			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	----	PVC	8"
INLET PIPE 2	N/A	N/A	N/A
OUTLET PIPE	----	PVC	8"
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION	----	----	----
SURFACE LOAD	PARKWAY	OPEN PLANTER	PARKWAY
FRAME & COVER	3 EA ø30"	N/A	2 EA ø24"
WETLANDMEDIA VOLUME (CY)			TBD
WETLANDMEDIA DELIVERY METHOD			PER CONTRACT
ORIFICE SIZE (DIA. INCHES)			TBD
NOTES:			



PLAN VIEW



LEFT END VIEW

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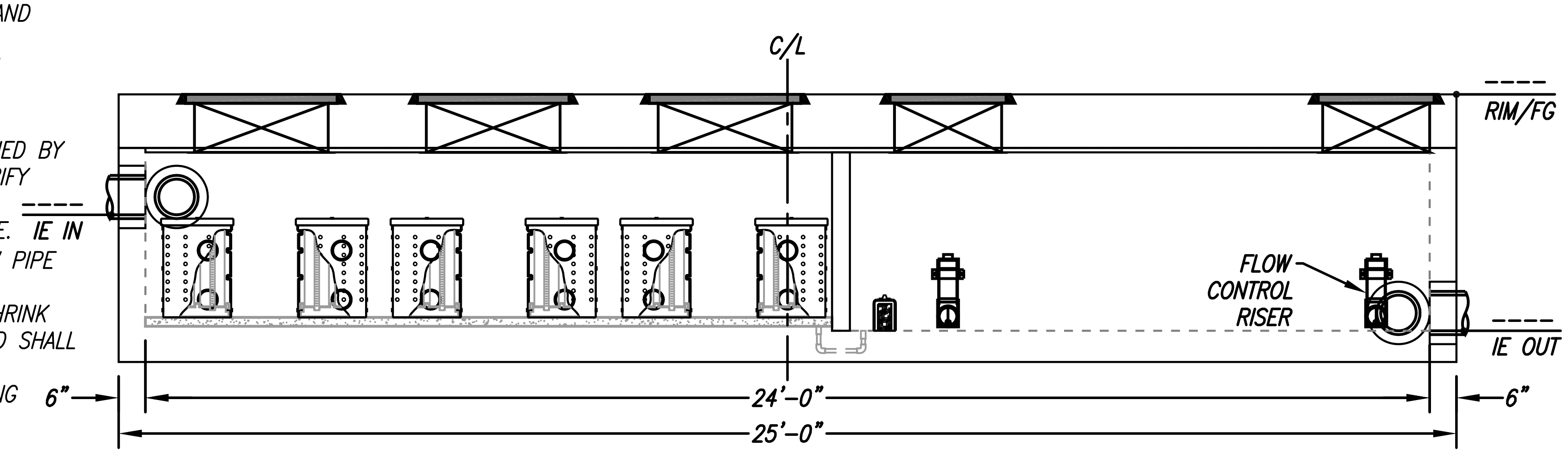
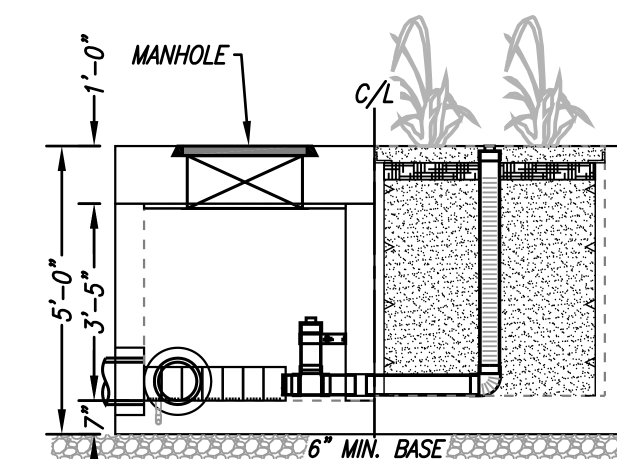
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
3. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL GAPS AROUND PIPES SHALL BE SEALED WATER TIGHT WITH A NON-SHRINK GROUT PER MANUFACTURERS STANDARD CONNECTION DETAIL AND SHALL MEET OR EXCEED REGIONAL PIPE CONNECTION STANDARDS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. DRIP OR SPRAY IRRIGATION REQUIRED ON ALL UNITS WITH VEGETATION.
7. CONTRACTOR RESPONSIBLE FOR CONTACTING MODULAR WETLANDS FOR ACTIVATION OF UNIT. MANUFACTURES WARRANTY IS VOID WITH OUT PROPER ACTIVATION BY A MODULAR WETLANDS REPRESENTATIVE.



ELEVATION VIEW



RIGHT END VIEW

TREATMENT FLOW (CFS)	0.693
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	2.0
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT MANUFACTURER.

1/31/17/HAYDEN

MWS-L-8-24-V
STORMWATER BIOFILTRATION SYSTEM STANDARD DETAIL

E.12 BF-1 Biofiltration

Location: 43rd Street and Logan Avenue, San Diego, California

MS4 Permit Category
Biofiltration

Manual Category
Biofiltration

Applicable Performance Standard
Pollutant Control
Flow Control

Primary Benefits
Treatment
Volume Reduction (Incidental)
Peak Flow Attenuation (Optional)

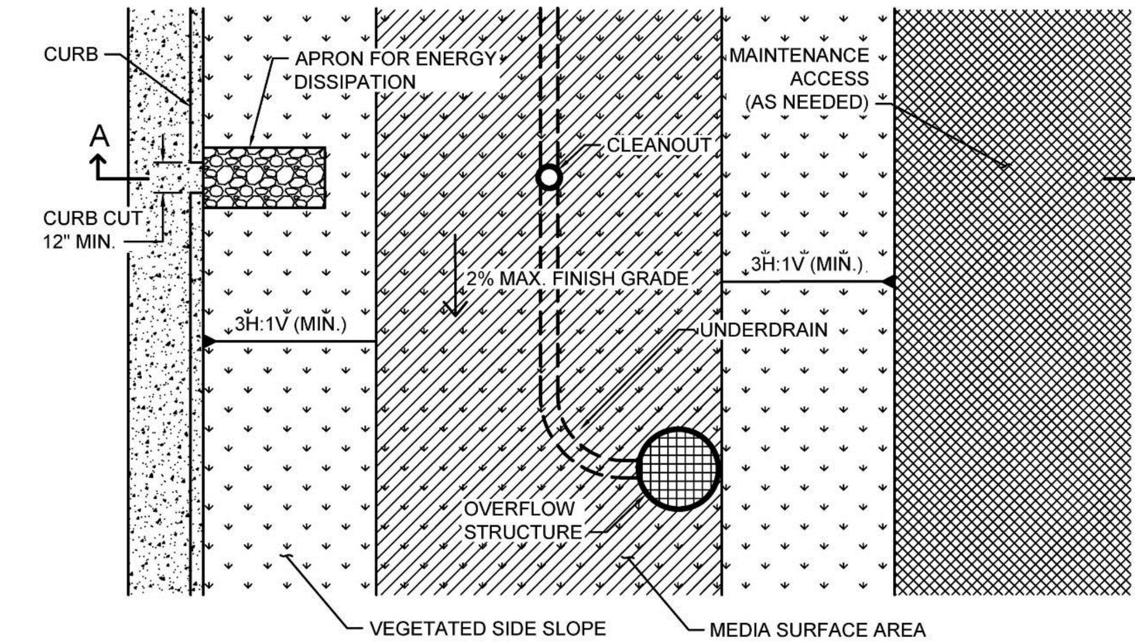
Description

Biofiltration (Bioretention with underdrain) facilities are vegetated surface water systems that filter water through vegetation, and soil or engineered media prior to discharge via underdrain or overflow to the downstream conveyance system. Bioretention with underdrain facilities are commonly incorporated into the site within parking lot landscaping, along roadsides, and in open spaces. Because these types of facilities have limited or no infiltration, they are typically designed to provide enough hydraulic head to move flows through the underdrain connection to the storm drain system. Treatment is achieved through filtration, sedimentation, sorption, biochemical processes and plant uptake.

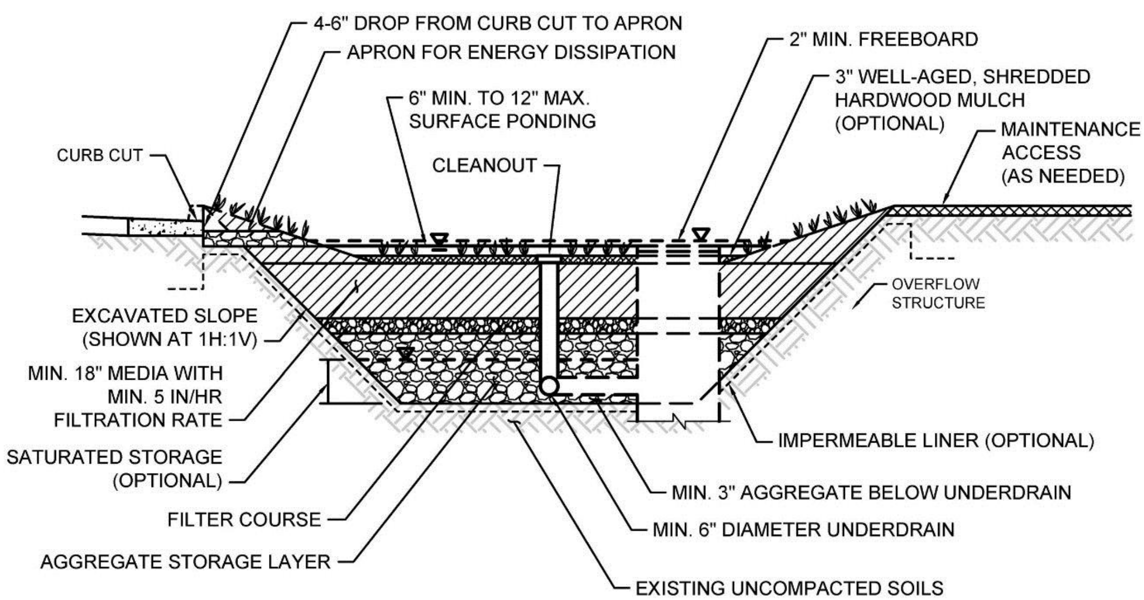
Typical bioretention with underdrain components include:

- Inflow distribution mechanisms (e.g, perimeter flow spreader or filter strips)
- Energy dissipation mechanism for concentrated inflows (e.g., splash blocks or riprap)
- Shallow surface ponding for captured flows
- Side slope and basin bottom vegetation selected based on expected climate and ponding depth
- Non-floating mulch layer (Optional)
- Media layer (planting mix or engineered media) capable of supporting vegetation growth
- Filter course layer consisting of aggregate to prevent the migration of fines into uncompacted native soils or the aggregate storage layer
- Aggregate storage layer with underdrain(s)
- Impermeable liner or uncompacted native soils at the bottom of the facility

- Overflow structure



PLAN
NOT TO SCALE



SECTION A-A'
NOT TO SCALE

Typical plan and Section view of a Biofiltration BMP

Design Adaptations for Project Goals

Biofiltration Treatment BMP for storm water pollutant control. The system is lined or un-lined to provide incidental infiltration, and an underdrain is provided at the bottom to carry away filtered runoff. This configuration is considered to provide biofiltration treatment via flow through the media layer. Storage provided above the underdrain within surface ponding, media, and aggregate storage is considered included in the biofiltration treatment volume. Saturated storage within the aggregate storage layer can be added to this design by raising the underdrain above the bottom of the aggregate storage layer or via an internal weir structure designed to maintain a specific water level elevation.

Integrated storm water flow control and pollutant control configuration. The system can be designed to provide flow rate and duration control by primarily providing increased surface ponding and/or having a deeper aggregate storage layer above the underdrain. This will allow for significant detention storage, which can be controlled via inclusion of an outlet structure at the downstream end of the underdrain.

Design Criteria and Considerations

Bioretention with underdrain must meet the following design criteria. Deviations from the below criteria may be approved at the discretion of the City Engineer if it is determined to be appropriate:

	Siting and Design	*Intent/Rationale*
☐	Placement observes geotechnical recommendations regarding potential hazards (e.g., slope stability, landslides, liquefaction zones) and setbacks (e.g., slopes, foundations, utilities).	Must not negatively impact existing site geotechnical concerns.
☐	An impermeable liner or other hydraulic restriction layer is included if site constraints indicate that infiltration or lateral flows should not be allowed.	Lining prevents storm water from impacting groundwater and/or sensitive environmental or geotechnical features. Incidental infiltration, when allowable, can aid in pollutant removal and groundwater recharge.
☐	Contributing tributary area shall be ≤ 5 acres (≤ 1 acre preferred).	Bigger BMPs require additional design features for proper performance. Contributing tributary area greater than 5 acres may be allowed at the discretion of the City Engineer if the following conditions are met: 1) incorporate design features (e.g. flow spreaders) to minimizing short circuiting of flows in

Siting and Design		***Intent/Rationale***
		the BMP and 2) incorporate additional design features requested by the City Engineer for proper performance of the regional BMP.
☐	Finish grade of the facility is ≤ 2%.	Flatter surfaces reduce erosion and channelization within the facility.
Surface Ponding		
☐	Surface ponding is limited to a 24-hour drawdown time.	Surface ponding limited to 24 hours for plant health. Surface ponding drawdown time greater than 24-hours but less than 96 hours may be allowed at the discretion of the City Engineer if certified by a landscape architect or agronomist.
☐	Surface ponding depth is ≥ 6 and ≤ 12 inches.	Surface ponding capacity lowers subsurface storage requirements. Deep surface ponding raises safety concerns. Surface ponding depth greater than 12 inches (for additional pollutant control or surface outlet structures or flow-control orifices) may be allowed at the discretion of the City Engineer if the following conditions are met: 1) surface ponding depth drawdown time is less than 24 hours; and 2) safety issues and fencing requirements are considered (typically ponding greater than 18" will require a fence and/or flatter side slopes) and 3) potential for elevated clogging risk is considered.
☐	A minimum of 2 inches of freeboard is provided.	Freeboard provides room for head over overflow structures and minimizes risk of uncontrolled surface discharge.
☐	Side slopes are stabilized with vegetation and are = 3H:1V or shallower.	Gentler side slopes are safer, less prone to erosion, able to establish vegetation more quickly and easier to maintain.
Vegetation		

	Siting and Design	*Intent/Rationale*
☐	Plantings are suitable for the climate and expected ponding depth. A plant list to aid in selection can be found in Appendix E.20.	Plants suited to the climate and ponding depth are more likely to survive.
☐	An irrigation system with a connection to water supply should be provided as needed.	Seasonal irrigation might be needed to keep plants healthy.
Mulch (Optional)		
☐	A minimum of 3 inches of well-aged, shredded hardwood mulch that has been stockpiled or stored for at least 12 months is provided.	Mulch will suppress weeds and maintain moisture for plant growth. Aging mulch kills pathogens and weed seeds and allows the beneficial microbes to multiply.
Media Layer		
☐	Media maintains a minimum filtration rate of 5 in/hr over lifetime of facility. An initial filtration rate of 8 to 12 in/hr is recommended to allow for clogging over time; the initial filtration rate should not exceed 12 inches per hour.	A filtration rate of at least 5 inches per hour allows soil to drain between events. The initial rate should be higher than long term target rate to account for clogging over time. However an excessively high initial rate can have a negative impact on treatment performance, therefore an upper limit is needed.
☐	Media is a minimum 18 inches deep, meeting either of these two media specifications: City of San Diego Storm Water Standards Appendix F (February 2016, unless superseded by more recent edition) **<u>or</u>** County of San Diego Low Impact Development Handbook: Appendix G -Bioretention Soil Specification (June 2014, unless superseded by more recent edition). Alternatively, for proprietary designs and custom media mixes not meeting the media specifications contained in the 2016 City of San Diego Storm Water Standards or County LID Manual, the media meets the pollutant treatment performance criteria in Section F.1.	A deep media layer provides additional filtration and supports plants with deeper roots. Standard specifications shall be followed. For non-standard or proprietary designs, compliance with F.1 ensures that adequate treatment performance will be provided.

	Siting and Design	*Intent/Rationale*
☐	Media surface area is 3% of contributing area times adjusted runoff factor or greater.	Greater surface area to tributary area ratios: a) maximizes volume retention as required by the MS4 Permit and b) decrease loading rates per square foot and therefore increase longevity. Adjusted runoff factor is to account for site design BMPs implemented upstream of the BMP (such as rain barrels, impervious area dispersion, etc.). Refer to Appendix B.2 guidance. Use Worksheet B.5-1 Line 26 to estimate the minimum surface area required per this criteria.
☐	Where receiving waters are impaired or have a TMDL for nutrients, the system is designed with nutrient sensitive media design (see fact sheet BF-2).	Potential for pollutant export is partly a function of media composition; media design must minimize potential for export of nutrients, particularly where receiving waters are impaired for nutrients.
Filter Course Layer		
☐	A filter course is used to prevent migration of fines through layers of the facility. Filter fabric is not used.	Migration of media can cause clogging of the aggregate storage layer void spaces or subgrade. Filter fabric is more likely to clog.
☐	Filter course is washed and free of fines.	Washing aggregate will help eliminate fines that could clog the facility and impede infiltration.
☐	Filter course calculations assessing suitability for particle migration prevention have been completed.	Gradation relationship between layers can evaluate factors (e.g., bridging, permeability, and uniformity) to determine if particle sizing is appropriate or if an intermediate layer is needed.
Aggregate Storage Layer		
☐	Class 2 Permeable per Caltrans specification 68-1.025 is recommended for the storage layer. Washed, open-graded crushed rock may be used, however a 4-6 inch washed pea gravel	Washing aggregate will help eliminate fines that could clog the aggregate storage layer void spaces or subgrade.

	Siting and Design	***Intent/Rationale***
	filter course layer at the top of the crushed rock is required.	
☐	The depth of aggregate provided (12-inch typical) and storage layer configuration is adequate for providing conveyance for underdrain flows to the outlet structure.	Proper storage layer configuration and underdrain placement will minimize facility drawdown time.
Inflow, Underdrain, and Outflow Structures		
☐	Inflow, underdrains and outflow structures are accessible for inspection and maintenance.	Maintenance will prevent clogging and ensure proper operation of the flow control structures.
☐	Inflow velocities are limited to 3 ft/s or less or use energy dissipation methods. (e.g., riprap, level spreader) for concentrated inflows.	High inflow velocities can cause erosion, scour and/or channeling.
☐	Curb cut inlets are at least 12 inches wide, have a 4-6 inch reveal (drop) and an apron and energy dissipation as needed.	Inlets must not restrict flow and apron prevents blockage from vegetation as it grows in. Energy dissipation prevents erosion.
☐	Underdrain outlet elevation should be a minimum of 3 inches above the bottom elevation of the aggregate storage layer.	A minimal separation from subgrade or the liner lessens the risk of fines entering the underdrain and can improve hydraulic performance by allowing perforations to remain unblocked.
☐	Minimum underdrain diameter is 6 inches.	Smaller diameter underdrains are prone to clogging.
☐	Underdrains are made of slotted, PVC pipe conforming to ASTM D 3034 or equivalent or corrugated, HDPE pipe conforming to AASHTO 252M or equivalent.	Slotted underdrains provide greater intake capacity, clog resistant drainage, and reduced entrance velocity into the pipe, thereby reducing the chances of solids migration.
☐	An underdrain cleanout with a minimum 6-inch diameter and lockable cap is placed every 250 to 300 feet as required based on underdrain length.	Properly spaced cleanouts will facilitate underdrain maintenance.
☐	Overflow is safely conveyed to a downstream storm drain system or discharge point Size overflow structure to pass 100-year peak flow	Planning for overflow lessens the risk of property damage due to flooding.

Siting and Design	*Intent/Rationale*
for on-line infiltration basins and water quality peak flow for off-line basins.	

Conceptual Design and Sizing Approach for Storm Water Pollutant Control Only

To design bioretention with underdrain for storm water pollutant control only (no flow control required), the following steps should be taken:

1. Verify that siting and design criteria have been met, including placement requirements, contributing tributary area, maximum side and finish grade slopes, and the recommended media surface area tributary ratio.
2. Calculate the DCV per Appendix B based on expected site design runoff for tributary areas.
3. Use the sizing worksheet presented in Appendix B.5 to size biofiltration BMPs.

