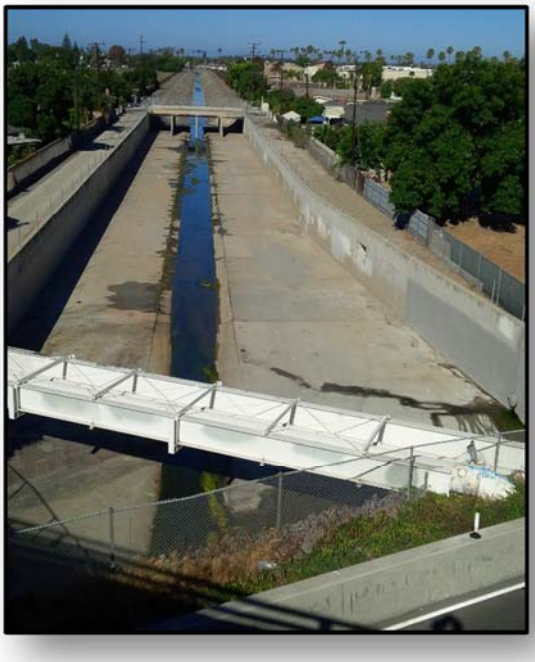
APPENDIX B - CIVIL ENGINEERING

For

WESTMINSTER, EAST GARDEN GROVE

FLOOD RISK MANAGEMENT STUDY



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APPENDIX B - CIVIL ENGINEERING

For

WESTMINSTER, EAST GARDEN GROVE

FLOOD RISK MANAGEMENT STUDY

1.0 Objective

The purpose of this appendix is to provide results from the Engineering Design effort. Design data and calculations were developed sufficiently to determine the technical and economic feasibility of each alternative and in the event that project is authorized, to provide a design basis leading to the development of the construction plans and specifications. The objective of the Westminster, East Garden Grove Feasibility Study is to investigate alternatives for flood risk reduction to the Orange County Community.

2.0 Study Area/Existing Project Features

The study area is contained within the Westminster watershed in western Orange County, California. The watershed is approximately 74 square miles and lies on a flat coastal plain that is almost entirely urbanized. Cities in the watershed include Anaheim, Stanton, Cypress, Garden Grove, Westminster, Fountain Valley, Los Alamitos, Seal Beach, and Huntington Beach.

The watershed is part of the former floodplain of the Santa Ana River (SAR) which historically meandered through out the existing watershed as far north as Anaheim Bay to as far south as Newport Bay. Channelization and large scale flood control Modifications have constrained the Santa Ana River to the main stem channel on the eastern border of the Westminster watershed.

Figure 1 depicts the watershed boundary in orange, the Santa Ana River (SAR) in light blue, and the major drainage channels throughout the watershed in dark blue.

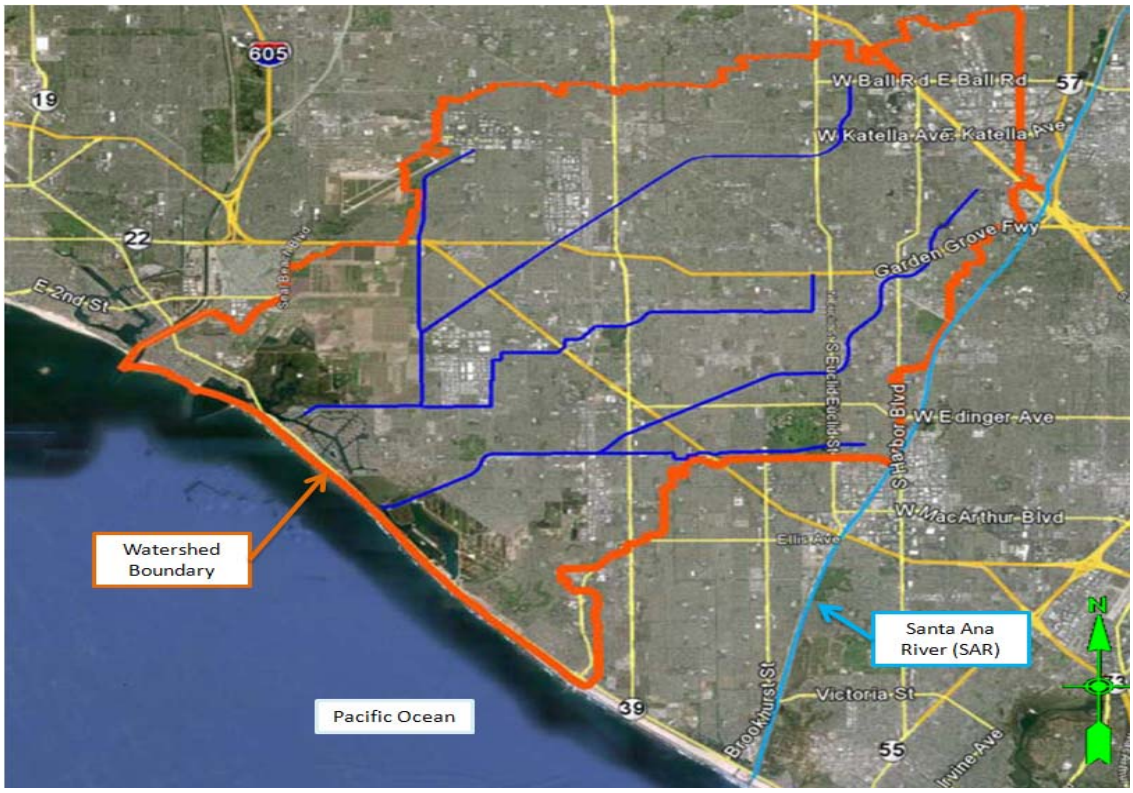

Figure 1: Westminster Watershed

The channels within the Westminster watershed collect local storm water runoff and vary in size, geometry, and lining. Typical channel configurations include concrete rectangular (including invert); riprap- lined trapezoidal (soft-bottom), concrete-lined trapezoidal (including invert), and enclosed culverts. Configurations vary by reach and change throughout the channel systems.

This study will take a watershed approach to flood risk management by modifying the existing channel cross section configurations and armoring to convey the design flow. The study focus however will be on the channels illustrated in Figure 2, and will support the systems that warrant Federal consideration and that are shown to be incrementally justified.

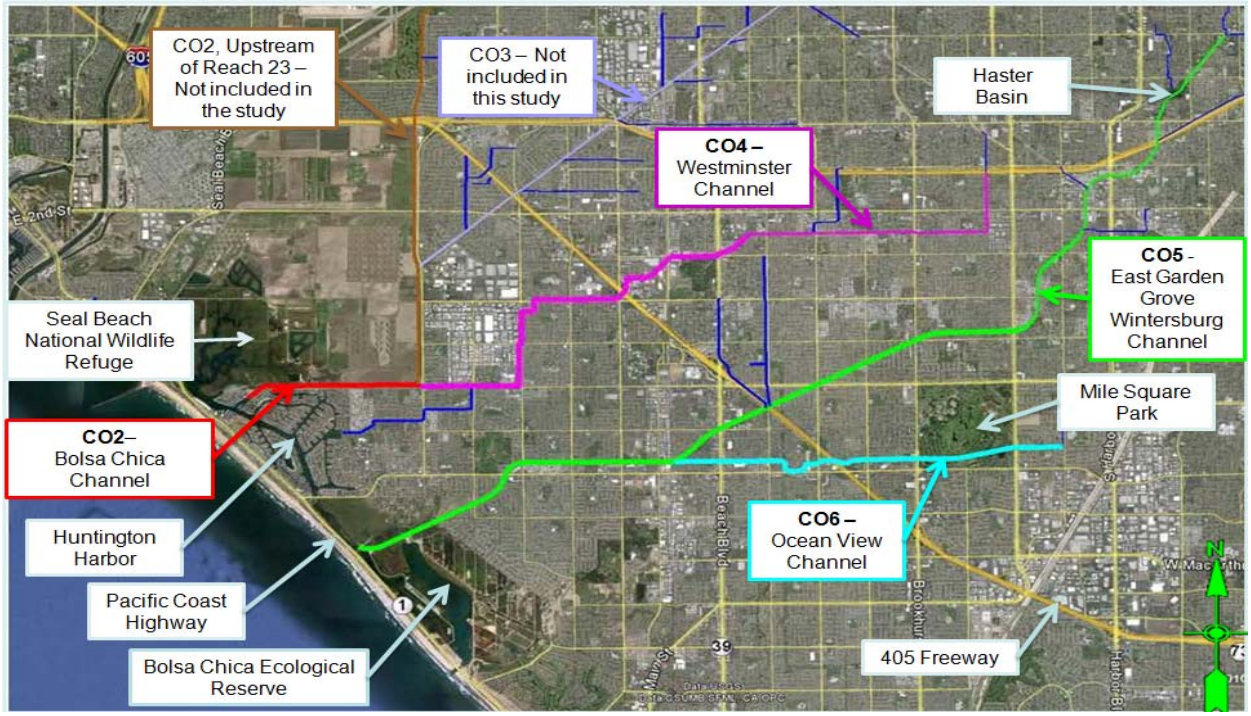

Figure 2: Drainage Channels within the Study Area

2.1 Bolsa Chica Channel (Channel C02)

The study will focus on the downstream-most segment that begins at the C02/C04 confluence at the Bolsa Chica Street/Edinger Avenue intersection. The segment extends to the west where it eventually discharges into Huntington Harbour.

2.2 Westminster Channel (Channel C04)

The C04 Channel begins approximately 0.25 miles west of the Highway 22 and Euclid Street overpass and extends approximately 8 miles southwest before joining the C02 channel near the Bolsa Chica Street/Edinger Avenue intersection.

2.3 East Garden Grove/Wintersburg Channel (Channel C05)

The C05 channel begins upstream of Haster Basin (a.k.a. Twin Lakes Park) and flows approximately eleven miles southwest where it discharges into Outer Bolsa Bay, located in the Bolsa Chica Ecological Reserve.

2.4 Ocean View Channel (Channel C06)

The C06 channel is a tributary to the C05 channel and begins east of Mile Square Park. The channel flows to the west, through the park, and continues an additional four miles where it ultimately discharges into the C05 channel at a point northeast of the intersection of Gothard Street and Warner Avenue.

2.5 Receiving Waters

This study will also focus on the receiving waters of the C02/C04 and C05/C06 channel systems. Figure 4 depicts the receiving waters of both the channel systems.

The C02/C04 channel system does not outlet directly to the Pacific Ocean. Waters from the C02/C04 system discharge into the north side of Huntington Harbour. The waters then pass through the northwestern end of the harbor into Seal Beach National Wildlife Refuge, under Pacific Coast Highway into Anaheim Bay and then flow from the Bay to the Pacific Ocean.

The C05/C06 channel system does not outlet directly to the Pacific Ocean. Waters from the C05/C06 system enter Outer Bolsa Bay, which is part of the Bolsa Chica Ecological Reserve, and flow under the Warner Avenue bridge through the south end of Huntington Harbour. A tide gate where C05 enters Outer Bolsa Bay marks the downstream limit of the OCPW flood control easement and ownership interests. The flows continue through Huntington Harbour, draining through the northwestern end of the harbor into Seal Beach National Wildlife Refuge where they join with the waters from the C02/C04 channel system. Once the waters pass through the southern end of the refuge they travel under Pacific Coast Highway into Anaheim Bay and then to the Pacific Ocean.

Figure 3: C02/C04 and C05/C06 Receiving Waters

The receiving waters are comprised of the following four regions:

- **Huntington Harbour –** City of Huntington Beach residential community that includes five manmade islands and water ways used for boating. The layout of the harbor is illustrated in Figure 5.

- **Seal Beach National Wildlife Refuge -**A wildlife refuge that was developed through a collaboration of the U.S. Fish and Wildlife Service and the Department of the Navy. The reserve is part of the Seal Beach Naval Weapons Station located to the northeast adjacent to the right bank of the C02 channel.

- **Anaheim Bay –** The Bay serves as the outlet to the Pacific Ocean for the Wildlife Refuge, as well as the C02/C04 channel system.

- **Bolsa Chica Ecological Reserve –** This area is a nature reserve to protect a significant coastal wetland, home for many endemic plant and animal species, including endangered.

Figure 4: Bolsa Chica Ecological Reserve

The Bolsa Chica Ecological Reserve (BCER), completed in 2006, is owned by the State Lands Commission. The lower segment of the CO5 channel bisects the reserve. The reserve is divided into six sections as depicted in Figure 6. The BCER is comprised of the following areas:

- Full Tidal Basin - The Full Tidal Basin is located along the eastern edge of the CO5 channel and is considered an environmentally sensitive area. The Full Tidal basin is separated from the CO5

Channel, the Muted Tidal Basin, and Inner Bolsa Bay by levees. Water exchange between the Muted Tidal Basin and the Full Tidal Basin is permitted by a series of culverts and is controlled by flap gates that respond to changes in tide. Water exchange between the Seasonal Pond Area and the basin is controlled by flap gates that respond to changes in tide. The basin is connected to the Pacific Ocean by an outlet that passes under Pacific Coast Highway.

- Muted Tidal Basin – The Muted Tidal Basins is located along the north eastern edge of the Full Tidal Basin. The basin is divided into three cells that are only allowing water to movie between them through overflow weirs during larger storm events. Each cell is separated from the Full Tidal Basin and the CO5 channel by a levee. Culverts permit water exchange between the Muted Tidal Basin and the Full Tidal Basin and flap gates allow regular but muted tidal influence.
- Inner Bolsa Bay - Inner Bolsa Bay is located between Pacific Coast Highway and the Full Tidal Basin. The bay is isolated from the Full Tidal Basin by a levee and is separated from Outer Bolsa Bay by a tide gate. The tide gate permits water from Outer Bolsa Bay to enter Inner Bolsa Bay to maintain a tidal influence within Inner Bolsa Bay. There is no water exchanged between the Full Tidal Basin and Inner Bolsa Bay.
- Muted Tidal Pocket - The Muted Tidal Pocket is located along the northern edge of the downstream end the CO5 channel. The Muted Tidal Pocket is isolated from the CO5 channel by a levee and is separated from Outer Bolsa Bay by a tide gate. The tide gate permits water from Outer Bolsa Bay into the Muted Tidal Pocket to maintain a muted tidal influence.
- Seasonal Ponds – The Seasonal Pond Area is located along the eastern edge of the Full Tidal Basin and is separated from the Full Tidal Basin by a levee. A single culvert controls discharge from the Seasonal Ponds Area into the Full Tidal Basin. This area is subject to runoff from surrounding developments. The seasonal pond has not yet been restored.
- Outer Bolsa Bay - Outer Bolsa Bay is located at the mouth of the CO5 channel. Water exchange between the CO5 channel and the bay is controlled by a tide gate. Outer Bolsa Bay is connected to Inner Bolsa Bay and the Muted Tidal Pocket by separate tide gates. These tide gates allow water to flow from Outer Bolsa Bay into either Inner Bolsa Bay or the Muter Tidal Pocket. Water is discharged from Outer Bolsa Bay through the Warner Ave Bridge into Huntington Harbor. Outer Bolsa Bay is separated from the Pacific Ocean by Pacific Coast Highway and Bolsa Chica State Beach.

2.6 Work Previously Completed

Due to immediate needs for flood risk reduction, OCPW has completed construction on channel Modifications in the lower segments of the CO5 channel near the Bolsa Chica Ecological Reserve. These Modifications include placing riprap along the banks of the CO5 channel near the downstream tide gate driving sheet pile into the existing levees along CO5. The sheet pile begins at the downstream end of the Muted Tidal Basin and extends upstream to Warner Avenue. Emergency sheet pile that was placed to prevent a levee breach was left in place along the right bank of CO5 and the new sheet pile extends from the upstream end of the emergency sheet pile to Warner Avenue, see figure 5.

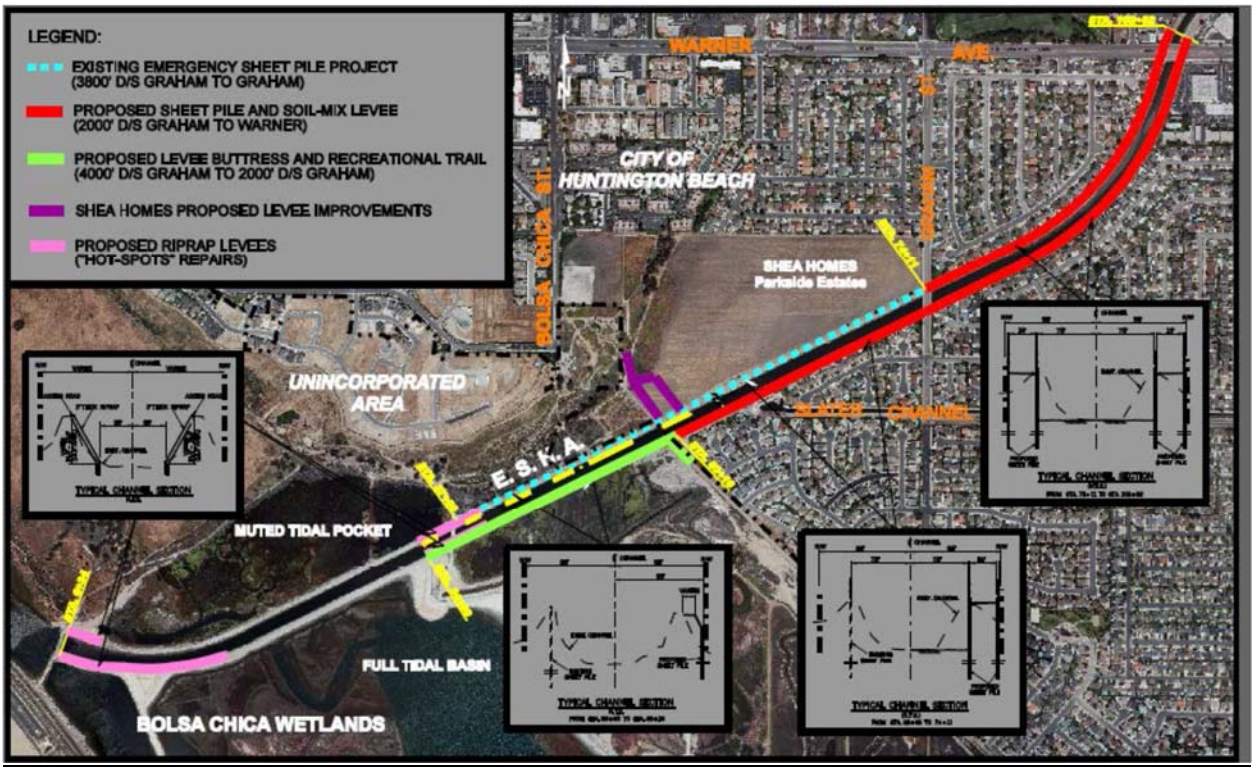

Figure 5: C05 Modifications Near BCER

3.0 Design Assumptions

These study assumptions were made during the original design analyses in March 2016 and verified and updated for the TSP report in August 2018:

- The quantities presented as an attachment to this appendix represent the detailed quantities developed for the revised channel designs. The cost estimates for the channel crossings and downstream Modifications (PCH floodwall, tide gates and Warner Ave Bridge) were developed differently as detailed design and quantities were not available for those items. For an explanation of the basis of cost for these items, refer to the Cost Appendix. Detailed design for these other features will be performed during the post-ADM design.

- The proposed modifications to the 405 highway crossing in alternative 3 have been removed from the proposed plan. All costs related to the Interstate 405 modifications have been removed from the project estimates, although some references remain in the channel configuration tables.

- Channels were developed to represent arrays of different types of possible channel Modifications. The entire channels were considered for modification to ensure flood risk was adequately addressed across the watershed and there was no increase in flood risk to downstream reaches as the capacity of the upstream reaches was increased.

- All channel reaches where sheet pile is being installed will consist of double layered sheet pile to account for seismic considerations. This is not called out specifically on the plates, but is true throughout the revised reaches and has been accounted for in the cost estimate.

- Due to limited funding and time allowed to work on feasibility phase of this project and for consistency with the calculation from USACE Hydraulics Section, the existing channel configurations used by Hydraulics Section were adopted for design. These will be updated during the post-ADM design.

- There were limited Groundwater studies, no detailed utilities, and geotechnical information was available for only certain portions of the channels. Proposed design is based on conceptual level site layout and preliminary H&H models.

- The proposed structural thickness of the modified channels were estimated by USACE Structures Section based on parametric design of similar structural channel walls and inverts in the region.

- All proposed channel Modifications must be contained within the channel right of way due to dense commercial and residential development throughout the watershed. Based on USACE Hydraulics Section's information, the proposed design concepts were developed assuming that there would be enough right-of-way when provided proposed dimensions.

- The proposed channel invert elevation cannot change significantly. High ground water and restricted change in elevation across the watershed limit the effectiveness of modifying the channel invert elevation.

- The proposed maximum flood wall height on the banks would be 3ft. This height is based on recommendations made by OCPW and would ensure maintenance equipment can travel over the flood wall and reach the invert of the channel.

- Maintain capacity for at least one access road along the top bank of the channel. A single access road would be required to ensure maintenance vehicles can access all reaches of the channel. The road could be on either side of the channel.

- Utilities mapped were based on available preliminary information from the sponsor. Field inspections for utilities have not yet been conducted. It is very likely multiple additional utilities will be discovered both during design and during construction.

- Initial H&H modeling has been completed. Geotechnical testing once completed could result in changes to proposed channel liner thicknesses.

- The proposed design is based on existing channel design type of armoring and therefore less changes are expected during design refinements. Geotechnical testing would again be required as with all other channel designs. Additionally, and side drains have not been included in any of the proposed channel improvement designs but would need to be included when a final an alternative has been selected.

- Some channels are over 50 years old and may be considered historical structures. If so, additional cultural surveys, documentation and coordination will be required.

- For proposed flood wall along PCH, Geotechnical and Structural design are yet to be completed. Final geotechnical investigations and design could result in changes to the assumptions for the flood wall design.

- The existing channels run through densely urban areas limiting site access. Noise concerns can limit construction schedules. Bubble curtains may be required for noise control. Specialized construction may be needed to minimize impact to downstream reaches. Bracing and shoring may be required for

personal properties. Open flow channels convey surface runoff. Downstream areas would experience tidal influences. High groundwater could also be encountered. Local storm events, while seldom, also have a high intensity and may affect design protection.

- For the proposed floodwall along PCH, construction impacts would result along Pacific Coast Highway which carries heavy traffic and bicycle traffic. Constrained working areas are expected. The adjacent bay is a prime ecological habitat, and inundation with high tides or storm events could also be problematic.

4.0 Minimum Channel Modifications Alternative

The Minimum Channel Modifications Alternative is referred to as Alternative 1 in all design plates, tables and calculations.

4.1 Channel Modifications

The channel Modifications in this alternative vary between no action on portions of the existing channel, to concrete lining of existing earthen channels and installation of sheet pile channel walls in leveed portions. Refer to Tables 1 through 3 in Attachment 3 for a detailed description of the Modifications that will be made in each reach of the channels. For a typical cross section of each improvement type, refer to Plate 2.

4.2 Downstream Modifications

Beyond the channel Modifications detailed above, this alternative will require some Modifications at the downstream end of the system. Based on the H&H modeling, the required Modifications include widening Warner Avenue Bridge, replacing the tide gates at the downstream end of the C05 Channel, and building a floodwall along the Pacific Coast Highway (PCH) at Outer Bolsa Bay.

As detailed in the Cost Appendix, the PCH Flood Wall conceptual design and quantities were developed as a part of the 2015 VE Report (Attachment 1, Westminster VE Study). A 3 foot seawall would be installed along the PCH, to the north of Channel C05's outlet to Outer Bosla Bay, to protect the highway from upstream flooding during storm events. The floodwall would be approximately 2500 feet long, extending much of the length of Outer Bosla Bay as shown in Figure 6.

Figure 6: Pacific Coast Highway Floodwall

The Warner Ave Bridge currently acts as a downstream constriction and so will be widened to allow additional flow to pass into Huntington Harbor from Outer Bolsa Bay. The Hydraulic modeling for this alternative requires the removal of approximately 0.85 acres of land on the east edge of the Bolsa Chica Conservancy parking long just upstream of Warner Ave. Warner Avenue Bridge itself will need to be widened, and the pedestrian bridge just south of the automobile bridge will also need to be either widened or replaced. Refer to figure 7 for these modifications. Detailed design has not been performed yet of this change. The cost estimate for the work was based on a similarly scoped effort to create an additional Ocean outlet from Outer Bolsa Bay to the Pacific Ocean, and can be reviewed in the cost appendix. A more site specific design and cost will be developed post-ADM, prior to the final report.

Figure 7: Warner Ave Bridge Modifications

The Tide Gates between Channel C05 and Outer Bolsa Bay will be improved. The existing gates consist of twelve 84-inch diameter, 28-feet long, corrugated metal pipes with heavy duty flap gates, which are hydraulically inefficient. The proposed gates are 11' by 11' box culverts, 30 feet long. Ten culverts are assumed to be installed, with flap gates on the downstream end of each and new concrete headwalls installed. These were sized based on the Hydraulic modeling, and as-builts of the existing gates and pipes were used for reference. Refer to sheets 20 through 23 of Attachment 2, East Garden Grove – Wintersburg Channel, Tidelands to Huntington Beach Blvd.

5.0 Maximum Channel Modifications Alternative

The Maximum Channel Modifications Alternative is referred to as engineering Alternative 3 in all design plates, tables and calculations. This alternative considered three sub-alternatives for Channel C06 and C-04: 3A-1, 3A-2, and 3B. The alternative moving forward includes only sub-alternative 3B, with no modifications to the crossing at Interstate 405. All costs related to the Interstate 405 modifications have been removed, although some references remain in the channel configuration tables. These channel dimensions will all be revised accordingly for the post-ADM design.

5.1 Channel Modifications

The channel Modifications in this alternative vary between no action on portions of the existing channel, to a concrete lined rectangular channel with steel sheet pile floodwalls at the most extensive. Refer to Tables 7 through 15 in Attachment 3 for a detailed description of the Modifications that will be made in

each reach of the channels. For a typical cross section of each improvement type, refer to Plates 5 through 8.

5.2 Diversion Channel at Westminster Mall

The maximum Modifications alternative includes a diversion channel on the C02/C04 channel at Westminster mall. On Channel C04 just downstream of the existing Hoover Street crossing, a diversion channel will be added to funnel a portion of the flow away from the existing channel. The proposed alignment follows an abandoned railway alignment which passes under the 405 Highway with an existing underpass. Two underground box culverts will be installed along this length. At Edwards St., the diversion will turn south and continue under the centerline of Edwards Street, replacing and overlapping with existing storm drains. The diversion will confluence with the existing open channel at the intersection of Edwards St. and Bolsa Ave. For a detailed description of the diversion channel, refer to Alternative 3A in Attachment 5, Diversion at Westminster Mall. Refer to Figure 8 for a plan view of the Diversion.

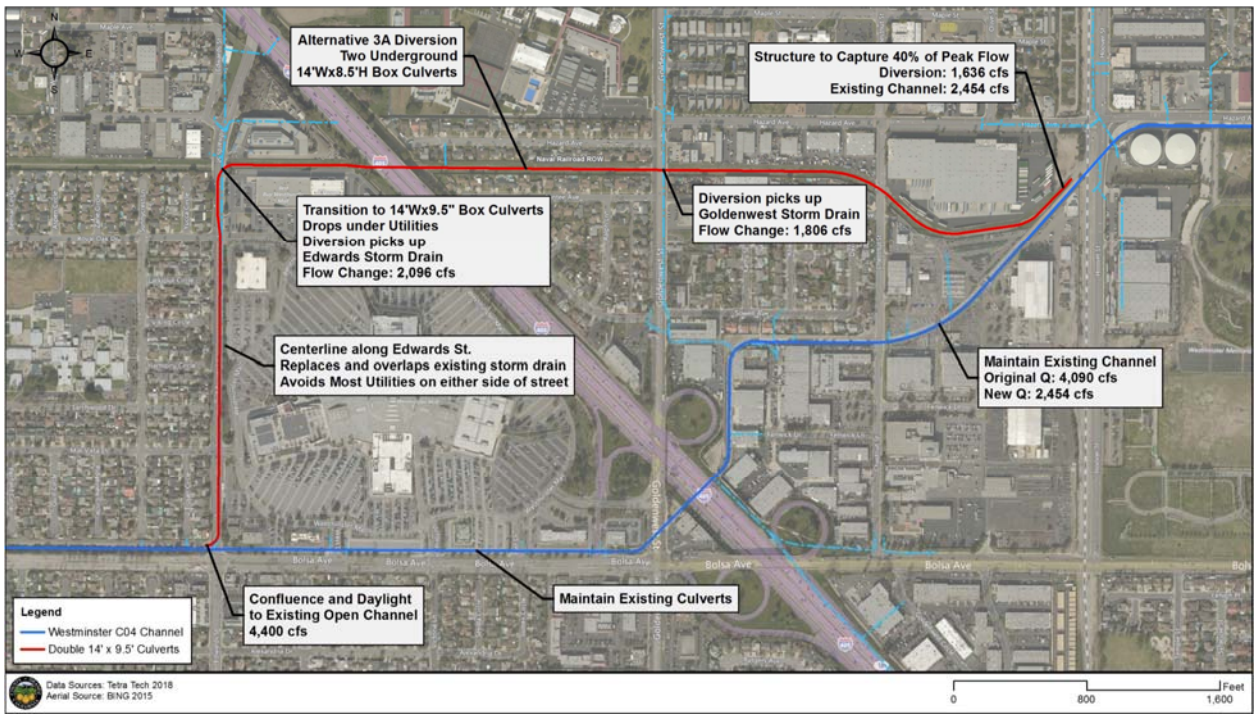

Figure 8: Westminster Mall Diversion

5.3 Downstream Modifications

Beyond the channel Modifications detailed above, this alternative will require some Modifications at the downstream end of the system. Based on the H&H modeling, the required Modifications include widening Warner Avenue Bridge, replacing the tide gates at the downstream end of the C05 Channel, and building a floodwall along the Pacific Coast Highway (PCH) at Outer Bolsa Bay. Refer to the Alternative 1 description above for a detailed description of what will be included in each of these Modifications.