Conceptual Design and Sizing Approach when Storm Water Flow Control is Applicable

Control of flow rates and/or durations will typically require significant surface ponding and/or aggregate storage volumes, and therefore the following steps should be taken prior to determination of storm water pollutant control design. Pre-development and allowable post-project flow rates and durations should be determined as discussed in Chapter 6 of the manual.

1. Verify that siting and design criteria have been met, including placement requirements, contributing tributary area, maximum side and finish grade slopes, and the recommended media surface area tributary ratio.
2. Iteratively determine the facility footprint area, surface ponding and/or aggregate storage layer depth required to provide detention storage to reduce flow rates and durations to allowable limits. Flow rates and durations can be controlled from detention storage by altering outlet structure orifice size(s) and/or water control levels. Multi-level orifices can be used within an outlet structure to control the full range of flows.
3. If bioretention with underdrain cannot fully provide the flow rate and duration control required by this manual, an upstream or downstream structure with significant storage volume such as an underground vault can be used to provide remaining controls.
4. After bioretention with underdrain has been designed to meet flow control requirements, calculations must be completed to verify if storm water pollutant control requirements to treat the DCV have been met.

E.13 BF-2 Nutrient Sensitive Media Design

Some studies of bioretention with underdrains have observed export of nutrients, particularly inorganic nitrogen (nitrate and nitrite) and dissolved phosphorus. This has been observed to be a short-lived phenomenon in some studies or a long term issue in some studies. The composition of the soil media, including the chemistry of individual elements is believed to be an important factor in the potential for nutrient export. Organic amendments, often compost, have been identified as the most likely source of nutrient export. The quality and stability of organic amendments can vary widely.

The biofiltration media specifications contained in the County of San Diego Low Impact Development Handbook: Appendix G -Bioretention Soil Specification (June 2014, unless superseded by more recent edition) and the City of San Diego Low Impact Development Design Manual (page B-18) (July 2011, unless superseded by more recent edition) were developed with consideration of the potential for nutrient export. These specifications include criteria for individual component characteristics and quality in order to control the overall quality of the blended mixes. As of the publication of this manual, the June 2014 County of San Diego specifications provide more detail regarding mix design and quality control.

The City and County specifications noted above were developed for general purposes to meet permeability and treatment goals. In cases where the BMP discharges to receiving waters with nutrient impairments or nutrient TMDLs, the biofiltration media should be designed with the specific goal of minimizing the potential for export of nutrients from the media. Therefore, in addition to adhering to the City or County media specifications, the following guidelines should be followed:

1. Select plant palette to minimize plant nutrient needs

A landscape architect or agronomist should be consulted to select a plant palette that minimizes nutrient needs. Utilizing plants with low nutrient needs results in less need to enrich the biofiltration soil mix. If nutrient quantity is then tailored to plants with lower nutrient needs, these plants will generally have less competition from weeds, which typically need higher nutrient content. The following practices are recommended to minimize nutrient needs of the plant palette:

- **Utilize native, drought-tolerant plants and grasses where possible.** Native plants generally have a broader tolerance for nutrient content, and can be longer lived in leaner/lower nutrient soils.

- **Start plants from smaller starts or seed.** Younger plants are generally more tolerant of lower nutrient levels and tend to help develop soil structure as they grow. Given the lower cost of smaller plants, the project should be able to accept a plant mortality rate that is somewhat higher than starting from larger plants and providing high organic content.

2. Minimize excess nutrients in media mix

Once the low-nutrient plant palette is established (item 1), the landscape architect and/or agronomist should be consulted to assist in the design of a biofiltration media to balance the interests of plant establishment, water retention capacity (irrigation demand), and the potential for nutrient export. The following guidelines should be followed:

- **The mix should not exceed the nutrient needs of plants.** In conventional landscape design, the nutrient needs of plants are often exceeded intentionally in order to provide a factor of safety for plant survival. This practice must be avoided in biofiltration media as excess nutrients will increase the chance of export. The mix designer should keep in mind that nutrients can be added later (through mulching, tilling of amendments into the surface), but it is not possible to remove nutrients, once added.

- **The actual nutrient content and organic content of the selected organic amendment source should be determined when specifying mix proportions.** Nutrient content (i.e., C:N ratio; plant extractable nutrients) and organic content (i.e, % organic material) are relatively inexpensive to measure via standard agronomic methods and can provide important information about mix design. If mix design relies on approximate assumption about nutrient/organic content and this is not confirmed with testing (or the results of prior representative testing), it is possible that the mix could contain much more nutrient than intended.

- **Nutrients are better retained in soils with higher cation exchange capacity.** Cation exchange capacity can be increased through selection of organic material with naturally high cation exchange capacity, such as peat or coconut coir pith, and/or selection of inorganic material with high cation exchange capacity such as some sands or engineered minerals (e.g., low P-index sands, zeolites, rhyolites, etc). Including higher cation exchange capacity materials would tend to reduce the net export of nutrients. Natural silty materials also provide cation exchange capacity; however potential impacts to permeability need to be considered.

- **Focus on soil structure as well as nutrient content.** Soil structure is loosely defined as the ability of the soil to conduct and store water and nutrients as well as the degree of aeration of the soil. Soil structure can be more important than nutrient content in plant survival and biologic health of the system. If a good soil structure can be created with very low amounts of organic amendment, plants survivability should still be provided. While soil structure generally develops with time, biofiltration media can be designed to promote earlier development of soil structure. Soil structure is enhanced by the use of amendments with high humus content (as found in well-aged organic material). In addition, soil structure can be enhanced through the use of organic material with a distribution of particle sizes (i.e., a more heterogeneous mix).

- **Consider alternatives to compost.** Compost, by nature, is a material that is continually evolving and decaying. It can be challenging to determine whether tests previously done on a given compost stock are still representative. It can also be challenging to determine how the properties of the compost will change once placed in the media bed. More stable materials such as aged coco coir pith, peat, biochar, shredded bark, and/or other amendments should be considered.

With these considerations, it is anticipated that less than 10 percent organic amendment by volume could be used, while still balancing plant survivability and water retention. If compost is used, designers should strongly consider utilizing less than 10 percent by volume.

3. Design with partial retention and/or internal water storage

An internal water storage zone, as described in Fact Sheet PR-1 is believed to improve retention of nutrients. For lined systems, an internal water storage zone worked by providing a zone that fluctuates between aerobic and anaerobic conditions, resulting in nitrification/denitrification. In soils that will allow infiltration, a partial retention design (PR-1) allows significant volume reduction and can also promote nitrification/denitrification.

Acknowledgment: This fact sheet has been adapted from the Orange County Technical Guidance Document (May 2011). It was originally developed based on input from: Deborah Deets, City of Los Angeles Bureau of Sanitation, Drew Ready, Center for Watershed Health, Rick Fisher, ASLA, City of Los Angeles Bureau of Engineering, Dr. Garn Wallace, Wallace Laboratories, Glen Dake, GDML, and Jason Schmidt, Tree People. The guidance provided herein does not reflect the individual opinions of any individual listed above and should not be cited or otherwise attributed to those listed.

E.14 BF-3 Proprietary Biofiltration Systems

The purpose of this fact sheet is to help explain the potential role of proprietary BMPs in meeting biofiltration requirements, when full retention of the DCV is not feasible. The fact sheet does not describe design criteria like the other fact sheets in this appendix because this information varies by BMP product model.

Criteria for Use of a Proprietary BMP as a Biofiltration BMP

A proprietary BMP may be acceptable as a "biofiltration BMP" under the following conditions:

(1) The BMP meets the minimum design criteria listed in Appendix F, including the pollutant treatment performance standard in Appendix F.1;

(2) The BMP is designed and maintained in a manner consistent with its performance certifications (See explanation in Appendix F.2); and

(3) The BMP is acceptable at the discretion of the City Engineer. In determining the acceptability of a BMP, the City Engineer should consider, as applicable, (a) the data submitted; (b) representativeness of the data submitted; (c) consistency of the BMP performance claims with pollutant control objectives; certainty of the BMP performance claims; (d) for projects within the public right of way and/or public projects: maintenance requirements, cost of maintenance activities, relevant previous city experience with operation and maintenance of the BMP type, ability to continue to operate the system in event that the vending company is no longer operating as a business; and (e) other relevant factors.

Guidance for Sizing a Proprietary BMP as a Biofiltration BMP

Proprietary biofiltration BMPs must meet the same sizing guidance as non-proprietary BMPs. Sizing is typically based on capturing and treating 1.50 times the DCV not reliably retained. Guidance for sizing biofiltration BMPs to comply with requirements of this manual is provided in Appendix F.2.

APPENDIX D

Site Design BMP
and
Source Control BMP References

- Site Design BMP Fact Sheets
- Source Control BMP Checklist

E.3 SD-5 Disperse Runoff from Impervious Area

MS4 Permit Category
Site Design

Manual Category
Site Design

Applicable Performance Criteria
Site Design

Primary Benefits
Volume Reduction
Peak Flow Attenuation

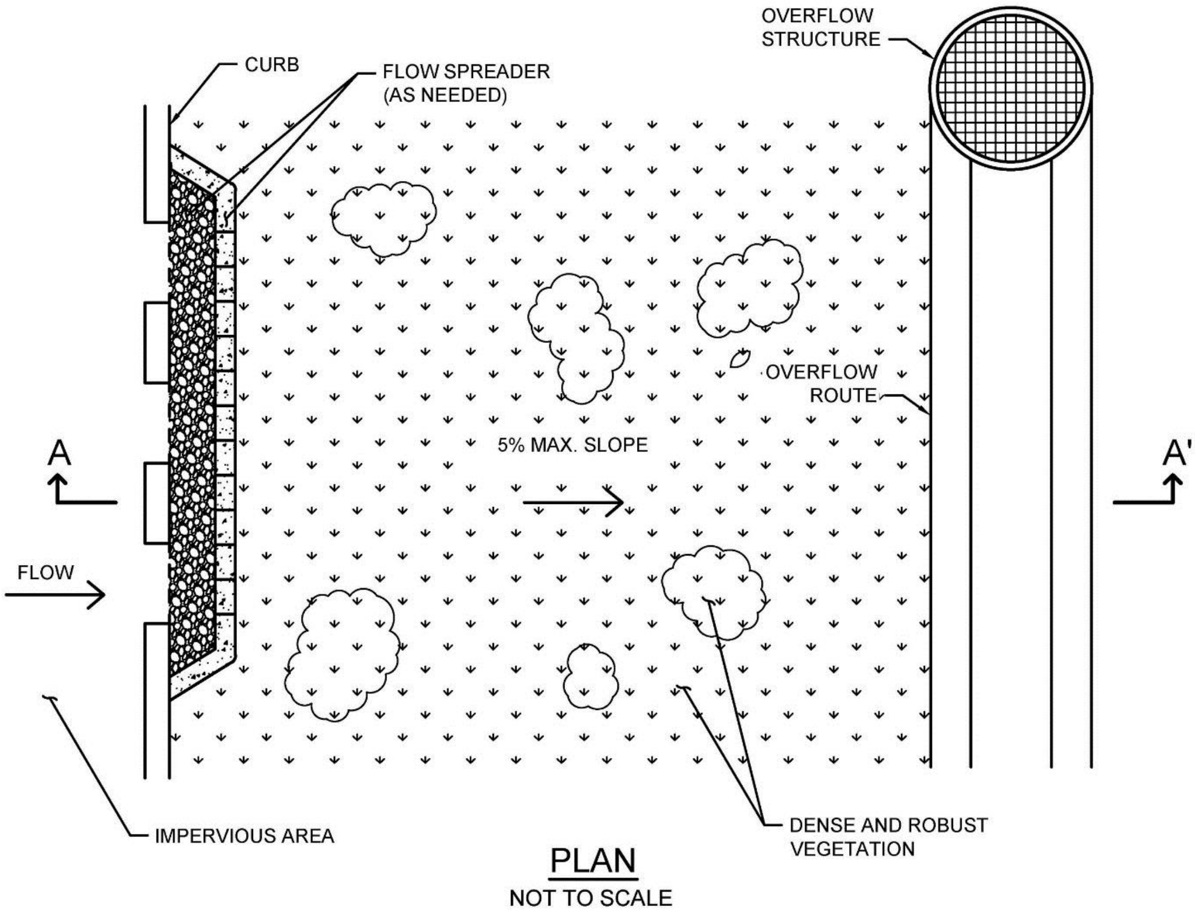
Photo Credit: Orange County Technical Guidance Document

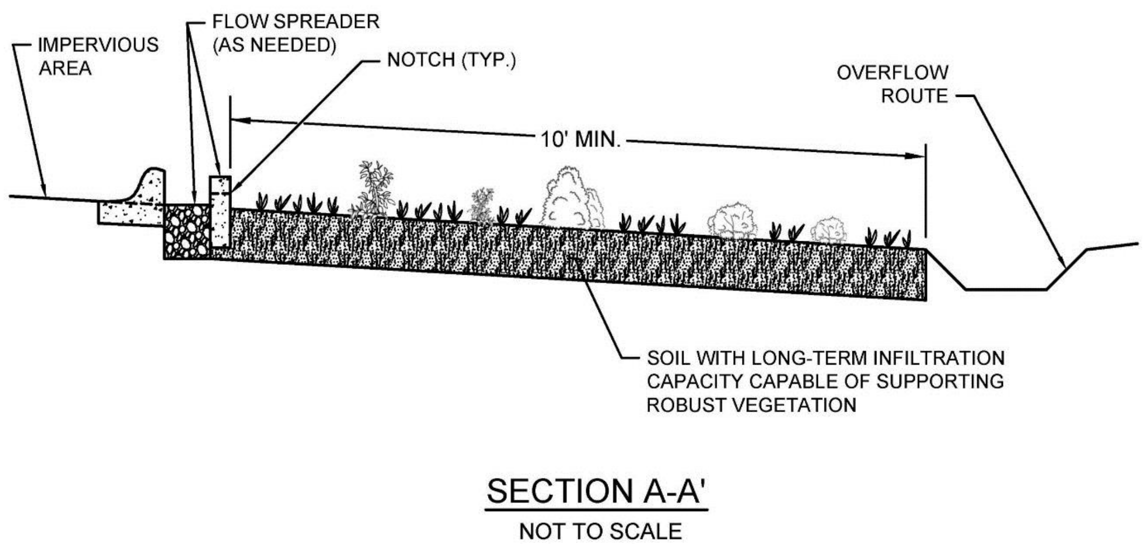
Description

Dispersing runoff from impervious area (dispersion) refers to the practice of effectively disconnecting impervious areas from directly draining to the storm drain system by routing runoff from impervious areas such as rooftops (through downspout disconnection), walkways, and driveways onto the surface of adjacent pervious areas. The intent is to slow runoff discharges, and reduce volumes. Dispersion with partial or full infiltration results in significant volume reduction by means of infiltration and evapotranspiration.

Typical dispersion components include:

- An impervious surface from which runoff flows will be routed with minimal piping to limit concentrated inflows
- Splash blocks, flow spreaders, or other means of dispersing concentrated flows and providing energy dissipation as needed
- Dedicated pervious area, typically vegetated, with in-situ soil infiltration capacity for partial or full infiltration
- Optional soil amendments to improve vegetation support, maintain infiltration rates and enhance treatment of routed flows
- Overflow route for excess flows to be conveyed from dispersion area to the storm drain system or discharge point





Typical plan and section view of a Dispersing Runoff from Impervious Area BMP

Design Adaptations for Project Goals

Site design BMP to reduce impervious area and DCV. Dispersing runoff from impervious area primarily functions as a site design BMP for reducing the effective imperviousness of a site by providing partial or full infiltration of the flows that are routed to pervious dispersion areas and otherwise slowing down excess flows that eventually reach the storm drain system. This can significantly reduce the DCV for the site.

Design Criteria and Considerations

Dispersion must meet the following design criteria. Deviations from the below criteria may be approved at the discretion of the City Engineer if it is determined to be appropriate:

Siting and Design		*Intent/Rationale*
☐	Dispersion is over areas with soil types capable of supporting or being amended (e.g., with sand or compost) to support vegetation. Media amendments must be tested to verify that they are not a source of pollutants.	Soil must have long-term infiltration capacity for partial or full infiltration and be able to support vegetation to provide runoff treatment. Amendments to improve plant growth must not have negative impact on water quality. For more details on Amended Soil, refer to Appendix E in County of San Diego BMP Design Manual.
☐	Dispersion has vegetated sheet flow over a relatively large distance (minimum 10 feet or maximum extent practicable) from inflow to overflow route.	Full or partial infiltration requires relatively large areas to be effective depending on the permeability of the underlying soils.
☐	Pervious areas should be flat (with less than 5% slopes) and vegetated.	Flat slopes facilitate sheet flows and minimize velocities, thereby improving treatment and reducing the likelihood of erosion.
Inflow velocities		
☐	Inflow velocities are limited to 3 ft/s or less or use energy dissipation methods (e.g., riprap, level spreader) for concentrated inflows.	High inflow velocities can cause erosion, scour and/or channeling.
Dedication		
☐	Dispersion areas must be owned by the project owner and be dedicated for the purposes of dispersion to the exclusion of other future uses	Dedicated dispersion areas prevent future conversion to alternate uses and

	Siting and Design	*Intent/Rationale*
	that might reduce the effectiveness of the dispersion area.	facilitate continued full and partial infiltration benefits.

Vegetation

☐	Dispersion typically requires dense and robust vegetation for proper function. Drought tolerant species should be selected to minimize irrigation needs. A plant list to aid in selection can be found in Appendix E.20.	Vegetation improves resistance to erosion and aids in runoff treatment.

Conceptual Design and Sizing Approach for Site Design

1. Determine the areas where dispersion can be used in the site design to reduce the DCV for pollutant control sizing.
2. Calculate the DCV for storm water pollutant control per Appendix B.2, taking into account reduced runoff from dispersion.
3. Determine if a DMA is considered "Self-retaining" if the impervious to pervious ratio is:
    a. 2:1 when the pervious area is composed of Hydrologic Soil Group A
    b. 1:1 when the pervious area is composed of Hydrologic Soil Group B

E.1 Source Control BMP Requirements

Worksheet E.1-1: Source Control BMP Requirements

How to comply: Projects shall comply with this requirement by implementing all source control BMPs listed in this section that are applicable to their project. Applicability shall be determined through consideration of the development project's features and anticipated pollutant sources. Appendix E.1 provides guidance for identifying source control BMPs applicable to a project. The City's Standard Project Requirements Checklist E-36 shall be used to document compliance with source control BMP requirements.

How to use this worksheet:

1. Review Column 1 and identify which of these potential sources of storm water pollutants apply to your site. Check each box that applies.
2. Review Column 2 and incorporate all of the corresponding applicable BMPs in your project site plan.
3. Review Columns 3 and 4 and incorporate all of the corresponding applicable permanent controls and operational BMPs in a table in your project-specific storm water management report. Describe your specific BMPs in an accompanying narrative, and explain any special conditions or situations that required omitting BMPs or substituting alternatives.

If These Sources Will Be on the Project Site …	**… Then Your Project Shall Consider These Source Control BMPs**		
1 **Potential Sources of Runoff Pollutants**	**2** **Permanent Controls—Show on Drawings**	**3** **Permanent Controls—List in Table and Narrative**	**4** **Operational BMPs—Include in Table and Narrative**
❑ **A.** Onsite storm drain inlets ❑ Not Applicable	❑ Locations of inlets.	❑ Mark all inlets with the words "No Dumping! Flows to Bay" or similar.	❑ Maintain and periodically repaint or replace inlet markings. ❑ Provide storm water pollution prevention information to new site owners, lessees, or operators. ❑ See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com. ❑ Include the following in lease agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."

If These Sources Will Be on the Project Site …	… Then Your Project shall consider These Source Control BMPs		
1 **Potential Sources of Runoff Pollutants**	**2** **Permanent Controls—Show on Drawings**	**3** **Permanent Controls—List in Table and Narrative**	**4** **Operational BMPs—Include in Table and Narrative**
❑ **B.** Interior floor drains and elevator shaft sump pumps ☑ Not Applicable		❑ State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer.	❑ Inspect and maintain drains to prevent blockages and overflow.
❑ **C.** Interior parking garages ☑ Not Applicable		❑ State that parking garage floor drains will be plumbed to the sanitary sewer or an approved BMP	❑ Inspect and maintain drains to prevent blockages and overflow.
❑ **D1.** Need for future indoor & structural pest control ☑ Not Applicable		❑ Note building design features that discourage entry of pests.	❑ Provide Integrated Pest Management information to owners, lessees, and operators.