6.0 Operation and Maintenance

Operation and Maintenance costs were developed based on historic annualized costs from Orange County Public Works for existing channel segments. A summary of the costs for each alternative and reach is

presented in the quantity calculation tables in Attachment 3. Operation and maintenance of the proposed project would be the responsibility of Orange County Flood Control District (OCFCD) and would include, but not limited to performing periodic inspections. Inspections would provide recommendations for maintenance including the following:

6.1 Vegetation Control

Active or passive establishment of vegetation on the earthen portions of the channels would attenuate erosion. However, vegetation maintenance may be required to ensure channel integrity. Structures to be maintained include the sides and bottom of channels, as well as access roads along the channels.

6.2 Rodent Control

Burrowing animals are capable of perforating channels with holes to the extent that the structural integrity of the channels may be jeopardized. To alleviate this problem, the rodent population should be kept under control by placing poison in the burrows. Rodent problems should be identified during the quarterly inspections.

6.3 Levee and Interior Drainage Structures Repair

In order to maintain the integrity of the levee and interior drainage structures, it is anticipated some repairs will be required after periods of significant flooding. This would include replacement of earth fill along eroded sections of the channel and interior drainage structures, repairs to gated outlets, and replacement of any damaged sections of soil cement, grouted/ungrouted riprap and gravel.

6.4 Sediment Removal

Removal of accumulated sediments in the vicinity of the channels will be required when it is determined there is a loss of channel capacity due to sediment build up.

Appendix B - Civil Engineering

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Appendix B - Civil Engineering

Attachment 1: Value Engineering Study

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of Engineers

VALUE ENGINEERING STUDY SUMMARY REPORT

WESTMINSTER, CALIFORNIA FLOOD RISK MANAGEMENT

PROJECT SPONSOR: LOS ANGELES DISTRICT

VALUE ENGINEERING TEAM STUDY

DOD SERVICE: USACE
VALUE ENGINEERING OFFICER: Arnecia Williams, AVS

Value Engineering Study on

WESTMINSTER, CALIFORNIA FLOOD RISK MANAGEMENT

Draft 25 September 2015
U.S. Army Engineer District, Los Angeles

VALUE ENGINEERING STUDY TEAM LEADER:

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Larry Walsh	Gary Goldman	Jim Starick

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3. Use a Floodwall on the Pacific Coast Highway 12

4. Convert All Trapezoidal Channels to Rectangular Concrete 15

5. Use Vinyl Sheet Pile for Floodwalls 18

6. Use Roller Compacted Concrete 21

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VALUE ENGINEERING TEAM STUDY

PROJECT DESCRIPTION AND BACKGROUND

PROJECT TITLE: WESTMINSTER, CALIFORNIA
FLOOD RISK MANAGEMENT

PROJECT LOCATION: WESTMINSTER, CALIFORNIA

The following was taken from the Report Synopsis for the
Westminster, East Garden Grove Flood Risk Management Study.

Study Authority. The study was authorized by a resolution adopted by the House of Representatives Committee on Public Works, dated 08 May 1964, which reads as follows:

> *"Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the reports on (a) San Gabriel River and Tributaries, published as House Document No. 838, 76th Congress, 3d Session; (b) Santa Ana River and Tributaries, published as House Document No. 135, 81st Congress, 1st Session; and (c) the project authorized by the Flood Control Act of 1936 for the protection of the metropolitan area in Orange County, with a view to determining the advisability of modification of the authorized projects in the interest of flood control and related purposes."*

Non-Federal Sponsor. The non-Federal sponsor is Orange County Public Works (OCPW). The Corps of Engineers and OCPW executed a feasibility cost sharing agreement (FCSA) in September 2003.

Study Area. The study area is contained within the Westminster Watershed in western Orange County, California. The watershed is approximately 74 square miles and lies on a flat coastal plain that is almost entirely urbanized. Cities in the watershed include Anaheim, Stanton, Cypress, Garden Grove, Westminster, Fountain Valley, Los Alamitos, Seal Beach, and Huntington Beach. The watershed is part of the former floodplain of the Santa Ana River (SAR) which historically meandered through out the existing watershed as far north as Anaheim Bay to as far south as Newport Bay. Channelization and large scale flood control improvements have constrained the Santa Ana River to the main stem channel on the eastern border of the Westminster Watershed. Figure 1 depicts the watershed boundary in orange, the Santa Ana River (SAR) in light blue, and the major drainage channels throughout the watershed in dark blue.

This Value Engineering Study was based on the information available during the development of the Feasibility Study. Please see the study referenced above for further information.

VALUE ENGINEERING TEAM STUDY

PROJECT DESCRIPTION AND BACKGROUND

PROJECT TITLE: WESTMINSTER, CALIFORNIA
FLOOD RISK MANAGEMENT

PROJECT LOCATION: WESTMINSTER, CALIFORNIA

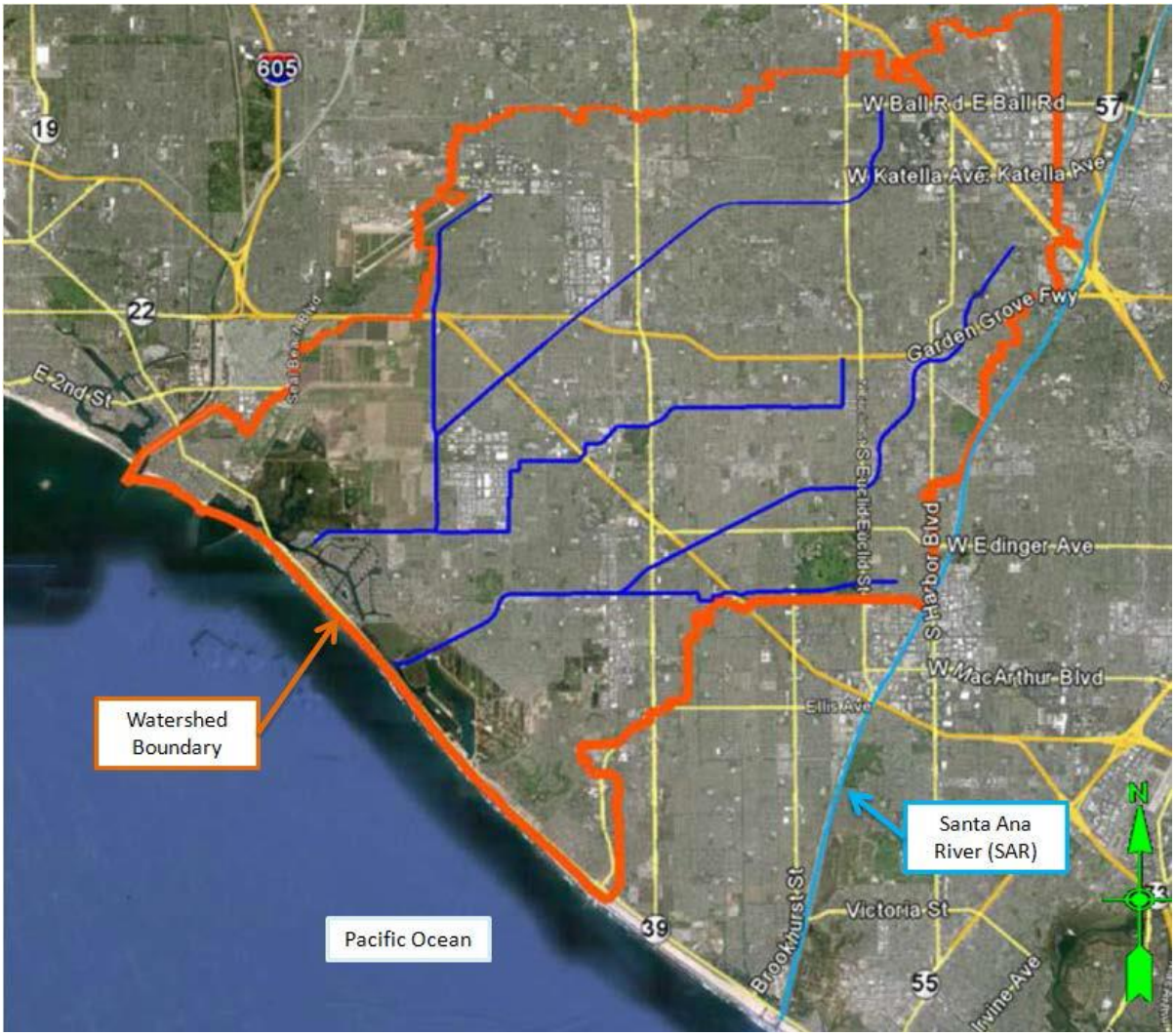


Figure 1

VALUE ENGINEERING TEAM STUDY
EXECUTIVE SUMMARY

Value Engineering is a process used to study the functions a project is to provide. As a result, it takes a critical look at how these functions are met and develops alternative ways to achieve the same function, while increasing the value of the project. In the end, it is hoped that the project will realize a reduction in cost, but adding value over reducing cost, is the focus of VE.

The Value Engineering Study was initiated during the week of 21 to 25 September 2015, at the Los Angeles District Office, in Los Angeles, California. The project was studied using the Corps of Engineers standard Value Engineering (VE) methodology, consisting of five phases:

Information Phase: The team studied drawings, figures, descriptions of project work, and cost estimates, to fully understand the work to be performed and the functions to be achieved. Cost Models were compared to determine areas of relative high cost, to ensure that the team focused on those parts of the project, which offered the most potential for cost savings. The team conducted a field trip to the site, accompanied by the local sponsor, to gain first-hand knowledge of the project.

Speculation Phase: The team speculated by conducting brainstorming sessions to generate ideas for alternative designs. All team members contributed ideas and critical analysis of the ideas was discouraged.

Analysis Phase: Evaluation, testing and critical analysis of all ideas generated during speculation was performed, to determine potential for savings and possibilities for risk. Ideas were ranked by priority for development. Ideas which did not survive critical analysis were deleted.

Development Phase: The priority ideas were developed into written proposals by VE team members during an intensive technical development session. Proposal descriptions, along with sketches, technical support documentation, and cost estimates were prepared to support implementation of ideas. Additional VE team comments were included for items of interest, which were not developed as proposals, and these comments follow the study proposals.

Presentation Phase: Presentation is a two step process. The published VE study report is distributed for review by project supporters and decision makers. A briefing is later conducted to decide which proposals merit implementation into project design. The summary of proposals follows on the next page.

VALUE ENGINEERING TEAM STUDY
SUMMARY OF PROPOSALS

Seventy-three ideas for ways to improve the project or reduce costs were generated during the speculation phase of this study. The analysis phase of the study reduced the number of ideas to twenty-six for development, of which seventeen ideas were designated as design comments, and are included in this report.

Of all the ideas from the analysis and development phases, nine ideas became proposals which, if accepted, can result in the savings shown below. Those that show a negative number, are value added proposals that increase cost while providing a benefit. Note: Each Proposal is based on a stand-alone implementation, and the current design and cost data.

PROPOSAL NO.	DESCRIPTION	SAVINGS
1.	Breach Levee (C05) Adjacent to the Muted Tidal Pocket	-$2,596,000
2.	Construct Weir in Levee (C05) Adjacent to Muted Tidal Pond	-$42,000
3.	Use a Floodwall on the Pacific Coast Highway	-$7,901,000
4.	Convert All Trapezoidal Channels to Rectangular Concrete	-$26,332,000
5.	Use Vinyl Sheet Pile for Floodwalls Note: Savings is for an Assumed Quantity per Station	$10,000
6.	Use Roller Compacted Concrete Note: Savings is for an Assumed Quantity per Station	$261,000
7.	Offset Pier Wall Debris Noses from Bridge Openings	$19,466,000
8.	Add Culverts adjacent to Warner Avenue Bridge	$20,386,000
9.	Use Con/Span Bridges in Lieu of Cast-In-Place Bridge Construction Note: Savings Shown is for a Single Typical Bridge	$39,000

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 1 PAGE NO: 1 OF 2
DESCRIPTION: Breach Levee (C05) Adjacent to the Muted Tidal Pocket

ORIGINAL DESIGN:

Currently, the levee is earthen with rock riprap slope protection and a crushed aggregate base (CMB) driving surface. Tide gates allow flows to pass through the levee between the channel and the Muted Tidal Pocket. The total length of the levee adjacent to the Muted Tidal Pocket is approximately 3,000 feet.

PROPOSED DESIGN:

Breach or remove the west levee to allow flows from C05 to enter the Muted Tidal Pocket. This allows flows to continuously mingle in the basin. The length of the levee that would be removed is approximately 3000 feet.

ADVANTAGES:

- Removing the levee eliminates the need for maintenance of the levee.
- Allows for continuous mixing of tidal (saltwater) and channel flows (fresh water).
- May decrease storm peak discharges for all events due to attenuation of peaks as a result of increasing storage volume.
- Increases flushing of the tidal waters.
- Flow velocity reduction due to increased wetted perimeter through the area.

DISADVANTAGES:

- Allows increased influence of debris and pollutants from the C05 channel into the tidal pocket.
- May alter type of habitat in the Muted Tidal Pocket. This would require a biologist to determine impacts of this proposal.
- May result in additional sediment deposition due to reduced flow velocities. Flow velocities will decrease due to increase flow section and adjacent ponded areas.

JUSTIFICATION:

Removing the levee would eliminate levee maintenance and promote flushing of the tidal area by both channel flows and tidal flows. Continuous mixing of flows may promote enhanced habitat, both aquatic and avian.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 1 PAGE NO: 2 OF 2

COST ESTIMATE WORKSHEET				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$0
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Remove Rock Riprap	CY	7,450	$100.00	$745,000
Remove Earth Levee	CY	122,200	$10.00	$1,222,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$1,967,000
		Net Cost Decrease		-$1,967,000
		Mark-ups	32.00%	-$629,440
		Total Cost Decrease		-$2,596,440

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 2 PAGE NO: 1 OF 2
DESCRIPTION: Construct Weir in Levee (C05) Adjacent to Muted Tidal Pond

ORIGINAL DESIGN:

Currently, the levee is earthen with rock riprap slope protection and a crushed aggregate base (CMB) driving surface. Tide gates allow flows to pass through the levee between the channel and the Muted Tidal Pocket. The total length of the levee adjacent to the Muted Tidal Pocket is approximately 3,000 feet.

PROPOSED DESIGN:

Construct a weir in the west levee to allow flows from C05 to enter the Muted Tidal Pocket. This allows flows to mingle in the basin. The length of the proposed weir is approximately 100 feet. Actual length will depend on design parameters. A weir would allow only larger storm flows to enter the Muted Tidal Pocket. The design height of the weir could be adjusted to increase or decrease the frequency of the flows entering the tidal area from the channel. Low flows, first flush discharges, dry weather flows and sediment would bypass the weir and flow directly to the Outer Bolsa Bay.

ADVANTAGES:

- Allows for increased mixing of tidal (saltwater) and channel flows (fresh water) during larger storm events.
- Increases flushing of the tidal waters during larger storm events.
- May decrease storm peak discharges due to attenuation of peaks as a result of increased storage volume.

DISADVANTAGES:

- Allows increased influence of debris and pollutants from the C05 channel into the tidal pocket.
- May alter type of habitat in the Muted Tidal Pocket. This would require a biological assessment to determine the impacts of this proposal.
- May result in additional sediment deposition in the channel area due to reduced flow velocities. Flow velocities will decrease due to flow reduction as flows split over the weir.

JUSTIFICATION:

Constructing a weir in the west levee of the C05 channel will promote flushing of the tidal area by both channel flows and tidal flows. Increased mixing of flows may promote enhanced habitat, both aquatic and avian.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 2 PAGE NO: 2 OF 2

COST ESTIMATE WORKSHEET				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$0
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Remove riprap	CY	124	$100.00	$12,400
Excavate Weir	CY	465	$10.00	$4,650
Concrete line weir	CY	30	$500.00	$15,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$32,050
		Net Cost Decrease		-$32,050
		Mark-ups	32.00%	-$10,256
		Total Cost Decrease		-$42,306

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 3 PAGE NO: 1 OF 3
DESCRIPTION: Use a Floodwall on the Pacific Coast Highway

ORIGINAL DESIGN:

The CO5 East Garden Grove Wintersburg Channel and CO6 Ocean View Channel both exit into the Bolsa Chica Ecological Reserve and the waters flow north. This area is located adjacent to the Pacific Coast Highway, which has varying elevations as low as 5' above sea level.

PROPOSED DESIGN:

With the potential of large amounts of water flowing from the CO5 and CO6 channels, pouring into the Bolsa Chica Ecological Reserve, we are proposing using the area to the north of this channel as a flood basin. This would require installing a seawall along the Pacific Coast Highway to the north of the channel, until it reaches the Warner Avenue Bridge.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 3 PAGE NO: 2 OF 3

DISADVANTAGES:

- Increase water capacity for flood area.
- Protect Pacific Coast Highway from potential flooding.

DISADVANTAGES:

- Interruption of natural habitat.

JUSTIFICATION:

Adding a seawall perpendicular to the Pacific Coast Highway would significantly increase the capacity for a flood basin.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 3 PAGE NO: 3 OF 3

COST ESTIMATE WORKSHEET				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$0
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
				$0
Dewatering	LF	5,000	$32.00	$160,000
Temporary Shoring	LF	5,000	$600.00	$3,000,000
Excavation of earth materials	CY	5,833	$3.00	$17,499
CIP Concrete Footings with Forms & Reinforcing	CY	2,500	$691.00	$1,727,500
CIP Concrete Walls with Forms & Reinforcing	CY	1,297	$833.00	$1,080,401
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$5,985,400
		Net Cost Decrease		-$5,985,400
		Mark-ups	32.00%	-$1,915,328
		Total Cost Decrease		-$7,900,728

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 4 PAGE NO: 1 OF 3
DESCRIPTION: Convert All Trapezoidal Channels to Rectangular Concrete

ORIGINAL DESIGN:

Within the Westminster Watershed, there are drainage channels ranging in size, materials, and shapes. A portion of these channels have trapezoidal side wall shapes with varying angles which rise back up to ground level elevations.

PROPOSED DESIGN:

The proposed design takes into consideration of building all channel sidewalls into a ninety degree wall design. These walls would be constructed of cast in place concrete using temporary shoring.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 4 PAGE NO: 2 OF 3

DESCRIPTION:

ADVANTAGES:

- Increase the hydraulics of the watershed.
- Low maintenance.
- Longevity of channel concrete walls vs natural or rip rap sidewalls.

DISADVANTAGES:

- None known

JUSTIFICATION:

There are many advantages to building all the channel sidewalls, as vertical members, creating a rectangular section as is shown above. Not only will the hydraulic capacities increase, but the concrete construction will have a lifespan that will last longer. By using this method, in channel storage will increase. The team proposes that, if work is to be conducted in a reach, that the maximum section be used as shown. This will maximize the conveyance in these reaches, which may preclude an enlargement in the future.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 4 PAGE NO: 3 OF 3

COST ESTIMATE WORKSHEET				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Reach 1 Channel Lining	LS	1	$4,588,632.00	$4,588,632
Reach 13 Channel Lining	LS	1	$13,640,183.57	$13,640,184
Reach 17 Channel Lining	LS	1	$6,609,213.09	$6,609,213
Reach 18 Channel Lining	LS	1	$7,838,584.19	$7,838,584
Reach 19 Channel Lining	LS	1	$3,430,265.53	$3,430,266
Reach 22 Channel Lining	LS	1	$8,311,807.00	$8,311,807
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$44,418,685
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Demo Concrete Walls	CY	4216	$181.00	$763,096
Demo Rip Rap Walls	CY	11264	$75.00	$844,800
Dewatering	LF	38,000	$32.00	$1,216,000
Temporary Shoring	LF	38,000	$950.00	$36,100,000
Excavation & Removal of Existing Soil	CY	85,150	$3.00	$255,450
Continious Strip Footing incl. Reinforcing & Forms	CY	17,790	$691.00	$12,292,890
CIP concrete Walls incl. Reinforcing & Forms	CY	15,480	$833.00	$12,894,840
				$0
				$0
				$0
				$0
				$0
		Total Additions		$64,367,076
		Net Cost Decrease		-$19,948,391
		Mark-ups	32.00%	-$6,383,485
		Total Cost Decrease		-$26,331,876

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 5 PAGE NO: 1 OF 3
DESCRIPTION: Use Vinyl Sheet Pile for Floodwalls

ORIGINAL DESIGN:

Materials used for the construction of floodwalls along the channels include steel sheet pile and concrete piles.

PROPOSED DESIGN:

In areas along the channels, particularly those influenced by the marine environment, the use of vinyl sheet piles is a good alternative to steel and concrete. Areas in direct contact with saltwater and those within a range of approximately 3 miles of the furthest extent of the saltwater advance, may benefit from the use of vinyl sheet piles. Vinyl is very resistant to corrosion. In areas where fine sediments deposit, sheet piles can be vibrated into place, as opposed to driven into place. This reduces noise, the need to excavate for the below grade support sections, and special equipment for driving the piles. Soil conditions dictate type of driving equipment. Hard driving requires a steel mandrel template to be used in conjunction with an impact hammer or vibratory hammer. Soft driving such as sand or in water requires only a vibratory hammer. Cost Savings have been documented to be substantial when compared to steel. Due to the lightweight of sheets, the installation rate can be accelerated. Offload and alignment by heavy equipment can be eliminated. Steel requires each side of the sheet to be painted (Cold tar-epoxy) for extended life. Also, a routine cathodic protection (electric charge to reduce corrosion) maintenance of sheets is eliminated.

ADVANTAGES:

- Resist corrosion
- Reduces maintenance and replacement due to corrosion
- Long service life
- No time delay for curing as in concrete prior to backfilling
- Generally less expensive than concrete or steel
- Increased rate of installation

DISADVANTAGES:

- Reduced strength.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 5 PAGE NO: 2 OF 3

JUSTIFICATION:

The performance of vinyl sheet piles in a marine environment is superior to concrete or steel. Vinyl sheet piles are interlocking and can be driven or vibrated into place. If determined to be structurally feasible there are cost savings when compared to concrete or steel piles. The lightweight of the product can save, in both equipment cost and rate of installation. The picture below is an example of a vinyl sheet pile wall.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 5 PAGE NO: 3 OF 3

COST ESTIMATE WORKSHEET				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Steel Sheet Pile Wall	SF	1,500	$35.00	$52,500
				$0
Assumes 15 Foot Sheet Pile Length				$0
12 Feet Imbedded and 3 Feet Exposed				$0
For Illistration 100 Feet of Wall is Used				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$52,500
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Vinyl sheet piles	SF	1,500	$30.00	$45,000
				$0
Assumes 15 Foot Sheet Pile Length				$0
12 Feet Imbedded and 3 Feet Exposed				$0
For Illistration 100 Feet of Wall is Used				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$45,000
		Net Cost Decrease		$7,500
		Mark-ups	32.00%	$2,400
		Total Cost Decrease		$9,900

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 6 PAGE NO: 1 OF 3
DESCRIPTION: Use Roller Compacted Concrete

ORIGINAL DESIGN:

The current design is a trapezoidal channel in some locations constructed of cast in place reinforced concrete.

PROPOSED DESIGN:

The proposed design would use a full or partial roller compacted concrete section to construct this feature.

ADVANTAGES:

- Simplifies construction.
- Less cost.

DISADVANTAGES:

- Not easily constructed in a restricted channel.
- Room for construction equipment.

JUSTIFICATION:

Roller compacted concrete provides an economical method for placing mass concrete. If all or part of the u frame structure could be placed using RCC, significant cost savings could be achieved. The cost savings shown, is for 100 feet of channel.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 6 PAGE NO: 2 OF 3

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 6 PAGE NO: 3 OF 3

COST ESTIMATE WORKSHEET				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Concrete Trapizoidal Channel	FT	100	$3,400.00	$340,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$340,000
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Roller Compacted Trapezoidal Channel	FT	100	$1,422.00	$142,200
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$142,200
		Net Cost Decrease		$197,800
		Mark-ups	32.00%	$63,296
		Total Cost Decrease		$261,096

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 7 PAGE NO: 1 OF 3
DESCRIPTION: Offset Pier Wall Debris Noses from Bridge Openings

ORIGINAL DESIGN:

The existing bridges have a variety of debris noses on the piers. It is anticipated that the debris noses will be protected, or replicated in the final design.

PROPOSED DESIGN:

The proposed design would extend the pier walls upstream into the channel and construct debris noses further from the bridge entrances. The design would use the conventional debris nose design, but separate the debris from the bridge opening.

ADVANTAGES:

- Improve hydraulic efficiency of the bridges.
- Avoid replacing existing bridges.
- Minimize traffic disruptions.
- Reduce duration of construction in channels.

DISADVANTAGES:

- Lengthening the pier walls to move the debris noses further upstream will add additional maintenance requirements.
- The debris noses will be further from the bridges, and somewhat more difficult to view from the roads
- These added concrete surfaces will also be a common target for vandalism and graffiti, causing additional maintenance.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 7 PAGE NO: 2 OF 3

JUSTIFICATION:

The advantages of this proposal are principally related to the channel/bridge hydraulics. As the debris collects on the pier walls, it restricts the bridge openings and reduces the capacity of the bridges. Although the debris noses already extend into the upstream channel, in high flow situations the constriction due to debris, flow disturbances due to the accumulated debris, and natural vena contracta of the bridge can combine to further reduce the capacity of the bridge crossing.

Extending the pier walls and debris noses further from the bridge openings, it is possible to separate the debris constriction away from the bridge opening. In the baseline study, the channels are running at a bank-full condition and the bridges will likely operate in pressure flow. Separating the pier/debris vena contracta from the bridge soffit vena contracta will improve the performance of the bridge entrances.

By retrofitting the existing bridges with improved debris noses, the existing bridge structures may be sufficient to pass the flow rates without requiring replacement and associated traffic disruptions.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 7 PAGE NO: 3 OF 3

COST ESTIMATE WORKSHEET				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Remove Existing Local Bridge	EA	10	$133,200.00	$1,332,000
Construct New Local Bridge	EA	10	$1,367,500.00	$13,675,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$15,007,000
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Construct Offset Debris Noses at Bridge	EA	10	$27,500.00	$275,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$275,000
		Net Cost Decrease		$14,732,000
		Mark-ups	32.00%	$4,714,240
		Total Cost Decrease		$19,446,240

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 8 PAGE NO: 1 OF 3
DESCRIPTION: Add Culverts adjacent to Warner Avenue Bridge

ORIGINAL DESIGN:

The baseline study requires either a widening of the channel and reconstruction of the Warner Avenue Bridge, or a new ocean outfall to provide additional capacity for the C05 outlet.

PROPOSED DESIGN:

This proposal involves supplementing the existing Warner Avenue Bridge hydraulic capacity with a large multi-cell box culvert that traverses the existing constriction into Huntington Harbor and outlets into the harbor.

ADVANTAGES:

- Protects existing Pedestrian Bridge near Warner Avenue.
- Eliminates reconstruction of deep foundations for bridges.
- Reduces amount of work within/over the waterbody.
- Lowers traffic impacts verses a bridge construction.
- The constant tidal influence will prevent sediment accumulation in the box culvert.

DISADVANTAGES:

- The principal disadvantage to this proposal is the difficulty of inspecting the submerged invert of a culvert and the maintenance in this situation.

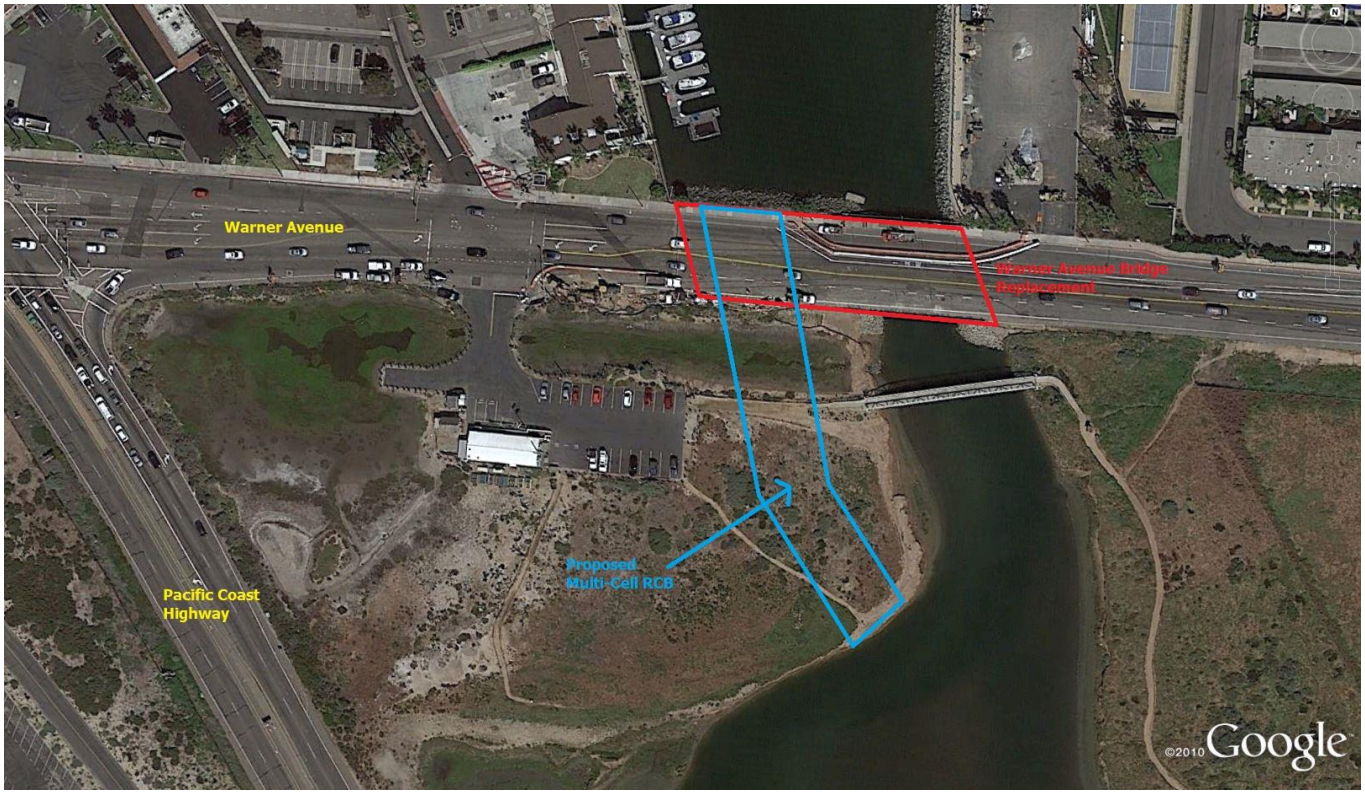
VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 8 PAGE NO: 2 OF 3

JUSTIFICATION:

Using a multi-cell box culvert improves the operation of the C05 outfall without causing adverse impacts to the local community, traffic, and recreational area. The box culvert preserves the existing pedestrian bridge. A widened channel and bridge would most likely combine the pedestrian access into a street-adjacent access, thereby reducing the pedestrian access to the Bolsa Chica Ecological Preserve Trail System. If a pedestrian bridge is mandated under a future proposal, the pedestrian bridge will be longer to span the widened channel.