If These Sources Will Be on the Project Site …	… Then Your Project shall consider These Source Control BMPs		
1 **Potential Sources of Runoff Pollutants**	**2** **Permanent Controls—Show on Drawings**	**3** **Permanent Controls—List in Table and Narrative**	**4** **Operational BMPs—Include in Table and Narrative**
❑ **D2.** Landscape/ Outdoor Pesticide Use ❑ Not Applicable	❑ Show locations of existing trees or areas of shrubs and ground cover to be undisturbed and retained. ❑ Show self-retaining landscape areas, if any. ❑ Show storm water treatment facilities.	State that final landscape plans will accomplish all of the following. ❑ Preserve existing drought tolerant trees, shrubs, and ground cover to the maximum extent possible. ❑ Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to storm water pollution. ❑ Where landscaped areas are used to retain or detain storm water, specify plants that are tolerant of periodic saturated soil conditions. ❑ Consider using pest-resistant plants, especially adjacent to hardscape. ❑ To ensure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.	❑ Maintain landscaping using minimum or no pesticides. ❑ See applicable operational BMPs in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com. ❑ Provide IPM information to new owners, lessees and operators.

If These Sources Will Be on the Project Site …	… Then Your Project shall consider These Source Control BMPs		
1 **Potential Sources of Runoff Pollutants**	**2** **Permanent Controls—Show on Drawings**	**3** **Permanent Controls—List in Table and Narrative**	**4** **Operational BMPs—Include in Table and Narrative**
❑ **E.** Pools, spas, ponds, decorative fountains, and other water features. ❑ Not Applicable	❑ Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet.	❑ Pool backwash to be plumbed to the sanitary sewer. Place a note on the plans and state in the narrative that this connection will be made according to city requirements.	❑ See applicable operational BMPs in Fact Sheet SC-72, "Fountain and Pool Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com.
❑ **F.** Food service ❑ Not Applicable	❑ For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment. ❑ On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.	❑ Describe the location and features of the designated cleaning area. ❑ Describe the items to be cleaned in this facility and how it has been sized to ensure that the largest items can be accommodated.	

If These Sources Will Be on the Project Site …	… Then Your Project shall consider These Source Control BMPs		
1 **Potential Sources of Runoff Pollutants**	**2** **Permanent Controls—Show on Drawings**	**3** **Permanent Controls—List in Table and Narrative**	**4** **Operational BMPs—Include in Table and Narrative**
❑ **G.** Refuse areas ❑ Not Applicable	❑ Show where site refuse and recycled materials will be handled and stored for pickup. ❑ If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent run- on and show locations of berms to prevent runoff from the area. Also show how the designated area will be protected from wind dispersal. ❑ Any drains from dumpsters, compactors, and tallow bin areas shall be discharged to an approved BMP. ❑ Refer to City Standard Drawing GS-16 for details.	❑ State how site refuse will be handled and provide supporting detail to what is shown on plans. ❑ State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.	❑ State how the following will be implemented: Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on- site. See Fact Sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com.

If These Sources Will Be on the Project Site …	… Then Your Project shall consider These Source Control BMPs		
1 **Potential Sources of Runoff Pollutants**	**2** **Permanent Controls—Show on Drawings**	**3** **Permanent Controls—List in Table and Narrative**	**4** **Operational BMPs—Include in Table and Narrative Table and Narrative**
❑ **H.** Industrial processes. ❑ Not Applicable	❑ Show process area.	❑ If industrial processes are to be located onsite, state: "All process activities to be performed indoors. No processes to drain to exterior or to storm drain system."	❑ See Fact Sheet SC-10, "Non-Stormwater Discharges" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com.
❑ **I.** Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.) ❑ Not Applicable	❑ Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or runoff from area and protected from wind dispersal. ❑ Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults. ❑ Storage of hazardous materials and wastes must be in compliance with the city's hazardous materials ordinance and a Hazardous Materials Management Plan for the site.	❑ Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains. Where appropriate, reference documentation of compliance with the requirements of local Hazardous Materials Programs for: ▪ Hazardous Waste Generation ▪ Hazardous Materials Release Response and Inventory ▪ California Accidental Release Prevention Program ▪ Aboveground Storage Tank ▪ Uniform Fire Code Article 80 Section 103(b) & (c) 1991 ▪ Underground Storage Tank	❑ See the Fact Sheets SC-31, "Outdoor Liquid Container Storage" and SC-33, "Outdoor Storage of Raw Materials" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com.

If These Sources Will Be on the Project Site …	… Then Your Project shall consider These Source Control BMPs		
1 **Potential Sources of Runoff Pollutants**	**2** **Permanent Controls—Show on Drawings**	**3** **Permanent Controls—List in Table and Narrative**	**4** **Operational BMPs—Include in Table and Narrative**
❑ **J.** Vehicle and Equipment Cleaning ❑ Not Applicable	❑ Show on drawings as appropriate: (1) Commercial/industrial facilities having vehicle /equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses. (2) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed.	❑ If a car wash area is not provided, describe measures taken to discourage onsite car washing and explain how these will be enforced.	Describe operational measures to implement the following (if applicable): ❑ Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system. ❑ Car dealerships and similar may rinse cars with water only. ❑ See Fact Sheet SC-21, "Vehicle and Equipment Cleaning," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

If These Sources Will Be on the Project Site …	… Then Your Project shall consider These Source Control BMPs		
1 Potential Sources of Runoff Pollutants	**2 Permanent Controls—Show on Drawings**	**3 Permanent Controls—List in Table and Narrative**	**4 Operational BMPs—Include in Table and Narrative**
❑ **K.** Vehicle/Equipment Repair and Maintenance ❑ Not Applicable	❑ Accommodate all vehicle equipment repair and maintenance indoors or designate an outdoor work area and design the area to protect from rainfall, run-on runoff, and wind dispersal. ❑ Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas. ❑ Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.	❑ State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area. ❑ State that there are no floor drains or if there are floor drains, note the city from which an industrial waste discharge permit will be obtained and that the design meets city's requirements. ❑ State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the city from which an industrial waste discharge permit will be obtained and that the design meets city's requirements.	In the report, note that all of the following restrictions apply to use the site: ❑ No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains. ❑ No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately. ❑ No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment.

If These Sources Will Be on the Project Site …	… Then Your Project shall consider These Source Control BMPs		
1 **Potential Sources of Runoff Pollutants**	**2** **Permanent Controls—Show on Drawings**	**3** **Permanent Controls—List in Table and Narrative**	**4** **Operational BMPs—Include in Table and Narrative**
❑ **L.** Fuel Dispensing Areas ❑ Not Applicable	❑ Fueling areas[1] shall have impermeable floors (i.e., portland cement concrete or equivalent smooth impervious surface) that are (1) graded at the minimum slope necessary to prevent ponding; and (2) separated from the rest of the site by a grade break that prevents run-on of storm water to the MEP. ❑ Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area[1].] The canopy [or cover] shall not drain onto the fueling area.		❑ The property owner shall dry sweep the fueling area routinely. ❑ See the Business Guide Sheet, "Automotive Service—Service Stations" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com.

1. The fueling area shall be defined as the area extending a minimum of 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.

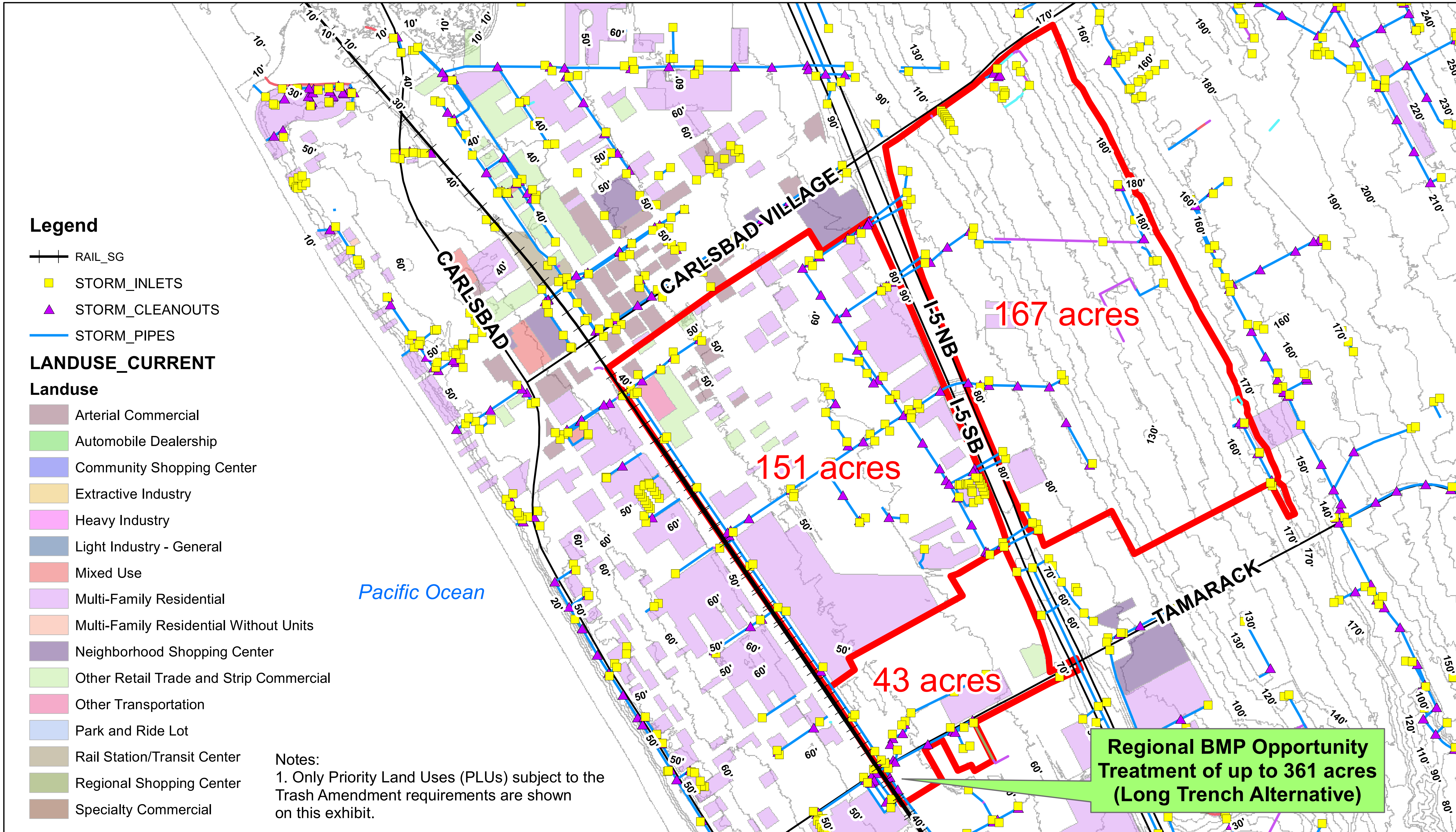
If These Sources Will Be on the Project Site …	… Then Your Project shall consider These Source Control BMPs		
1 **Potential Sources of Runoff Pollutants**	**2** **Permanent Controls—Show on Drawings**	**3** **Permanent Controls—List in Table and Narrative**	**4** **Operational BMPs—Include in Table and Narrative**
M. Loading Docks ❑ Not Applicable	❑ Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct storm water away from the loading area. Water from loading dock areas should be drained to an approved BMP. Direct connections to storm drains from depressed loading docks are prohibited. ❑ Loading dock shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation. ❑ Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.		❑ Move loaded and unloaded items indoors as soon as possible. ❑ See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com.

If These Sources Will Be on the Project Site …	… Then Your Project shall consider These Source Control BMPs		
1 **Potential Sources of Runoff Pollutants**	**2** **Permanent Controls—Show on Drawings**	**3** **Permanent Controls—List in Table and Narrative**	**4** **Operational BMPs—Include in Table and Narrative**
❑ **N.** Fire Sprinkler Test Water ❑ Not Applicable		❑ Provide a means to drain fire sprinkler test water to the sanitary sewer or approved BMP.	❑ See the note in Fact Sheet SC-41, “Building and Grounds Maintenance,” in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com.
O. Miscellaneous Drain or Wash Water ❑ Boiler drain lines ❑ Condensate drain lines ❑ Rooftop equipment ❑ Drainage sumps ❑ Roofing, gutters, and trim ❑ Not Applicable		❑ Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system. ❑ Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system. ❑ Rooftop mounted equipment with potential to produce pollutants shall be roofed and/or have secondary containment. ❑ Any drainage sumps onsite shall feature a sediment sump to reduce the quantity of sediment in pumped water. ❑ Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff.	

If These Sources Will Be on the Project Site …	… Then Your Project shall consider These Source Control BMPs		
1 **Potential Sources of Runoff Pollutants**	**2** **Permanent Controls—Show on Drawings**	**3** **Permanent Controls—List in Table and Narrative**	**4** **Operational BMPs—Include in Table and Narrative**
❑ **P.** Plazas, sidewalks, and parking lots. ❑ Not Applicable			❑ Plazas, sidewalks, and parking lots shall be swept regularly to prevent the accumulation of litter and debris. Debris from pressure washing shall be collected to prevent entry into the storm drain system. Washwater containing any cleaning agent or degreaser shall be collected and discharged to the sanitary sewer and not discharged to a storm drain.

APPENDIX E

Off-site Drainage Area Exhibit



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TYLININTERNATIONAL
engineers | planners | scientists

Carlsbad Village Double Track Project

Off-site Watershed Exhibit

10/10/19

ATTACHMENT H:

OPINION OF PROBABLE COST FOR 10% DESIGN

CARLSBAD VILLAGE RAILROAD TRENCH

Short Trench Alternative Estimate — Design Level: 10%

April 2020 — Estimated By: T.Y. Lin International

Item	Quantity	Unit	Unit Price	Amount	Subtotals
DESIGN					
Environmental	3	%	CCE	$5,260,246	
Design-30% Package	3	%	CCE	$5,260,246	
Design-60% and Permits	3.6	%	CCE	$6,312,295	
Design-90%, Final, Bid Support	3.6	%	CCE	$6,312,295	
SANDAG Administration	3.7	%	CCE	$6,487,637	
NCTD Administration	0.6	%	CCE	$1,052,049	
				Design Subtotal	**$30,684,768**
RIGHT OF WAY					
Temporary R/W, Easements	1	LS	$80,000	$80,000	
Property Acquisition	0	AC	$0	$0	
R/W Contingency	35	%	R/W Costs	$28,000	
				Right of Way Subtotal	**$108,000**
CONSTRUCTION COST ESTIMATE					
				Construction Cost Estimate (CCE)	**$175,400,000**
ANCILLARY CONSTRUCTION COSTS					
Design Services During Construction	2.76	%	CCE	$4,839,426	
Construction Management and Testing	16	%	CCE	$28,054,645	
SANDAG Const. Admin.	1.7	%	CCE	$2,980,806	
NCTD Const. Admin.	0.35	%	CCE	$613,695	
NCTD Support	4.8	%	CCE	$8,416,394	
Signal Support Services	1	LS	$240,000	$240,000	
Crossing Test Trains	1	LS	$50,000	$50,000	
Positive Train Control Support / Dispatch System Modifications	1	LS	$1,200,000	$1,200,000	
Railroad Flagging Services	20000	Hours	$70	$1,400,000	
				Ancillary Construction Cost Subtotal	**$47,794,967**
OFF-SITE ENVIRONMENTAL MITIGATION					
Non-Coastal (Freshwater Marsh) Wetlands	3	Acre	$225,000	$675,000	
				Offsite Mitigation Cost Subtotal	**$675,000**
TOTAL PROJECT COST ESTIMATE					**$254,700,000**
COST ESCALATION					
Year of Expenditure		Annual %	Cumulative	Estimated	Escalation
2020		0.00%	0.00%	$254,700,000	$0
2021		2.69%	2.69%	$261,551,430	$6,851,430
2022		2.69%	5.38%	$268,587,163	$13,887,163
2023		2.69%	8.07%	$275,812,158	$21,112,158
2024		2.69%	10.76%	$283,231,505	$28,531,505
2025		2.69%	13.45%	$290,850,433	$36,150,433
2026		2.69%	16.14%	$298,674,309	$43,974,309
			TOTAL EXPENDITURES IN 2020 DOLLARS	$254,700,000	
			TOTAL COST ESCALATION		$43,974,309
			PROJECT COST IN YEAR OF EXPENDITURE DOLLARS		**$298,700,000**

CARLSBAD VILLAGE RAILROAD TRENCH

Short Trench Alternative Estimate Design Level: 10%

April 2020 Estimated By: T.Y. Lin International

Item	Quantity	Unit	Unit Price	Amount	Subtotals
Construction Cost Estimate Based on Preliminary 10% Design					
Trackwork					
Track-136lb CWR, Ties, & Ballast	22960	TF	$285	$6,543,600	
Track-115lb CWR, Ties, & Ballast	300	TF	$285	$85,500	
Subballast	4,318	CY	$65	$280,670	
Track Removal	16489	TF	$56	$923,384	
Track Realignment/Shifting	6933	TF	$90	$623,970	
Temporary Turnout Relocation	1	EA	$200,000	$200,000	
Temporary No. 24 Turnout	2	EA	$800,000	$1,600,000	
Turnout Removal	2	EA	$50,000	$100,000	
Temporary Shoofly Track	7100	TF	$285	$2,023,500	
Install Insulated Joints	8	PAIR	$12,000	$96,000	
				Trackwork Subtotal	**$12,476,624**
Site Civil					
Clear and Grub	628540	SF	$1	$628,540	
Earthwork-Excavation	425000	CY	$40	$17,000,000	
Imported Borrow Embankment	0	CY	$50	$0	
Temporary Embankment/Removal	4000	CY	$55	$220,000	
Temporary Shoring	6600	SF	$30	$198,000	
Dewatering	1	LS	$1,000,000	$1,000,000	
At-grade Xing New Panel	490	LF	$2,500	$1,225,000	
Temporary Fencing and Controls	1	LS	$200,000	$200,000	
Temporary Platform	8700	SF	$12	$104,400	
Inter-track Fence	1200	LF	$100	$120,000	
Platform/Parking/Street Demolition	32000	SF	$2	$64,000	
Building Demolition	4935	SF	$8	$39,480	
Relocate Historic Train Depot	1	LS	$100,000	$100,000	
Construct Station Platform	28050	SF	$12	$336,600	
Construct AC Pavement	280000	SF	$4	$1,125,600	
Aggregate Base	280000	SF	$2	$515,200	
Construct PCC Pavement	3258	SF	$20	$65,160	
Construct Sidewalk	16000	SF	$15	$240,000	
Construct Curb and Gutter	2172	LF	$37	$80,364	
Construct Median Curb and Gutter	1107	LF	$23	$25,461	
Detectable Warning Tiles	5620	SF	$22	$123,640	
Mini-High Platform	4	EA	$42,000	$168,000	
Construct Type A SD Cleanout	1	EA	$6,930	$6,930	
Construct Type B Curb Inlet	2	EA	$6,160	$12,320	
Fencing	11504	LF	$22	$253,088	
Storm Drain Pump Station	1	EA	$1,000,000	$1,000,000	
Construct Headwall (D-35A)	2	EA	$7,600	$15,200	
Construct Type B SD Cleanout	18	EA	$8,000	$144,000	
Install 12" PVC Storm Drain	213	LF	$105	$22,365	
Install 18" PVC Storm Drain	19	LF	$250	$4,750	
Install 30" RCP Storm Drain	1959	LF	$156	$305,604	
Install 36" RCP Storm Drain	1274	LF	$189	$240,786	

CARLSBAD VILLAGE RAILROAD TRENCH

Short Trench Alternative Estimate Design Level: 10%

April 2020 Estimated By: T.Y. Lin International

Item	Quantity	Unit	Unit Price	Amount	Subtotals
Remove Storm Drain	487	LF	$84	$40,908	
Concrete Channel	3591	LF	$1,100	$3,950,100	
Drainage DItch	9460	LF	$24	$227,040	
Install 24-inch RCP	95	LF	$250	$23,750	
Install 30-inch RCP	830	LF	$375	$311,250	
Construct Headwall	3	EA	$5,940	$17,820	
Rip-Rap	300	CY	$185	$55,500	
MWS-L-4-6-V	1	EA	$13,200	$13,200	
MWS-L-8-20-V	1	EA	$57,750	$57,750	
MWS-L-8-16-V	1	EA	$46,540	$46,540	
MWS-L-8-24-V	1	EA	$68,750	$68,750	
Landscape and Irrigation	1	LS	$75,000	$75,000	
Traffic Control	1	LS	$250,000	$250,000	
Traffic Striping	1	LS	$100,000	$100,000	
				Civil Subtotal	**$30,822,096**
Structures					
Buena Vista Lagoon Bridge	9899	SF	$295	$2,920,205	
Remove Existing Buena Vista Lagoon Bridge	1	LS	$1,230,000	$1,230,000	
Carlsbad Blvd Overpass	10200	SF	$260	$2,652,000	
Remove Existing Carlsbad Blvd Overpass	1	LS	$770,000	$770,000	
Beech Ave Pedestrian Overpass	792	SF	$205	$162,360	
Grand Ave Overpass	5544	SF	$230	$1,275,120	
Carlsbad Village Dr. Overpass	5544	SF	$230	$1,275,120	
Oak Ave Overpass	3036	SF	$205	$622,380	
Chestnut Pedestrian Overpass	792	SF	$205	$162,360	
Stairway Retaining Walls	1000	CY	$665	$665,000	
Construct Concrete Steps	101	CY	$820	$82,820	
Trench Structure	1	LS	$52,380,000	$52,380,000	
				Structures Subtotal	**$64,197,365**
Utility Relocation					
UG Fiber Optic in HDPE Conduit	9565	LF	$50	$478,250	
12-inch HP Gas	1400	LF	$180	$252,000	
10-inch VCP Sewer	260	LF	$175	$45,500	
Street Light and Pull Box	2	EA	$3,000	$6,000	
1-inch Irrigation Service	1	EA	$2,400	$2,400	
Relocate 10-inch water	240	LF	$180	$43,200	
Relocate 1-inch gas	160	LF	$100	$16,000	
Relocate Gas - through bridge	280	LF	$300	$84,000	
Relcoate Water-through bridge	560	LF	$180	$100,800	
Construct Special Case 10ft Manhole @ 48"	1	EA	$14,000	$14,000	
Remove Sewer Pipe	381	LF	$46	$17,709	
Sewer Manhole (3'x5')	12	EA	$5,500	$66,000	
Install 6-inch PVC Sewer Main	152	LF	$92	$13,922	
Install 8-inch PVC Sewer Main	1037	LF	$108	$111,612	
Install 10-inch PVC Sewer Main	1852	LF	$162	$300,024	
Relocate Telecom-through bridge	280	LF	$300	$84,000	
Relocate UG Fiber Optic	9769	LF	$50	$488,450	
Relocate UG Telecom	346	LF	$50	$17,300	
				Utility Relocation Subtotal	**$2,141,167**

CARLSBAD VILLAGE RAILROAD TRENCH

Short Trench Alternative Estimate Design Level: 10%

April 2020 Estimated By: T.Y. Lin International

Item	Quantity	Unit	Unit Price	Amount	Subtotals
Environmental					
SWPPP (Temp Erosion Control)	1	LS	$250,000	$250,000	
Permenant Erosion Control	75000	SF	$1	$75,000	
Onsite Coastal Wetlands	0.6	Acre	$145,000	$87,000	
Onsite Non-Coastal (Southern Willow Scrub)	0.4	Acre	$145,000	$58,000	
Onsite Non-Coastal (Freshwater Marsh)	0.3	Acre	$145,000	$43,500	
Onsite Sensative Uplands	0.2	Acre	$145,000	$29,000	
Monitors - Environmental/Biological	1400	Hours	$150	$210,000	
Monitors - Paleo/Archeology	960	Hours	$150	$144,000	
				Environmental Mitigation Subtotal	**$896,500**
Signal					
Temporary Shoofly					
Temp. Relocate Fiber Duct Bank Above Ground (Hi-Line)	1	LS	$500,000	$500,000	
Retire CP Longboard	1	LS	$80,000	$80,000	
Furnish, Install, Test and Commission Temp CP Laguna	1	LS	$1,600,000	$1,600,000	
Relocate Carlsbad Village Station Comm Shelter	1	LS	$300,000	$300,000	
Retire Carlsbad Village Station Ped. Crossing	1	LS	$50,000	$50,000	
Furnish, Install, Test and Commission Grand Ave Warning Devices/Reloca	1	LS	$250,000	$250,000	
Furnish, Install, Test and Commission Carlsbad Village Dr Warning Devices	1	LS	$250,000	$250,000	
Furnish, Install, Test and Commission Temp 2292 Signal	1	LS	$750,000	$750,000	
Retire CP Carl	1	LS	$80,000	$80,000	
Furnish, Install, Test and Commission Temp CP Tamarack	1	LS	$1,500,000	$1,500,000	
Furnish, Install, Test and Commission Tamarack Warning Devices/Relocat	1	LS	$250,000	$250,000	
Railroad Trench Double Track					
Perm. Relocate Fiber Duct Bank Adjacent to Railroad Trench	1	LS	$500,000	$500,000	
Modify Cassidy St Grade Crossing Train Detection Circuits	1	LS	$100,000	$100,000	
Furnish, Install, Test and Commission 2281-2284 Signals	1	LS	$750,000	$750,000	
Modify Temp CP Laguna-Furnish, Install, Test, Commission 2285/2287 Sig	1	LS	$200,000	$200,000	
Retire Grand Ave Grade Crossing Warning System	1	LS	$30,000	$50,000	
Retire Carlsbad Village Dr Grade Crossing Warning System	1	LS	$30,000	$50,000	
Furnish, Install, Test and Commission 2292/2294 Signals in Trench	1	LS	$250,000	$250,000	
Modify Temp CP Tamarack-Furnish, Install, Test, Commission 2301-2304 S	1	LS	$200,000	$200,000	
Modify Tamarack Ave Grade Crossing Train Detection Circuits and Warnir	1	LS	$200,000	$200,000	
				Signal Subtotal	**$7,910,000**
Architectural					
Platform Shelter	12	EA	$110,000	$1,320,000	
Temporary Platform Shelter	5	EA	$110,000	$550,000	
Platform Benches	12	LS	$5,200	$62,400	
Tubular Hand Rails	904	LF	$75	$67,800	
Signs	1	LS	$25,000	$25,000	
Construct New Restroom Building	1	LS	$300,000	$300,000	
Elevator	4	EA	$200,000	$800,000	
Platform Ammenities	1	LS	$50,000	$50,000	
				Architectural Subtotal	**$3,175,200**
Electrical					
Station Electrical and Communication System	1	LS	$2,500,000	$2,500,000	
Parking Lot Lighting	1	LS	$225,000	$225,000	
Temporary Station Electrical and Communication System	1	LS	$900,000	$900,000	
				Electrical Subtotal	**$3,625,000**
Base Construction Estimate (BCE)					**$125,243,952**

CARLSBAD VILLAGE RAILROAD TRENCH

Short Trench Alternative Estimate Design Level: 10%

April 2020 Estimated By: T.Y. Lin International

Item	Quantity	Unit	Unit Price	Amount	Subtotals
Other Construction Costs					
Contractor Mobilization (once)	7.5	%	BCE	$9,393,296	
Contractor Demobilization (once)	2.5	%	BCE	$3,131,099	
Contingency	30	%	BCE	$37,573,186	
				Other Construction Cost Subtotal	**$50,097,581**
Construction Cost Estimate (CCE)					**$175,341,533**

CARLSBAD VILLAGE RAILROAD TRENCH

Long Trench Alternative Estimate Design Level: 10 %

April 2020 Estimated By: T.Y. Lin International

Item	Quantity	Unit	Unit Price	Amount	Subtotals
DESIGN					
Environmental	3	%	CCE	$7,781,184	
Design-30% Package	3	%	CCE	$7,781,184	
Design-60% and Permits	3.6	%	CCE	$9,395,779	
Design-90%, Final, Bid Support	3.6	%	CCE	$9,395,779	
SANDAG Administration	3.7	%	CCE	$9,694,058	
NCTD Administration	0.6	%	CCE	$1,640,533	
				Design Subtotal	**$45,688,518**
RIGHT OF WAY					
Temporary R/W, Easements	1	LS	$80,000	$80,000	
Property Acquisition	1	LS	$7,350,000	$7,350,000	
R/W Contingency	35	%	R/W Costs	$2,600,500	
				Right of Way Subtotal	**$10,030,500**
CONSTRUCTION COST ESTIMATE					
				Construction Cost Estimate (CCE)	**$259,400,000**
ANCILLARY CONSTRUCTION COSTS					
Design Services During Construction	2.76	%	CCE	$7,158,689	
Construction Management and Testing	16.0	%	CCE	$41,499,647	
SANDAG Const. Admin.	1.7	%	CCE	$4,474,181	
NCTD Const. Admin.	0.35	%	CCE	$894,836	
NCTD Support	4.80	%	CCE	$12,449,894	
Signal Support Services	1	LS	$240,000	$240,000	
Crossing Test Trains	1	LS	$50,000	$50,000	
Positive Train Control Support / Dispatch System Modifications	1	LS	$1,200,000	$1,200,000	
Railroad Flagging Services	25000	Hours	$70	$1,750,000	
				Ancillary Construction Cost Subtotal	**$69,717,247**
OFF-SITE ENVIRONMENTAL MITIGATION					
Non-Coastal (Freshwater Marsh) Wetlands	3	Acre	$225,000	$675,000	
				Offsite Mitigation Cost Subtotal	**$675,000**
TOTAL PROJECT COST ESTIMATE					**$385,600,000**
COST ESCALATION					
Year of Expenditure	Annual %		Cumulative	Estimated	Escalation
2020	0.00%		0.00%	$385,600,000	$0
2021	2.69%		2.69%	$395,972,640	$10,372,640
2022	2.69%		5.38%	$406,624,304	$21,024,304
2023	2.69%		8.07%	$417,562,498	$31,962,498
2024	2.69%		10.76%	$428,794,929	$43,194,929
2025	2.69%		13.45%	$440,329,513	$54,729,513
2026	2.69%		16.14%	$452,174,376	$66,574,376
			TOTAL EXPENDITURES IN 2020 DOLLARS	$385,600,000	
			TOTAL COST ESCALATION		$66,574,376
			PROJECT COST IN YEAR OF EXPENDITURE DOLLARS		**$452,200,000**

CARLSBAD VILLAGE RAILROAD TRENCH

Long Trench Alternative Estimate Design Level: 10 %

April 2020 Estimated By: T.Y. Lin International

Item	Quantity	Unit	Unit Price	Amount	Subtotals
Construction Cost Estimate Based on Preliminary 10% Design					
Trackwork					
Track-136lb CWR, Ties, & Ballast	23223	TF	$285	$6,618,555	
Track-115lb CWR, Ties, & Ballast	300	TF	$285	$85,500	
Subballast	5,607	CY	$65	$364,455	
Track Removal	16752	TF	$56	$938,112	
Track Realignment/Shifting	4630	TF	$90	$416,700	
Temporary Turnout Relocation	1	EA	$200,000	$200,000	
Temporary No 24 Turnout	2	EA	$800,000	$1,600,000	
Turnout Removal	2	EA	$50,000	$100,000	
Temporary Shoofly Track	8600	TF	$285	$2,451,000	
Install Insulated Joints	8	PAIR	$12,000	$96,000	
				Trackwork Subtotal	**$12,870,322**
Site Civil					
Clear and Grub	760432	SF	$1	$760,432	
Earthwork-Excavation	661840	CY	$40	$26,473,600	
Temporary Embankment/Removal	4000	CY	$55	$220,000	
Temporary Shoring	6600	SF	$30	$198,000	
Dewatering	1	LS	$1,800,000	$1,800,000	
At-grade Xing New Panel	356	LF	$2,500	$890,000	
Temporary Fencing and Controls	1	LS	$200,000	$200,000	
Temporary Platform	8700	SF	$12	$104,400	
Inter-track Fence	1200	LF	$100	$120,000	
Platform/Parking/Street Demolition	32000	SF	$2	$64,000	
Building Demolition	20899	SF	$8	$167,192	
Relocate Historic Train Depot	1	LS	$100,000	$100,000	
Construct Station Platform	28050	SF	$12	$336,600	
Construct AC Pavement	280000	SF	$4	$1,125,600	
Aggregate Base	280000	SF	$2	$515,200	
Construct PCC Pavement	5683	SF	$20	$113,660	
Construct Sidewalk	16000	SF	$15	$240,000	
Construct Curb and Gutter	2172	LF	$37	$80,364	
Construct Median Curb and Gutter	1107	LF	$23	$25,461	
Detectable Warning Tiles	5620	SF	$22	$123,640	
Mini-High Platform	2	EA	$42,000	$84,000	
Construct Type A SD Cleanout	1	EA	$6,930	$6,930	
Construct Type B Curb Inlet	2	EA	$6,160	$12,320	
Fencing	15718	LF	$22	$345,796	
Storm Drain Pump Station	2	EA	$1,000,000	$2,000,000	
Install 12" PVC Storm Drain	213	LF	$105	$22,365	
Install 18" PVC Storm Drain	19	LF	$250	$4,750	
Construct Headwall (D-35A)	2	EA	$7,700	$15,400	
Install 30" RCP Storm Drain	1830	LF	$156	$285,480	
Install 36" RCP Storm Drain	1274	LF	$189	$240,786	
Install 48" RCP Storm Drain	840	LF	$228	$191,520	
Install 54" RCP Storm Drain	3135	LF	$332	$1,040,820	
Install 60" RCP Storm Drain	780	LF	$371	$289,380	
Remove 84" RCP SD	3453	LF	$120	$414,360	
Construct Type B SD Cleanout	30	EA	$8,000	$240,000	

CARLSBAD VILLAGE RAILROAD TRENCH

Long Trench Alternative Estimate			Design Level: 10 %		
April 2020			Estimated By: T.Y. Lin International		
Item	Quantity	Unit	Unit Price	Amount	Subtotals
84" RCP Storm Drain	3451	LF	$640	$2,208,640	
Remove Storm Drain	595	LF	$84	$49,980	
Remove Sewer Pipe	841	LF	$53	$44,573	
Concrete Channel	3595	LF	$260	$934,700	
Drainage DItch	12966	LF	$24	$311,184	
Install 24-inch RCP	95	LF	$250	$23,750	
Install 30-inch RCP	830	LF	$375	$311,250	
Construct Headwall	3	EA	$5,940	$17,820	
Rip-Rap	300	CY	$185	$55,554	
MWS-L-4-6-V	1	EA	$13,200	$13,200	
MWS-L-8-20-V	1	EA	$57,750	$57,750	
MWS-L-8-16-V	1	EA	$46,540	$46,540	
MWS-L-8-24-V	1	EA	$68,750	$68,750	
Landscape and Irrigation	1	LS	$75,000	$75,000	
Traffic Control	1	LS	$350,000	$350,000	
Traffic Striping	1	LS	$100,000	$100,000	
				Civil Subtotal	**$43,520,747**
Structures					
Buena Vista Lagoon Bridge	9899	SF	$295	$2,920,205	
Remove Existing Buena Vista Lagoon Bridge	1	LS	$1,230,000	$1,230,000	
Carlsbad Blvd Overpass	10200	SF	$260	$2,652,000	
Remove Existing Carlsbad Blvd Overpass	1	LS	$770,000	$770,000	
Beech Ave Pedestrian Overpass	660	SF	$205	$135,300	
Grand Ave Overpass	4620	SF	$230	$1,062,600	
Carlsbad Village Dr. Overpass	4620	SF	$230	$1,062,600	
Oak Ave Overpass	2530	SF	$205	$518,650	
Chestnut Ave Overpass	3080	SF	$205	$631,400	
Tamarack Ave Overpass	3300	SF	$230	$759,000	
Stairway Retaining Walls	1000	CY	$665	$665,000	
Construct Concrete Steps	101	CY	$820	$82,820	
Trench Structure	1	LS	$96,000,000	$96,000,000	
				Structures Subtotal	**$108,489,575**
Utility Relocation					
UG Fiber Optic in HDPE Conduit	9565	LF	$50	$478,250	
12-inch HP Gas	1400	LF	$180	$252,000	
10-inch VCP Sewer	1	LF	$46,500	$46,500	
Street Light and Pull Box	2	EA	$3,000	$6,000	
1-inch Irrigation Service	1	EA	$2,400	$2,400	
Relocate 10-inch water	240	LF	$180	$43,200	
Relocate 1-inch gas	160	LF	$100	$16,000	
Relocate Gas - through bridge	400	LF	$300	$120,000	
Relcoate Water-through bridge	560	LF	$180	$100,800	
Relocate Telecom-through bridge	280	LF	$300	$84,000	
Remove 48" RCP Sewer	3552	LF	$41	$146,200	
Remove Manhole	7	EA	$2,053	$14,368	

CARLSBAD VILLAGE RAILROAD TRENCH

Long Trench Alternative Estimate Design Level: 10 %

April 2020 Estimated By: T.Y. Lin International

Item	Quantity	Unit	Unit Price	Amount	Subtotals
Construct Special Case 10ft Manhole @ 48"	3	EA	$14,000	$42,000	
Sewer Manhole (3'x5')	18	EA	$5,500	$99,000	
48" RCP Sewer Main	5314	LF	$210	$1,115,940	
Remove Sewer Pipe	841	LF	$46	$39,090	
Install 6-inch PVC Sewer Main	152	LF	$83	$12,598	
Install 8-inch PVC Sewer Main	755	LF	$97	$73,046	
Install 10-inch PVC Sewer Main	3542	LF	$162	$573,804	
Relocate UG Fiber Optic	9769	LF	$50	$488,450	
Relocate UG Telecom	466	LF	$50	$23,300	
Relocate UG Electric	120	LF	$200	$24,000	
				Utility Relocation Subtotal	**$3,800,946**
Environmental					
SWPPP (Temp Erosion Control)	1	LS	$350,000	$350,000	
Permenant Erosion Control	75000	SF	$1	$75,000	
Onsite Coastal Wetlands	0.6	Acre	$145,000	$87,000	
Onsite Non-Coastal (Southern Willow Scrub)	0.4	Acre	$145,000	$58,000	
Onsite Non-Coastal (Freshwater Marsh)	0.3	Acre	$145,000	$43,500	
Onsite Sensative Uplands	0.2	Acre	$145,000	$29,000	
Monitors - Environmental/Biological	1400	Hours	$150	$210,000	
Monitors - Paleo/Archeology	1840	Hours	$150	$276,000	
				Environmental Mitigation Subtotal	**$1,128,500**
Signal					
Temporary Shoofly					
Temp. Relocate Fiber Duct Bank Above Ground (Hi-Line)	1	LS	$600,000	$600,000	
Retire CP Longboard	1	LS	$80,000	$80,000	
Furnish, Install, Test and Commission Temp CP Laguna	1	LS	$1,600,000	$1,600,000	
Relocate Carlsbad Village Station Comm Shelter	1	LS	$300,000	$300,000	
Retire Carlsbad Village Station Ped. Crossing	1	LS	$50,000	$50,000	
Furnish, Install, Test and Commission Grand Ave Warning Devices/Relo	1	LS	$250,000	$250,000	
Furnish, Install, Test and Commission Carlsbad Village Dr Warning Devic	1	LS	$250,000	$250,000	
Furnish, Install, Test and Commission Temp 2292 Signal	1	LS	$750,000	$750,000	
Retire CP Carl	1	LS	$80,000	$80,000	
Furnish, Install, Test and Commission Tamarack Warning Devices/Reloc	1	LS	$250,000	$250,000	
Furnish, Install, Test and Commission Temp CP Encina	1	LS	$1,650,000	$1,650,000	
Railroad Trench Double Track					
Perm. Relocate Fiber Duct Bank Adjacent to Railroad Trench	1	LS	$600,000	$600,000	
Modify Cassidy St Grade Crossing Train Detection Circuits	1	LS	$100,000	$100,000	
Furnish, Install, Test and Commission 2281-2284 Signals	1	LS	$750,000	$750,000	
Modify Temp CP Laguna-Furnish, Install, Test, Commission 2285/2287 S	1	LS	$200,000	$200,000	
Retire Grand Ave Grade Crossing Warning System	1	LS	$50,000	$50,000	
Retire Carlsbad Village Dr Grade Crossing Warning System	1	LS	$50,000	$50,000	
Furnish, Install, Test and Commission 2292/2294 Signals in Trench	1	LS	$250,000	$250,000	
Retire Tamarack Ave Grade Crossing Warning System	1	LS	$50,000	$50,000	
Furnish, Install, Test, Commission 2301-2304 Signals	1	LS	$600,000	$600,000	
Retire Temp CP Encina	1	LS	$80,000	$80,000	
				Signal Subtotal	**$8,590,000**