The traffic disruptions associated with a bridge removal and reconstruction have a longer duration and are much more impactful than a box culvert. It is possible to construct this culvert using a temporary detour road that would permit Warner Avenue to remain open during construction with little loss of capacity. It is unlikely that the bridge can be extended without lengthy closures of Warner Avenue.



VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 8 PAGE NO: 3 OF 3

COST ESTIMATE WORKSHEET				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Remove Existing 135'x85' Bridge	EA	1	$504,900.00	$504,900
Remove Existing 150'x16' Ped Bridge	EA	1	$105,600.00	$105,600
Construct New 300'x85' Bridge	EA	1	$16,957,500.00	$16,957,500
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$17,568,000
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Construct 4-9' Rise x 12' Span RCB	LF	450	$4,720.00	$2,124,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$2,124,000
		Net Cost Decrease		$15,444,000
		Mark-ups	32.00%	$4,942,080
		Total Cost Decrease		$20,386,080

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 9 PAGE NO: 1 OF 3
DESCRIPTION: Use Con/Span Bridges in Lieu of Cast-In-Place Bridge Construction

ORIGINAL DESIGN:

The present design calls for constructing a number of bridges throughout the proposed improvement area. These bridges are predominantly of the cast-in-place reinforced concrete construction type.

PROPOSED DESIGN:

The proposed design calls for constructing the bridges using precast reinforced concrete arches produced by Con/Span®. These bridges generally rest on a cast-in-place concrete footer, and may have either precast or cast in place wing walls and headwalls. Arch sections are lowered onto the footing and connected segmentally, followed by wing wall and headwall construction. Because data are not currently available for which spans are proposed to be replaced, a typical representation is presented in this proposal for a 40 foot x 40 foot bridge crossing.

ADVANTAGES:

- Formwork not required for construction of arch.
- Curing time not required for arch section.
- Where span length can eliminate construction of intermediate bents, hydraulic performance can be improved.
- Reduced debris accumulation.
- Generally rapid construction process reduces traffic impacts.
- Aesthetically appealing versus typical cast in place bridges.

DISADVANTAGES:

- Possible lack of local contractor experience, although Con/Span lists 85 existing installations of roadways over waterways in California.
- Will likely require pile foundation support similar to cast-in-place bridges.
- Limited to sizes available from manufacturer.
- Seismic performance will need to be verified.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 9 PAGE NO: 2 OF 3

JUSTIFICATION:

Construction of short span bridges may be simpler using the Con/Span precast arch design rather than cast-in-place bridges. Con/Span requires fewer steps to construct, resulting in savings of time, cost, and impacts to existing roadways. The cost to the public will be minimized by reducing the roadway's out-of-service time. Clear-spanning the waterway improves hydraulic performance versus using intermediate bents and columns. Proprietary design software, and additional detailed information is available at

www.con-span.com and local contacts are available at http://www.conteches.com/Connect/Local-Resources/States/California.

Typical Con/Span Installation

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 9 PAGE NO: 3 OF 3

COST ESTIMATE WORKSHEET

DELETIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Cast-in-place concrete bridges	SF	1,600	$175.00	$280,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$280,000

STRUCTURAL SECTION	(STR. DEPTH / MAX SPAN) SIMPLE	CONTINUOUS	COMMON SPAN RANGE (feet)	* COST RANGE (price/sqft)	REMARKS
RC SLAB	0.06	0.045	16 - 44	90 - 200	CAST-IN -PLACE CONCRETE BRIDGES ACCOUNT FOR APPROXIMATELY 65% OF BRIDGES BUILT ON CALIFORNIA STATE HIGHWAYS
RC T-BEAM	0.07	0.065	40 - 60	155 - 250	
RC BOX	0.06	0.055	50 - 120	160 - 250	
CIP/PS SLAB	0.03	0.03	40 - 65	115 - 200	
CIP/PS BOX	0.045	0.04	100 - 250	110 -315	

ADDITIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Concrete arch with wingwalls	SF	1,600	$75.00	$120,000
Additional earthwork	SF	1,600	$1.00	$1,600
Additional road materials (base, asphalt)	SF	1,600	$2.50	$4,000
Labor	SF	1,600	$78.00	$124,800
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$250,400
		Net Cost Decrease		$29,600
		Mark-ups	32.00%	$9,472
		Total Cost Decrease		$39,072

VALUE ENGINEERING COMMENTS

1. ***Employ Interconnection Channels within the Watershed.*** To accommodate non-uniform rainfall patterns (i.e. storm centering) within the watershed, it is suggested that construction of interconnecting channels between the extant regional channels to allow for flow demand/capacity balancing, could be considered.

2. ***Construct a Diversion Channel from C05 to an Alternate Location/Outfall.*** Although this comment was already studied in one location in the baseline report, the opportunity to divert flow from the C05 system warrants further investigation. Three alternatives appear to be possible. First, reevaluate the possibility of a diversion to the Santa Ana River. Second, investigate an alignment that will permit a C05 diversion to outlet at the existing ocean outfall along the south side of the Bolsa Chica Ecological Reserve. Third, assess the possibility of constructing a diversion under Springdale Street from C05 to the Seasonal Pond area within the Bolsa Chica Ecological Reserve.

3. ***Close the Oil Operations and Use the Area for Flood Control***. Within the Westminster Watershed, lies a large area that includes oil pumps for oil extraction from the earth. We are suggesting that a further investigation with the agency in charge of the oil pumps could conducted. This would involve closing down the oil pumps, ceasing operations, and developing the land for future flood control. This would require removing the oil pumps, the foundations they reside on & all the underground plumbing/electrical associated with each. A direct result of this operation would be that no further oil pumping in the area would occur while reserving the area for flood control.

4. **Improve the Protection Around the Oil Wells and Use the Area for Flood Control**. In order to keep the oil pumps in operation and not hinder any oil extraction, we are suggesting doing further research to provide protection around the current oil pumps. After contacting the agency to gain approval for this idea, it is suggested that engineering a barrier system to withstand any penetrating water from reaching the oil pumps, would then implemented. Proceeding with this action would appease the agency that owns the oil pumps, as operations would have minimal interruption while providing land for future flood control.

5. ***Raise the Oil Wells and Use the Area for Flood Control.*** The oil wells currently sit at a low elevation. Opening up this area for allowing flood waters would require the existing oil wells to be raised up from their current height. In doing so, this would require the oil wells to temporarily cease operations while the current foundations are built up and prepared for potential flood waters to occupy the space. This item should be considered if there is a constraint of flooding space not available elsewhere in the flood basin, and it is more cost effective, versus building barriers around each oil pump.

VALUE ENGINEERING COMMENTS

6. ***Reprofile The Channel To Use Super Critical Flow Under Bridges.*** Re-profiling the channel involves re-constructing the channel invert. It may not be possible to achieve supercritical flow through the bridges, given the minimal fall along the channel. However, increasing the channel slope may still increase the hydraulic efficiency through the bridges. The opportunities for steepening the channel at the bridges would be on a case-by-case basis. This may preclude replacement of some bridges

7. ***Consider Precast/Prestressed Warner Bridge.*** Using precast concrete bridge sections reduces the construction time, over cast-in-place sections. The use of precast concrete requires sections to be transported by truck to the site. Prestressing and/or post-tensioning the slab may allow more structurally efficient deck sections that minimize the bridge deck profile, thereby reducing the length of the bridge approaches.

8. ***Replace the Bridges With Precast Single Span Structures.*** During the field trip to the location, the team discussed, and saw the debris load on the bridges. It is suggested, that maximum length precast concrete members be used for new bridge construction. This should help minimize maintenance.

9. ***Use Underground Detention In Mile Square Park.*** To preserve the full park for public use, consider using underground detention chambers (i.e. Stormtech MC-4500) in lieu of surface storage. A diversion could be constructed from the C05 channel to the park in Ward Street. The underground structures can be constructed under all three of the golf courses, utilizing fairways and rough, while preserving the existing tee and green complex. The underground detention water could be retained, treated, and reused for irrigation, or directed to a deep infiltration drywell. The basic MC-4500 chamber can store approximately 4.5 cubic feet of water per square foot of installed chamber and stone. To maximize the flood control benefit, the C05 diversion structure should be configured to intercept the storm hydrograph peak only, thereby reducing the largest flow rates that comprise the smaller fraction of the total hydrograph. In addition to the flood control benefits, the use of an idea that retains and reuses, or infiltrates the runoff instead of flushing directly to the ocean, would generate public goodwill and conform to Governor Brown's Executive Order B-29-15 regarding storm water capture.

VALUE ENGINEERING COMMENTS

10. ***Regrade Mile Square Park for High Ground and Lakes.*** The Ocean View Channel (CO6) flows through Mile Square Park (MSP) en route west to the Pacific Ocean. CO5 runs nearby, but just north of MSP. This idea considers excavating a large portion of the southern end of MSP and placing the fill on the northern portion of MSP. The deepened southern section would then serve as a detention basin capable of smoothing the flow anticipated in downstream portions of CO5 and CO6. A diversion channel would connect CO5 southward to MSP. This may eliminate the need for various flow-rate improvements downstream, however the plan may meet political resistance. Additionally, consideration should be given to the potential impacts to existing nearby structures. Historical groundwater depth measurements in this area measure 15 feet deep and sometimes as little as 12 feet deep. This may be a cost effective solution considering the potential elimination of downstream improvements. Potential Best Management Practice benefits of infiltration basin design may be realized.

11. ***Improve the Crossings of the 405 at C04, C05 and C06 in Conjunction with the OCTA I-405 Design Build Project.*** OCTA is finalizing the I-405 widening preliminary engineering phase. As a component of the upcoming work, OCTA will need additional easements to widen over these channels. As a condition of approval, OCPW could request that these channel crossings be improved and incorporated into the OCTA project. Traffic staging and construction would be feasible because it would be a component of a larger project.

12. ***Improve Or Remove The Tide Gates, And Use Tideflex Gates Where Practical.*** There are currently a set of steel flap gates, that were reported to be marginally operable. Consideration could be given to replacing these with Tideflex Gates. Based on location and head, they should provide superior performance.

VALUE ENGINEERING COMMENTS

13. ***Recess Flap Gates into the Channels, and Modify the Existing Ones that Protrude.*** The current project has several flap gates. Some of these are recessed, and some protrude into the channel. For new construction it is suggested that the flap gates be recessed into the channel walls to protect them from debris from high flows. The existing flap gates that protrude could be recessed as an improvement.

14. ***Enclose Channels where Possible and Use for Maintenance Roads.*** In areas where a rectangular section is used, concrete box could be constructed. Then a layer of soil could be added to make an open area for maintenance activities.

15. ***Enclose Channels Where Possible and Use For Parks.*** The area over the box described above could also be used for parks and recreation.

16. ***Work From Downstream To Upstream.*** The work of increasing the hydraulic capacity within the channels should proceed from the downstream reaches to the upstream reaches. Increasing conveyance capacity in the upstream reaches while the downstream reaches remain deficient, provides only marginal local conveyance benefits. Because the flow regime in the channels is generally subcritical, the channel hydraulics are controlled by the downstream sections. Therefore, enhancing the downstream channel hydraulics can provide hydraulic benefits for unimproved reaches upstream.

17. ***Use All Hot Roll Sheet Pile.*** During the speculation phase, the team considered alternate sheet pile types other than vinyl. The use of cold rolled sections, and other materials were considered by the tea, however they are not recommended.

SUPPORTING DOCUMENTS

VALUE ENGINEERING TEAM STUDY

APPENDIX A:

CONTACT DIRECTORY

VALUE ENGINEERING TEAM STUDY
APPENDIX A: CONTACT DIRECTORY & VE STUDY TEAM MEMBERS

Value Engineering Study Team
Westminster Flood Risk Management Project
September 21-25, 2015

	Name	Discipline	Phone	Email
1	Ronald Burkhard	CVS/VE Facilitator	843-860-3549	burkhardvalue@hotmail.com
2	Arnecia Williams	VEO	213-452-3747	Arnecia.N.Williams@usace.army.mil
3	Steve Giffen	Civil Engineer/Sedimentation Specialist	949-372-3433	sgiffen@mbakerintl.com
4	Larry Walsh	Planner	213-452-3804	lawence.F.Walsh@usace.army.mil
5	Gary Goldman	Geotechnical Engineer	714-730-2320	Gary.Goldman@hdrinc.com
6	Brad Losey	Hydraulics	714-404-6721	blosey@mbakerintl.com
7	Kevin Goryance	Cost Consultant	703-676-3340	kgoryance@pmsimail.com
8	Ron Gaut	OCPW Design Division	714-647-3983	Ron.Gaut@ocpw.ocgov.com
9	Phil Jones	OCPW Design Division Manager	714-647-3977	
10	Robert McLean	OCPW Design Division	714-647-3951	
11	Gonzalo Galvan	SPL Structual Engineer	213-452-3697	Gonzalo.galvan@usace.army.mil
12	Walter David	SPL Real Estate	213-452-3160	Walter.Davis@usace.army.mil
13	David Silvertooth	SPL Hydrualic Engineer	213-452-3569	david.l.silvertooth@usace.army.mil
14	Jim Starick	HDRINC Geotechnical Engineer	714-296-2891	Jim.Starick@HDRINC.com

VALUE ENGINEERING TEAM STUDY

APPENDIX B:

SPECULATION LIST

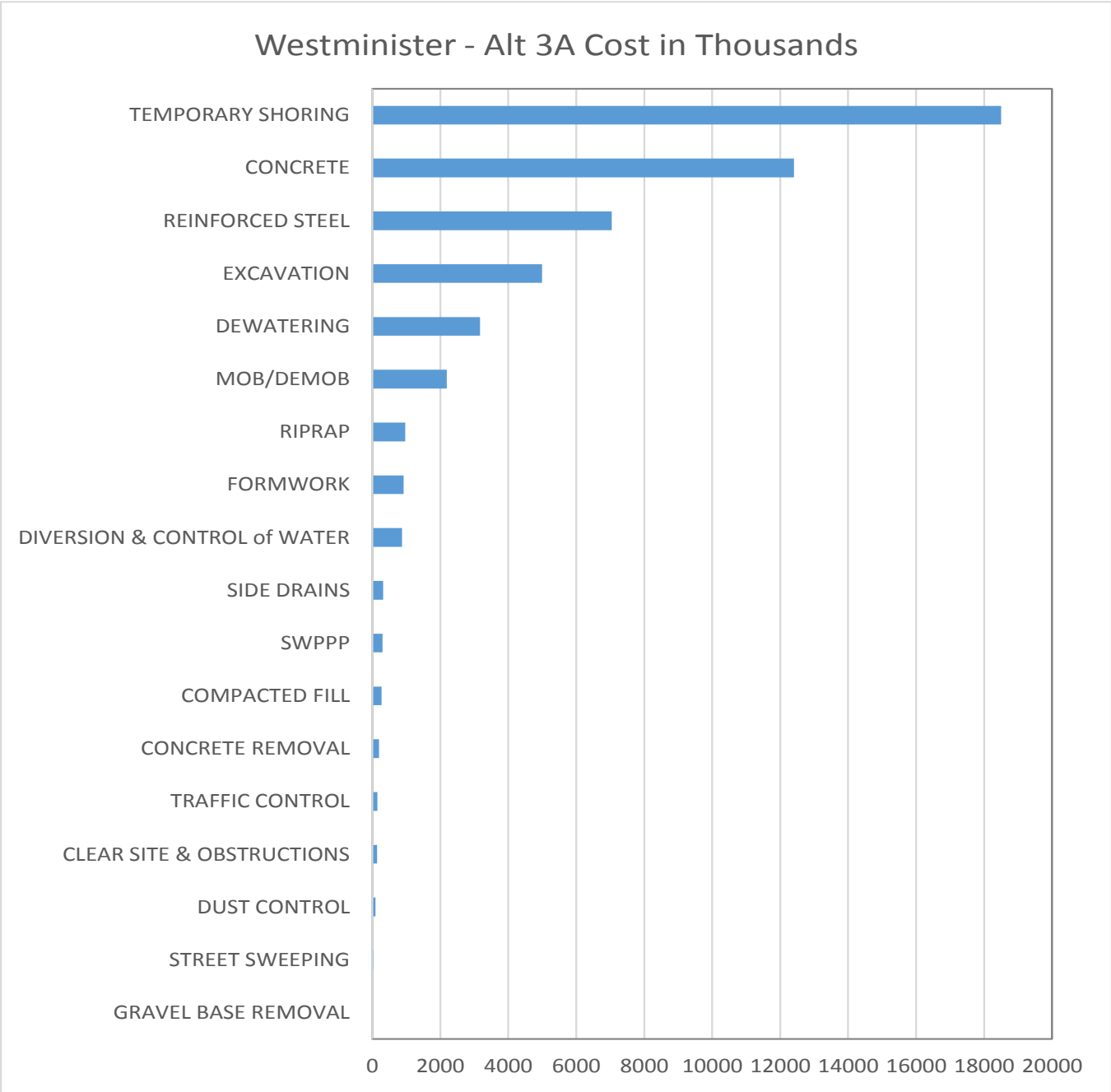
C		Comment
P		Proposal
X		Deleted
BD		Being done
C	1	Run a diversion channel from C05 to the seasonal ponds
C	2	Create a diversion channel to the Santa Ana River
BD	3	Increase capacity and optimize the operation of the Haster basin
C	4	Use interconnectivity channels
C	5	Close the oil operations and use the area for flood control
C	6	Improve the protection around the oil wells and use the area for flood control
C	7	Raise the oil wells and use the area for flood control
P	8	Breach the levee into the muted tidal pocket
P	9	Add a side weir into the muted tidal pocket
X	10	Local runoff reduction in the water shed
X	11	Consider deep injection wells
P	12	Use a floodwall on the pacific coast highway
P	13	Convert all trapezoidal channels to rectangular concrete
P	14	Use vinyl flood walls
X	15	Pump ground water into a deeper section
X	16	Use cold roll steel sheet pile
P	17	Use roller compacted concrete slopes
C	18	Reprofile the channel to use super critical flow under bridges
BD	19	Reconfigure and optimize tidal basin
X	20	Consider partial or total buy out of properties
X	21	Consider a new park based on buy out of properties
P	22	Offset debris noses from bridge piers
X	23	Consider bascule bridges
X	24	Consider bascule bridge for Warner Avenue
C	25	Consider precast prestressed Warner bridge
X	26	Remove the western basin levee
X	27	Use soil cement for levees
C	28	Replace the bridges with precast single span structures
X	29	Reduce the maintenance width to 10 feet
X	30	Use an in channel maintenance corridor in selected areas
X	31	Add a buried weed barrior
X	32	Remove the instream habitat
X	33	Use pavers for bank erosion protection
X	34	Use articulated mats for erosion protection

X	35	Use geogrid for erosion protection
X	36	Use a chocolate bayou type bank protection
X	37	Revisit the stone gradation
X	38	Use a rockometer
P	39	Add a second culvert adjacent to the Warner ave bridge
X	40	Use precast u frame sections
P	41	Use conspan for future bridges
C	42	Use underground detention in mile square park
C	43	Regrade mile square park for high ground and lakes
X	44	Use the meadow lark golf course for a detention area
X	45	Minimize the use of concrete based on velocity
X	46	Consider use of grouted rip rap
X	47	Create an additional crossing of warner avenue
X	48	Remove the Warner avenue obstruction completely
X	49	Use the cemetery for detention
X	50	Raise the roadways to increase capacity
C	51	Improve the crossings of the 405 at CO4, C05 and C06 in conjunction with OCTA 405 design build
X	52	Use a blanket contract with option pieces
X	53	Use a incremental performance contract
X	54	Create an emergency overflow/spillway at PCH
X	55	Add an emergency notification system
X	56	Use last chance lines upstream of bridges
C	57	Improve or remove the tide gates
C	58	Recess existing flap gates into the channels
C	59	Remove existing flap gates into channel
C	60	Use tide flex where practical
C	61	Delete the cable fence in restricted areas
X	62	Replace the cable fence with a 3 foot concrete barrier
X	63	Retrofit cable fence with 3 foot concrete barrier
X	64	Use a secant pile wall where practical
X	65	Add in channel storage where possible
C	66	Enclose channels where possible and use for maintenance roads
C	67	Enclose channels where possible and use for parks
X	68	Add in channel thruster (wood screw) pumps and closed conduit
	70	Enclose channels where possible and use for public roads
BD	71	Use soft bottom channels
C	72	Work from downstream to upstream
C	73	Use all hot roll sheet pile

VALUE ENGINEERING TEAM STUDY

APPENDIX C:

COST MODEL



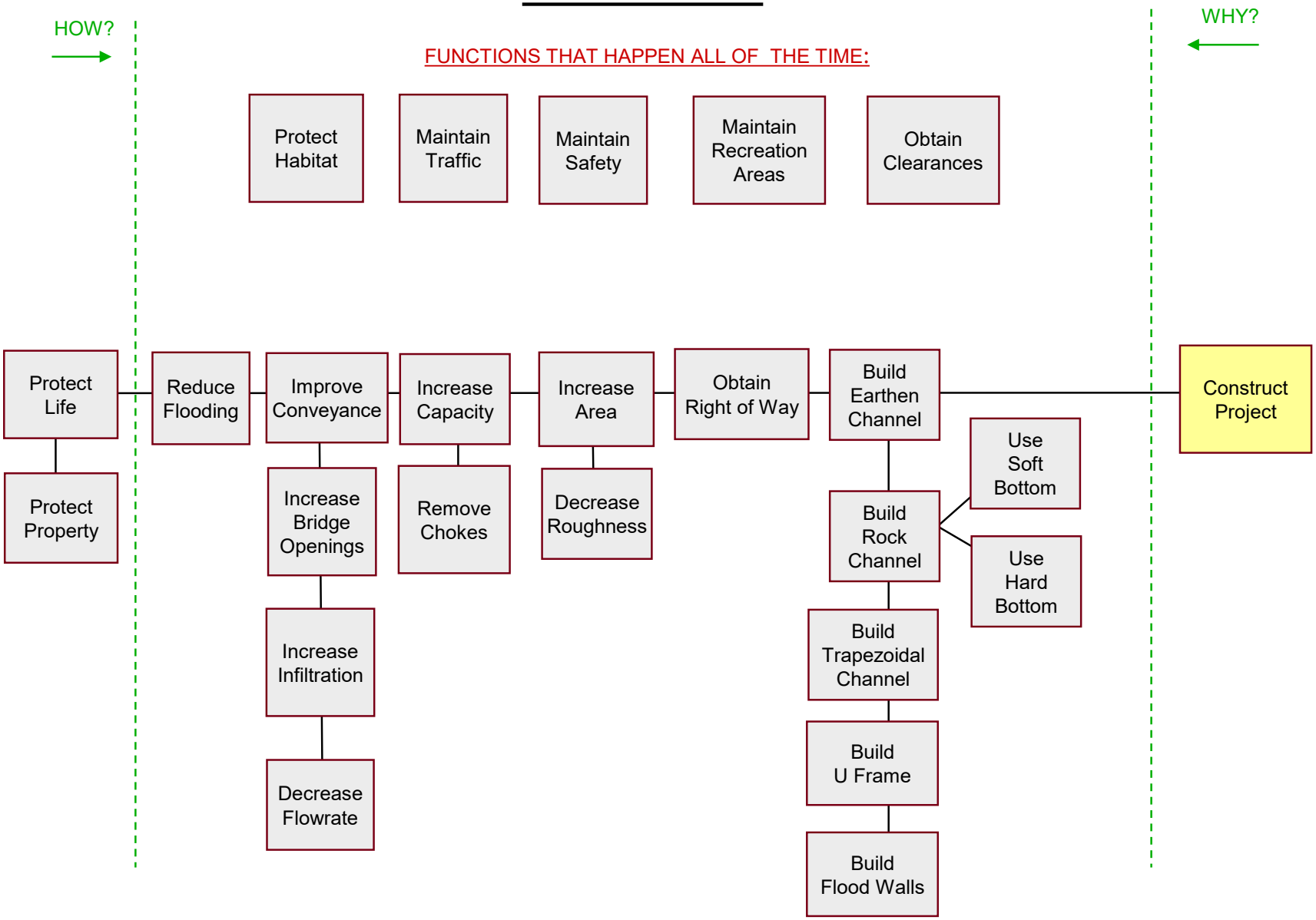
Note, only a representative reach is shown for illustration.

VALUE ENGINEERING TEAM STUDY

APPENDIX D:

FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM

FAST DIAGRAM



Appendix B - Civil Engineering

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For Double-sided Printing

Appendix B - Civil Engineering

Attachment 2: As Builts – East Garden Grove – C05 Wintersburg Channel, Tidelands to Huntington Beach Blvd

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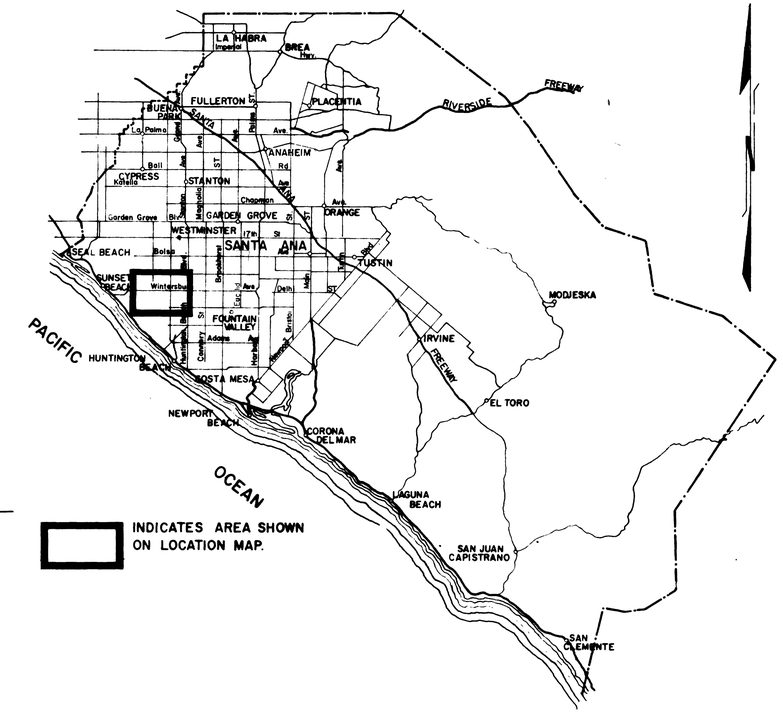
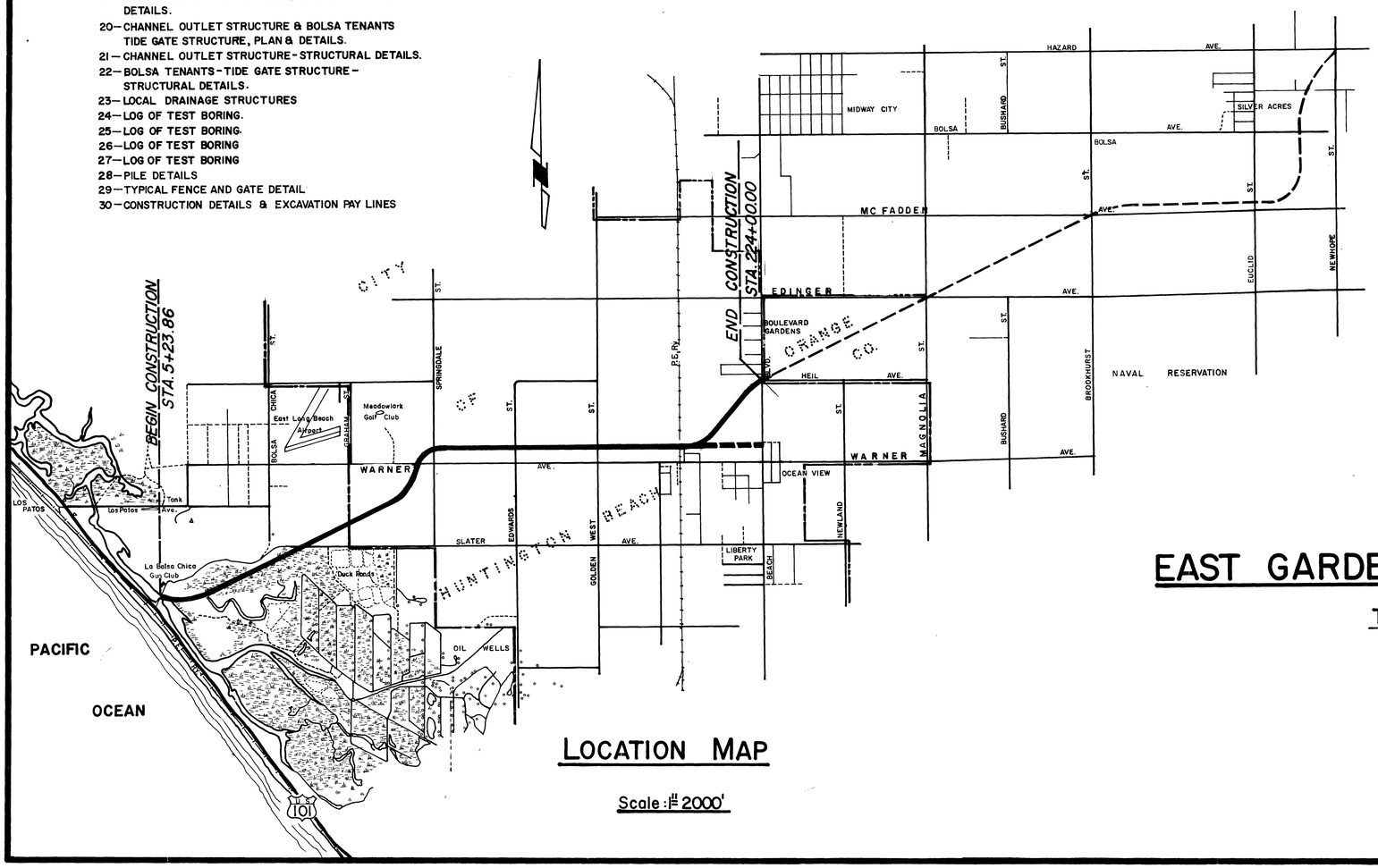
For Double-sided Printing

C05-101-1-A SHEET 1 OF 30

INDEX OF DRAWINGS

SHEET NO.	TITLE
1	TITLE SHEET
2	PLAN & PROFILE STA. 6+33.86 TO STA. 46+00.00
3	PLAN & PROFILE STA. 46+00.00 TO STA. 99+00.00
4	PLAN & PROFILE STA. 99+00.00 TO STA. 153+00.00
5	PLAN & PROFILE STA. 153+00.00 TO STA. 187+00.00
6	PLAN & PROFILE STA. 187+00.00 TO STA. 224+00.00
7	SHOOFLY ROADBED - PLAN & PROFILE.
8	PACIFIC ELECTRIC RY. BRIDGE - STRUCTURAL DETAILS. STA. 191+66.81.
9	PACIFIC ELECTRIC RY. BRIDGE STRUCTURAL DETAILS.
10	OIL FIELD ROAD BRIDGE - PLAN & PROFILE.
11	SLATER AVE. BRIDGE - PLAN & PROFILE.
12	WINTERSBURG AVENUE BRIDGE - PLAN & PROFILE.
13	SPRINGDALE STREET BRIDGE - PLAN & PROFILE.
14	EDWARDS STREET BRIDGE - PLAN & PROFILE.
15	GOLDEN WEST STREET BRIDGE - PLAN & PROFILE.
16	FARM BRIDGE - PLAN & PROFILE.
17	PLAN & PROFILE FARM BRIDGE STA. 178+59± CONSTRUCTION DETAILS
18	PRESTRESS CONCRETE BRIDGE, SUBSTRUCTURE DETAILS.
19	PRESTRESS CONCRETE BRIDGE, SUPERSTRUCTURE DETAILS.
20	CHANNEL OUTLET STRUCTURE & BOLSA TENANTS TIDE GATE STRUCTURE, PLAN & DETAILS.
21	CHANNEL OUTLET STRUCTURE - STRUCTURAL DETAILS.
22	BOLSA TENANTS - TIDE GATE STRUCTURE - STRUCTURAL DETAILS.
23	LOCAL DRAINAGE STRUCTURES
24	LOG OF TEST BORING.
25	LOG OF TEST BORING.
26	LOG OF TEST BORING
27	LOG OF TEST BORING
28	PILE DETAILS
29	TYPICAL FENCE AND GATE DETAIL
30	CONSTRUCTION DETAILS & EXCAVATION PAY LINES





LOCATION MAP

Scale: 1" = 2000'

ORANGE COUNTY, CALIFORNIA

VICINITY MAP

1 inch = 4 miles

PLANS FOR
THE CONSTRUCTION OF

EAST GARDEN GROVE—WINTERSBURG CHANNEL

TIDELANDS TO HUNTINGTON BEACH BLVD

APPROVED: H. G. Osborne
FLOOD CONTROL ENGINEER.