CARLSBAD VILLAGE RAILROAD TRENCH					
Long Trench Alternative Estimate			Design Level: 10 %		
April 2020			Estimated By: T.Y. Lin International		
Item	Quantity	Unit	Unit Price	Amount	Subtotals
Architectural					
Platform Shelter	12	EA	$110,000	$1,320,000	
Temporary Platform Shelter	5	EA	$110,000	$550,000	
Platform Benches	12	EA	$5,200	$62,400	
Tubular Hand Rails	904	LF	$148	$133,792	
Signs	1	LS	$25,000	$25,000	
Construct New Restroom Building	1	LS	$300,000	$300,000	
Elevator	4	EA	$200,000	$800,000	
Platform Ammenities	1	LS	$50,000	$50,000	
				Architectural Subtotal	**$3,241,192**
Electrical					
Station Electrical and Communication System	1	LS	$2,500,000	$2,500,000	
Parking Lot Lighting	1	LS	$225,000	$225,000	
Temporary Station Electrical and Communication System	1	LS	$900,000	$900,000	
				Electrical Subtotal	**$3,625,000**
Base Construction Estimate (BCE)					**$185,266,282**
Other Construction Costs					
Contractor Mobilization (once)	7.5	%	BCE	$13,894,971	
Contractor Demobilization (once)	2.5	%	BCE	$4,631,657	
Contingency	30	%	BCE	$55,579,884	
				Other Construction Cost Subtotal	**$74,106,513**
Construction Cost Estimate (CCE)					**$259,372,794**

ATTACHMENT I:

PUBLIC INPUT REPORT

LOWERING THE RAILROAD TRACKS THROUGH CARLSBAD VILLAGE AND BARRIO

PUBLIC INPUT REPORT

City of Carlsbad

Lowering the Railroad Tracks Through Carlsbad Village and Barrio Public Input Report

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Introduction

The City of Carlsbad values community engagement based on several key principles:

- Members of the public have a right to be involved in decisions affecting their lives.
- Adequate time and resources are provided to allow for meaningful public involvement.
- The public involvement planning process is begun at the earliest stages of decision-making.
- Opportunities for public involvement are clearly defined, including the decision or decisions to be made, the decision-making process and how the public has influenced the decision.
- It is the city's responsibility to seek out and facilitate the involvement of those interested in or affected by a decision. The city errs on the side of reaching out to people who might not be interested, rather than potentially missing people who are.
- Diverse participation helps ensure a broad range of perspectives is considered.
- Public involvement processes are designed to enable members of the public to participate in ways comfortable and convenient for them.
- City staff provide balanced and factual information to the public and do not engage in advocacy.
- Public dialogue strives for a focus on values over interests and positions.
- Members of the public do not need to have technical expertise to provide valuable input. Their everyday experiences as members of the community have intrinsic value to even the most complex and technical decisions.
- Public involvement planning is coordinated across all city departments to ensure consistency and avoid process fatigue.

Lowering the Railroad Tracks Through Carlsbad Village and Barrio

Train traffic through Carlsbad is anticipated to double by 2035. To accommodate the increase, the San Diego Association of Governments is planning to build a second set of train tracks alongside the existing tracks throughout the region. "Double tracking" has already been built in southern Carlsbad and throughout the LOSSAN cooridor that runs from San Luis Obispo to San Diego and is now being explored for northern Carlsbad.

In 2014, the Carlsbad City Council made it a city priority to pursue lowering the railroad tracks through Carlsbad Village and Barrio due to impacts of increased train traffic and emergency response times. Lowering the tracks would involve trenching and constructing the double tracks below existing street elevations.

The City of Carlsbad, SANDAG and North County Transit District completed a study in 2017, determining that lowering the railroad tracks in a trench is technically feasible and has economic benefits. Two alternatives are now under evaluation: a short trench and long trench.

Both alternatives would double track across the Buena Vista Lagoon and require replacement of the Carlsbad Boulevard overcrossing bridge. Trenching would begin just south of the lagoon at Carlsbad Boulevard.

The short trench alternative spans 6,000 feet and would run from Carlsbad Boulevard to the north side of Tamarack Avenue. It would construct new vehicle overpasses at Grand Avenue, Carlsbad Village Drive and Oak Avenue, with new pedestrian/cyclist overpasses at Beech Avenue/Carlsbad Village Station and Chestnut Avenue.

The long trench alternative spans 8,400 feet and would run from Carlsbad Boulevard to the south side of Tamarack Avenue. It would include vehicle overpasses at Grand Avenue, Carlsbad Village Drive, Oak Avenue, Chestnut Avenue and Tamarack Avenue, with a new pedestrian/cyclist overpass at Beech Avenue/Carlsbad Village Station.

To determine the preferred alignment of the proposed railroad trench and gain public input, city staff organized various opportunities to engage the public to review the two proposed alternatives and identify the community's needs, priorities and values. The public input process consisted of one large public workshop, community group presentations and an online survey.

Public Workshop

The City of Carlsbad, SANDAG and NCTD held a public input workshop to inform the community about the potential project and to seek input about the two proposed alternatives, the short trench and long trench options.

A mailer that included project information and visuals were mailed to all property owners west of the 5 freeway between the Buena Vista Lagoon and Agua Hedionda. The workshop was also promoted on social media channels including Facebook, Twitter and Nextdoor and the city's eblast.

Following a project overview from SANDAG project manager Linda Culp, questions were posed for small group discussions to identify values, community priorities and concerns about the two alternatives.

November 20, 2019
Harding Community Center
6 – 8 p.m.

Community Presentations

The city also coordinated with various Village and Barrio stakeholder groups to give presentations and answer questions.

Carlsbad Chamber of Commerce Government Affairs Committee Meeting
Dec. 4, 2019
Carlsbad business owners and community leaders

Army and Navy Academy
Dec. 6, 2019
Army and Navy board of directors and community leaders

Carlsbad Village Association/Village Voices
Jan. 7, 2020
Village business owners, residents and community leaders

Friends of the Barrio at Lola's
Jan. 10, 2020
Barrio residents and community leaders

The city reached out to the Buena Vista Lagoon Foundation but did not hear back.

The project team also met with the most affected property owners who would be affected by the long trench alternative The city hosted the group at the Faraday administration building on Dec. 5, 2019.

Online Survey

The online survey provided an opportunity for members of the public to provide input at a time convenient to them. Topic areas identified at the public workshop helped inform the questions on the online survey. The survey was available in English and in Spanish.

Nov. 21 – Dec. 13, 2019
522 respondents
8691 individual responses
165 comments

About the Findings

By providing multiple ways for the public to provide input, decision makers can hear from a larger and more diverse group of community members. Respondents were asked to disclose where they live and the system prevented more than two responses per computer IP address (a computer's unique address). However, unlike a scientific survey, the findings of this process cannot be generalized to the entire Carlsbad population within a defined level of confidence.

That's why the input in this report should be considered with a similar weight as other qualitative forms of feedback that have always been part of the city's decision-making process, such as comments made at City Council meeting or emails sent to the city expressing an opinion.

Overall Themes

Comments have been categorized for the purpose of identifying key themes. Readers are strongly encouraged to read the verbatim comments in the appendices to get a better understanding of specific ideas, priorities and concerns expressed. Following are some of the key themes from the online comments:

- Noise
- Safety
- Accessibility/access
- Traffic
- Funding/costs
- Emergency access
- Environmental concerns
- Construction impacts

Workshop Input

With approximately 100 participants, the public workshop reflects the input of a small percentage of the overall community. However, by choosing to spend several hours at a public meeting, these community members, the majority who indicated that they live in the immediate areas around the Village and Barrio, demonstrate a high level of interest in this project. For that reason, this input is being reported separately from the online input and deserves unique consideration. Detailed information about the responses for all questions is available in the appendices.

Pros and Cons of Short Trenching Option

Pros:
- Cheaper to build
- No homes acquisition needed
- Keeps Chestnut as a pedestrian/bike only crossing
- Improves accessibility

Cons:
- More traffic delays over long trench option as Tamarack would continue to be an at-grade crossing
- Won't solve noise and pollution issues at Tamarack
- Less safe than long trench option
- Businesses and home owners impacted

Pros and Cons of Long Trenching Option

Pros:
- Improves safety all along Carlsbad Village/Barrio
- Reduces noise and pollution in downtown area including Tamarack
- Improves emergency response times and access
- Improved train operations
- Improves traffic flow
- Does it right the first time- trenches Tamarack

Cons:
- More expensive option
- Chestnut is an all vehicle crossing
- Accessibility/access east-west might increase traffic in neighborhood
- Businesses and home owners impacted
- Longer construction time
- Three properties need to be acquired

Online Input

Input from the public workshop was used to refine questions for the online survey.

Total participants: 522
Total responses: 8691
Comments: 165

Detailed information about the responses for all questions is available in the appendices.

Key Themes From 165 Comments (some comments referenced multiple themes)

[Trenching] Improves safety

Reduces noise and pollution

Improves accessibility

Participants expressed support for the long trench option by a large margin, contingent on learning the sources of funding.

Most would prefer to keep Chestnut pedestrian/bike only (several people listed the short trenching option as their preferred alternative solely due to this difference between the two concepts presented)

Next Steps

The project team plans to give an update about the Alternatives Analysis Report and public input feedback as an informational item to the following:

- City of Carlsbad's Traffic & Mobility Commission – May 4, 2020, 5 p.m. at Carlsbad City Hall, 1200 Carlsbad Village Drive, Carlsbad
- Carlsbad City Council – May 12 at 5 p.m. at the Faraday Center, 1635 Faraday Ave., Carlsbad
- NCTD Board of Directors – May 21, 2 p.m. at NTCD, 810 Mission Ave., Oceanside
- SANDAG Transportation Committee – TBD

No funding sources have been identified yet for the next phase of the project, which will include additional studies. The results of community outreach and studies may be used by decision makers to help choose one of the alternatives- the short trench or long trench alternative.

Once an alternative is selected and additional studies are in progress, there will be multiple opportunities for public input throughout project phases.

Lowering the Railroad Tracks Through Carlsbad Village and Barrio Public Input Report

Appendices Table of Contents

Online Survey Quantitative Data

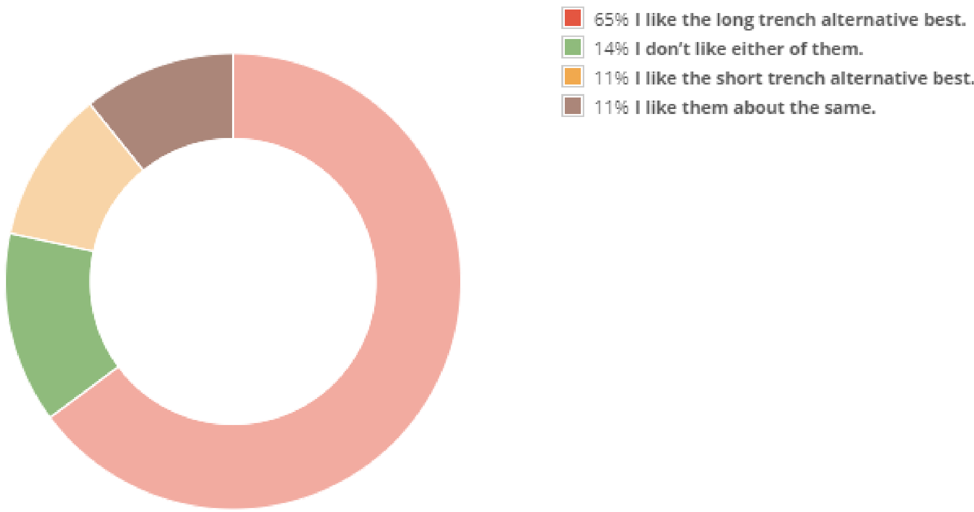
When considering lowering the double railroad tracks below street level, some of the factors that were expressed at the Nov. 20 public input workshop are listed below. How important is each of these factors to you?

	1 - Not important	2	3 - Neutral	4	5 - Very important
Public safety and emergency response	3% 1 - Not important	2% 2	8% 3 - Neutral	12% 4	74% 5 - Very important
Traffic circulation for cars	8% 1 - Not important	2% 2	14% 3 - Neutral	22% 4	55% 5 - Very important
General east-west access	4% 1 - Not important	2% 2	18% 3 - Neutral	24% 4	52% 5 - Very important
Pedestrian/bike safety	3% 1 - Not important	3% 2	10% 3 - Neutral	16% 4	68% 5 - Very important
Impact on property values	11% 1 - Not important	5% 2	34% 3 - Neutral	15% 4	35% 5 - Very important
Railroad operations	7% 1 - Not important	5% 2	31% 3 - Neutral	25% 4	33% 5 - Very important
Train noise	12% 1 - Not important	5% 2	20% 3 - Neutral	20% 4	43% 5 - Very important
Neighborhood revitalization	9% 1 - Not important	4% 2	23% 3 - Neutral	24% 4	40% 5 - Very important
Construction impacts to neighborhoods	11% 1 - Not important	10% 2	34% 3 - Neutral	18% 4	27% 5 - Very important
Construction impacts to small businesses	9% 1 - Not important	6% 2	34% 3 - Neutral	25% 4	26% 5 - Very important
Property acquisition requirement	13% 1 - Not important	7% 2	40% 3 - Neutral	14% 4	27% 5 - Very important

In consideration of the differences between the short trench and long trench alternative, how important are the following aspects to you?

	1 - Not important	2	3 - Neutral	4	5 - Very important
Pedestrian/bike access across Chestnut Avenue	10% 1 - Not important	3% 2	18% 3 - Neutral	17% 4	52% 5 - Very important
Driver/pedestrian/bike access across Chestnut	16% 1 - Not important	5% 2	22% 3 - Neutral	17% 4	40% 5 - Very important
Driver/pedestrian/bike access across Tamarack Avenue	8% 1 - Not important	2% 2	10% 3 - Neutral	13% 4	67% 5 - Very important
Length of construction	17% 1 - Not important	7% 2	34% 3 - Neutral	12% 4	29% 5 - Very important
Project costs	16% 1 - Not important	6% 2	32% 3 - Neutral	17% 4	30% 5 - Very important

Overall, what do you think about these alternatives?



What additional information would help you understand the project? (Showing all 165 comments verbatim)

Comment	**Tags**
Do it. The sooner the better.	Priority
I chose the short trench because I strongly feel that the Chestnut crossing should only be for pedestrians and bikes! This is our neighborhood and Chestnut bisects our very busy parks Chase Field and Pine Park. Please no auto crossing at Chestnut. I would have preferred the long trench version except for that major difference.	Chestnut, long trench, accessibility/access
The info is good. Its still very high level, but enough to understand the plan. For the safety of our community I believe the below ground train project is important. I do worry about the impact to the simplicity of pedestrian life during the construction.	priority, accessibility/access, construction impacts
I'm very concerned about cost and whether the money can be out to more effective public transportation efforts.	funding/costs
If we are going to do the trench we must trench to south of Tamarack. Pedestrian, bicycle, and car traffic to and from our Carlsbad schools and beaches is constantly heavy on Tamarack.	long trench, traffic, accessibility/access
The long trench really addresses the traffic for beach and school that uses Tamarack Ave.	long trench
The long trench frees up the most traffic which is growing in volume constantly.	long trench

Comment	Tags
We regularly use the rail trail, and request that construction impacts to the rail trail be minimized	accessibility/access, construction impacts
I will be very much against the short option. I see no reason to support the short option. For me and my entire neighborhood around Tamarak, unless the long option is funded, we will form a very effective opposition.	long trench
Build long track now if you build just the short track the community will only be pact in a few years and will need to go thru this all over again. Let's get it done now.	long trench
long trench please	long trench
It seems like a shortsighted and inefficient use of funds, the inconvenience of construction etc., not to optimize the double tracking option and look to the future	funding/costs
Ground level visuals/graphics would help me understand the plan more	
It is unnecessary and unneeded cost and effort. Many other priorities top this project.	funding/costs
I would prefer knowing the costs of the short vs. long trench options before prioritizing whether I like either choices.	funding/costs
Why waste a bunch of money to have only a small benefit?	funding/costs
Residents have waited since the 1930's for access across train track to the beach....now is the time to finally get this done, and improve the traffic flow and safety of pedestrians	Chestnut, accessibility/access
Please continue the long trench for the entire length of the City. Prioritize safety for all.	long trench, safety
The long trench is the best option - safety is number 1 and a significant noise reduction is good for the surrounding properties	long trench, safety, noise
Exact costs & where the $ is coming from	funding/costs
Solana Brach did it Encinitas Cardiff and Oceanside should too	priority
How will it be financed? what will the the cost to Carlsbad residents?	funding/costs
A visual rendering of Tamarack with the trench and a study of the traffic flows including first responders with Chestnut being open for vehicles would be very helpful	Chestnut, long trench, traffic
Get it all done at once so we don't have to go through the process in 5 or ten years	priority
I will oppose the short option. Makes no sense. Why do it at all if you don't do the long	long trench
1. If we save one life it is very important. 2. Traffic congestion created by 100 trains per day would be a financial detriment to the visitor, business and community.	safety, traffic
Only the long!!!	long trench

Comment	Tags
I am all in favor of public safety and aesthetics, but the money for this project could be better spent on things that would make more of a positive impact for the community	funding/costs
I think a trench will destroy the esthetics of Carlsbad. It reminds me of Solena Beach which looks terrible - a huge ditch that separates the town components	accessibility/access
I think there are other less expensive alternatives that will be safe, provide access for tamarack and Chestnut, be safe for cars and people that will not ruin the look of Carlsbad	funding/costs, Chestnut
1. How will tunneling integrate with the planned development of the Carlsbad NCTD train/bus station as a regional transportation hub. 2. How will you ensure resident input at all stages of the process? (For the Master Plan, the City hired a consultant that relied on the CVA/ business interests as opposed to resident interest. They must not make the same mistake with this project!)	
Love the long term planning by the City here.	
The train is not going away and we need to remove the public safety hazards at all intersections - too many people have died and it's time to improve the area to ensure safety and reduce noise levels. Other communities have accomplished this successfully and it's time Carlsbad supports the community to lower the tacks with the long trench alternative.	
As a resident who lives in the area- I think it is a valuable project for safety, access, aesthetics, and noise pollution control	safety, accessibility/access, noise
Why is the bike/ walk only (no cars) only on the short trench plan? The long trench with only buke and walking accross chestnut would make more sense since the long trench brings Plenty of other driving access to the beach side. Also I have a suggestion for replacement property if the 3 houses are purchased.	Chestnut, long trench
none.	
Traffic analysis for the changes to the immediate region. A complete report on the total cost for all choices: who, what, when, where, how much, who is the keeper of the budget for same	traffic, funding/costs
It is very important that the tracks be trenches for safety reasons at Tamarack Avenue. This is a major route for school children for Jefferson elementary, valley middle school. If the tracks are to be trenched in Carlsbad Village, all crossings should be lowered!! It is the only way to nearly eliminate the continual problem of people getting hit by trains in Carlsbad. It will also lower the noise	safety, long trench, noise