APPROVED: James R. Wheeler
As to portion within the city of Huntington Beach
CITY ENGINEER

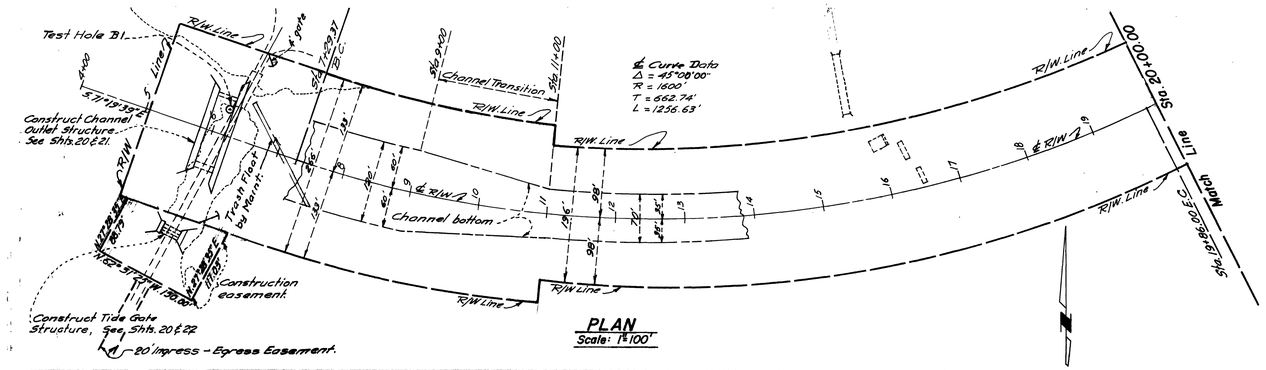
SEPTEMBER 1959
ORANGE COUNTY FLOOD CONTROL DISTRICT
SANTA ANA CALIFORNIA

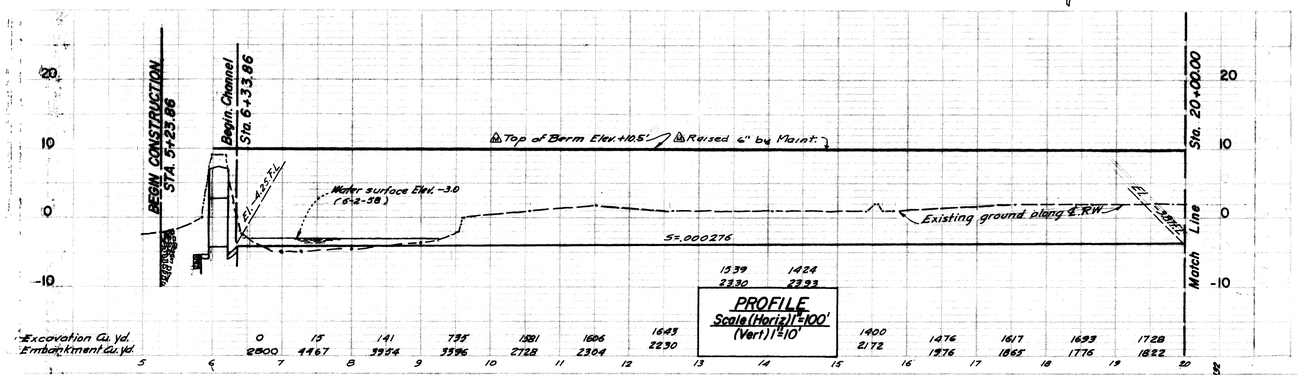
"AS BUILT"

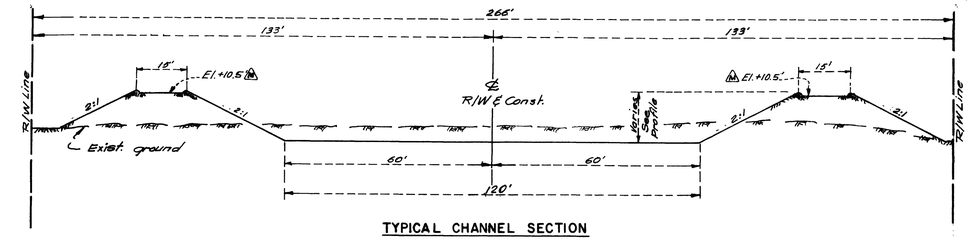
DWG. C05-101-1-A

SHEET 1 OF 30

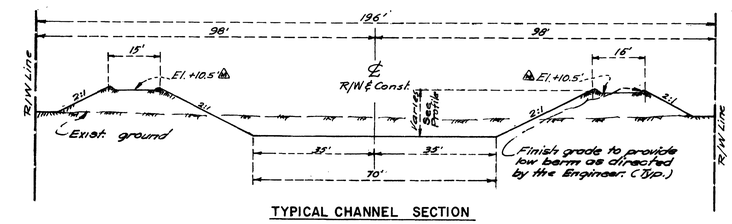
2 OF 30



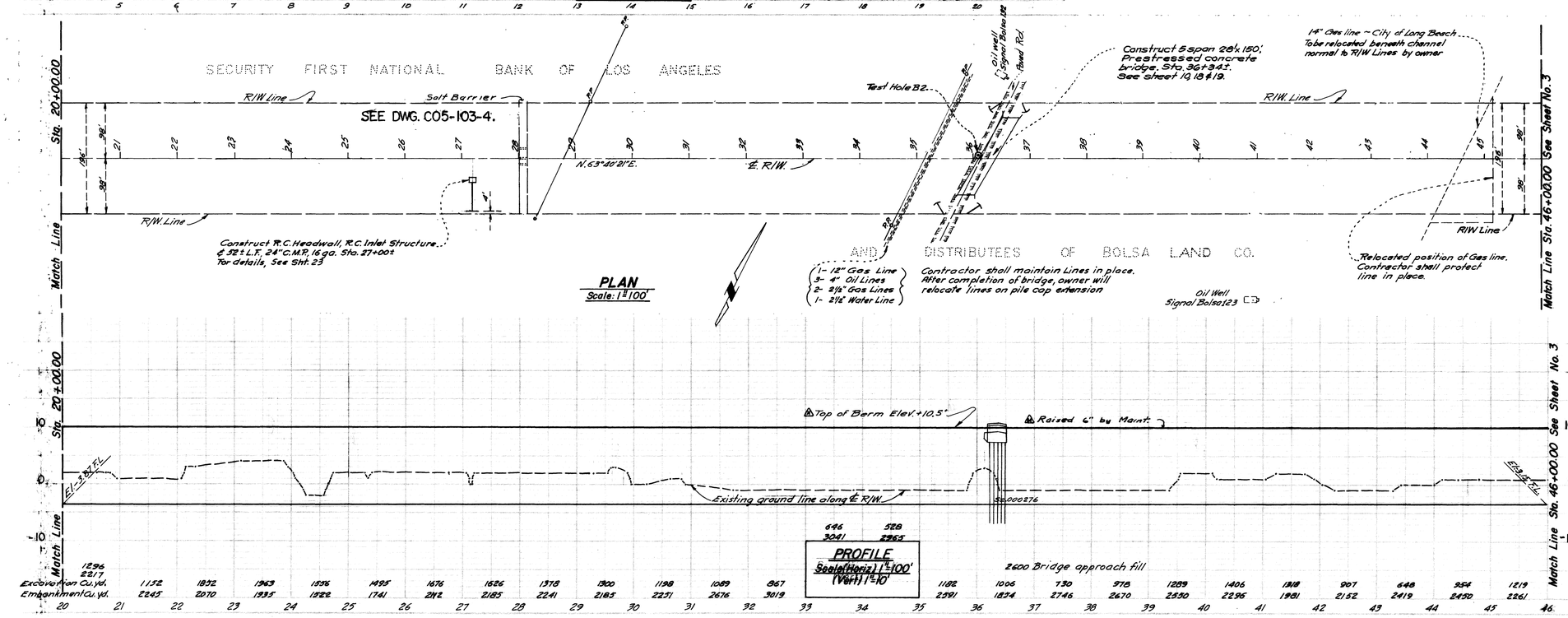




TYPICAL CHANNEL SECTION
STA. 6+33.86 – STA. 9+00.00
Scale: 1" = 20'



TYPICAL CHANNEL SECTION
STA. 11+00.00 – STA. 46+00.00
Scale: 1" = 20'



HYDRAULIC DATA	
Q = 2980,	b = 70'
n = .020	n = .030
dn = 8.0'	dn = 10.1'
Vn = 4.3 fps.	Vn = 3.3 fps.
dc = 3.7'	dc = 3.7'

Fencing Notes:
For Gate and Fencing details at Channel Outlet Structure, See Sheet 20. # 29.

Bench Mark:
C-5-2. Elev. 16.368 - Chiseled "□" at angle point in curb 40'± N'ly from N.E. corner of tidal gates. Marked "B.M." in orange paint.
C-5-6. Elev. 0.339 - Chiseled "□" in center concrete pier, 50'± S'wly from oil well pump "Bolsa 123.

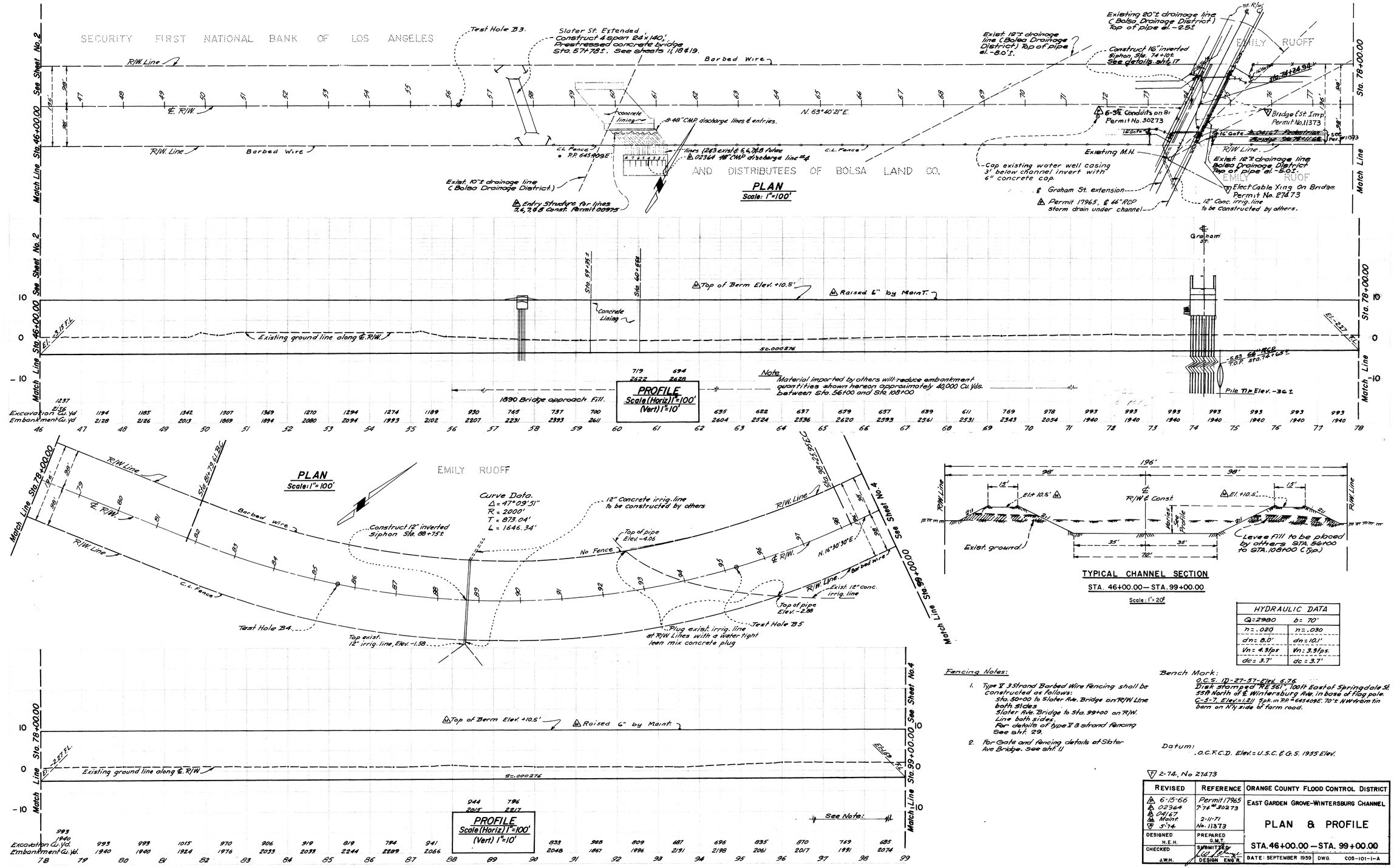
Datum:
O.C.F.C.D. Elev. = U.S.C. & G.S. 1955 Elev.

REVISED	REFERENCE	ORANGE COUNTY FLOOD CONTROL DISTRICT
Maint.	2-11-71	EAST GARDEN GROVE–WINTERSBURG CHANNEL
DESIGNED H.E.H.	PREPARED G.M.T.	PLAN & PROFILE
CHECKED J.W.H.	SUBMITTED DESIGN ENGR	STA. 6+33.86 – STA. 46+00.00
	DATE: SEPTEMBER 1959	DWG. C05-101-4-A

SHEET 2 OF 30

30

3 OF



HYDRAULIC DATA	
Q=2980	b= 70'
n=.020	n=.030
dn=8.0'	dn=10.1'
Vn=4.3fps	Vn=3.3fps.
dc=3.7'	dc=3.7'

Fencing Notes:

1. Type I 3 strand Barbed Wire Fencing shall be constructed as follows:
   Sta. 50+00 to Slater Ave. Bridge on R/W Line both sides
   Slater Ave. Bridge to Sta. 99+00 on R/W. Line both sides.
   For details of type I 3 strand fencing See sht. 29.
2. For Gate and fencing details at Slater Ave Bridge. See sht. 11

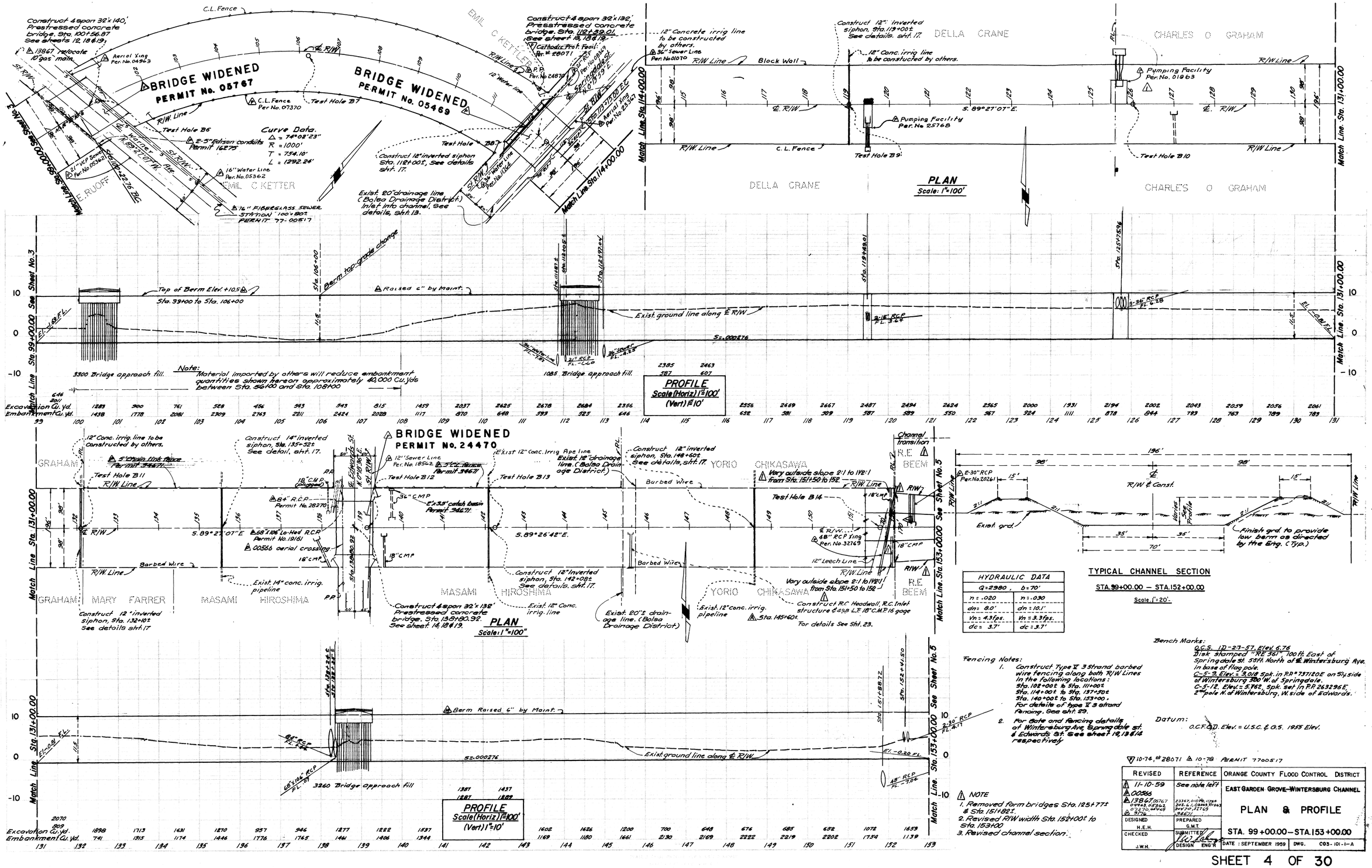
Bench Mark:
O.C.S. 17-27-57-Elev. 6.76
Disk stamped "RE 5617" 100 ft. East of Springdale St. 33 ft North of ℄ Wintersburg Ave. in base of flag pole.
C-5-7. Elev.=1.21 spk. in P.P. #645409E. 70'± NW from tin barn on N'ly side of farm road.

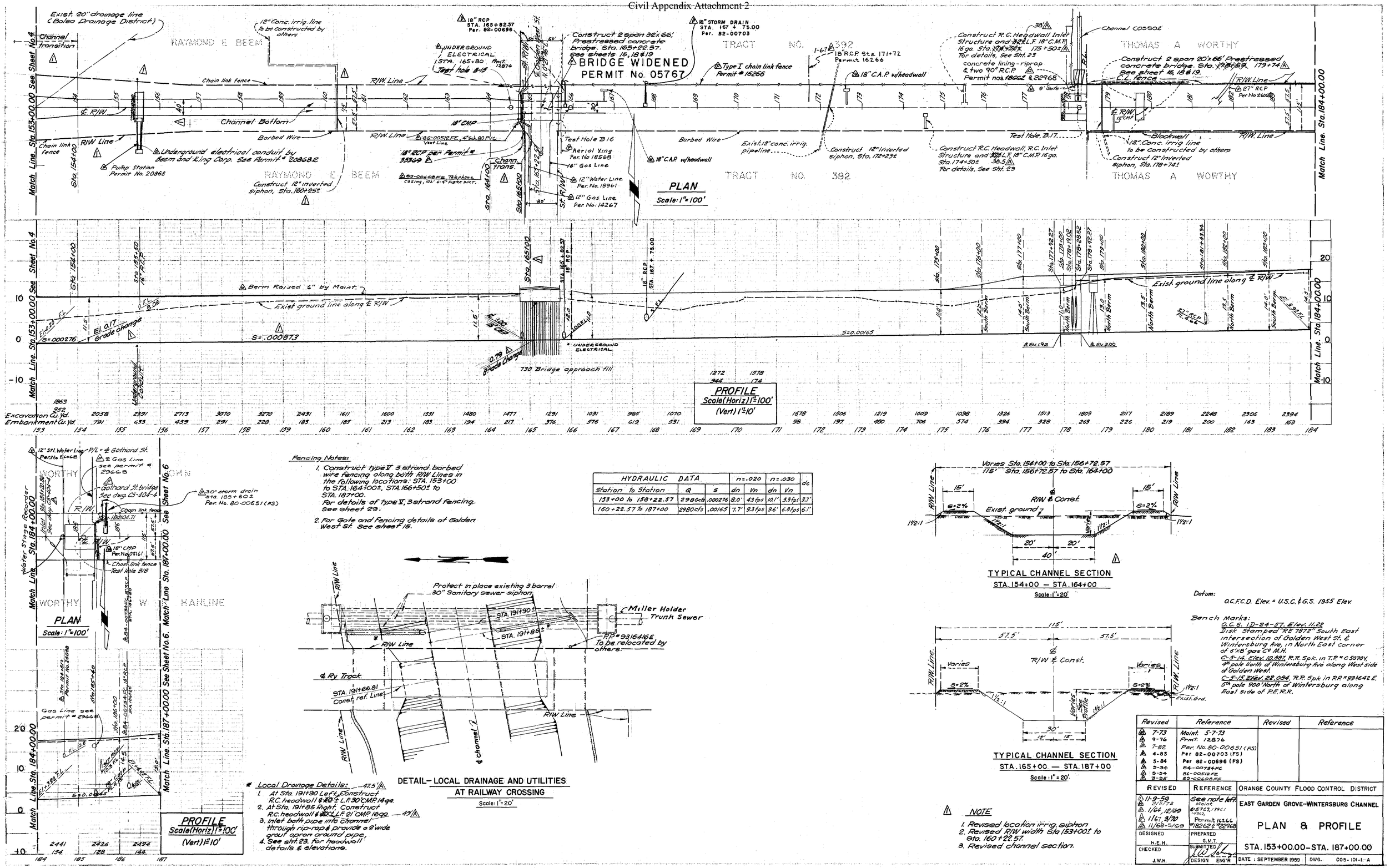
Datum:
O.C.F.C.D. Elev.=U.S.C.&G.S. 1955 Elev.

▽ 2-74, No 21473

REVISED	REFERENCE	ORANGE COUNTY FLOOD CONTROL DISTRICT
△ 6-15-66	Permit 17965	EAST GARDEN GROVE–WINTERSBURG CHANNEL
△ 02364	7-74 #30273	PLAN & PROFILE
△ 04147		
△ Maint.	2-11-71	
▽ 5-74	No. 11373	
DESIGNED H.E.H.	PREPARED G.M.T.	STA. 46+00.00 — STA. 99+00.00
CHECKED J.W.H.	SUBMITTED DESIGN ENG'R.	DATE: SEPTEMBER 1959 DWG. COS-101-1-A

SHEET 3 OF 30


BRIDGE WIDENED
PERMIT No. 05767
BRIDGE WIDENED
PERMIT No. 05469
Construct 4 span 32'x140' Prestressed concrete bridge. Sta. 100+56.87 See sheets 12, 18 & 19.
Construct 4 span 32'x132' Prestressed concrete bridge. Sta. 112+39.01 See sheet 18, 18 & 19.
Curve Data.
Δ = 74°02'23"
R = 1000'
T = 734.10'
L = 1292.24'
Construct 12" inverted siphon, Sta. 112+00± See details sht. 17.
Exist. 20" drainage line (Bolsa Drainage District) Inlet into channel, See details, Sht. 13.
Construct 12" inverted siphon Sta. 119+00± See details, sht. 17.
Pumping Facility Per. No. 25768
Pumping Facility Per. No. 01963
PLAN
Scale: 1"=100'
DELLA CRANE
CHARLES O GRAHAM
E. RUFF
EMIL C KETTER
Match Line Sta. 114+00.00
Match Line Sta. 131+00.00
Model Line S89°00'00"E See Sheet No. 3
Top of Berm Elev. +10.5
Sta. 99+00 to Sta. 106+00
Berm top grade change
Raised 6" by Maint.
Exist. ground line along ℄ R/W
3300 Bridge approach fill.
1085 Bridge approach fill.
Note: Material imported by others will reduce embankment quantities shown hereon approximately 40,000 Cu. yds between Sta. 56+00 and Sta. 108+00
PROFILE
Scale (Horiz) 1"=100'
(Vert) 1"=10'
Excavation Cu. yd.
Embankment Cu. yd.
BRIDGE WIDENED
PERMIT No. 24470
Construct 4 span 32'x132' Prestressed concrete bridge. Sta. 131+80.92. See sheet 14, 18 & 19.
Construct 14" inverted siphon, Sta. 135+52± See detail, sht. 17.
Construct 12" inverted siphon, Sta. 142+08± See details, sht. 17.
Construct 12" inverted siphon, Sta. 148+60± See details, sht. 17.
Exist. 12" Conc. irrig. line
Exist. 20" drainage line. (Bolsa Drainage District)
Construct R.C. Headwall, R.C. Inlet structure & 45 L.F. 18" C.M.P. 16 gage
For details See Sht. 23.
Vary outside slope 2:1 to 1½:1 from Sta. 151+50 to 152.
Barbed Wire
Exist. 14" conc. irrig. pipeline
Exist. 12" conc. irrig. pipeline
Sta. 145+60±
Berm Raised 6" by Maint.
3260 Bridge Approach Fill
PLAN
Scale: 1"=100'
PROFILE
Scale (Horiz) 1"=100'
(Vert) 1"=10'
Channel transition
R.E. BEEM
YORIO
CHIKASAWA
MASAMI
HIROSHIMA
GRAHAM
MARY
FARRER
Match Line Sta. 153+00.00
See Sheet No. 5
See Sheet No. 6
TYPICAL CHANNEL SECTION
STA. 99+00.00 — STA. 152+00.00
Scale: 1"=20'
Finish grd. to provide low berm as directed by the Eng. (Typ.)
Exist. grd.
R/W & Const.
HYDRAULIC DATA
Q=2980, b=70'
n=.020 n=.030
dn=8.0' dn=10.1'
Vn=4.3fps. Vn=3.3fps.
dc=3.7' dc=3.7'
Fencing Notes:
1. Construct Type V 3 strand barbed wire fencing along both R/W Lines in the following locations: Sta. 102+00± to Sta. 111+00±, Sta. 114+00± to Sta. 137+50±, Sta. 140+00± to Sta. 153+00. For details of type V 3 strand fencing. See sht. 29.
2. For Gate and fencing details at Wintersburg Ave, Springdale St. & Edwards St. See sheet 14, 18 & 14 respectively.
Bench Marks:
O.C.S. 12-27-57. Elev. 6.76 Disk stamped "RE 587" 100 ft. East of Springdale St. 35 ft. North of ℄ Wintersburg Ave. in base of flag pole.
C-5-9. Elev. = 9.018 Spk. in P.P. #737120E on S'ly side of Wintersburg 300' W. of Springdale.
C-5-12. Elev. = 5.762, Spk. set in P.P. 263296E 2 pole N. of Wintersburg, W. side of Edwards.
Datum: O.C.F.C.D. Elev. = U.S.C. & G.S. 1955 Elev.
NOTE
1. Removed farm bridges Sta. 125+77± & Sta. 151+82±.
2. Revised R/W width Sta. 152+00± to Sta. 153+00.
3. Revised channel section.
10-74, #28071 10-78 PERMIT 7700517
REVISED: 11-10-59; 00586
REFERENCE: See note left
ORANGE COUNTY FLOOD CONTROL DISTRICT
EAST GARDEN GROVE-WINTERSBURG CHANNEL
PLAN & PROFILE
STA. 99+00.00 — STA. 153+00.00
DESIGNED H.E.H.
CHECKED J.W.H.
PREPARED G.M.T.
SUBMITTED DESIGN ENG'R
DATE: SEPTEMBER 1959
DWG. C03-101-1-A
SHEET 4 OF 30



Fencing Notes:

1. Construct type V 3 strand barbed wire fencing along both R/W Lines in the following locations: STA. 153+00 to STA. 164+00±, STA. 166+50± to STA. 187+00. For details of type V, 3 strand fencing. See sheet 29.
2. For Gate and Fencing details of Golden West St. See sheet 15.

HYDRAULIC DATA			n=.020		n=.030		dc
Station to Station	Q	S	dn	Vn	dn	Vn	
153+00 to 158+22.57	2980cfs	.000276	8.0'	4.3fps	10.1'	3.3fps	3.7'
160+22.57 to 187+00	2980cfs	.00165	7.7'	9.3fps	9.6'	6.8fps	6.1'

DETAIL - LOCAL DRAINAGE AND UTILITIES AT RAILWAY CROSSING

Scale: 1" = 20'

* Local Drainage Details: — 47.5

1. At Sta. 191+90 Left, Construct R.C. headwall & 40± L.F. 30" CMP, 14 ga.
2. At Sta. 191+85 Right, Construct R.C. headwall & 40± L.F. 21" CMP, 16 ga. — 49
3. Inlet both pipe into Channel through rip-rap & provide a 2' wide grout apron around pipe.
4. See sht. 23 for headwall details & elevations.

TYPICAL CHANNEL SECTION

STA. 154+00 — STA. 164+00

Scale: 1" = 20'

TYPICAL CHANNEL SECTION

STA. 165+00 — STA. 187+00

Scale: 1" = 20'

Datum: O.C.F.C.D. Elev. = U.S.C. & G.S. 1955 Elev.

Bench Marks:

O.C.S. ID-24-57, Elev. 11.22 Disk Stamped "RE 7872" South East intersection of Golden West St. & Wintersburg Ave. in North East corner of 6'x8' gate C.P. M.H.

C-5-14, Elev. 10.987, R.R. Spk. in T.P. # C.5070Y, 4th pole North of Wintersburg Ave along West side of Golden West.

C-5-15, Elev. 22.084, R.R. Spk in P.P. # 931642 E. 5th pole 900' North of Wintersburg along East side of P.E.R.R.

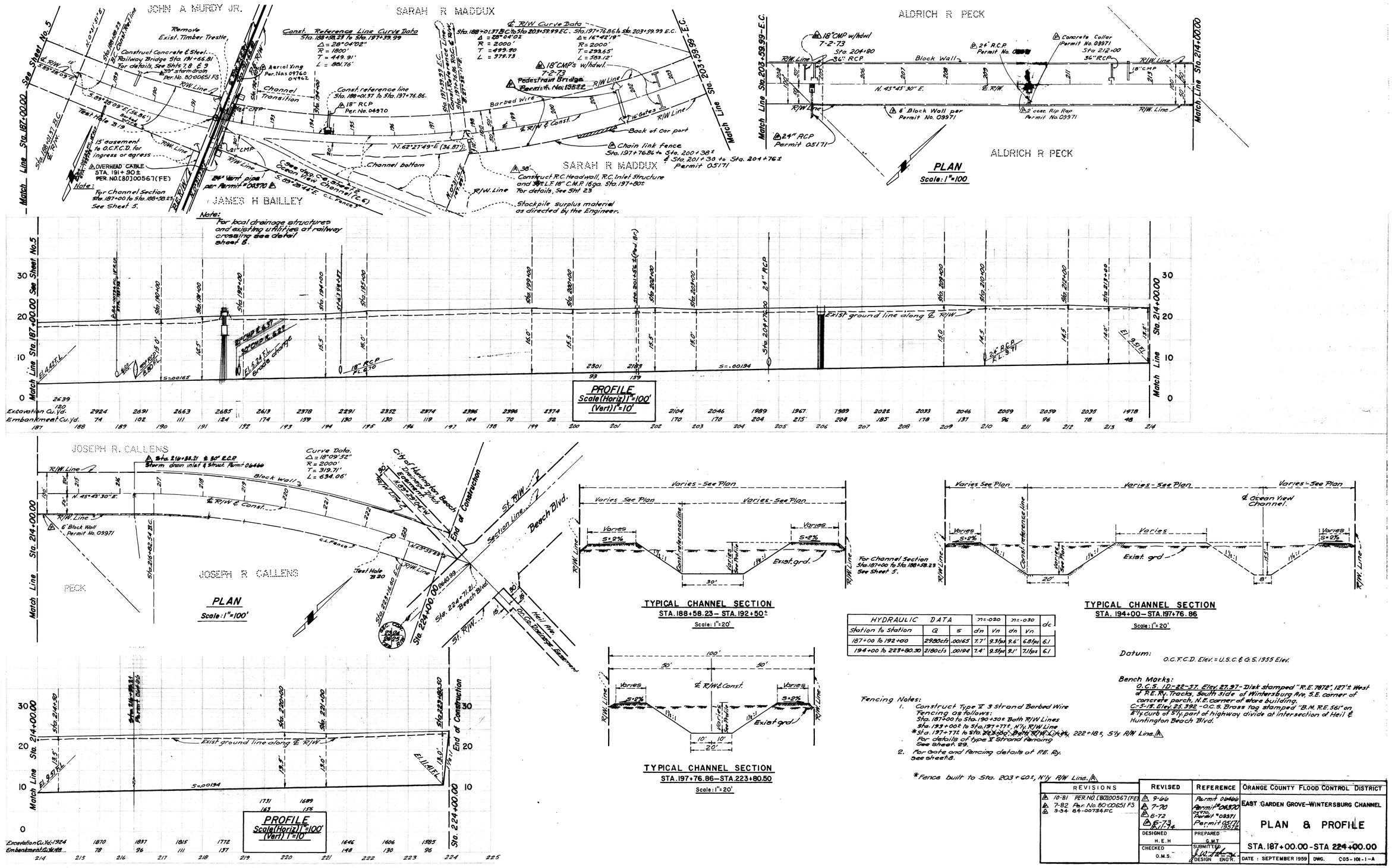
NOTE

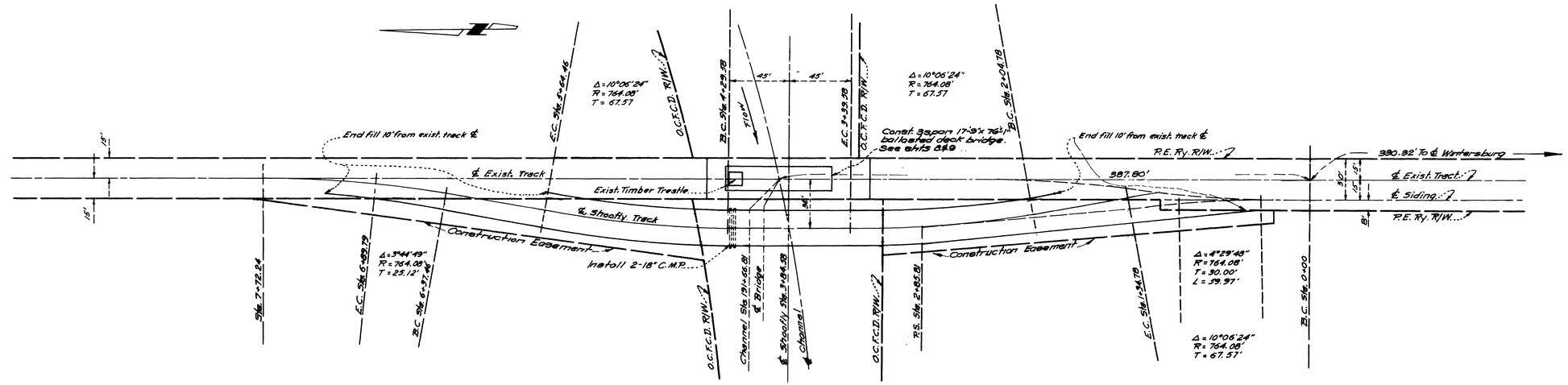
1. Revised location irrig. siphon
2. Revised R/W width Sta 153+00± to Sta. 160+22.57.
3. Revised channel section.

Revised	Reference	Revised	Reference
7-73	Maint. 5-7-73		
9-76	Prmt. 12876		
7-82	Per. No. 80-00651 (FS)		
4-83	Per 82-00703 (FS)		
5-84	Per 82-00696 (FS)		
3-94	84-00734FC		
5-94	86-00512FE		
3-95	89-00608FE		

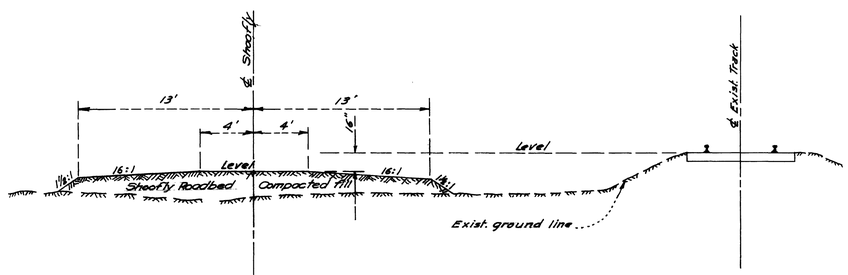
REVISED	REFERENCE	ORANGE COUNTY FLOOD CONTROL DISTRICT
11-9-59	See note left.	EAST GARDEN GROVE-WINTERSBURG CHANNEL
2/11/72	Maint. 65767, 1961 12262,	
1/64, 12/69		PLAN & PROFILE
1/67, 3/70	Permit 16266	
11/68-5/69	#18262 & #22968	
DESIGNED H.E.H.	PREPARED G.M.T.	STA. 153+00.00-STA. 187+00.00
CHECKED J.W.H.	SUBMITTED DESIGN ENG'R	DATE: SEPTEMBER 1959 DWG. C05-101-1-A

6 OF 30

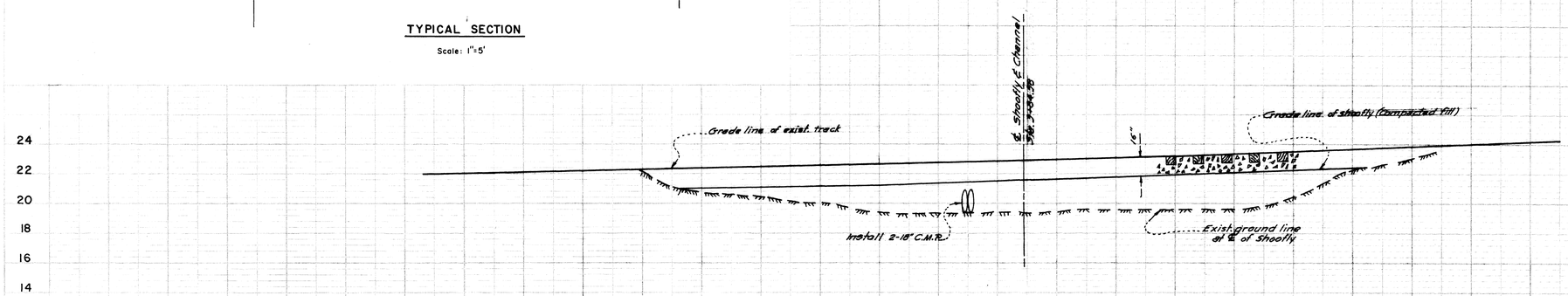

JOHN A MURDY JR.
SARAH R MADDUX
ALDRICH R PECK
JAMES H BAILLEY
JOSEPH R. CALLENS
Const. Reference Line Curve Data
Sta. 188+58.23 to Sta. 197+59.99
Δ = 28°04'02"
R = 1800'
T = 449.91'
L = 881.76'
Remove Exist. Timber Trestle
Construct Concrete & Steel Railway Bridge Sta. 191+66.81 For details, See Shts 7, 8 & 9
Aerial Xing Per. Nos 09760 09962
Channel Transition
Barbed Wire
Back of car port
Chain link fence Sta. 197+76.86 to Sta. 200+38± & Sta. 201+30 to Sta. 204+76± Permit 05171
Construct R.C. Headwall, R.C. Inlet Structure and 30± L.F. 18" C.M.P. 16ga. Sta. 197+80± For details, See Sht 23
Stockpile surplus material as directed by the Engineer.
Channel bottom
Test Hole 2819
15' easement to O.C.F.C.D. for ingress or egress
OVERHEAD CABLE STA. 191+90± PER. NO. (80)00567(FE)
Note: For Channel Section Sta. 187+00 to Sta. 188+58.23 See Sheet 5.
Note: For local drainage structures and existing utilities at railway crossing see detail sheet 6.
Match Line Sta. 187+00.00 See Sheet No. 5
Match Line Sta. 203+59.99 E.C.
Match Line Sta. 214+00.00
PLAN Scale: 1"=100
PROFILE Scale (Horiz) 1"=100' (Vert) 1"=10'
Exist ground line along ℄ R/W
Excavation Cu.Yd.
Embankment Cu.Yd.
PLAN Scale: 1"=100'
Curve Data. Δ = 18°09'52" R = 2000' T = 319.71' L = 634.06'
Block Wall
Test Hole 2820
City of Huntington Beach Easement
End of Construction
Beach Blvd.
Exist ground line along ℄ R/W
TYPICAL CHANNEL SECTION STA. 188+58.23 – STA. 192+50± Scale: 1"=20'
TYPICAL CHANNEL SECTION STA. 194+00 – STA. 197+76.86 Scale: 1"=20'
TYPICAL CHANNEL SECTION STA. 197+76.86 – STA. 223+80.50 Scale: 1"=20'
For Channel Section Sta. 187+00 to Sta. 188+58.23 See Sheet 5.
Exist. grd.
Const. reference line
℄ Ocean View Channel
Datum: O.C.F.C.D. Elev. = U.S.C. & G.S. 1955 Elev.
Bench Marks: O.C.S. ID-22-57. Elev. 27.97 - Disk stamped "R.E. 7872", 127'± West of R.E. Ry. Tracks, South side of Wintersburg Rd., S.E. corner of concrete porch, N.E. corner of store building. C.S. 1/8 Elev. 23.392 - O.C.S. Brass Tag stamped "B.M. R.E. 561" on E'ly curb of S'ly part of highway divide at intersection of Heil & Huntington Beach Blvd.
Fencing Notes:
1. Construct Type V 3 strand Barbed Wire Fencing as follows: Sta. 187+00 to Sta. 190+30± Both R/W Lines; Sta. 193+00± to Sta. 197+77±, N'ly R/W Line; *Sta. 197+77± to Sta. 223+80±, Both R/W Lines, 222+18±, S'ly R/W Line. For details of Type V Strand Fencing See sheet 29.
2. For Gate and Fencing details of R.E. Ry. See sheet 8.
*Fence built to Sta. 203+60±, N'ly R/W Line.
REVISIONS
10-81 PER NO. (80)00567(FE)
7-82 Per. No. 80-00651 FS
9-84 84-00734 FC
REVISED
9-66
7-70
6-72
6-73
8-1-94
REFERENCE
Permit 04466
Permit 04570
Permit 09971
Permit 09971
ORANGE COUNTY FLOOD CONTROL DISTRICT
EAST GARDEN GROVE-WINTERSBURG CHANNEL
PLAN & PROFILE
STA. 187+00.00 - STA 224+00.00
DESIGNED H.E.H
CHECKED O.M.S.
PREPARED G.M.T.
SUBMITTED
DESIGN ENG'R.
DATE: SEPTEMBER 1959
DWG. C05-101-1-A
SHEET 6 OF 30



PLAN
Scale: 1" = 40'



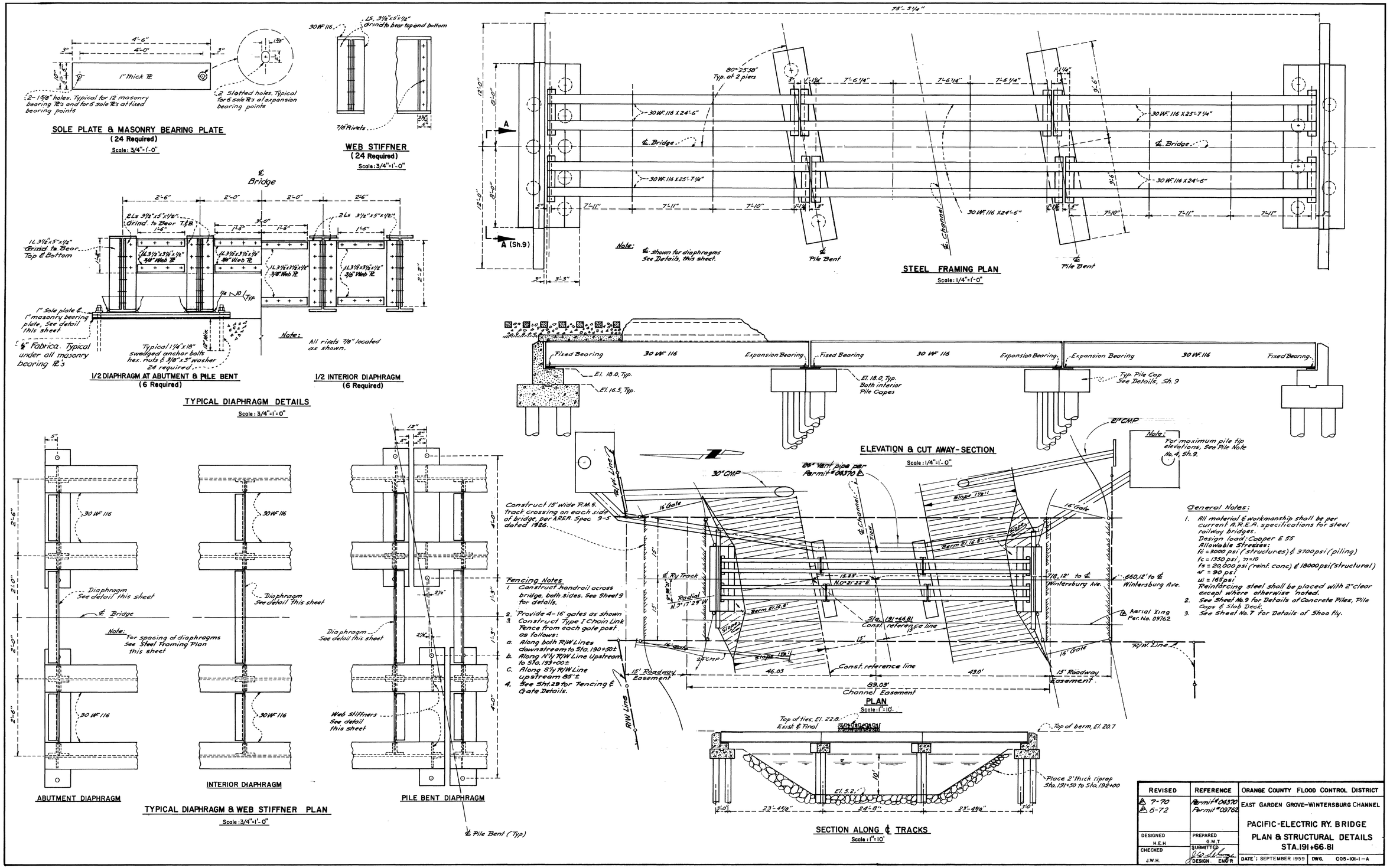
TYPICAL SECTION
Scale: 1" = 5'



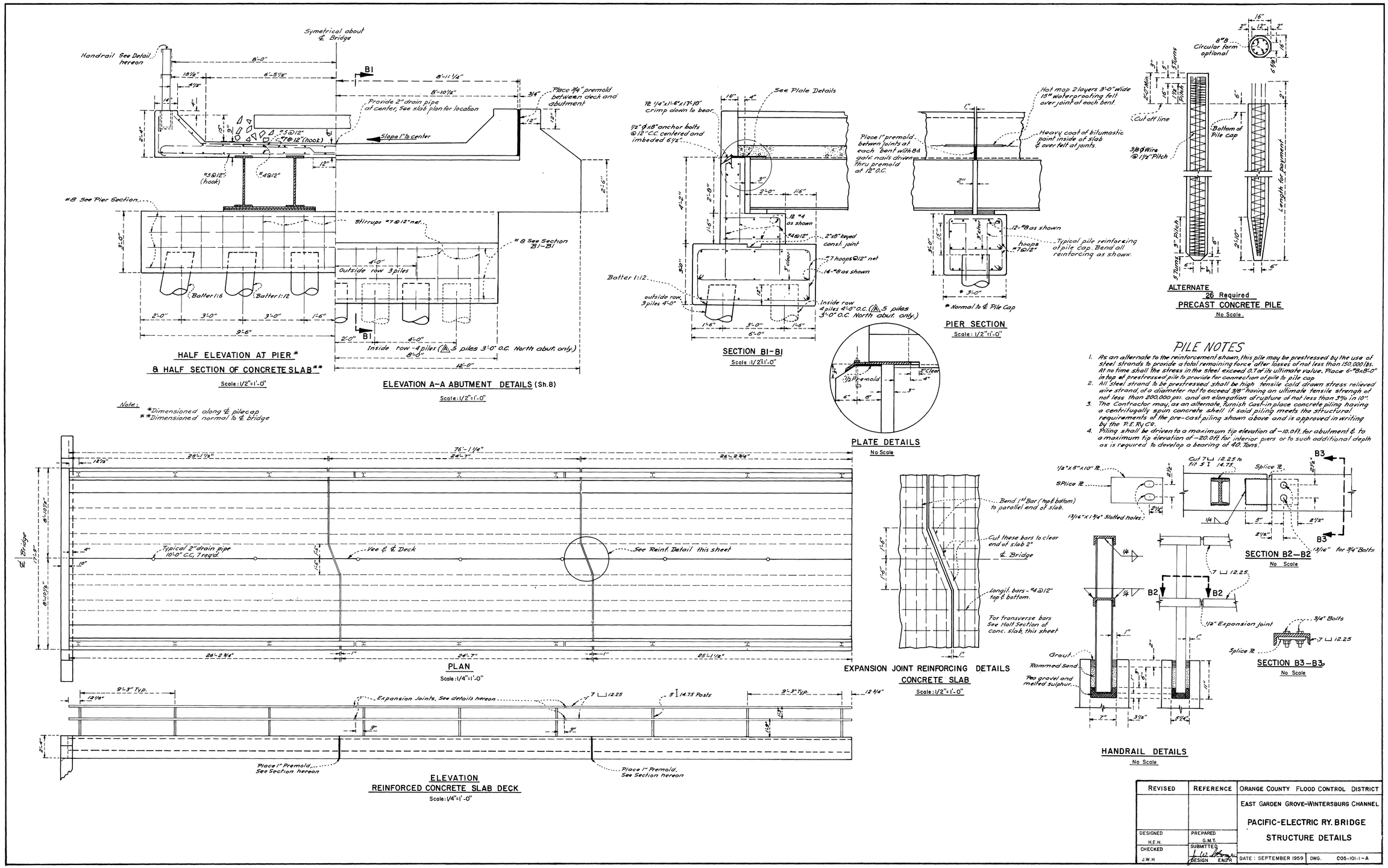
PROFILE
Scale (Horiz) 1" = 40'
(Vert) 1" = 4'

REVISED	REFERENCE	ORANGE COUNTY FLOOD CONTROL DISTRICT
		EAST GARDEN GROVE-WINTERSBURG CHANNEL SHOOFLY ROADBED PLAN & PROFILE
DESIGNED G.E.M.	PREPARED G.M.T.	
CHECKED J.W.H.	SUBMITTED	DATE: SEPTEMBER 1959 — DWG. C05-101-1-A

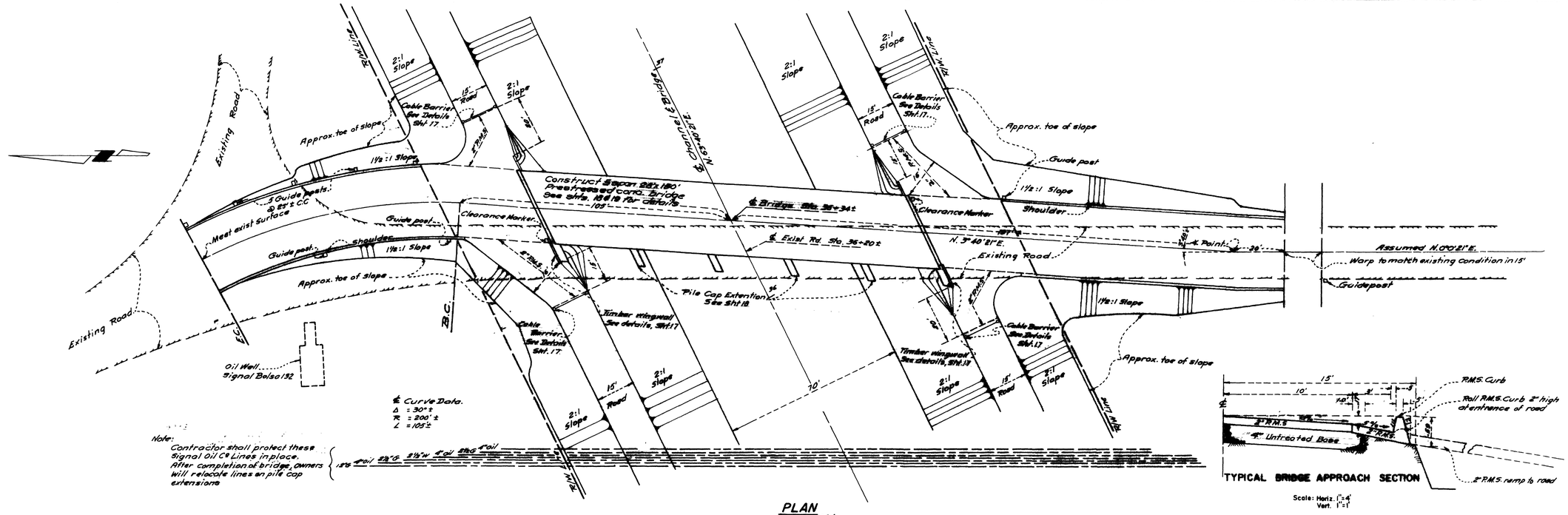
SHEET 7 OF 30

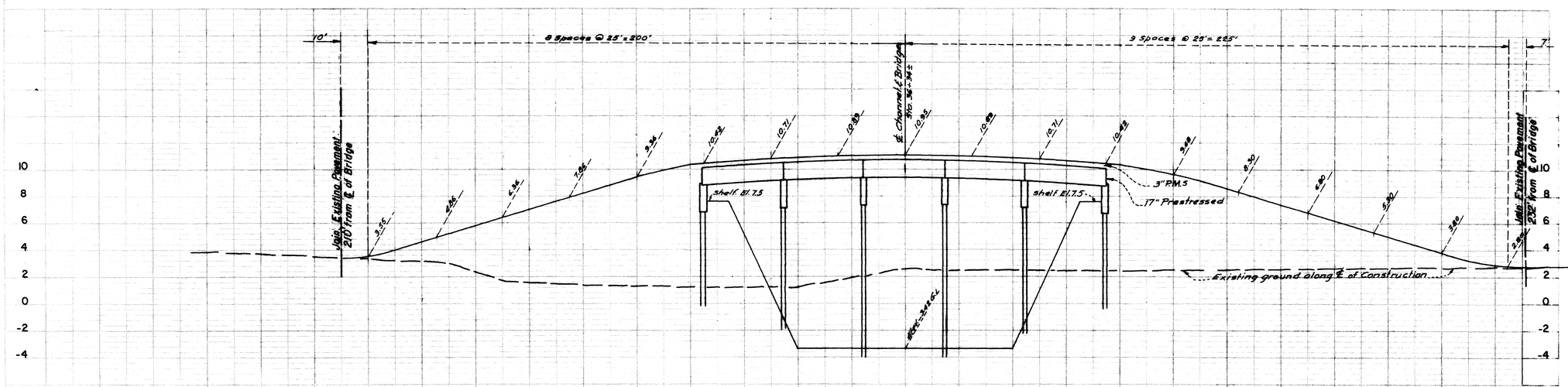

SOLE PLATE & MASONRY BEARING PLATE
(24 Required)
Scale: 3/4"=1'-0"
1" thick PL
2-1 5/8" holes. Typical for 12 masonry bearing PL's and for 6 sole PL's at fixed bearing points
2 Slotted holes. Typical for 6 sole PL's at expansion bearing points
WEB STIFFNER
(24 Required)
Scale: 3/4"=1'-0"
7/8" Rivets
℄ Bridge
1/2 DIAPHRAGM AT ABUTMENT & PILE BENT
(6 Required)
1/2 INTERIOR DIAPHRAGM
(6 Required)
TYPICAL DIAPHRAGM DETAILS
Scale: 3/4"=1'-0"
Typical 1 1/4"x18" swedged anchor bolts hex. nuts & 3/8"x3" washer 24 required
All rivets 7/8" located as shown.
STEEL FRAMING PLAN
Scale: 1/4"=1'-0"
30 WF 116 X 24'-6"
30 WF 116 X 25'-7 1/4"
℄ Bridge
℄ Pile Bent
℄ Channel
ELEVATION & CUT AWAY-SECTION
Scale: 1/4"=1'-0"
Fixed Bearing
Expansion Bearing
30 WF 116
El. 18.0, Typ.
El. 16.5, Typ.
El. 18.0, Typ. Both interior Pile Capes
Typ. Pile Cap See Details, Sh. 9
21" CMP
For maximum pile tip elevations, see Pile Note No. 4, Sh. 9.
ABUTMENT DIAPHRAGM
INTERIOR DIAPHRAGM
PILE BENT DIAPHRAGM
TYPICAL DIAPHRAGM & WEB STIFFNER PLAN
Scale: 3/4"=1'-0"
Diaphragm See detail this sheet
Web Stiffners See detail this sheet
℄ Pile Bent (Typ)
Construct 15' wide P.M.S. track crossing on each side of bridge, per AREA Spec. 9-5 dated 1926.
Fencing Notes
1. Construct handrail across bridge, both sides. See Sheet 9 for details.
2. Provide 4-16' gates as shown.
3. Construct Type I Chain Link Fence from each gate post as follows:
a. Along both R/W Lines downstream to Sta. 190+50±
b. Along N'ly R/W Line Upstream to Sta. 193+00±
c. Along S'ly R/W Line upstream 85'±
4. See Sht. 29 for Fencing & Gate Details.
PLAN
Scale: 1"=10'
Const. reference line
Channel Easement
15' Roadway Easement
R/W Line
Aerial Xing Per. No. 09762
660.12' to ℄ Wintersburg Ave.
718.12' to ℄ Wintersburg Ave.
SECTION ALONG ℄ TRACKS
Scale: 1"=10'
Top of ties, El. 22.8, Exist. & Final
Top of berm, El. 20.7
Place 2' thick riprap Sta. 191+50 to Sta. 192+00
General Notes:
1. All material & workmanship shall be per current A.R.E.A. specifications for steel railway bridges.
Design load: Cooper E 55
Allowable Stresses:
fc = 3000 psi (structures) & 3700 psi (piling)
fc = 1350 psi, n=10
fs = 20,000 psi (reinf. conc) & 18000 psi (structural)
v = 90 psi
u = 165 psi
Reinforcing steel shall be placed with 2" clear except where otherwise noted.
2. See Sheet No. 9 for Details of Concrete Piles, Pile Caps & Slab Deck.
3. See Sheet No. 7 for Details of Shoo Fly.
REVISED
REFERENCE
ORANGE COUNTY FLOOD CONTROL DISTRICT
7-70
6-72
Permit #04370
Permit #09762
EAST GARDEN GROVE-WINTERSBURG CHANNEL
PACIFIC-ELECTRIC RY. BRIDGE
PLAN & STRUCTURAL DETAILS
STA. 191+66.81
DESIGNED H.E.H
PREPARED G.M.T
CHECKED J.W.H.
SUBMITTED
DESIGN ENG'R
DATE: SEPTEMBER 1959
DWG. C05-101-1-A