Comment	Tags
pollution caused by the trains for those of us in the neighborhood. Please do it right & do it all the way through downtown Carlsbad or don't do it all all.	
Too many NIMBYs at the meeting. Everything was fine with them as long as you didn't open their street (Chestnut) open to traffic. I live on the other side and my neighborhood is a parking lot but that's life. Chestnut as a road or no go!!	traffic, Chestnut
I dont like that oak Avenue will be opened to car traffic. We live at 3080 Lincoln and our parking is on oak and we can barely back out as it is. We do not need more east west traffic on Oak.	traffic
Study emergency response times differences across Carlsbad Village Drive and Tamarack Avenue if the tracks are trenched. Life loss at on grade crossings is also important information.	emergency access, safety
I believe building the railroad trench through Carlsbad Village and Barrio is extremely important and I strongly urge all parties including the City of Carlsbad, SANDAG, NCTD, the public and others to commence with this vital project at once. One only need to look South to Solana Beach to see the success of their lowering of the tracks in that city. This project is so important in so many different aspects first being public safety. If there will be an increase in train traffic in the future, there surely will be an increase in injuries or fatalities as trains pass by with high speed. Also, there will be constant interruption in traffic flow as vehicles must yield the right of way to trains. Both safety factors and east west access have been affected and will be more impacted by increase in train traffic during the Carlsbad street faires held each May and November. I cannot stress enough the importance of this vital project in public safety, vehicle flow, economic benefits, etc., to the City of Carlsbad, to it's citizens and to the many visitors who vacation in Carlsbad. I grew up in Carlsbad and I love the city and while I do not currently reside in Carlsbad, in my heart I never really left and I do hope to return physically one day to live there once again. If there is anything I can do to assist in making the railroad trench project a reality please do not hesitate to call upon me.	priority, safety, traffic
Quite Zone now since the trenching will be many years from now.	quiet zone, Noise
I am hoping the trench will lower the noise...	noise
The speaker gloss over environmental benefit just remarking "of course" on that bullet. But it's not obvious how there are environmental benefits. In fact, I am wondering whether the	safety, environmental concerns

Comment	**Tags**
CEQA process has considered climate change and sea level rise. If (when) we have tsunamis and king tides with predicted sea level rise, how will the trenched options account for both public safety and environmental integrity? With the trenches being below the water table, how will run-off from impermeable surfaces affect our groundwater and ocean? Will there be a stormwater detention basin built into the project and what will that look like?	
Will the construction be over a year long period?	construction impacts
Although the long trench costs more it's the right thing to do You know that down the road the long trench will be needed and it will cost exponentially more then!!	long trench, funding/costs
Potential traffic on tamarack May back up to beach in the future.. very important to make the train go under because 100 trains a day will have a big impact. I think it means a train every 15 minutes.. think about that? More info on frequency of trains and traffic projections would be good. Also if whistle can be removed when the train is below ground	traffic, long trench, noise
I want long option	long trench
The options for funding would be important to know just for the fact that there are options and that this project isn't starting with nothing. It would also be helpful if there were projects like this in other cities/towns across the country that have completed and the reality of the actual economic and social impact to the city/town after the project was completed.	funding/costs
Give the Barrio beach access at Chestnut as has been promised for decades.	Chestnut, accessibility/access
Construction schedule for both alternatives.	construction impacts
Plan for the future, do the whole project and get it done with. We're already behind the times. Extend the runway at CLD airport at the same time. We have to be a more transportation friendly community.	long trench, accessibility/access
1) Increase in tax revenue - because of Prop 13 the sooner the better so properties don't get locked into a lower tax base. Values will increase dramatically when the double track is implemented 2) Access to funds from the high speed rail $20 billion project which now is for Bakersfield to Merced. Politicians are looking for great PR projects to fund as a way out of their mess 3) Accelerated schedule	funding/costs
Funding sources	funding/costs

Comment	Tags
Stop the surveys! We have been asking for Chestnut bike/ pedestrian pass for YEARS! Should have double tracked & underpass at the same time. Ass backwards!	Chestnut, Long trench
Models, a video	
My brother was hit by an Amtrak train resulting in the death of his best friend and loss of his right arm. I am very for pedestrian safety in regards to the track. It's too dangerous how it is. Too many deaths or injuries.	safety
No penny pinching: get it done right!	funding/costs
Keep Carlsbad quaint. This is not Huntington Beach.	construction impacts
Schedule for Implementing the project as soon as possible.	construction impacts
I hope you will also consider possible problems caused by sea level rise. If the bottom of the trench is below sea level, how would you keep it dry? If the lagoon railroad bridges leading into Carlsbad have to be raised or re-routed, what would that do to the trenched sections? Would they be obsolete?	environmental concerns
How long this construction will take disrupting traffic, businesses and the noise during construction.	noise, traffic, construction impacts
If we are going to spend the time and money, do it right and go with long trench which provides the most benefits consistent with priorities citizens have had for years now. Very strongly in favor of LONG TRENCH option!	long trench
The long trench alternative is best for the long term growth of our city.	long trench
I like a trench, but I prefer the long trench option WITHOUT driver access at Chestnut. I'm amazed that's not an easy option to choose!	long trench, Chestnut
At each site of pedestrian and/or auto overpass I suggest building a parking terrace. This would provide needed parking and provide a buffer so there would be curtailed access to the tracks.	construction impacts
If we are going to do this then the long trench idea is by far superior. Why stop at Tamarack which is already busy with train stoppages.	long trench
I cannot say whether I like short or long or *any* trench until I know the costs, and more importantly, how much of the cost is to be paid by Carlsbad. If we are paying for most of it, it is way too expensive to do. Also, having a tunnel rather than a trench -- is not a good idea. Tunnels will create creepy havens for homeless and criminals.	funding/costs
Obviously the costs for each trench alternative.	funding/costs

Comment	Tags
We have to think about how to design cities for emerging technologies, trends and behaviors. Thank you for being proactive!	
Traffic will continue to increase. Building the long trench seems to me the smart alternative for the long term.	traffic, long trench
Complete and utter waste of time and money. Not all all necessary. Please stop all consideration of this project.	funding/costs
How much of the project will be paid for by Carlsbad? Too much of this survey is irrelevant without knowing who is paying for the project. For example, I think that if we are doing the trenching we might as well do the long trench since it really isn't that much further - but only if the majority of the cost is paid by SANDAG and NCTD.	long trench, funding/costs
I recommend using plexiglass to cover the tracks, thus creating a tunnel to reduce noise, construction costs and overall length of construction. The cost will be approximately a $1 million and the time could be a year versus the $80 million+ and four years that will impact the residents and community. As someone who lives close to Tyler and Chestnut, the four years of noise, dust and inconvenience to myself and others in the Barrio neighborhood would have a negative impact on our quality of life.	noise, construction impacts
Given the huge shortfall in regional transportation funding this high cost project should be a very low priority	funding/costs, Priority
How will the rising sea level impact below-sea level trenching of the train tracks? How is this being taken into consideration in the planning?	environmental concerns
This will undoubtably raise the cost of living in Carlsbad. When is enough enough?	construction impacts
Given the accelerating sea level rise, perhaps a third alternative of moving the rails inland should be considered.	environmental concerns
I prefer the long trench option but with a pedestrian and bike crossing only option for Chestnut. Having a car crossing at Chestnut would add additional traffic to an already congested beach area on Chestnut and Garfield. There's not enough parking for the cars already in the area. We don't need more cars trying to park on Chestnut west of the tracks.	long trench, Chestnut, traffic
I am concerned about how long this will take since I go into the village every day at least once. It won't affect people that don't live here.	construction impacts
Having the train pass Carlsbad Village is the signature of Carlsbad. Instead we should invest that money in our children, youth, and families.	traffic/costs

Comment	Tags
Projected property value & tax increases as a result of the reduced noise	
I do not want to see more traffic on chestnut and Roosevelt. It is already dangerous, noisy, and un healthy. Creating more routes to the coast, adds to the problem. And parking still isn't being addressed. Keep it pedestrian and bicycles only please.	traffic, Chestnut
As a resident of Olde Carlsbad, I am so happy to hear about this moving forward!	
Property acquisition, estimated length of project.	construction impacts
Fire prevention staffing and funding to aide in inspections for new construction services.	Emergency access, funding/costs
We need to reduce the number of grade crossings to allow faster train speeds and less car congestion.	traffic
Can the top of the trench be covered at all?	
I want to read more and I am going to my City council member and ask them how the Village and barrio feel.	
Trains move many more people than cars. Forgot about prioritizing cars (which emit carbon, and are cooking our planet) and prioritize trains, pedestrians, and bikes instead.	accessibility/access, environmental concerns
Must go with Long trench option to incorporate Tamarack as it is a vital intersection for community and coast. An investment from the city of $50 -100 million dollars to go along with Federal and State funds is warranted and appropriate if we wish to maintain and even improve on quality of life in our great city.	long trench, funding/costs
We will have one shot at this. The long trench is ideal for safety. We do a disservice to future generations by not Planning ahead. I do not see the city finishing the trench in the future. The Long Trench creates a free and clear Carlsbad of train traffic. Improving safety. It is clearly the best option,	long trench, safety
Who is benefiting from the properties acquired in the impacted areas?	construction impacts
Very much in favor of the long track option with covered parkspace above to unify the Barrio neighborhood with the "Beach" area neighborhoods west of the tracks	long trench
who is in charge of the plans operation	construction impacts
Del Mar bluffs need to be fixed. Long term, maybe 40 years, a twin-tunnel from Temecula to San Diego needs to be bored and connected to surface stations. Enjoy.	construction impacts
This is pretty good	construction impacts
We live in the Barrio and don’t mind the sound of the train(s). We do, however feel very concerned about the loss of life on the	safety

Comment	Tags
tracks, and hope there is a solution. Very sad to think so many commit suicide so close to us.	
I understand it. Would like to know the approximate time element for construction and completion.	construction impacts
I do not think a trench is needed. But what ever	
The idea of spending hundreds of millions of dollars on trenching the tracks for a short delay is ridiculous. Cities that face major impact from freight trains bisecting cities have an obligation to trench roads or tracks (e.g. Irvine along Culver). The Village is not majorly impacted by tracks running through the same way other cities are impacted.	funding/costs, construction impacts
is it less costly to do an overpass along that route. Would look the the elevated tracks in cities like Chicago and NY.	construction impacts
I contacted Ms. Culp via email with my questions and she was most helpful and provided a detailed explanation.	construction impacts
I like having more East-west access throughout the village.	traffic
It would be nice to have pedestrian/bike access only - no cars - at Oak, Chestnut, and Chinquapin. Leave Tamarack as is. Thanks.	Chestnut, accessibility/access
Cost	funding/costs
California needs high speed rail from San Diego through Los Angeles to San Francisco just as there is already high speed rail from Washington, DC through New York City to Boston. Drop inland rail projects and spend the money where the riders are.	construction impacts
I would like to donate	construction impacts
Trains are important and should be supported. Anything that helps prevent fatalities from either suicides or accidents (pedestrians and cyclists) involving trains should be strongly considered, even if it is just additional fencing, gates, etc.	safety
I think the safety of the area's pedestrians, bicyclists and cars and the flow of traffic should be what is the most important in regards to this project.	safety, traffic
Connect chestnut over the tracks	Chestnut
either way, a pedestrian only crossing should go on chestnut...	Chestnut
I'm up to date. I would like to see some type of multi-level parking structure over the tracks in the Village.	construction impacts
Due to the bluff erosion at the track and the probability of the tracks being moved inland I do not understand why the city would spend the money to lower the tracks when they will most likely be moved.	funding/costs, environmental concerns
Hope that will stop the horns/whistles.	noise
Pedestrian only on Chestnut. Lincoln is very narrow on the south end. I can’t imagine more traffic coming from chestnut. We do	Chestnut, traffic

Comment	Tags
not have sidewalks on Lincoln. Lots of foot traffic, bikes, and cars already. Too dangerous to add more vehicle access.	
I do not like the idea of a trench. Take the money that would be wasted and reduce our bills. Solana Beach did it and had problems getting rid of the dirt from the trench. Things have been fine for decades - leave our town alone - it's fine as it is.	funding/costs
I like the at-grade alternative.	construction impacts
Not needed! I enjoy listening to the trains horn while lying in bed	construction impacts
I would like to understand the traffic impact on Chestnut Ave if the cars can cross the tracks at Chestnut.	traffic, Chestnut, construction impacts
Projection of dwelling to be purchased/removed for the project. Timeline of construction project. Construction noise impact on surrounding homes and businesses.	noise, construction impacts
Hi -- I hope it's ok to share my personal thoughts, my intention as a long-term resident is to be helpful and I'm grateful for an opportunity to submit here: â€“ 1) I'm an American Citizen, but born in the UK. I've never understood why all the railroad crossings in Carlsbad don't have 4 barrier gates blocking the entire railroad track. It seems incredibly dangerous to only have two gates on the two sides that it's oddly assumed pedestrians will cross the tracks... while two gates are just... not there... leaving the railroad full exposed to somebody walking onto the tracks and getting killed. I've noticed it's not like this in other towns and villages around the vicinity, just Carlsbad. In the UK there are always 4 barriers fully blocking the tracks, except on the most rural of crossings. But in Carlsbad so many times I've stopped at the railroad crossing and wondered time and again as I watch pedestrians standing incredibly close to a speeding train passing through... wow, no barrier in two of four places, just two steps forwards and somebody could be killed. 2) I wish the City of Carlsbad would construct Freeway Sound Walls. Freeway noise is such a greater and constant impact on so many residents living within several blocks of the freeway... than the intermittent sound of trains and train horns. It's not just streets close to the freeway. As far up as the West side of Highland, properties are subject to constant, loud freeway noise. It's the same in the Barrio, an area where a lot of money is being spent to upgrade and improve, and yet nothing is done about the constant noise pollution of the freeway. I know the I-5 expansion	safety, noise, construction impacts

Comment	Tags
project has scheduled Sound Walls alongside Holiday Park... but the reality is that they won't be installed for 17 years! We need sound walls like they have further North up the I-5, which make a huge difference to quality of life for residents, and probably reduce pollution too. For me personally, I'd far rather have some sound walls and still hear the trains -- although I realize the sound of trains isn't the only problem trying to be fixed. I'm mentioning both of the above because -- I don't understand why either or both are not priorities over the proposed two projects. Thanks for your time.	
Great idea! Make it happen!	
The quality & well-being of our Village is being degraded by the ever increasing train traffic downtown south past Tamarack to Aqua Hediondo Lagoon. A few months ago there was a death on the tracks between Tamarack & the Lagoon. The long trench alternative is the best for Carlsbad, especially for the increased use by people to access the Lagoon and its trails, fishing & beach access. With development in the Barrio we are seeing increased population all along th raiload and a trench would provide safety, better traffic flow includig emergency vehicles, and reduction of noise. The train whistles seem to be louder and longer due to people along the tracks. I would welcome the construction all the way from downtown past Tamarack Avenue to the Lagoon. There has been almost constant consturction with a new storm drain, sanitary sewer and double track construction beween Tamarack & the Lagoon and would have no issues with construction of a trench in the same area. My neighbors and I have not complained as this infrastructure is needed, as well as the railroad trench from the Lagoon, past Tmarack and through downtown Carlsbad. Please have the political will to acomplish this for our Village. Thanks	traffic, safety, long trench, noise
More details of the construction plan, especially the needed land to be purchased, would be greatly appreciated	construction impacts
What other CA community governments have been successful in a similar track tunnel project?	
If cost will really be 100% federally funded, then fine, go with the long track. If homeowners are to burden any costs, then I don't see a favorable cost to benefit ratio & oppose a trench project.	funding/costs
We have been waiting for this for a long time! Would really improve quality of life for many residents. Absolutely plan for the longer project.	long trench

Comment	Tags
In stead of expanding carpool lanes, build a high-speed rail down I-5	construction impacts
Instead of trenching the entire rail alignment (which is far too drastic for this kind of issue), I think you should create underground crossings for each road including Chestnut Ave. The major construction will also only need to be done at those crossings, mitigating the noise for residential, with the exception of placing 2nd track.	Chestnut, noise, construction impacts
Let's think long term and install the long trench now. Increases train traffic will only increase noise and hinder crossing on Tamarac	long trench
This is a great plan for the future. We need a plan that accommodates future growth, and safety. Let's do it right...let's do it one time!	safety
1) Are the property owners who would specifically benefit (or who would benefit from trenching more than those living in other areas of Carlsbad, in particular East of I-5) going to bear more of the expense of trenching via some type of redevelopment district or impact bond? 2) Will Carlsbad be able to recoup some or all of the cost of trenching by charging a usage fee (e.g. per train or per train car) on trains that pass through Carlsbad utilizing the trench? While I understand that certain rights-of-way may exist that preclude Carlsbad from charging a usage fee, the current easement/rights-of-way apply to the "at grade" infrastructure and utilization, and it seems that if Carlsbad contributes $200 million plus for the construction costs, then Carlsbad ought to be able to negotiate certain ownership/royalty rights on increased activity enabled by the City's significant investment. 3) Separate from but in the same context as my discussion in point #2 above, has the City of Carlsbad looked into negotiating with the current right-of-way owner for the railroad tracks to share the construction costs more substantially due to the following: A) While the current right-of-way owner may have the unilateral authority to add a second track, undoubtedly, such an effort on their part to add a second track "at grade" and to commensurately increase train traffic (exponentially) will likely run into substantial opposition from local residents as well as	funding/costs, traffic, safety, environmental concerns

Comment	Tags
potential litigation since increased train activity will have damaging impacts on the environment, property values, local business, and the health of nearby residents. As such, by not only approving this project, but by paying for it, City of Carlsbad Taxpayers would be increasing the changes that the double tracking project is approved, completed, completely more quickly, and completed at a lower cost due to reduced local opposition and litigation. B) Furthermore, by doing more than just "allowing" trenching but actually "paying for trenching", the residents of Carlsbad are actually being asked to subsidize the train operations passing through Carlsbad, and under the principal of "equity", Carlsbad taxpayers should not be expected to bear the entire cost of the project while the economic beneficiaries are allowed to be "free-riders". Trenching will clearly enable more frequent use of the two track infrastructure that otherwise would be "at grade" because trenching will reduce noise, traffic, pedestrian fatalities, and other impacts that at a minimum would generate substantial ongoing opposition from local residents and businesses, but that might actually subject the two-track at-grade operations by statute and litigation due to violations of noise and environmental impact laws both currently in existent and those that may be enacted in the future. So, the City of Carlsbad should explicitly acknowledge that trenching will financially benefit the train operators, and as such, the City of Carlsbad has an obligation to protect Carlsbad Taxpayers by refusing to fund trenching unless the train operators share in the costs proportionally to their economic benefit.	
This is a very important project to grow the support of public transportation while at the same time supporting the beach pedestrian and other traffic. The long trench is the only option that makes sense	long trench, accessibility/access, traffic
Projected Difference in noise level. Cost of each proposal. How to beautify the area	noise, funding/costs
What will be done to protect the small businesses from the construction impact.	construction impacts
I briefly reviewed (admittedly, did not read in-depth) the economic impact study regarding the trenches. I have a hard time with the $215 million to $350 million price tag for this project. I also find it hard to believe there would be an additional $1.9 billion to $17 billion increase in retail and restaurant sales that	funding/costs, noise, accessibility/access, environmental concerns

Comment	Tags
would otherwise not occur if the trains remained at-grade. And property values would go DOWN $171 million if we refuse to trench? I doubt that. Admittedly I'm not an expert, but those numbers seem far fetched to me. I think the overall argument that there would be an economic surplus that outweighs the fiscal cost of the trenching is not a viable argument. Would property values go up? Sure. Who would that impact? A select few people who own property near the train tracks. And again, the additional sales tax numbers given are assuming there are these shoppers who are spending an extra several billion dollars because they didn't have to wait an extra 30 seconds to cross the train track. With all of this said, I still like the idea of trenches in our city. The reduced noise and increased accessibility would be fantastic. But the price tag is very hard for me to swallow. Whether the money comes from local, state, or federal sources, no matter what - at the end of the day that is taxpayer dollars going towards this project (just taxed at different sources). Have public-private partnerships been considered to reduce taxpayer costs? On an unrelated note, how is flooding of the underground trenches prevented when we have unusually high amounts of rain? Would one crown the tracks to disperse rain rushing into the underground trenches?	
The sooner you start, the less it will cost. This will improve life in the Village imesureably. Lets get on with it.	priority
Cost estimates and schedule	funding/costs, construction impacts
1. Have you considered tunneling. Elan Musk bored a 1.14 mile long tunnel 20 to 40' deep to Lax at a cost of 10 million dollars. They did spend 40 million on tunnel boring equipment design, redesign etc. (per the web site) 2. I have heard SANDAG is doing studies for the Coaster alignment to divert it from the Coastal Bluffs and it includes tunneling. 3. Tunneling would provide a huge paseo with tremendous opportunities for the residents. Having a canyon still divides the residents in that area and greatly diminishes future uses. The construction impact to the neighbors for the excavation and export of dirt will be huge.	construction impacts