SHEET 8 OF 30


Symetrical about ℄ Bridge
Handrail See Detail hereon
Provide 2" drain pipe at center, See slab plan for location
Place 3/4" premold between deck and abutment
Slope 1" to center
#8 See Pier Section
Stirrups #7 @ 12" net
#8 See Section B1-B1
Outside row 3 piles
Batter 1:6
Batter 1:12
Inside row - 4 piles (5 piles 3'-0" o.c. North abut. only)
HALF ELEVATION AT PIER*
& HALF SECTION OF CONCRETE SLAB**
Scale: 1/2"=1'-0"
ELEVATION A-A ABUTMENT DETAILS (Sh.8)
Scale: 1/2"=1'-0"
Note: *Dimensioned along ℄ pilecap
**Dimensioned normal to ℄ bridge
See Plate Details
1/2" ø x 8" anchor bolts @ 12" C.C. centered and imbeded 6 1/2"
Batter 1:12
outside row 3 piles 4'-0"
Inside row 4 piles 4'-0" o.c. (5 piles 3'-0" o.c. North abut. only)
SECTION B1-B1
Scale: 1/2"=1'-0"
PLATE DETAILS
No Scale
Hot mop 2 layers 3'-0" wide 15# waterproofing felt over joint of each bent.
Heavy coat of bitumastic paint inside of slab & over felt at joints.
Place 1" premold between joints at each bent with 8d galv. nails driven thru premold at 12" o.c.
Typical pile reinforcing at pile cap. Bend all reinforcing as shown.
* Normal to ℄ Pile Cap
PIER SECTION
Scale: 1/2"=1'-0"
Circular form optional
Cut off line
Bottom of Pile cap
Length for pavement
ALTERNATE
26 Required
PRECAST CONCRETE PILE
No Scale
PILE NOTES
1. As an alternate to the reinforcement shown, this pile may be prestressed by the use of steel strands to provide a total remaining force after losses of not less than 150,000 lbs. At no time shall the stress in the steel exceed 0.7 of its ultimate value. Place 6-#8 x 8'-0" in top of prestressed pile to provide for connection of pile to pile cap.
2. All steel strand to be prestressed shall be high tensile cold drawn stress relieved wire strand, of a diameter not to exceed 3/8" having an ultimate tensile strength of not less than 200,000 psi. and an elongation at rupture of not less than 3% in 10".
3. The Contractor may, as an alternate, furnish cast-in place concrete piling having a centrifugally spun concrete shell if said piling meets the structural requirements of the pre-cast piling shown above and is approved in writing by the P.E.Ry.Co.
4. Piling shall be driven to a maximum tip elevation of -10.0 ft. for abutment & to a maximum tip elevation of -20.0 ft. for interior piers or to such additional depth as is required to develop a bearing of 40 Tons.
Typical 2" drain pipe 10'-0" C.C. Treqd.
Vee ℄ & Deck
See Reinf. Detail this sheet
PLAN
Scale: 1/4"=1'-0"
Expansion Joints, See details hereon
Place 1" Premold, See Section hereon
ELEVATION
REINFORCED CONCRETE SLAB DECK
Scale: 1/4"=1'-0"
Bend 1" Bar (top & bottom) to parallel end of slab.
Cut these bars to clear end of slab 2"
℄ Bridge
Longit. bars - #4 @ 12" top & bottom.
For transverse bars See Half Section of conc. slab, this sheet
EXPANSION JOINT REINFORCING DETAILS
CONCRETE SLAB
Scale: 1/2"=1'-0"
1/2" x 5" x 10" PL
Splice PL
13/16" x 1 3/4" Slotted holes
Cut 7 [12.25 to fit 5 I 14.75
13/16" for 3/4" Bolts
SECTION B2-B2
No Scale
1/2" Expansion Joint
3/4" Bolts
Grout
Rammed Sand
Pea gravel and melted sulphur
SECTION B3-B3
No Scale
HANDRAIL DETAILS
No Scale
REVISED
REFERENCE
ORANGE COUNTY FLOOD CONTROL DISTRICT
EAST GARDEN GROVE-WINTERSBURG CHANNEL
PACIFIC-ELECTRIC RY. BRIDGE
STRUCTURE DETAILS
DESIGNED H.E.H.
PREPARED G.M.T.
CHECKED J.W.H.
SUBMITTED DESIGN ENGR
DATE: SEPTEMBER 1959
DWG. C05-101-1-A

SHEET 9 OF 30





General Notes.

1. For bridge substructure details See Sheet 18
2. For bridge superstructure details See Sheet 19
3. For pile details, See Sheet 28
4. For guide post and clearance marker details, See Sht. 19

PROFILE
Scale: Horiz. 1"=20
Vert. 1"=4'

REVISED	REFERENCE	ORANGE COUNTY FLOOD CONTROL DISTRICT
		EAST GARDEN GROVE–WINTERSBURG CHANNEL OIL FIELD ROAD BRIDGE PLAN & PROFILE
DESIGNED J.W.H.	PREPARED G.M.T.	
CHECKED H.E.H.	SUBMITTED DESIGN ENG'R	DATE: SEPTEMBER 1959 DWG. C05-101-1-A

SHEET 10 OF 30

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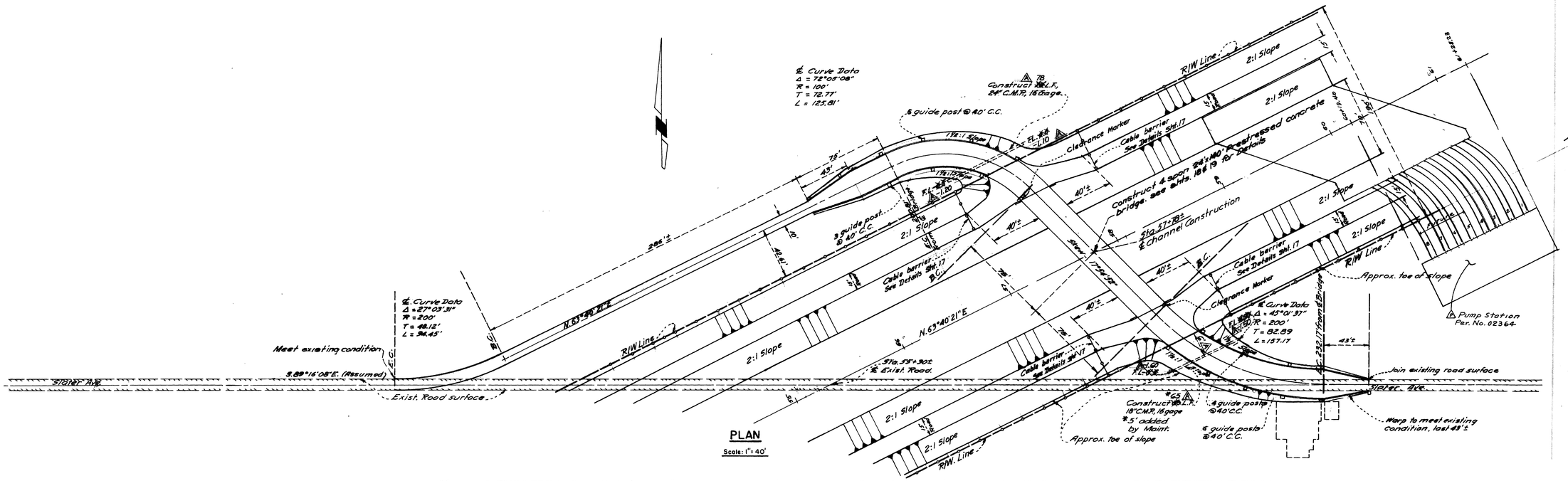
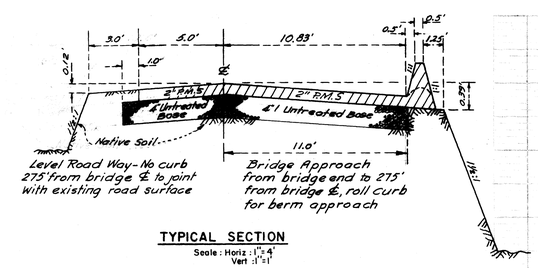
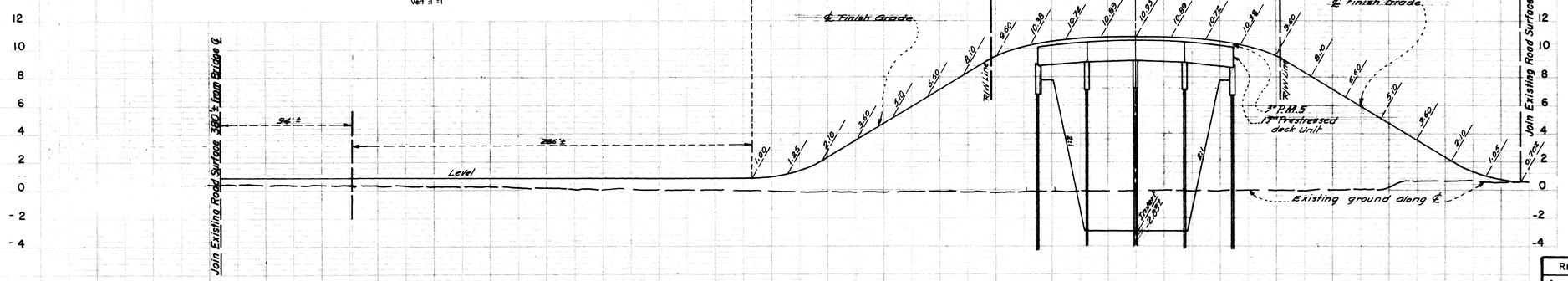




TYPICAL SECTION
Scale: Horiz. 1" = 4'
Vert. 1" = 1'



PROFILE
Scale (Horiz) 1" = 40'
(Vert) 1" = 4'

Excavation Cu. yd
Embankment Cu. yd.

General Notes:

1. For bridge substructure details See Sht. 18
2. For bridge superstructure details See Sht. 19
3. For pile details, See Sht. 28
4. For guide post & clearance marker details See Sht. 19

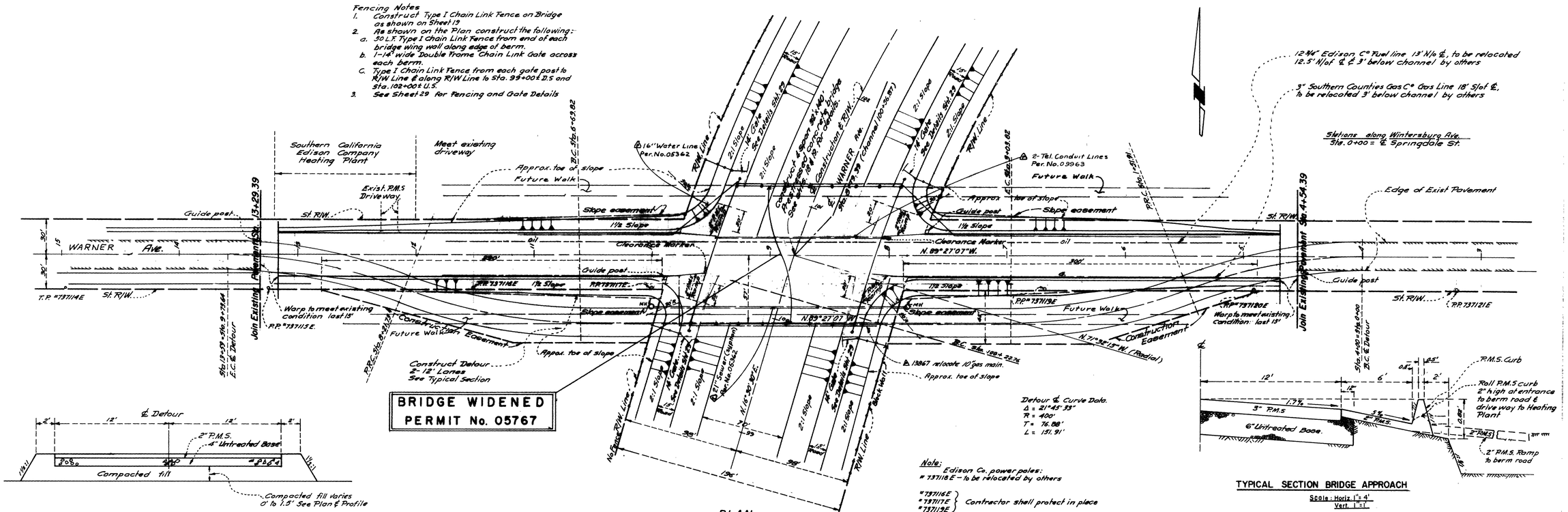
REVISED	REFERENCE	ORANGE COUNTY FLOOD CONTROL DISTRICT
02364		EAST GARDEN GROVE–WINTERSBURG CHANNEL
		SLATER AVE. BRIDGE PLAN & PROFILE
DESIGNED G.E.M.	PREPARED G.M.T.	
CHECKED J.W.H. H.E.H	SUBMITTED DESIGN ENG'R.	DATE: SEPTEMBER 1959 DWG. C03-101-1-A

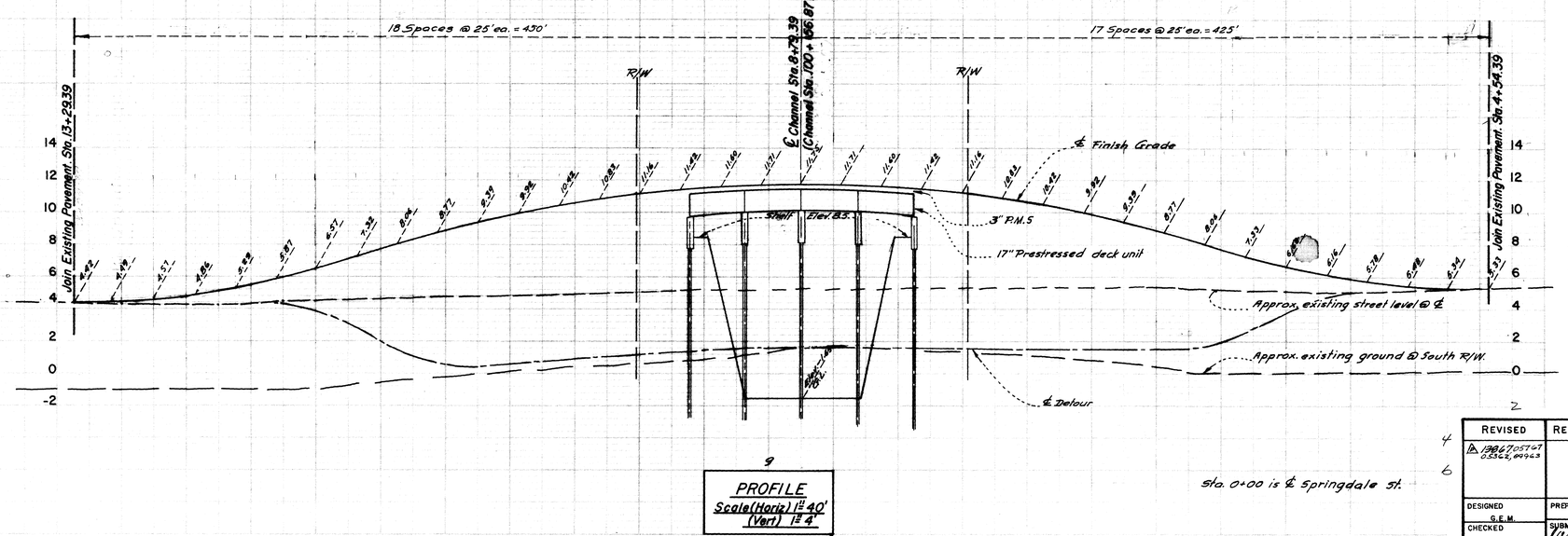
SHEET 11 OF 30

C03-101-1-A

12 OF 30

Fencing Notes
1. Construct Type I Chain Link Fence on Bridge as shown on Sheet 19
2. As shown on the Plan construct the following:
   a. 30 L.F. Type I Chain Link Fence from end of each bridge wing wall along edge of berm.
   b. 1-14' wide Double frame Chain Link Gate across each berm.
   c. Type I Chain Link Fence from each gate post to R/W Line & along R/W Line to Sta. 99+00± D.S. and sta. 102+00± U.S.
3. See Sheet 29 for Fencing and Gate Details





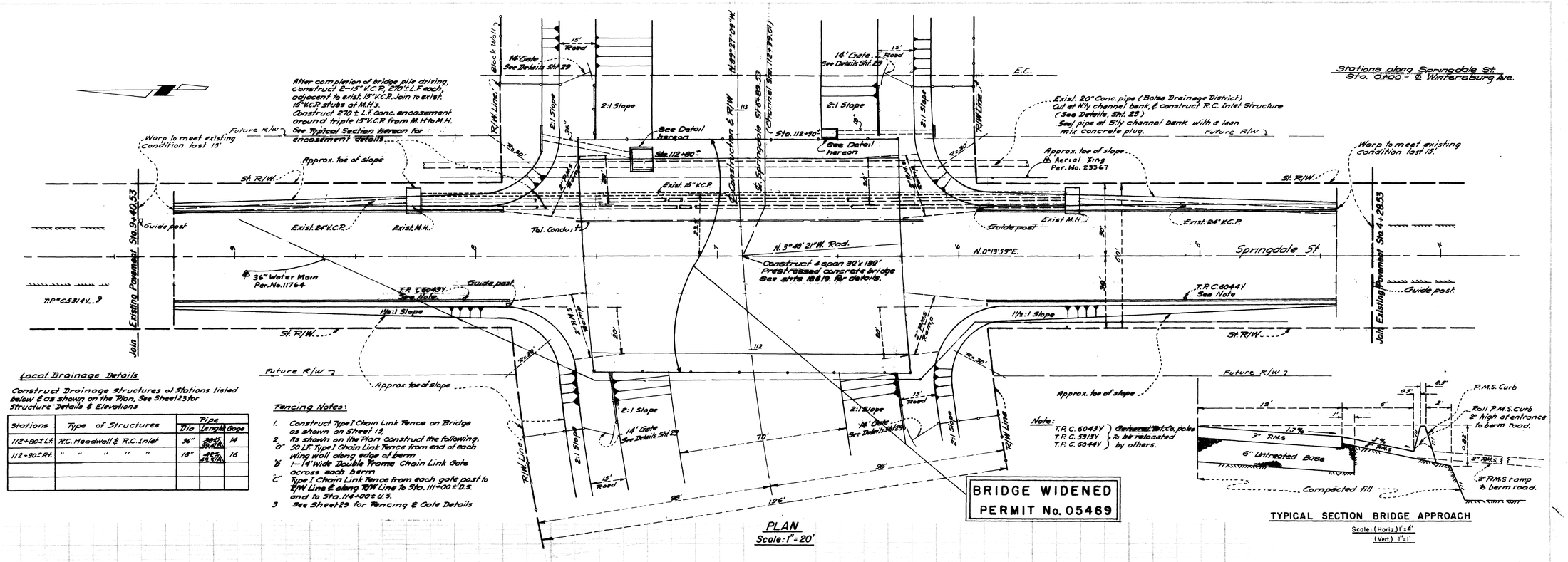
PROFILE
Scale (Horiz) 1" = 40'
(Vert) 1" = 4'

General Notes.
1. For bridge substructure details, See Sheet 18
2. For bridge superstructure details, See Sheet 19
3. For pile details, See Sheet 28
4. For guide post & clearance marker details See Sht. 19

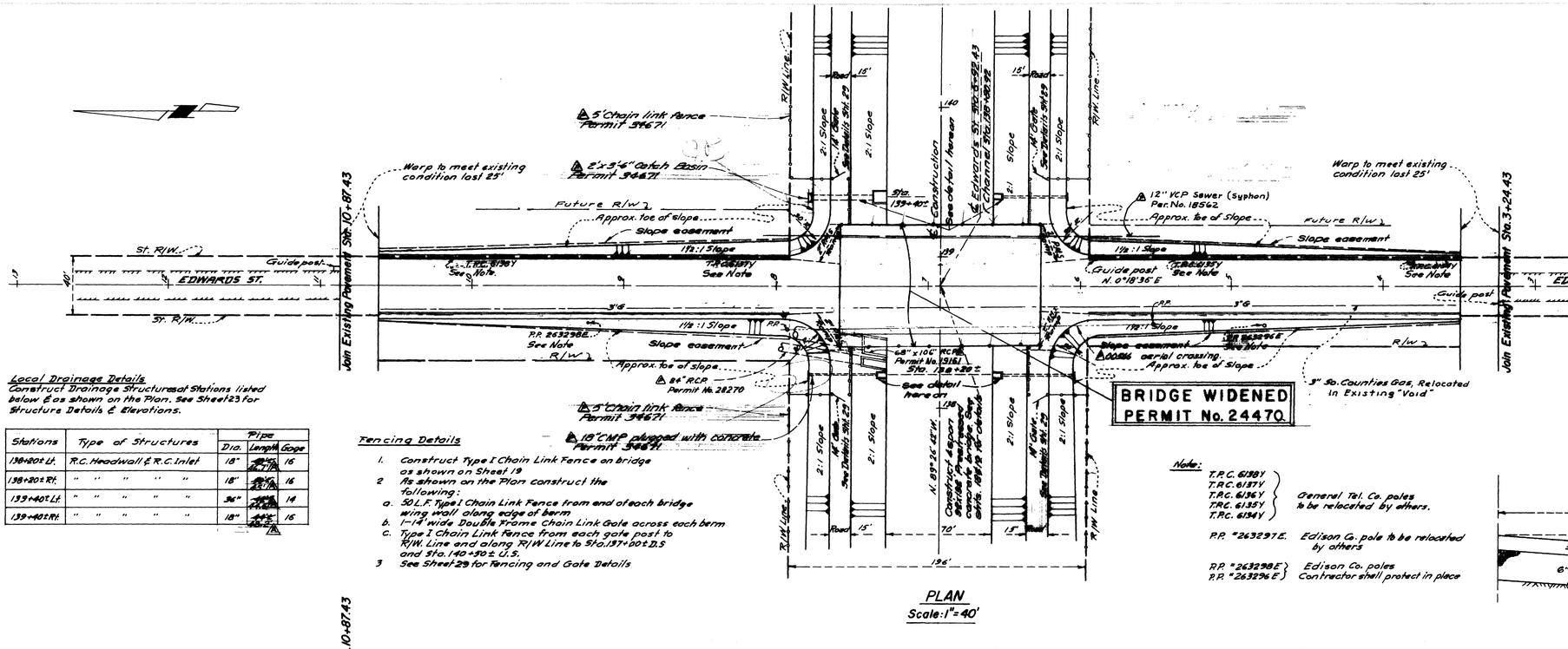
REVISED	REFERENCE	ORANGE COUNTY FLOOD CONTROL DISTRICT
4 13867 05767 05362, 09963		EAST GARDEN GROVE-WINTERSBURG CHANNEL
6		WARNER AVENUE BRIDGE PLAN & PROFILE
DESIGNED G.E.M.	PREPARED G.M.T	
CHECKED J.W.H	SUBMITTED DESIGN ENG'R.	DATE: SEPTEMBER 1959 DWG. C05-J01-1-A

SHEET 12 OF 30

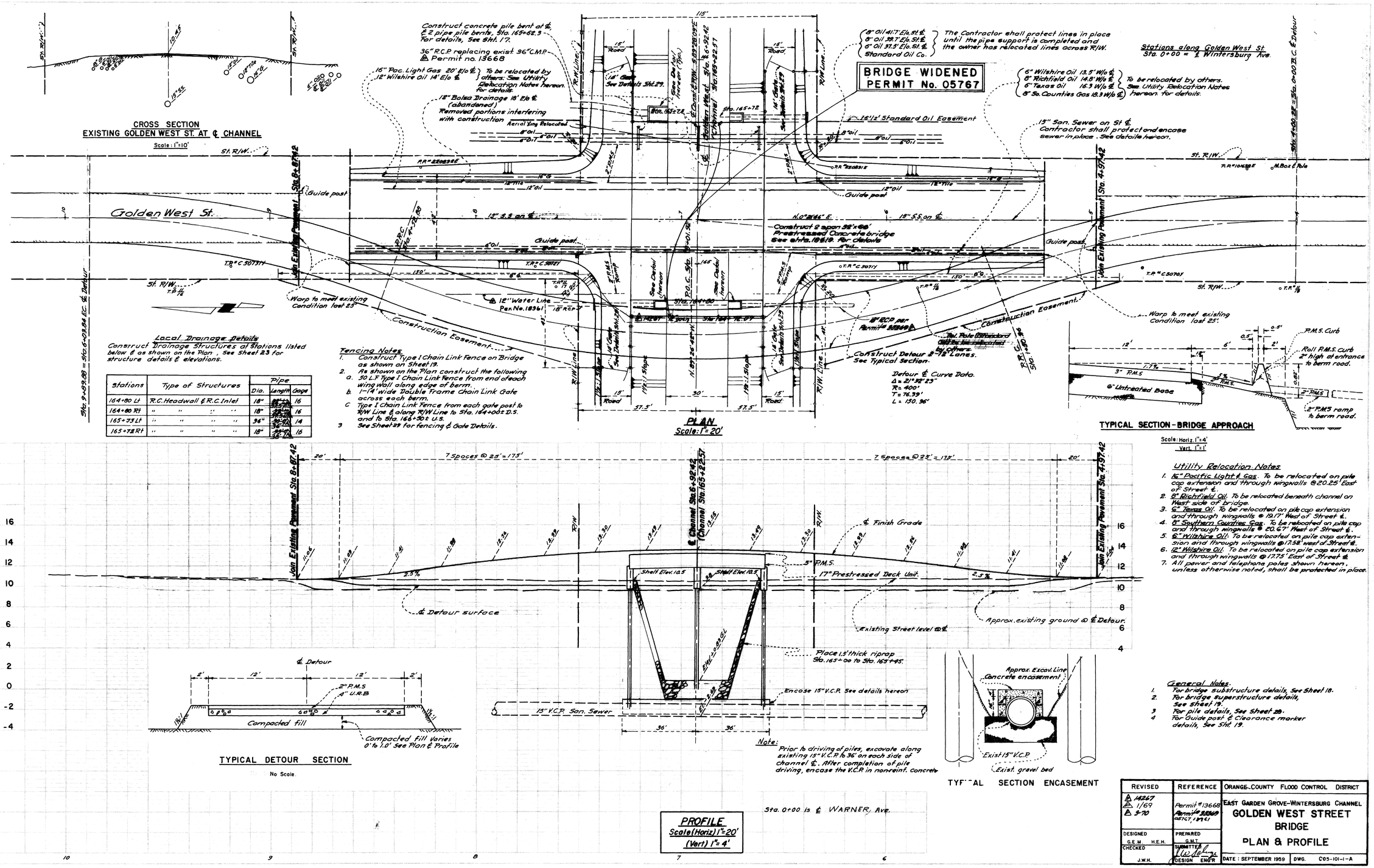
13 OF 30



SHEET 13 OF 30


5' Chain link fence Permit 34671
2'x3'6" Catch Basin Permit 34671
Warp to meet existing condition last 25'
Future R/W
Approx. toe of slope
Slope easement
1½:1 Slope
Guide post
EDWARDS ST.
ST. R/W
Join Existing Pavement Sta. 10+87.43
Join Existing Pavement Sta. 3+24.43
12" V.C.P. Sewer (Syphon) Per. No. 18562
Stations along Edwards St.
Sta. 0+00 = ℄ Wintersburg Ave.
Construct Drainage Structures at Stations listed below & as shown on the Plan. See Sheet 23 for Structure Details & Elevations.
Local Drainage Details
Fencing Details
1. Construct Type I Chain Link Fence on bridge as shown on Sheet 19
2. As shown on the Plan construct the following:
a. 50 L.F. Type I Chain Link Fence from end of each bridge wing wall along edge of berm
b. 1-14' wide Double Frame Chain Link Gate across each berm
c. Type I Chain Link Fence from each gate post to R/W Line and along R/W Line to Sta. 137+00 ± D.S and Sta. 140+50 ± U.S.
3. See Sheet 29 for Fencing and Gate Details
BRIDGE WIDENED PERMIT No. 24470
3" So. Counties Gas, Relocated in Existing "Void"
Note:
General Tel. Co. poles to be relocated by others.
Edison Co. pole to be relocated by others
Edison Co. poles Contractor shall protect in place
PLAN
Scale: 1" = 40'
TYPICAL SECTION BRIDGE APPROACH
Scale: (Horiz) 1" = 4' (Vert) 1" = 1
6" Untreated Base
P.M.S. Curb
Roll P.M.S. curb 2" high at entrance to berm road.
2" P.M.S ramp to berm road.
15 Spaces @ 25' each = 375'
14 Spaces @ 25' each = 350'
℄ Finish Grade
3" P.M.S
17" Prestressed deck unit
Exist. ground along ℄ of street
12" Sewer
General Notes
1 For bridge substructure details, See Sht. 18
2 For bridge superstructure details, See Sht. 19
3 For pile details, See Sht. 28
4 For guide post & clearance marker details, See Sht. 19
PROFILE
Scale (Horiz) 1" = 40' (Vert) 1" = 4'
Sta. 0+00 is ℄ of Wintersburg Ave
REVISED
REFERENCE
ORANGE COUNTY FLOOD CONTROL DISTRICT
EAST GARDEN GROVE-WINTERSBURG CHANNEL
EDWARDS STREET BRIDGE
PLAN & PROFILE
DESIGNED G.E.M. H.E.H.
CHECKED J.W.H.
PREPARED G.M.T.
SUBMITTED DESIGN ENGR.
DATE: SEPTEMBER 1959
DWG. C05-101-1-A
SHEET 14 OF 30

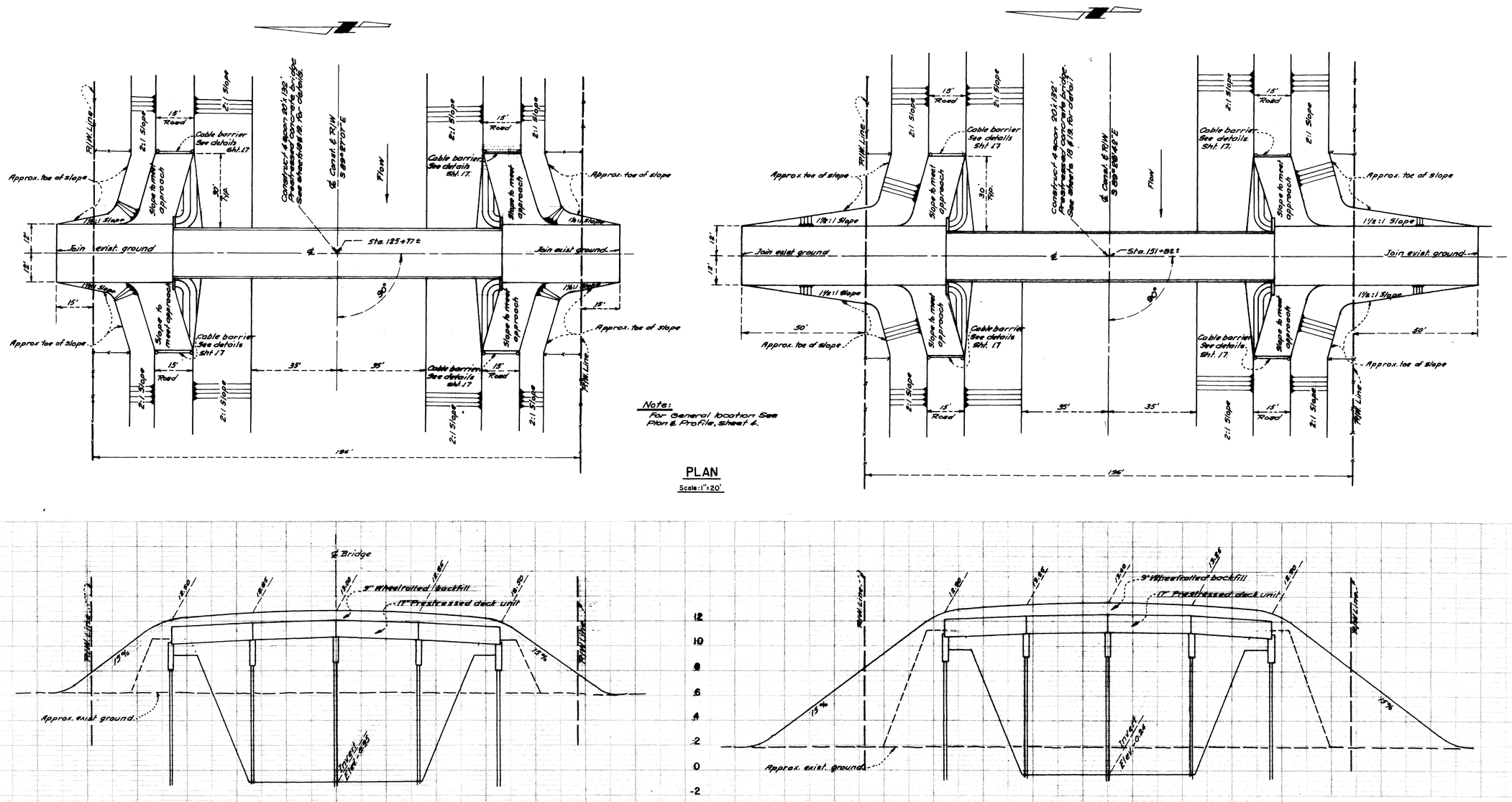
15 OF 30



SHEET 15 OF 30

C05-101-1-A

16 OF 30



Note:
For General location See Plan & Profile, Sheet 4.

PLAN
Scale: 1" = 20'

PROFILE
Scale (Horiz) 1" = 20'
(Vert) 1" = 4'

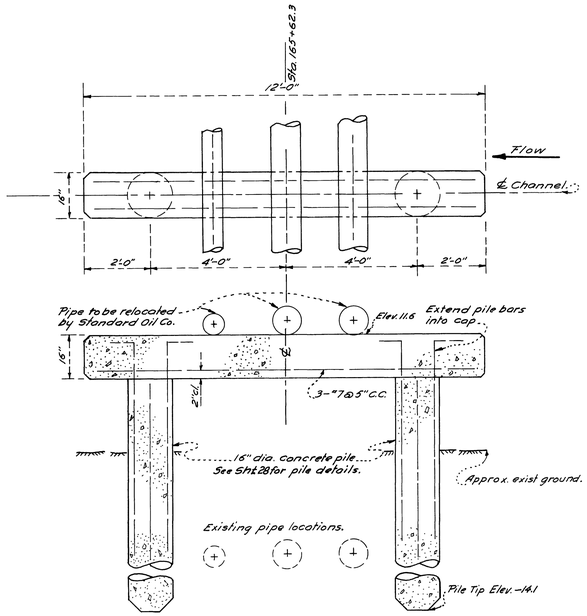
THIS SHEET DELETED BY CHANGE ORDER

General Notes:

1. For bridge substructure details, See Sht 18.
2. For bridge superstructure details, See Sht. 19
3. For pile details, See Sht. 29
4. For Guide post & Clearance marker details, See Sht. 15

REVISED	REFERENCE	ORANGE COUNTY FLOOD CONTROL DISTRICT
		EAST GARDEN GROVE-WINTERSBURG CHANNEL
		FARM BRIDGES
DESIGNED G.E.M.	PREPARED G.M.T.	PLAN & PROFILE
CHECKED J.W.H.	SUBMITTED DESIGN ENGR	DATE: SEPTEMBER 1959 DWG. C05-101-1-A

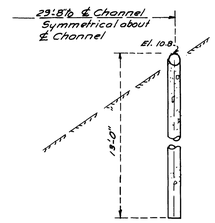
SHEET 16 OF 30



CONCRETE PILE PIPE SUPPORT

STA. 165 + 62.3 – Sh.15

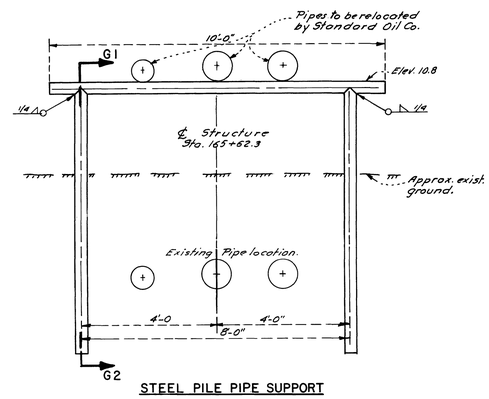
Scale: 1/2"=1'-0"



SECTION G1-G1

No Scale

Note: Construct creosoted timber wingwall on both ends of bridge, on downstream side, after relocation of pipe lines by owner and before completion of berm road. Construct concrete wingwalls on upstream side. For details of concrete wingwall See Sht. 18.

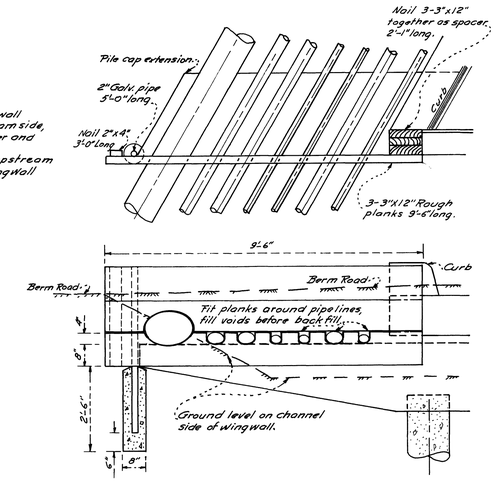


STEEL PILE PIPE SUPPORT

STA. 165 + 62.3 – Sh.15

(2-Required)

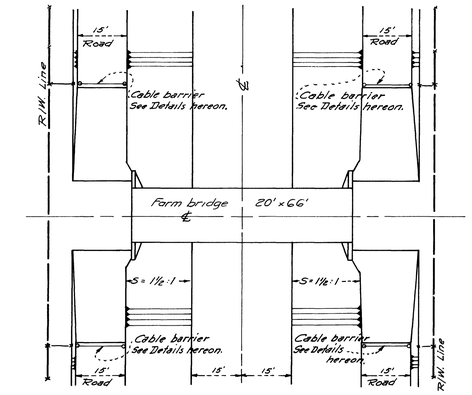
Scale: 1/2"=1'-0"



TIMBER WINGWALL

OIL FIELD BRIDGE-Sh.10

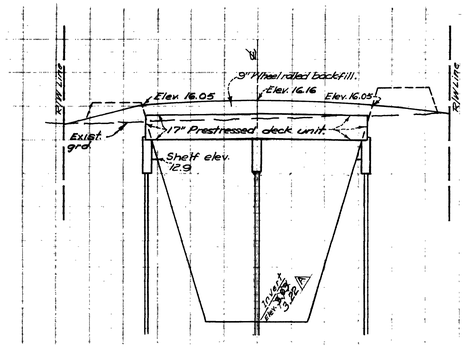
Scale: 1/2"=1'-0"



PLAN

FARM BRIDGE — STA. 179+74 △1 ~~178+59±~~

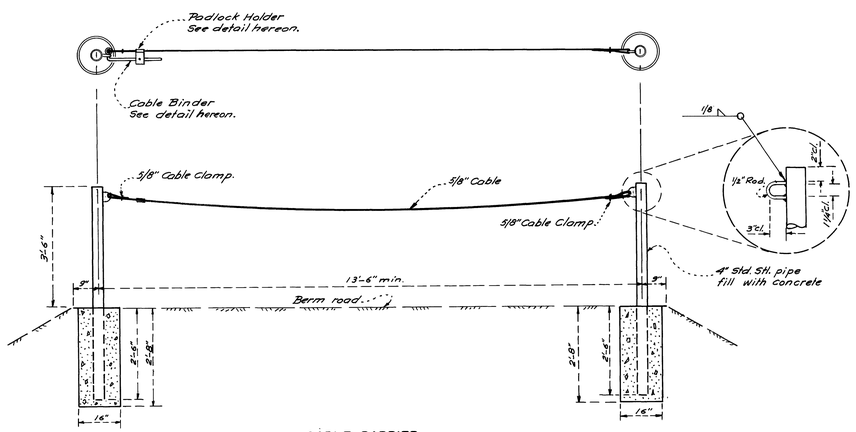
Scale: 1"=20'



PROFILE

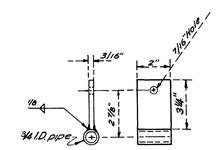
Scale: Horiz. 1"=20'

Vert. 1"=4'



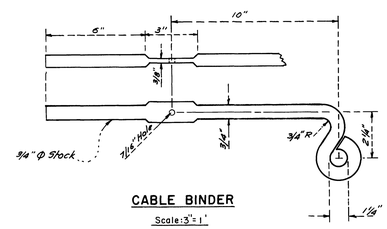
CABLE BARRIER

No Scale



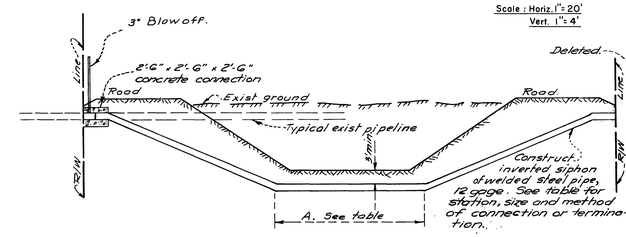
PADLOCK HOLDER

Scale 3"=1'



CABLE BINDER

Scale: 3"=1'



Station	Pipe dia	A	Approx. Total length	Case
74+10±	16"	112'	218'	II
88+75±	12"	100'	195'	I
~~104+00±~~	~~12"~~	~~111'~~	~~216'~~	~~III~~
112+00±	12"	101'	198'	II
119+00±	12"	100'	196'	II
132+10±	12"	100'	196'	II
135+52±	14'	100'	195'	I
142+08±	12"	100'	195'	I
148+60±	12"	100'	195'	I
160+25±	12"	46	115'	II
172+23±	12"	36'	118'	I
~~178+74±~~	12"	35'	115'	I

PIPELINE CROSSING

TYPICAL IRRIGATION PIPELINE CROSSING DETAIL

No Scale

Case I. Connect both ends to existing pipe by means of 2'-6" x 2'-6" x 2'-6" concrete block. (Shown at left of above detail.)

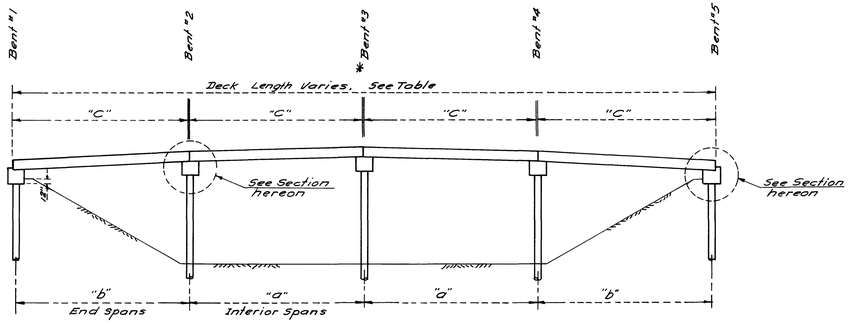
Case II. Connect one end, as shown on Plan & Profile, to existing pipe. Terminate other end at R/W line. (Shown at right end of above detail.)

Case III. Terminate both ends at R/W line.

Note . If connecting line is not completed when the inverted siphon is constructed, end the siphon 15" from the R/W line, plug and mark location with a stake.

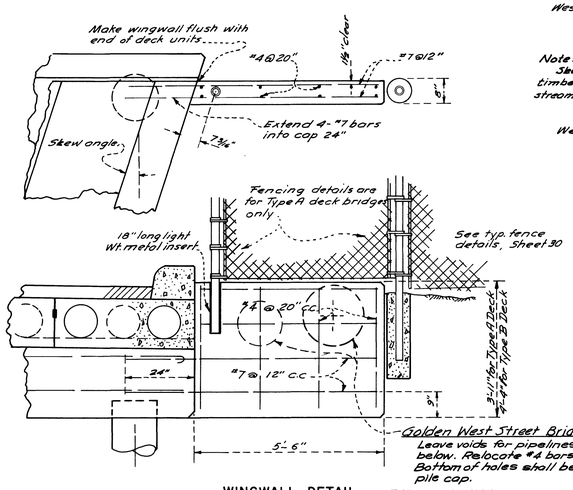
REVISED	REFERENCE	ORANGE COUNTY FLOOD CONTROL DISTRICT
△1 11-10-59	Chgd siphon Sta. 160+25±	EAST GARDEN GROVE–WINTERSBURG CHANNEL
		CONSTRUCTION DETAILS
		FARM BRIDGE — STA. 178+59±
DESIGNED H. E. H.	PREPARED G.M.T.	PLAN & PROFILE
CHECKED J.W.H	SUBMITTED DESIGN ENG'R	DATE: SEPTEMBER 1959 DWG. C05-101-1-A

△1 (NOTE SHT. 16 DELETED BY CHANGE ORDER) SHEET 17 OF 30



TYPICAL SECTION AT ℄ OF BRIDGE
LOOKING UPSTREAM
No Scale

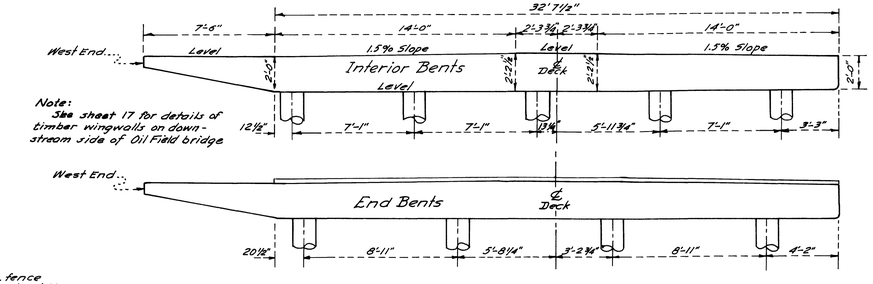
* Oil Field bridge with 5 spans has two bents #3. sym. about ℄ channel



WINGWALL DETAIL
Scale: 1/2"=1'-0"

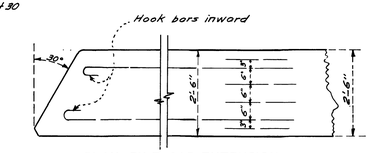
EAST WINGWALLS:
20" hole with ℄ 4'-1" from edge of deck.
16" hole with ℄ 1'-7" from edge of deck.

WEST WINGWALLS
10" hole with ℄ 1'-5" from edge of deck.
10" hole with ℄ 2'-11" from edge of deck.
10" hole with ℄ 4'-5" from edge of deck.

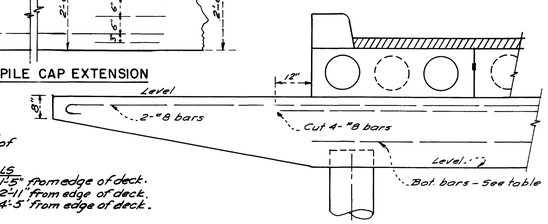


Note: See sheet 17 for details of timber wingwalls on downstream side of Oil Field bridge

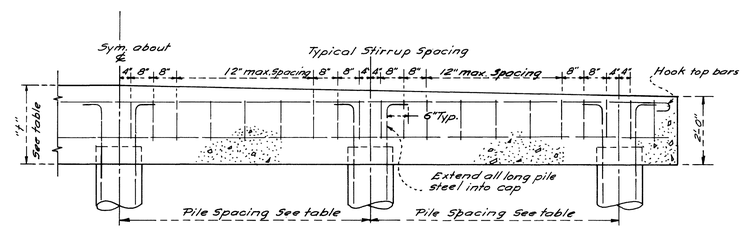
OIL FIELD BRIDGE
PILE CAP & PILE SPACING DETAILS
Scale: 1/4"=1'-0"



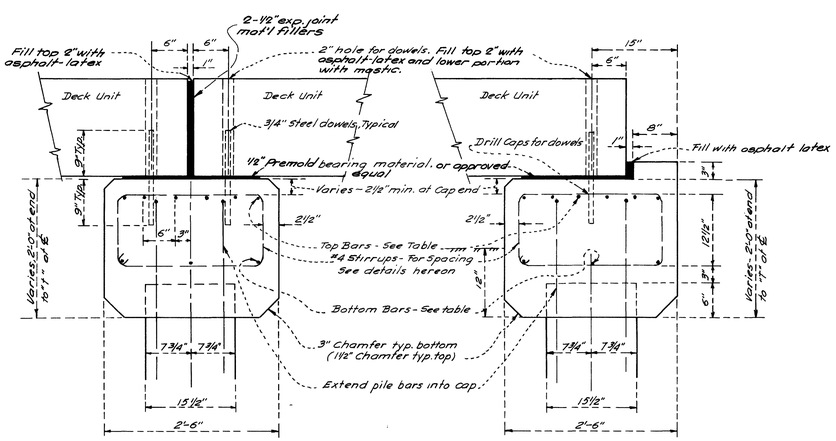
PLAN-PILE CAP EXTENSION



OIL FIELD BRIDGE
PILE CAP EXTENSION
Scale: 1/2"=1'-0"



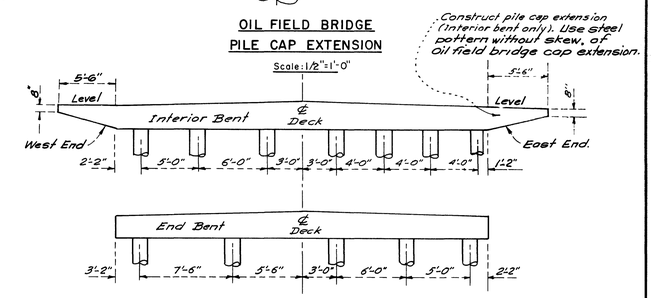
TYPICAL PILE CAP DETAILS
No Scale



INTERIOR PILE CAPS

ABUTMENT PILE CAPS

TYPICAL PILE CAP SECTIONS
Scale: 1"=1'-0"



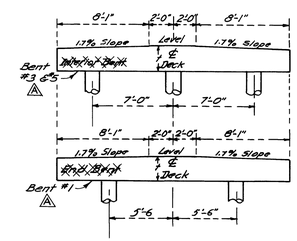
GOLDEN WEST STREET BRIDGE
PILE SPACING DETAILS
No Scale

NOTE: As Built Tip Elevations given are for Maximum Depth of Piles.

BRIDGE LOCATION		GENERAL LAYOUT				BENT SPAN		NO. PILES		TOTAL No. OF PILES	MAX. TIP ELEV.		PILE CUTOFF ELEVATIONS					PILE CAP DATA						FOR BRIDGE APPROCH DETAILS SEE SHEET
STREET NAME	℄ STATION	DECK LENGTH	No. OF SPANS	DECK WIDTH	SKEW ANGLE	LENGTH "a"	LENGTH "b"	BENTS 1 & 5	BENTS 2,3 & 4		BENTS 1 & 5	BENTS 2,3 & 4	BENT 1	BENT 2	BENT 3	BENT 4	BENT 5	LENGTH	DEPTH "t"	BENTS 1 & 5 Bot. Bars	BENTS 1 & 5 Top Bars	BENTS 2,3 & 4 Bot. Bars	BENTS 2,3 & 4 Top Bars	
* OIL FIELD	36+34±	150'-4"	5	28'-3"	30°00'00"	30'-1"	29'-6½"	‡4@8'-11"	5@7'-1"	28	-42 -26	-42 -25	6.97	7.34	7.52	7.34	6.97	40'-1½"	See detail	3-#9	6-#8	3-#7	6-#8	10
SLATER	57+78±	140'-3"	4	24'-3"	17°54'32"	35'-1"	34'-6½"	‡4@7'-0"	5@5'-3"	23	-42 -40	-42 -40	7.12	7.47	7.58	7.47	7.12	25'-6"	2'-2½"	3-#8	6-#7	3-#6	6-#7	11
WINTERSBURG	100+56.87	140'-3"	4	32'-4"	17°54'32"	35'-1"	34'-6½"	‡5@7'-6"	7@5'-0"	31	-49	-49 -40	8.02	8.24	8.31	8.24	8.02	34'-0"	2'-3¼"	3-#8	6-#7	3-#6	6-#6	12
SPRINGDALE	112+39.01	132'-3"	4	32'-4"	4°21'14"	33'-1"	32'-6½"	5@7'-3"	7@4'-10"	31	-45 -41	-46 -40	8.30	8.61	8.71	8.61	8.30	32'-5"	2'-3¼"	3-#8	6-#7	3-#6	6-#6	13
~~FARM~~	~~125+77±~~	~~132'-3"~~	~~4~~	~~20'-2"~~	~~0°00'00"~~	~~33'-1"~~	~~32'-6½"~~	‡2@11'-0"	3@7'-0"	~~13~~	~~-48~~	~~-48~~	~~8.83~~	~~9.18~~	~~9.33~~	~~9.18~~	~~8.83~~	~~20'-2"~~	~~2'-1 5/8"~~	~~6-#8~~	~~6-#9~~	~~4-#7~~	~~6-#9~~	~~16~~
EDWARDS	138+80.92	132'-3"	4	32'-4"	** 0°14'42"	33'-1"	32'-6½"	5@7'-3"	7@4'-10"	31	-48 -42	-47	8.95	9.19	9.21	9.02	8.62	32'-4"	2'-3¼"	3-#8	6-#7	3-#6	6-#6	14
~~FARM~~	~~151+82±~~	~~132'-3"~~	~~4~~	~~20'-2"~~	~~0°00'00"~~	~~33'-1"~~	~~32'-6½"~~	‡2@11'-0"	3@7'-0"	~~13~~	~~-46~~	~~-46~~	~~9.23~~	~~9.58~~	~~9.73~~	~~9.58~~	~~9.23~~	~~20'-2"~~	~~2'-1 5/8"~~	~~6-#8~~	~~6-#9~~	~~4-#7~~	~~6-#9~~	~~16~~
GOLDEN WEST	165+22.57	66'-1"	2	32'-4"	** 0°11'32"	—	32'-6½"	See detail	See detail	17	-35 -26	-32 -25	10.00	—	10.11	—	10.00	32'-4"	2'-3¼"	3-#8	6-#8	3-#7	6-#8	15
FARM	~~172+39±~~ 173+74± △	66'-1"	2	20'-2"	0°00'00"	—	32'-6½"	‡2@11'-0" △ Bent #5 3@7'-0"	3@7'-0"	~~8~~ △	‡ -31 -25	‡ -27 -25	~~12.38~~ △ 12.57	—	~~12.43~~ △ 12.68	—	~~12.38~~ △ 12.57	20'-2"	2'-1 5/8"	6-#8	6-#9	4-#7	6-#9	17

* Oil field bridge has no pile bent @ ℄ channel
** Construct without skew where angle is less the one degree
‡ Bents with even number of piles – No pile @ ℄ cap, space sym. about ℄.

‡ Given tip elevation is for bidding purposes only. District will furnish tip elevation within 30 days after bid opening.



TYPICAL FARM BRIDGE
PILE CAP & PILE SPACING DETAIL
No Scale

General Notes

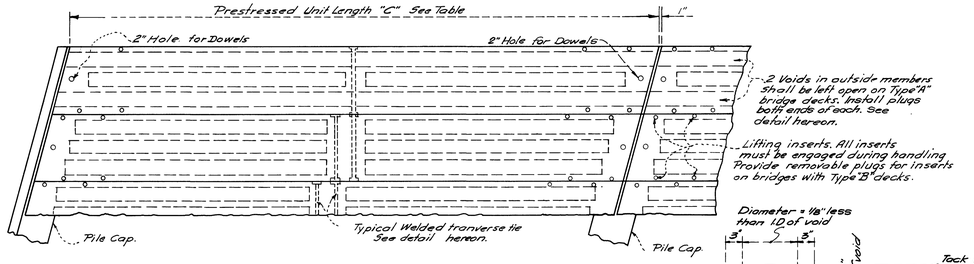
1. For bridge superstructure details, see Sh. 19
2. For pile details, see Sh. 28
3. For guide post & clearance marker details see Sh. 19

REVISED	REFERENCE	ORANGE COUNTY FLOOD CONTROL DISTRICT
△ 11-10-59	Deleted by chg. order	EAST GARDEN GROVE-WINTERSBURG CHANNEL
		PRESTRESS CONCRETE BRIDGE SUBSTRUCTURE DETAILS
DESIGNED G.E.M.	PREPARED G.M.T.	
CHECKED J.W.H.	SUBMITTED DESIGN ENGR.	DATE: SEPTEMBER 1959 DWG. C05-101-1-A

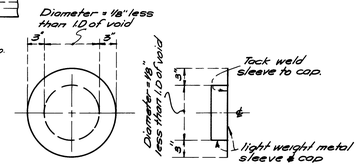
SHEET 18 OF 30

18 OF 30

19 OF 30

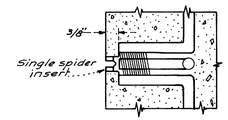


PARTIAL DECK PLAN
TYPICAL H20-S16-44 PRESTRESSED DECK UNIT
No Scale

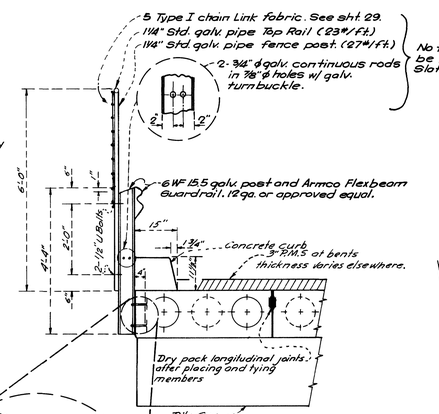


PLUG DETAIL
Scale: 1" = 1'-0"

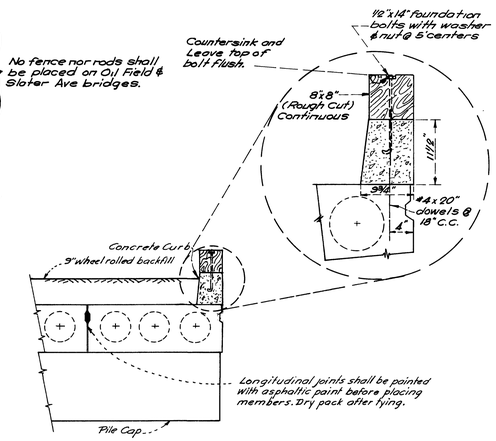
Note:
Provide 2-1 1/4" single spider inserts and 1-3/4" single spider insert for each post and 2-3/4" single spider inserts @ 12'-6" c.c. centered between every other pair of posts for future utility supports. Safe tension ratings to be 16,000# for 1 1/4" spider and 6,000 for 3/4" spider. Insetts to be Richmond as sold by W.J. Burke & Co. or opp. eq.