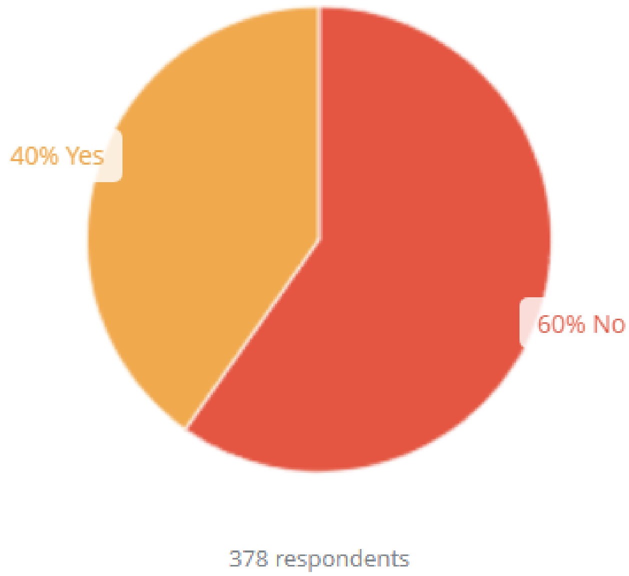
Comment	Tags
4. Have you considered going overhead. If not, why? 5. I did a minute study for the City at the Grand Ave and Carlsbad Village Drive crossing. My memory tells me there are sewer lines 20' deep at those locations. How will those lines be rerouted? 6. I feel there is a tremendous need for a parking structure in downtown Carlsbad. If the push for further use of mass transit in the future comes to fruition, we will really need the parking structure for commuters. Have any conversations taken place regarding a parking structure? Where will people park for the downtown businesses when construction is taking place? 7. I'm a Civil Engineer and we have lived in Carlsbad for 31years. I was with a developer for a quite a few years and built several residential projects from 1986 to 1991. I'm a big fan of Carlsbad.	
What about sea level rising? Will it affect underground water aquifers? If it does have effects, do NOT trench.	environmental concerns
I grow up in a railroad town. I feel the railroad gives Carlsbad a good small town feel. I love hearing the train even up on the hill if the air is right.	construction impacts
I like the long trench option. I want this to be done. We should do it now as it will be a bigger project and more expensive project the longer we wait. I believe we need to connect the barrio back to the coast. Prevent the obstruction of emergency response vehicles to the coastal/tourist areas. I am very concerned about the safety issue. In the future we will have many more trains. We need to keep pedestrians and bicycles away from the trains. I frequently see children walking on the tracks (the actual tracks) between Tamarack and Carlsbad Village Drive in the afternoon. We have people who seek out the tracks to end their life, it is an attractive nuisance, but other people just get too close. With a covered trench we could create new priceless real estate above the tracks. Possibly we could have an open space area/downtown park to plant some native trees and plants, a bike trail, and a dog area.	long trench, emergency access, safety, traffic
These questions were written to get the response you're looking for, with the exception of the last question. I don't think there should be a trench at all. "Neighborhood revitalization" how could answering that result in a trench question, it can be revitalized with, without, or with a monorail or water taxi, it's completely irrelevant.	Construction impacts
I think the need for car overpasses is very limited because it only takes a few minutes to drive from Tamarack to Carlsbad Village Drive, for instance. The emphasis should be on bike/pedestrian	Chestnut, long trench

Comment	Tags
overpasses and the long trench option should not cause an additional car crossing at Chestnut.	
Dark tunnel or gash is ugly. Solana beach track area is ugly; uninviting; our family never shops there because of that. a village with a gash...unpleasant... hardly California coastal feel there except at extreme s end of Solana beach. attractive decking with open areas & commercial neighborhood coffee shops, kiosks, park where kids/grandkids can "watch the trains" (safely we're sure) can be a big POSITIVE.	construction impacts
I am going to read more and talk to my city council member	construction impacts
Money better spent on projects for personal vakyes abd not the railroad. People hafve learned to live with the way it is.	funding/costs
We are a first class city and are all so fortunate to be living here. Let's make our downtown safe and beautiful for everyone. I frequent downtown 2-3 times a month and always wondered why we still have trains running through our main intersections. The citizens and visitors of Carlsbad deserve the best and safest access to our downtown businesses.	safety
Did you consider the alternative of double tracking at grade (we still need that), but lowering the streets/pedestrian paths under the tracks at all the key intersections (Carlsbad Village Dr, Chestnut, Tamarack, other streets)? What is the trade-off of lowering a few streets under tracks vs digging out long train trench? Less disruption? Less cost overall? Less time? Feasible? What have we learned from other close-by cities that have trenches or roads under tracks, like Solano Beach? Thank you.	construction impacts
I think that this effort to keep trains separate from cars, biked, pedestrians and cars is long overdue.	accessibility/access, safety
We greatly appreciate this opportunity to comment on the short and long trench alternatives. After speaking with our neighbors across Tamarack, we highly recommend the long trench alternative since we live right by the Tamarack crossing. We were surprised to hear that the train traffic is expected to double through Carlsbad by 2035. We are all concerned about how more trains across Tamarack will negatively impact pedestrian safety, biker safety, driver safety, emergency response times, car traffic, train noise, and property values. As a community, we strongly advocate for the long trench alternative.	long trench, safety, traffic, emergency access, noise
Since my family and I live near Tamarack, and the train traffic is expected to double in 15 years, I believe the long trench alternative is the best option. Thank you very much for your time.	long trench

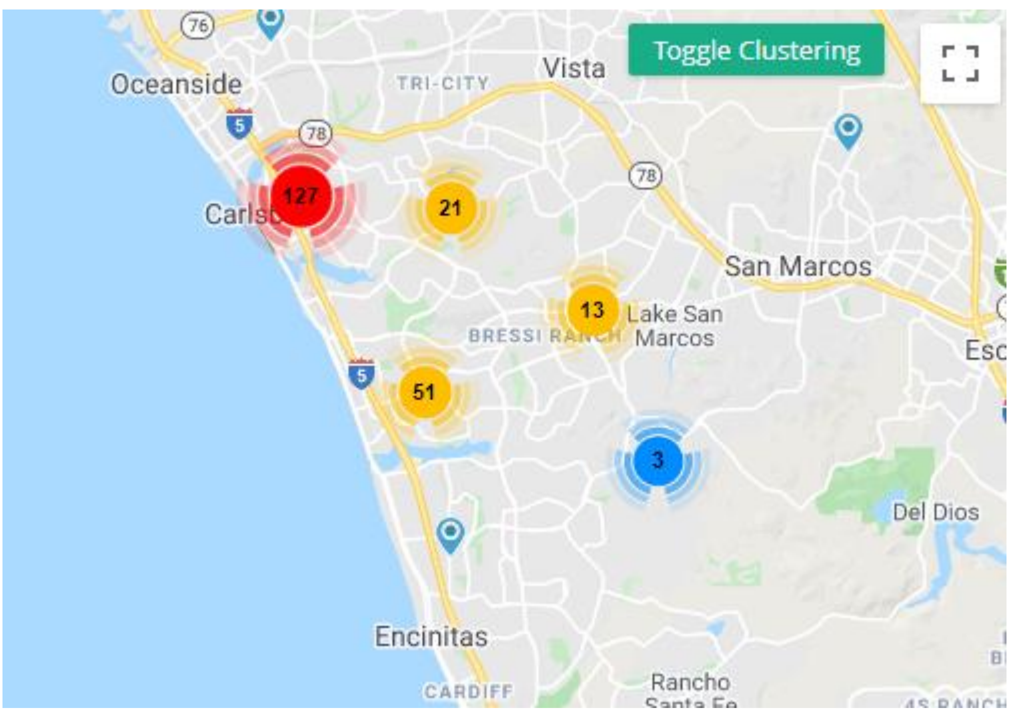
Comment	Tags
If the long trench alternative is to be preferred, the cost difference should be funded by a special assessment district taxable to the property owners in the vicinity of the benefited area that will experience higher property values. If not approved by property owners, lower cost alternative (short trench) should be preferred.	long trench, funding/costs
The costs of the project and the funding source(s). What disruptions will the project cause "I.e quality of life in nearby communities.?	funding/costs, construction impacts
How will the overpasses affect the ambience of the village along Carlsbad Village Drive. There seems to be a lot of them.	construction impacts
Traffic study counts for Tamarack Avenue, Chestnut, and Carlsbad Village Drive (East/West access from Freeway I-5). Carlsbad District One residents (South of Tamarack) are greatly impacted by Train Horns, engine noise and air pollution, and pedestrian and bicycle safety on and near this major East/West corridor. There is no valid reason for even considering the "Short Trench option". Our community South of Tamarack requests the "Long Term Option and that we not be treated differently.	traffic, noise, accessibility/access, safety
I think the trains should be lowered.	Long trench
I think this is a complete waste of tax payer money for little to no benefit, let alone the impact construction would have on the community. This project seems driven by a very few that have unrealistic expectations and don't fully understand the impact	funding/costs, construction impacts
Depends on the difference in costs and time as to which alternative is best.	funding/costs
I have been involved as a volunteer in emergency planning and preparedness in Carlsbad for many years. I also served as Chair of the Chamber in 2004. The Chamber sponsors the Spring and Fall Fairs annually, and they are billed as the largest single-day street fairs in the nation....with upwards of 100,000 people on the streets (per the Chamber). From a business standpoint...and a community emergency planning perspective.....having AMTRAK run through our City at 90 mph is a recipe for disaster. I attended the Trenching Workshop on November 20th and this speed was confirmed by NCTD and SANDAG officials at the workshop. At-grade crossings are extremely unsafe and severely impact rail service for those passengers who are delayed due to train verses pedestrian incidents. This makes rail transportation extremely	emergency access, safety

Comment	Tags
unreliable. Alternative forms of mobility are a major consideration for cities and SANDAG. As I am writing this, all rail service is stopped in Encinitas due to a train incident (12-12-19). This happens fairly regularly. So, Carlsbad's and SANDAG's goals should be to eliminate all at-grade crossings in the City. Grand, CVD, Tamarack AND Cannon should be considered for trenching for many other reasons. I know Cannon is not being considered, but it should also be on the list. The General Plan (3-P.43) lists this as a policy. Yes, this trenching will impact residents and businesses, but it is important from both safety and reliability purposes, to make these improvements sooner than later. Officials need to have a separate workshop for the Chamber, Village Merchants Assn and Visit Carlsbad to determine ways to mitigate interruptions caused to businesses during construction. Bottom line, I recommend and support trenching to include Tamarack and additional study and consideration be given to Cannon as well.	
Please explain why not lower tracks in all of Carlsbad starting down in poinsettia area	
Knowing more details about time, cost, impact during construction	funding/costs, construction impacts
This large infrastructure investment, if done in conjunction with a cohesive village and barrio plan, should lead to continued revitalization of one of the greatest assets the city has.	construction impacts

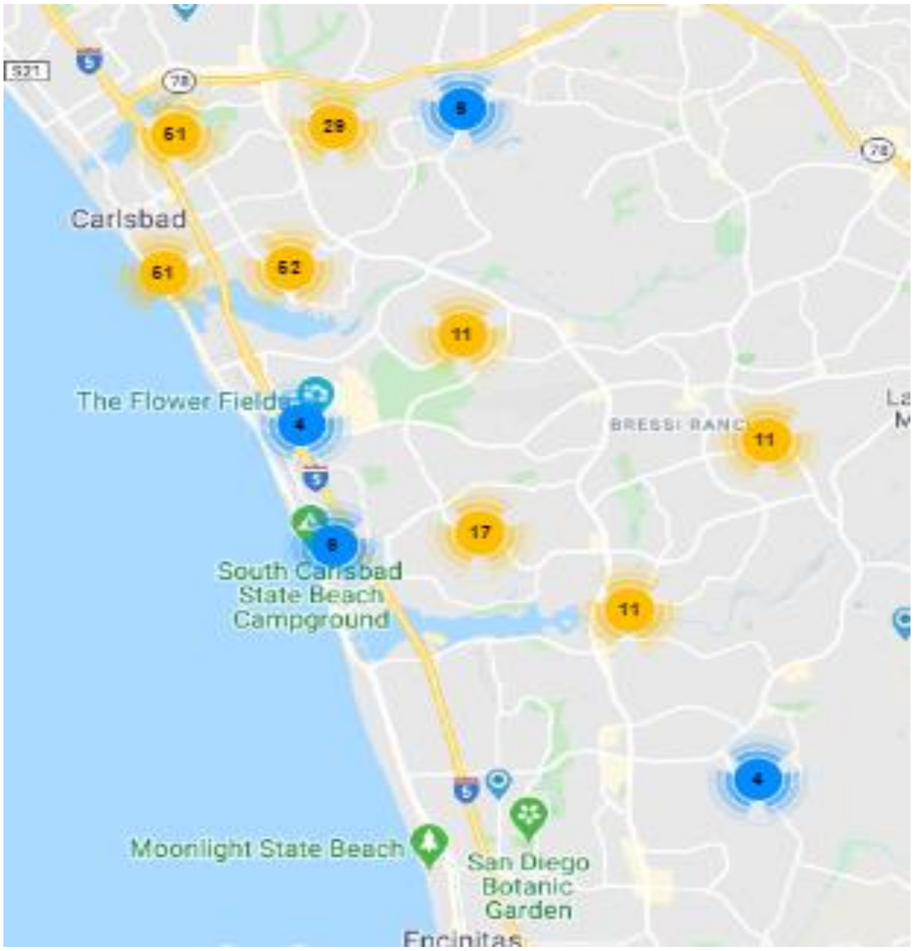
Do you work or own a business in Carlsbad?



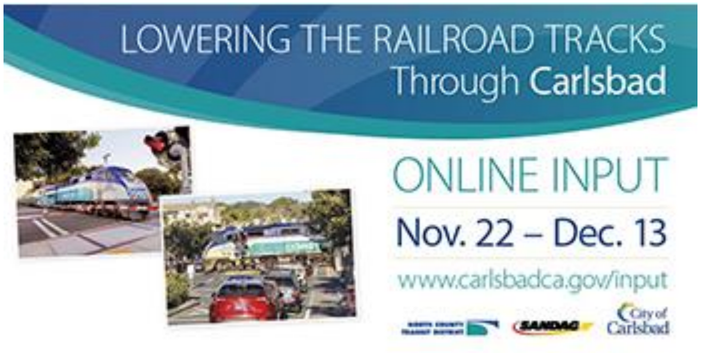
If yes, where is it located? (Total 215)



Geographic Distribution of Online Survey Respondents (331 answers)



Social Media Comments



City of Carlsbad - Official
Page Liked · November 5, 2019 ·

Train traffic through Carlsbad is expected to double by 2035. Learn what options the city, SANDAG - San Diego Association of Governments and North County Transit District (NCTD) are exploring to lower the railroad tracks and minimize safety and traffic concerns through the Village and Barrio. Learn more https://loom.ly/gFHcvnw

10 · 8 Comments 6 Shares

Like · Comment · Share

Oldest

Jenny Kim Lower it, like in Solana Beach?! Kinda late to that party, but I'm pretty sure it won't be needed. By 2035 the Del Mar bluffs will fall and there will be NO train traffic, since there is no plan for alternative train tracks instead of along the crumbling bluffs..
Like · Reply · 15w · 1

Kerry Keough Siekmann It would be the proper time to also discuss quiet zones! Especially since there will be twice as many train whistles!
Like · Reply · 15w · 2

Diane Bee You certainly didn't care about "quiet zones" when you approved the 4+ story, horrendous, ugly, architectural nightmare building at State and Oak and told them they could use the public lots for their timeshares! It is appalling you were ever on the planning commission. And how you were "thrilled that [they] chose Carlsbad" to build their eyesore. So I say to you, you purchased your home near a train track, so live with it. There was never a guarantee that there would be quiet zones.
Like · Reply · 15w · Edited · 2

Kerry Keough Siekmann Diane Bee you are pleasant as ever!
Like · Reply · 15w · 1

Diane Bee How ironic, from someone who is especially nasty at city council meetings! I think about the foolish decisions made every time I drive by that building. And think of you telling a private owner that he could use *public* parking for his timeshares! Disgusting and pathetic. So yeah - sorry it's not a pleasant topic. But neither is that horrible building.
Like · Reply · 15w · Edited · 1

Diane Bee Your legacy to Carlsbad

Like · Reply · 15w 3

Carla Barber A really unCarlsbad building. More like LA

Like · Reply · 14w 1

Shawn Steele Kerry Keough Siekmann also, if they lowered the tracks there would be no crossings 🙄

Like · Reply · 13w

Write a reply...

City of Carlsbad - Official

November 26, 2019 ·

Public input wanted ➡️ Train traffic through Carlsbad is expected to double by 2035. 🚉 🚉 To accommodate the increase, the San Diego Association of Governments is planning to build a second set of train tracks through northern Carlsbad, resulting in a continuous 8.6-mile stretch of double tracks.

In 2014, the Carlsbad City Council made it a city priority to explore lowering the tracks below street level in a trench. Now, two alternatives are being considered. Check out the options and let us know what you think through an online survey. https://loom.ly/3MOiCR4

5 7 Comments 1 Share

Like Comment Share

5 7 Comments 1 Share

Like Comment Share

Oldest

Suzanne Gerda Rob Midford

Like · Reply · 12w

Jenny Kim 1. How long would all that work take to complete? *In Reality, not high hopes

2. Does anyone think the Del Mar bluffs are going to last thru 2035?? If even one bluff fails at the tracks, there will be 0 train traffic thru Carlsbad...'

1

Like · Reply · 12w

Tim Emery The volume warrants the subterranean track I'm for both expansion is necessary that said we are a tourist village let's keep peeps safe not all are used to the train traffic

Like · Reply · 12w

Rick Gordon Anyone noticed the extra volume on train whistles the last couple months. I'm thinking SANDAG has increased the volume to push the rail trenching.

Like · Reply · 11w

Jenny Kim https://www.cbs8.com/.../509-7251739f-4841-4947-ac7b...

CBS8.COM

Trains will continue to run despite bluff collapse near tracks in Del Mar

Like · Reply · 11w

Geoff Kin NO trains today, BUS from Solana Beach to downtown main station!

Like · Reply · 11w

Jenny Kim They say the new inland track route, away from the Del Mar Bluffs is at least 30 years away. Just wait until the bluffs go and do it then, we'll probably have NO train for years & years, as we wait for the new route to be done.

Like · Reply · 11w

Kris Wright ▶ Wake Up Carlsbad
November 26, 2019 ·

Please take a moment to take the survey where you can input your thoughts about whether you want trenching the train tracks that go through the Village and Barrio. The survey provided allows you to provide an opinion as to whether you want a "long" or "short" trench or not one at all. However the cost is not listed in the survey-which I hear is quite extensive.

There is a place to comment at the end. A community input workshop was also held on Nov. 20th. Your input is important. Survey ends December 13th.

CARLSBADCA.GOV

City of Carlsbad - Carlsbad Village Double Track Project

Train traffic through Carlsbad is expected to double by 2035. Since the railroad crosses through two of Carlsbad's oldest…

6

21 Comments

Laurie Masten I just have to say the following: about two years ago I sat on a City of Carlsbad advisory panel on this very issue. Almost unanimously, as I recall, this group of Carlsbad residents (about 12 to 14 of us) said NO to the trenching. What has changed? W...
See More

14

Like · Reply · 12w

Casandra Tompkins Laurie Masten It seems to continually keep coming around. Previously it was former Councilman Dr Mark Packard always bring it up. Now it seems it is SANDAG and our mayor (who will not be able to vote on this due to the number of properties he owns along the railroad tracks on Tyler St.).

Like · Reply · 12w

Elaine Rasmussen Moss No I do not think this is a good idea

5

Like · Reply · 12w

Jan Neff-Sinclair It keeps coming back because the mayor's properties along Tyler St will go up in value if the trenching goes through.

7

Like · Reply · 12w

Casandra Tompkins Jan Neff-Sinclair He owns about half that block?

Like · Reply · 12w

Jan Neff-Sinclair Casandra, I don't think it is that much, but it is hard to tell with LLCs in the mix.

Like · Reply · 12w

View 2 more replies

Paula Yokoyama Too expensive.

3

Like · Reply · 12w

Casandra Tompkins Paula Yokoyama Money that should be spent on mass transit. We should make minor changes first like increasing lighting at the crossing on Grand. It is very dark there when driving through.
(P.S. Happy Thanksgiving to you & your family.)

Like · Reply · 12w

Paula Yokoyama Casandra Tompkins thanks and same to you!!!

1

Like · Reply · 12w

Kris Wright Laurie Masten I agree. From what I've discovered, the cost of the trenching will be astronomical. I don't believe that people have changed their minds but that this is another survey to satisfy government officials to prove that the project engineers have gotten public input as per the law.

I am astounded that this survey is NOT including the costs involved.

7

Laura Drelleshak I think a lot depends on where the $400 million to pay for it comes from. If it's mostly from the city, no. If it's a grant from some other gov't agency, then consider it.

3

Like · Reply · 12w

Rich Numrich All of the costs that will pay for this incredibly expensive project have not been conclusively detailed by SANDAG. Yet, as usual, us taxpayers are funding millions of dollars for the planning cost. And Carlsbad is kicking in hundreds of thousands dollars.

On the surface, it sounds like a great benefit for Carlsbad. …
See More

4

Like · Reply · 12w

> **Kris Wright** The survey then seems to be ill timed. When the costs are delineated as to actually how much comes out of the coffers from the City of Carlsbad, *then* the survey should be put to the public so we know exactly how much we would have to pay. I do know that the City of Carlsbad has paid thousands already for "studies."
>
> 1
>
> Like · Reply · 12w · Edited

> **TJ Childs** Hundreds of thousands I think the figure $375,000 for studies was shown at the trenching workshop.
>
> 3
>
> Like · Reply · 12w

Vickey Syage What a slanted, completely partial survey i support of the trenching. All the questions are worded to support the project. Only one question, at the very end asks which option do you prefer and offers a "none of the options" answer. Everything else is written to support trenching......

4

Like · Reply · 11w

> **Paula Yokoyama** Way too expensive for the small benefit. if you want to take Amtrak, drive to Solana beach and park long term and take advantage of their really nice train station.
>
> 1
>
> Like · Reply · 11w

> **Vickey Syage** Paula Yokoyama I agree. Just took the survey. Had to say "not important" to every issue listed even though in and of themselves, some of those issues are important to me -otherwise the survey would support the project. Really, really prejudiced survey -not objective at all.
>
> 4
>
> Like · Reply · 11w

Kris Wright This is a chance to say No to trenching. You can fill out the survey appropriately if that is how you feel.

3

Like · Reply · 11w

Casandra Tompkins I was on the fence until the cliff collapse in Del Mar within a few feet of the tracks. Now Carlsbad will not get a penny from SANDAG or NCTD and rightly so. The train tracks along the Del Mar cliffs need moved before a massive disaster happens.

2

Like · Reply · 11w

Workshop Input Data

The community workshop process started with a presentation by Linda Culp, representative of SANDAG, showing the long trench and short trench alternatives. People had the opportunity to ask questions. Table facilitators asked participants to assess the pros and cons of each alternative while a scribe took notes on flipcharts at each table. People engaged in open discussion with the facilitator and among each other. Scribe made sure comments, observations, and questions regarding the project were recorded. At the end of this process, each table shared their input to the rest of the group.

Workshop Input Comments Organized by Theme

Topic:	# of responses
Noise	23
Safety	34
Accessibility	14
Funding	9
Impacts	11
Traffic	10
Pollution	4
Favorable to project	14
Train ops	10
Community input	10

Below, we include transcriptions of the comments gathered by the scribes using the flipcharts. Each table is separated by a blue bar. Please note that, In some instances, people at a table listed exactly the same cons for both options. Comments have been transcribed verbatim from the scribes notes on the flipcharts.

Pros of long trench option

Continuation of coastal rail trail
Less traffic - More options both sides
Less noise in southern portion
Safety at Tamarack
Less noise for more people
More safety - 1st responders cross Tamarack
Increased property values (less noise)
No noise @ Tamarack
Less traffic congestion
Allows more access on both sides of Tamarack
Economy of scale: if it makes sense to do short trench, then do long trench and plan for the future
Like vehicle across @ Chestnut
Noise reduction
Improved wayfinding
Improved train operation shorter headways
Emergency vehicle access
Do it right way - Long
Extra overpass
Safety
Increase property values
Economic revitalization
Access to beach for public safety and recreation
Train tracks a barrier to neighborhood
Tamarack is included
More noise control
Safety and movement (kids especially)
Improves quality of life
Strong consensus to have a crossing @ Chestnut for pedestrians and bikes
Long option favored by group
Alleviates traffic

Emergency response - Tamarack & CVD
Long term benefit
Safety – Pedestrians
No train horn
Biking safety over Tamarack

Further eliminates train noise past Tamarack
Potential for parks on top of trench
More improvements all done at one time
Like this option the most
Better emergency response with overpass at Tamarack
Dust/noise reduction

Chestnut vehicular traffic allowed
Property values increase
Reduced noise
Improve reliability
Improve safety
Trains may be able to operate at faster speeds - More efficient schedule
Real transit stop for downtown to serve more dense housing @ Village

Less noise/no crossings
Creates/Opens Tamarack for better flow of traffic
Safety improvements
More economic benefits
Improves reliability of trains
Good for adding more services minus the negative impacts
Think long term

No noise from trains/horns!
Ped/auto access @ Chestnut
Long term planning - do it right first time
Train horn eliminated
Increase property values
Improve air quality
Improve traffic flow on Tamarack
Improves safety @ Chestnut/Tamarack Ave.

Traffic flows better
Improve flow on Tamarack (+)
Safer for pedestrian/bike +
Better for first responders access (+)

Safety (school crossings)
Ease of access (esp. emergency vehicles)
Quieter in residential areas
More beneficial to more residents/visitors
Reduced pollution

Concerns about long trench option

3 homes acquired
Cost

Potential for increased volume at Tamarack?
Where will historic depot be located?

New crossings may increase traffic in residential neighborhood (i.e. Oak) Minimum benefit and narrow street
Concerned with vehicle crossing @ Chestnut
Construction noise, dust, debris
Funding mechanism

Noise
Increased traffic
Increase trains
Chestnut cars increase
Traffic flow near Chestnut
Length of construction

Traffic N + S @ Chestnut
Acquiring property (Feedback?)
Parking
Lightning
Black dust/soot

Costlier
Takes longer to complete project
Why not a tunnel?
Impact on local businesses during construction - how long?

Cost vs. Benefit - worth it?
3 impacted properties
Additional costs to Carlsbad residents

Cars over Chestnut - Impact quality of life

Concern for speed limit at Tamarack crossing
Traffic calming measures?
Safety of allowing vehicles crossing at Chestnut
Pedestrian only at Chestnut
Too much traffic through Chestnut
Station disruption

Impacts to homes/properties
Impacts to small businesses/construction
Increased bus traffic around transit center (Beach/Christiansen)

Why do they need a crossing for cars at Chestnut? Is it necessary? Should be optional
Businesses impacted by this project
Extra cost
Where is the funding coming from (XXX)

Paying for it
Auto access @ Chestnut
Beach parking @ Chestnut

Construction
Businesses impacted
3 properties/residences

Residential input
Integration with NCTD plans
ETA? When start?
Maintain local control
Chestnut overpass - pedestrian (preference) only vs. vehicle
Displaced homes
Where dirt going?
How paying for it?

Pros about short trench option

Continuation of coastal rail trail Less traffic - More options both sides Less noise in southern portion Safety at Tamarack Less noise for more people More safety - 1st responders cross Tamarack Increased property values (less noise)
No noise @ Tamarack Less traffic congestion Allows more access on both sides of Tamarack Economy of scale: if it makes sense to do short trench, then do long trench and plan for the future
Like vehicle across @ Chestnut Noise reduction Improved wayfinding Improved train operation shorter headways Emergency vehicle access
Do it right way - Long Extra overpass
Safety Increase property values Economic revitalization
Access to beach for public safety and recreation Train tracks a barrier to neighborhood Tamarack is included More noise control Safety and movement (kids especially) Improves quality of life Strong consensus to have a crossing @ Chestnut for pedestrians and bikes Long option favored by group
Alleviates traffic Emergency response - Tamarack & CVD Long term benefit Safety – Pedestrians No train horn

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Lightning
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Cost vs. Benefit - worth it?
3 impacted properties
Additional costs to Carlsbad residents
Cars over Chestnut - Impact quality of life

Concern for speed limit at Tamarack crossing
Traffic calming measures?
Safety of allowing vehicles crossing at Chestnut
Pedestrian only at Chestnut
Too much traffic through Chestnut

Station disruption
Impacts to homes/properties Impacts to small businesses/construction Increased bus traffic around transit center (Beach/Christiansen)
Why do they need a crossing for cars at Chestnut? Is it necessary? Should be optional Businesses impacted by this project Extra cost Where is the funding coming from (XXX)
Paying for it Auto access @ Chestnut Beach parking @ Chestnut
Construction Businesses impacted 3 properties/residences
Residential input Integration with NCTD plans ETA? When start? Maintain local control Chestnut overpass - pedestrian (preference) only vs. vehicle Displaced homes Where dirt going? How paying for it?

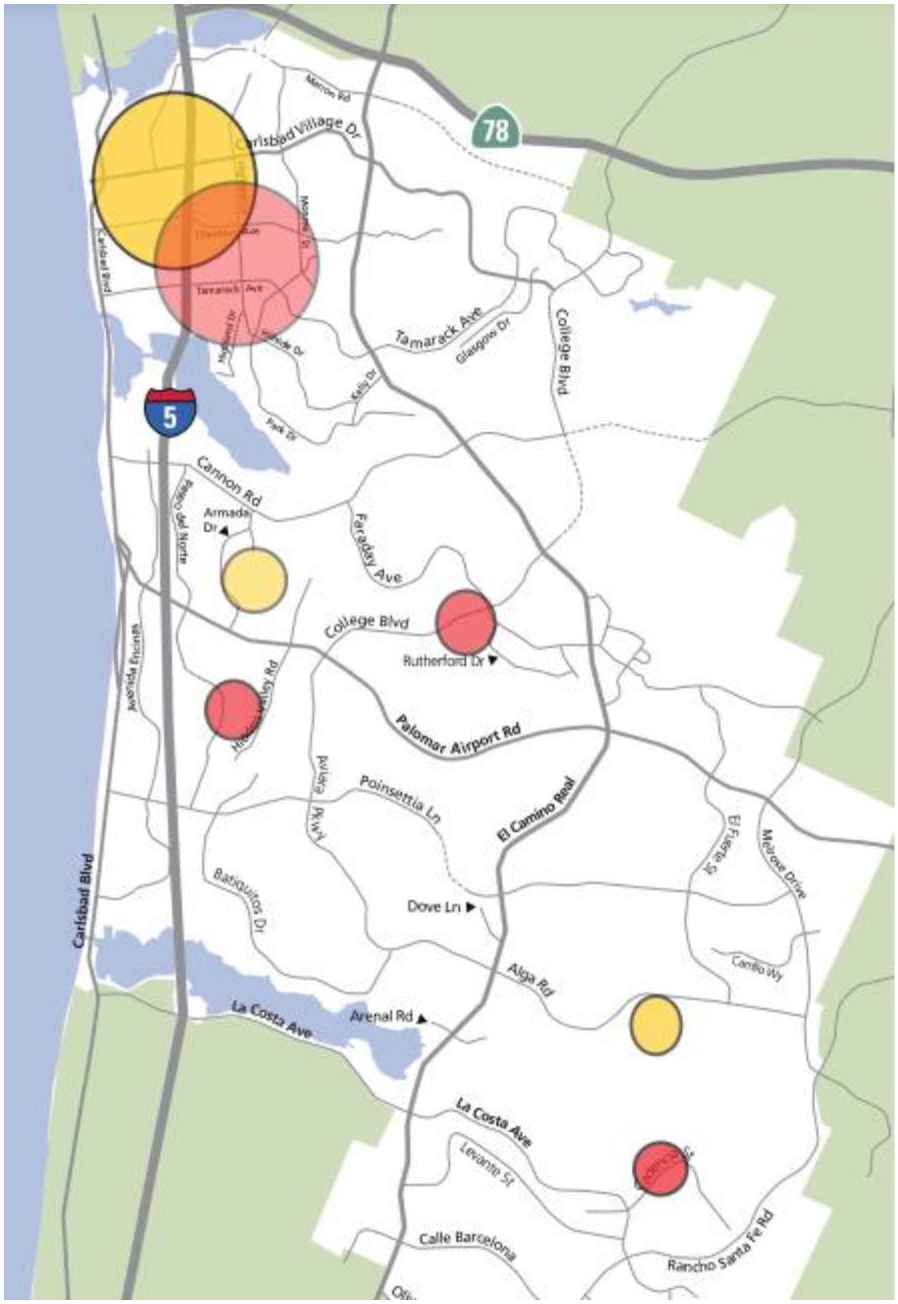
Workshop Evaluation

Participants were asked to rank the following on a scale of 1 – 5, 1 being "Do not agree" and 5 "I agree."

Opportunity to share ideas – 4.76
Format gave chance to participate – 4.72
Format made comfortable sharing – 4.72
City staff listened – 4.71
Understand how input will be used – 3.96
Liked the format – 4.43

Community Workshop Participant Geographical Location

Downtown area


Carlsbad Village Dr
Marron Rd
78
5
Tamarack Ave
Glasgow Dr
College Blvd
Kelly Dr
Park Dr
Cannon Rd
Paseo del Norte
Armada Dr
Faraday Ave
College Blvd
Rutherford Dr
Avenida Encinas
Palomar Airport Rd
Aviara Pkwy
Poinsettia Ln
El Camino Real
El Fuerte St
Melrose Drive
Carlsbad Blvd
Batiquitos Dr
Dove Ln
Alga Rd
Cadillo Wy
La Costa Ave
Arenal Rd
La Costa Ave
Levante St
Calle Barcelona
Rancho Santa Fe Rd

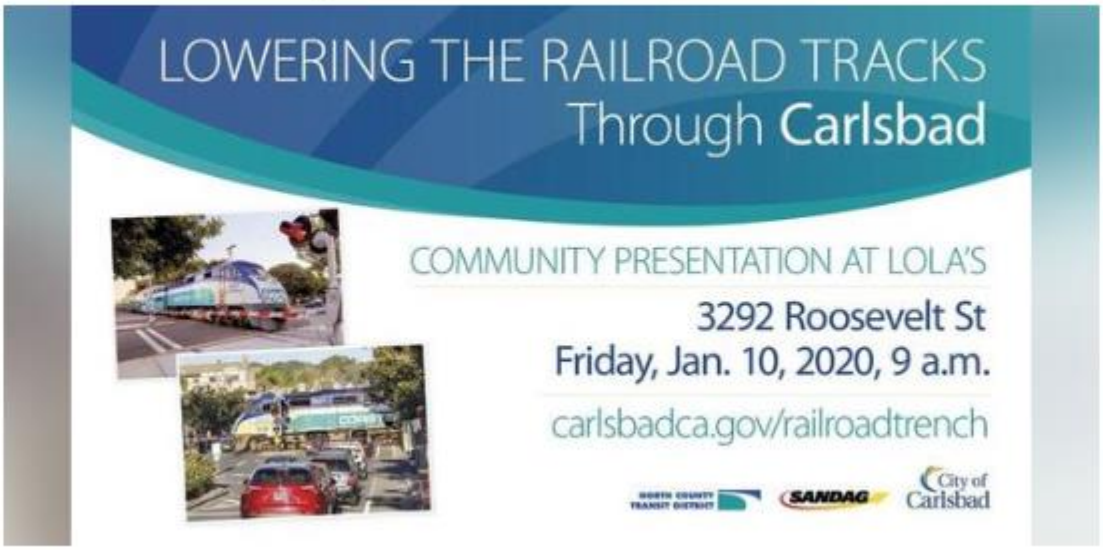
Carlsbad

Promotional Materials

Kristina Ray, City of Carlsbad AGENCY

Friends of the Barrio- Railroad trench presentation Jan. 10

This Friday, Jan. 10, team members from the potential project to lower the railroad tracks through the Village and Barrio will be joining Friends of the Barrio at Lola's at 9 a.m. All are welcome to join.



6 Jan · Subscribers of City of Carlsbad in 3 neighborhoods

Thank Comment 3 · 441 Impressions

LOWERING THE RAILROAD TRACKS Through **Carlsbad**

TRAIN TRAFFIC THROUGH CARLSBAD IS EXPECTED TO DOUBLE BY 2035. To accommodate the increase, the San Diego Association of Governments is planning to build a second set of tracks along the San Diego segment of the rail corridor that runs from San Luis Obispo to San Diego. Since the railroad crosses through two of Carlsbad's oldest neighborhoods, the Village and Barrio, the planned expansion poses unique challenges to the city.

In 2014, the Carlsbad City Council made it a city priority to explore lowering the tracks below street level in a trench through the Village and Barrio. A study conducted by the city, SANDAG and the North County Transit District determined in 2017 that lowering the railroad tracks into a trench is technically feasible.

Two alternatives are now under consideration:

- A short trench running from Carlsbad Blvd. to the north side of Tamarack Ave.
- A long trench running from Carlsbad Blvd. to the south side of Tamarack Ave.

Transforming the Village and Barrio

In Carlsbad, the railroad tracks are mostly at the same level as the street. When a train comes through, safety gates come down and drivers, pedestrians and bicyclists must stop and wait. With an expected 100 trains coming through Carlsbad by 2035, double the amount that currently passes through, the city is exploring ways to address safety, traffic and environmental concerns.

Lowering the railroad tracks through the Village and Barrio would separate train traffic from street traffic, creating an overpass for drivers, bicyclists and pedestrians over the tracks.

NORTH COUNTY TRANSIT DISTRICT · SANDAG · City of Carlsbad

Lowering the Railroad Tracks: Short Trench and Long Trench Options

What's the Difference?

The short trench alternative stops north of Tamarack Ave. It would create an overpass for pedestrians and bicyclists at Chestnut Ave. but not change Tamarack Ave., where train tracks would remain at street level with pedestrians, bicyclists and drivers.

The long trench alternative stops south of Tamarack Ave. It would create overpasses for pedestrians, bicyclists and drivers at both Chestnut Ave. and Tamarack Ave.

Who Uses the Train Tracks?

The train route that runs from San Luis Obispo to downtown San Diego is the second busiest intercity passenger rail line in the United States. The track is used by the NCTD COASTER, Amtrak Pacific Surfliner and BNSF freight trains, so capacity improvements such as double tracking along the entire railroad corridor is important at statewide and regional levels.

1. Existing Condition at Carlsbad Village Drive | 2. Rendering of Short and Long Trench through Carlsbad Village Drive | 3. Existing Condition at Chestnut Ave. | 4. Rendering of Short Trench Option at Chestnut Ave.

What's Next? **Attend** the Public Workshop

Public Workshop Nov. 20, 2019 6 - 8 p.m.

THE CITY OF CARLSBAD, SAN DIEGO ASSOCIATION OF GOVERNMENTS AND THE NORTH COUNTY TRANSIT DISTRICT are hosting a public workshop on **Nov. 20, 6 - 8 p.m.** at the Harding Community Center to inform the community about the potential project and to seek input about the two proposed alternatives, the short trench and long trench options.

Timeline

This project is in the preliminary planning phase. A timeline for final design and construction has not yet been set.

Lowering the Railroad Tracks Through **Carlsbad**

Train traffic through Carlsbad is expected to double by 2035. Learn what options the City of Carlsbad and regional transportation agencies are exploring to minimize safety and traffic concerns through the Village and Barrio.

City of Carlsbad
City of Carlsbad
1200 Carlsbad Village Drive
Carlsbad, CA 92008
www.carlsbadca.gov

HELP THE CITY OF CARLSBAD

determine the best way to lower the railroad tracks through Carlsbad Village and the Barrio to plan for increased train traffic.

WORKSHOP

Mark your calendar for Wednesday,

NOV. 20, 2019, 6 - 8 P.M.
Harding Community Center
3096 Harding St.

Take an online survey available **Nov. 20** at **www.carlsbadca.gov/input**

GET UPDATES

- Visit **www.carlsbadca.gov** and click on email notifications. Sign up for the Village and Barrio Railroad Trench list.
- carlsbadca.gov/railroadtrench
- 760-602-2746
- transportation@carlsbadca.gov