TYPICAL PIPE HANGER AND RAIL INSERT
No Scale

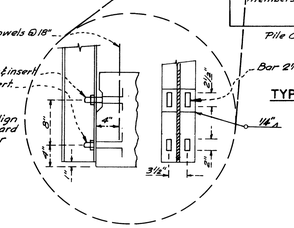


TYPE "A" DECK

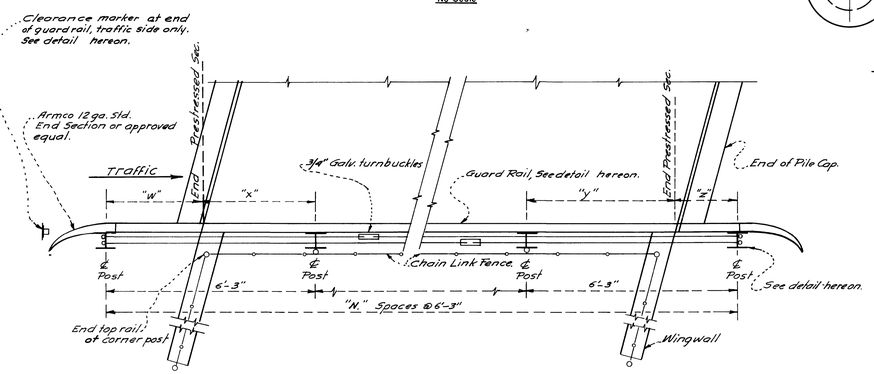


TYPE "B" DECK

TYPICAL GUARD RAIL AND FENCE DETAIL
Scale: 1/2" = 1'-0"

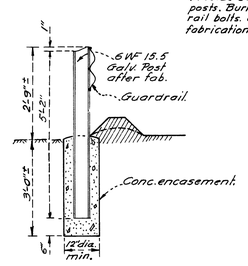


Note:
Provide suitable shims to align posts. Burr all fence and guard rail bolts. Galv. W posts after fabrication.

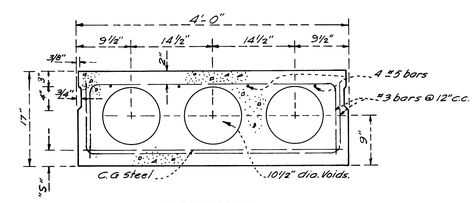


Note:
See table hereon for lettered dimensions.

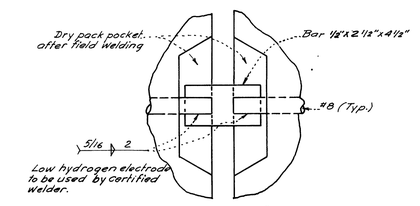
TYPICAL GUARD RAIL POST DETAIL
No Scale

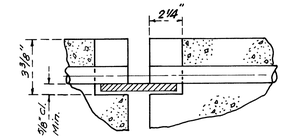


TYPICAL GUARD RAIL POST BEYOND BRIDGE
Scale: 1/2" = 1'-0"

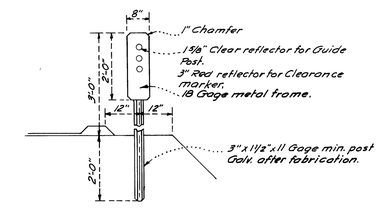


PRESTRESSED SECTION DECK UNIT
Scale: 1" = 1'-0"





WELDED TRANSVERSE TIE
Scale: 3" = 1'-0"



GUIDE POSTS & CLEARANCE MARKER DETAILS
Scale: 1/2" = 1'-0"

Bridge	No. Guide Posts	No. Clearance Markers
Oil Field	9	2
Slater	19	2
Wintersburg	4	2
Springdale	4	2
Edwards	4	2
Golden West	4	2

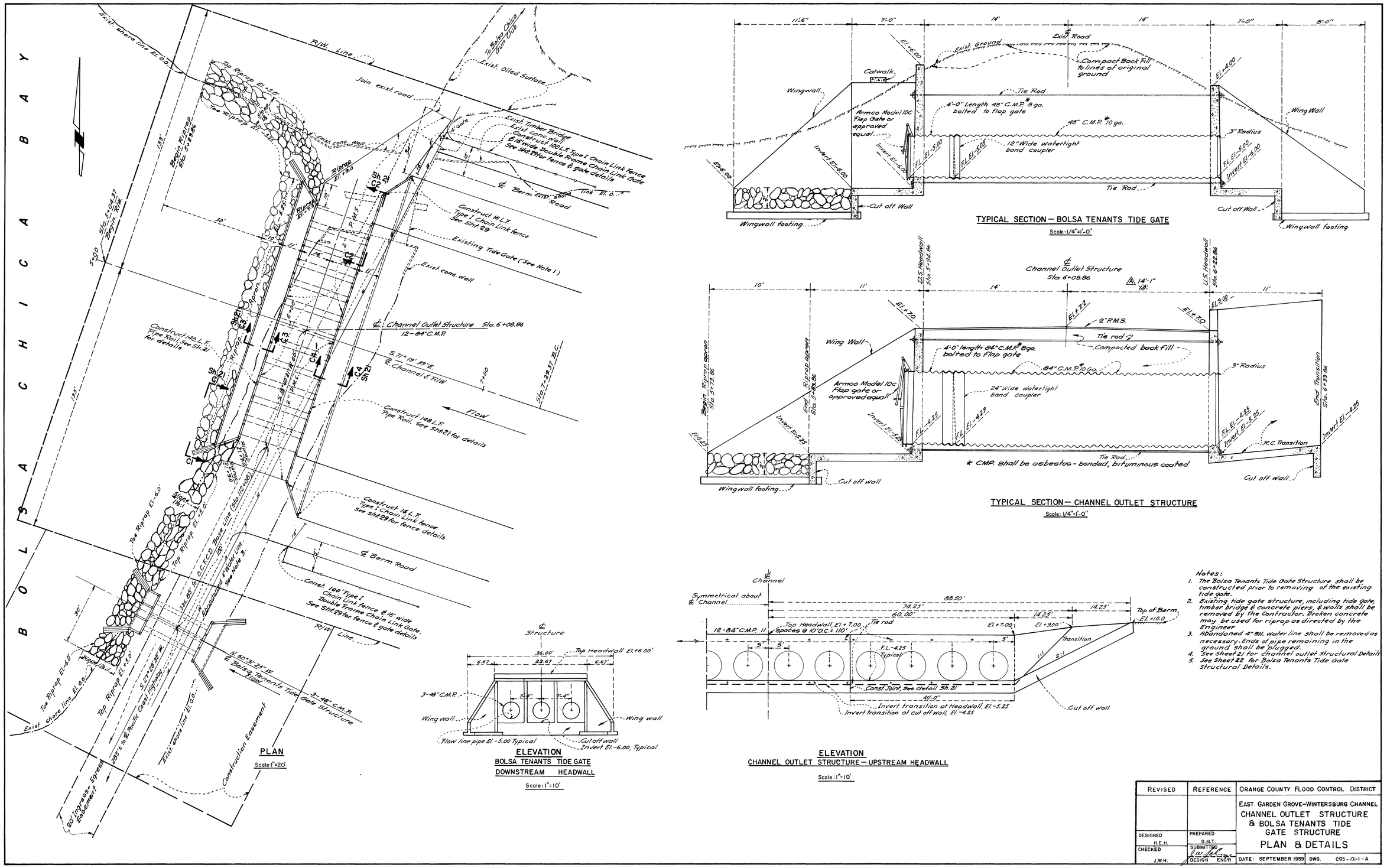
BRIDGE LOCATION		GENERAL LAYOUT				PRESTRESSED CONCRETE DECK UNITS						DECK	GUARD RAIL POST DETAIL					FOR BRIDGE APPROACH DETAILS SEE SHEET
STREET NAME	℄ STATION	DECK LENGTH	No. OF SPANS	DECK WIDTH	SKEW ANGLE	TOTAL No. UNITS	LENGTH C	BASIC WEIGHT	(1) DESIGN MOMENT	DIST. "S" TO C of G	(2) PRESTRESS DESIGN FORCE	TYPE	LENGTH W	LENGTH X	LENGTH Y	LENGTH Z	SPACES N	
OIL FIELD	36+34±	150'-4"	5	28'-3"	30°00'00"	35	30'	18,850#	2983 in.k	2.28 in.	302 k	A	2'-11 1/2"	3'-3 1/2"	3'-3 1/2"	2'-11 1/2"	25	10
SLATER	57+78±	140'-3"	4	24'-3"	17°34'52"	24	35'	21,720#	3763 in.k	2.75 in.	400 k	A	1'-10 1/4"	4'-4 3/4"	4'-4 3/4"	1'-10 1/4"	23	11
WINTERSBURG	100+56.87	140'-3"	4	32'-4"	17°34'52"	32	35'	21,720#	3763 in.k	2.75 in.	400 k	A	1'-10 1/4"	4'-4 3/4"	4'-4 3/4"	1'-10 1/4"	23	12
SPRINGDALE	112+39.01	132'-3"	4	32'-4"	4°21'14"	32	33'	20,570#	3444 in.k	2.62 in.	363 k	A	3'-4"	2'-11"	4'-4"	1'-11"	22	13
⚠ ~~FARM~~	~~125+77±~~	~~132'-3"~~	~~4~~	~~20'-2"~~	~~0°00'00"~~	~~20~~	~~33'~~	~~20,570#~~	~~3444 in.k~~	~~2.62 in.~~	~~363 k~~	~~B~~						~~16~~
EDWARDS	138+80.92	132'-3"	4	32'-4"	0°14'42"	32	33'	20,570#	3444 in.k	2.62 in.	363 k	A	3'-4"	2'-11"	4'-4"	1'-11"	22	14
⚠ ~~FARM~~	~~151+82±~~	~~132'-3"~~	~~4~~	~~20'-2"~~	~~0°00'00"~~	~~20~~	~~33'~~	~~20,570#~~	~~3444 in.k~~	~~2.62 in.~~	~~363 k~~	~~B~~						~~15~~
GOLDEN WEST	165+22.57	66'-1"	2	32'-4"	0°11'32"	16	33'	20,570#	3444 in.k	2.62 in.	363 k	A	1'-4"	4'-11"	4'-11"	1'-4"	11	15
FARM	178+59±	66'-1"	2	20'-2"	0°00'00"	10	33'	20,570#	3444 in.k	2.62 in.	363 k	B	—	—	—	—	—	17

1. Design Moment is the working moment.
2. Prestress Design Force is the working force (Force remaining in prestressing steel after all losses in concrete and steel).

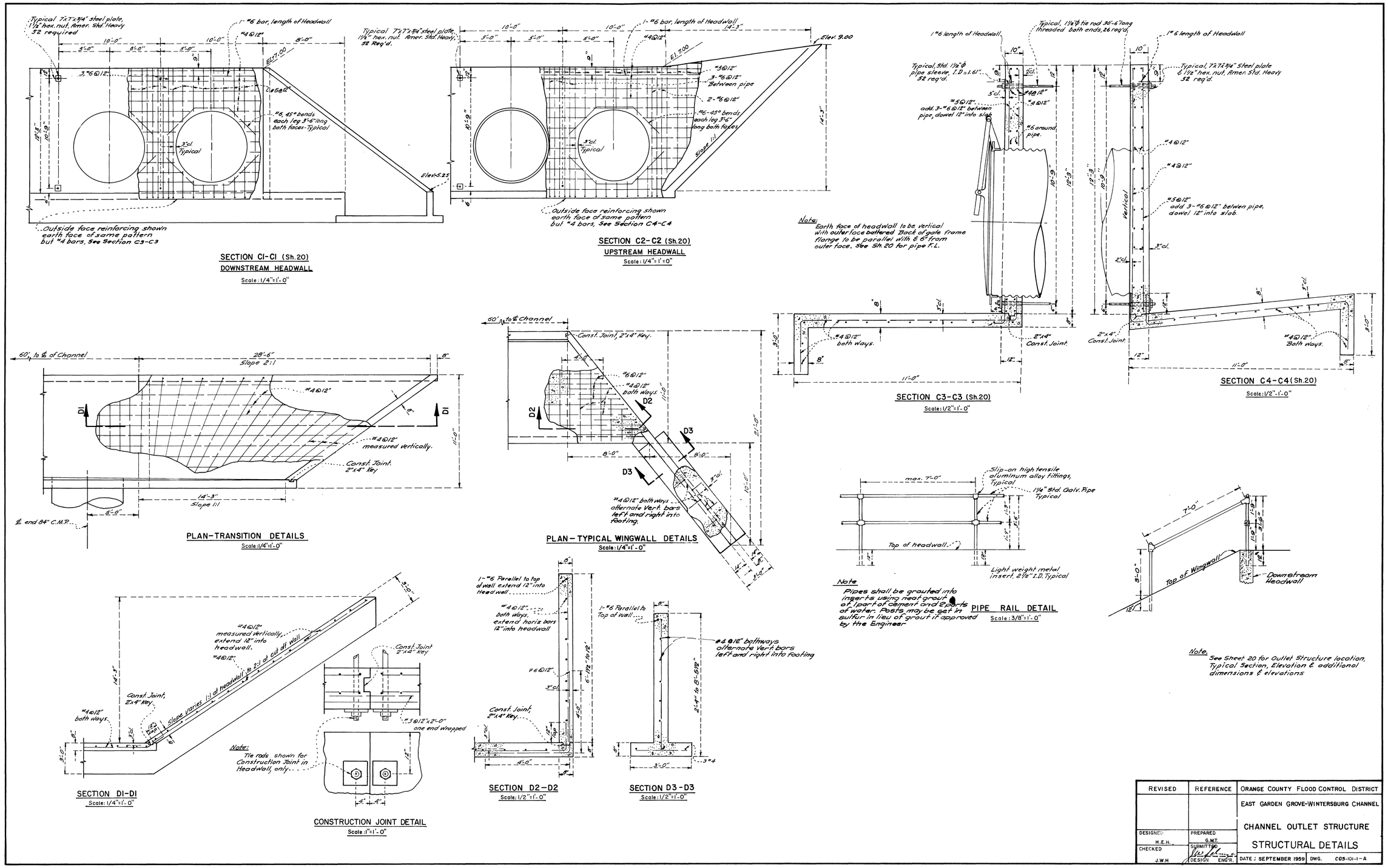
General Notes:
1 For bridge substructure details, See Sh. 18
2 For pile details, See Sht. 28.

REVISED	REFERENCE	ORANGE COUNTY FLOOD CONTROL DISTRICT
⚠ 11-10-59	Deleted by change order.	EAST GARDEN GROVE–WINTERSBURG CHANNEL
		PRESTRESS CONCRETE BRIDGE SUPERSTRUCTURE DETAILS
DESIGNED G.E.M.	PREPARED G.M.T.	
CHECKED J.W.H.	SUBMITTED DESIGN ENG'R	DATE: SEPTEMBER 1959 DWG. C05-101-1-A

20 OF 30



SHEET 20 OF 30



SHEET 21 OF 30

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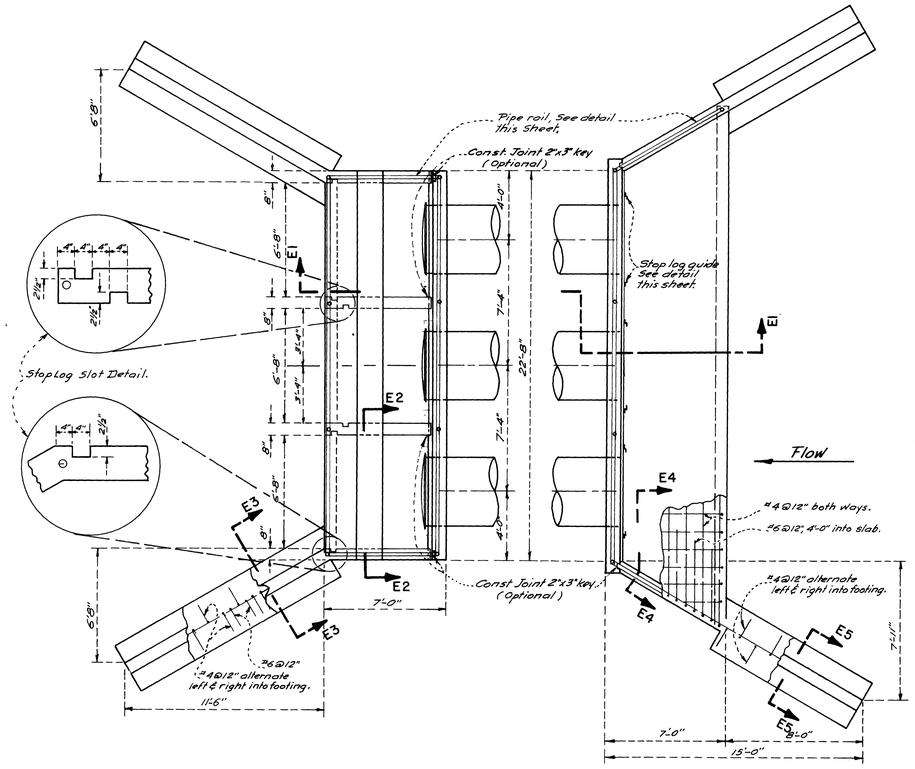
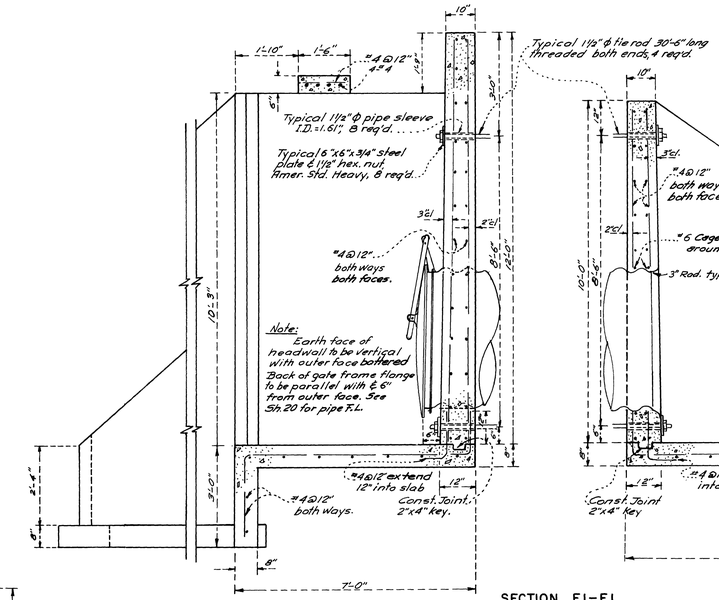
22 OF 30



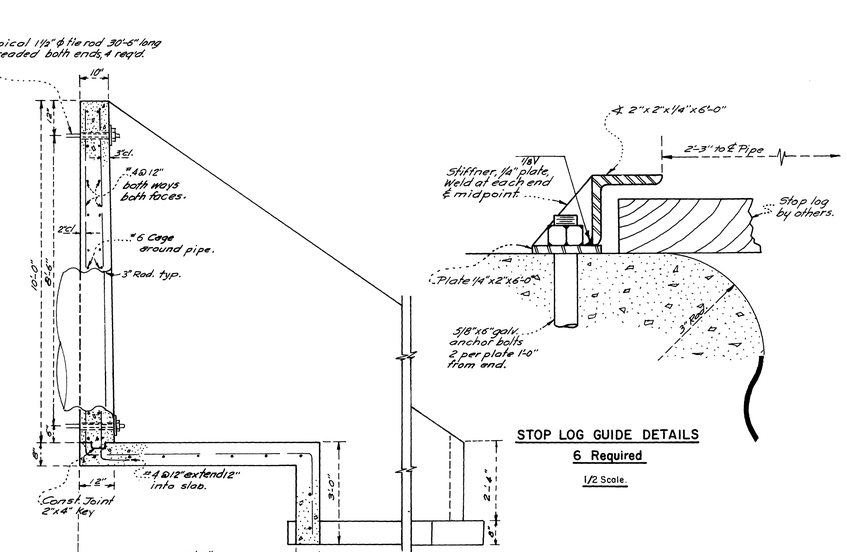
PLAN - BOLSA TENANTS TIDE GATE STRUCTURE

Scale: 1/4"=1'-0"



SECTION E1-E1

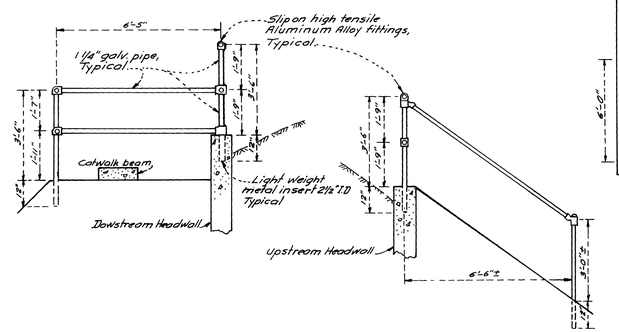
Scale: 1/2"=1'-0"

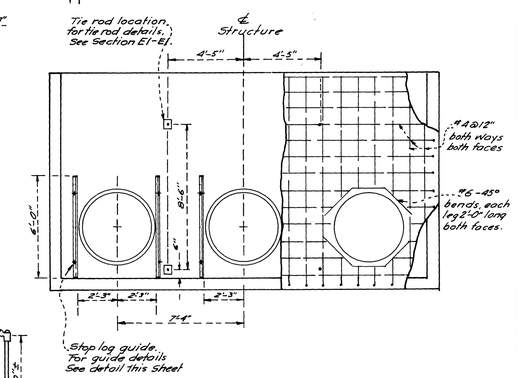


STOP LOG GUIDE DETAILS

6 Required

1/2 Scale.



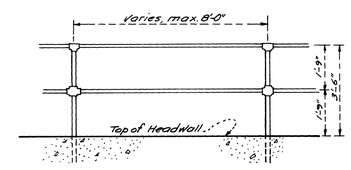


TYPICAL HEADWALL DETAILS

Scale: 1/4"=1'-0"

Notes:

1. See Sheet 20 for Tide Gate Structure location, Typical Section, Elevation, additional dimensions & elevations.

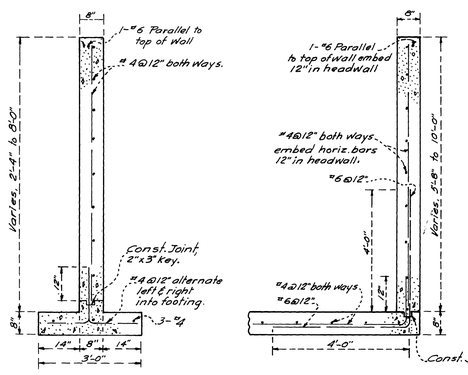


PIPE RAIL DETAIL

Scale: 3/8"=1'-0"

Note

Pipe shall be grouted into inserts using neat grout of 1 part cement and 2 parts of water. Posts may be set in sulfur in lieu of grout if approved by the Engineer.

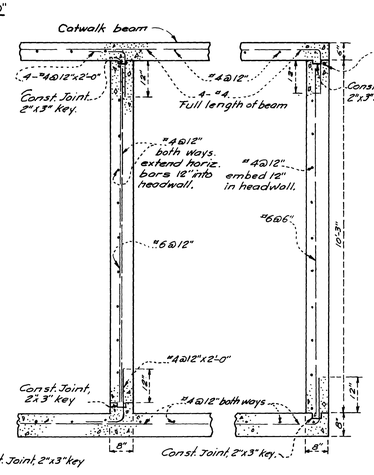


SECTION E5-E5

Scale: 1/2"=1'-0"

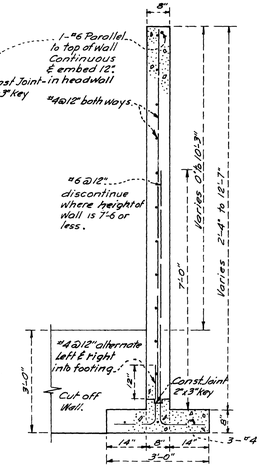
SECTION E4-E4

Scale: 1/2"=1'-0"



SECTION E2-E2

Scale: 1/2"=1'-0"



SECTION E3-E3

Scale: 1/2"=1'-0"

REVISED	REFERENCE	ORANGE COUNTY FLOOD CONTROL DISTRICT
		EAST GARDEN GROVE–WINTERSBURG CHANNEL
DESIGNED H.E.H.	PREPARED G.M.T.	BOLSA TENANTS TIDE GATE STRUCTURE STRUCTURAL DETAILS
CHECKED J.W.H.	SUBMITTED DESIGN ENG'R	DATE: SEPTEMBER 1959 DWG C05-101-1-A

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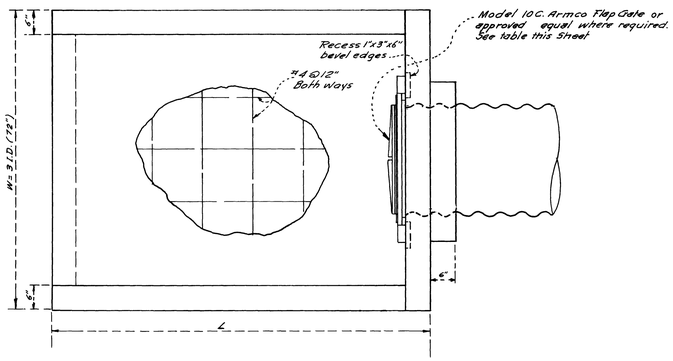
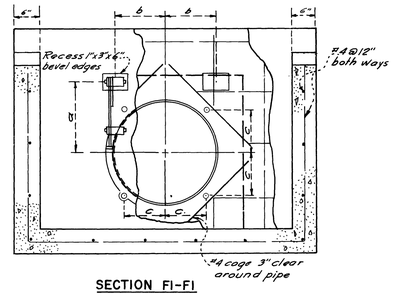
C05-101-1-A

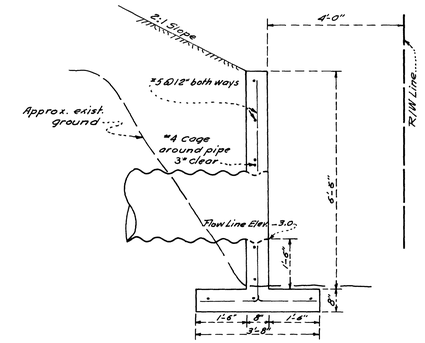


PLAN



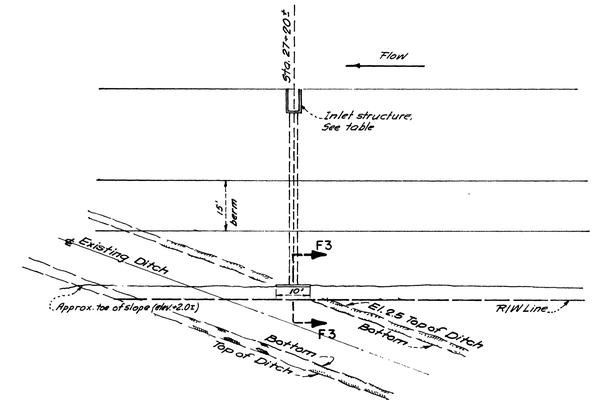
SECTION F1-F1

Scale: 3/4"=1'-0"



SECTION F3-F3

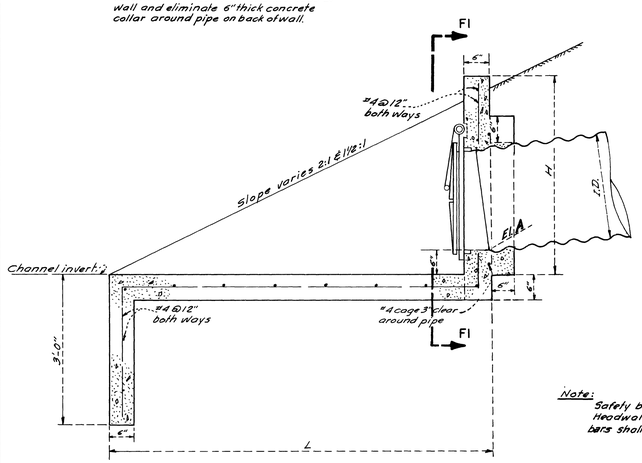
Scale: 1/2"=1'-0"



DRAINAGE STRUCTURE - STA. 27+00

Scale: 1"=20'

Note: For inlet structures not requiring flap gates, extend C.M.P. flush with channel face of wall and eliminate 6" thick concrete collar around pipe on back of wall.



SECTION ALONG ℄ PIPE

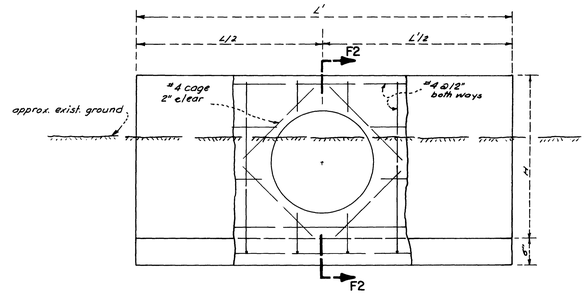
R.C. INLET STRUCTURE

Scale: 3/4"=1'-0"

TABLE LOCAL DRAINAGE STRUCTURES

LOCATION STATION	INTERSECTION	Pipe Size dia	Pipe Size lg	INLET STRUCTURE H	L	El.A	a	b	c	HEADWALL H	L'	El.B	d	Flap Gate Required
27+20± Rt.	———	24"	52'	4'-0"	10'-0"	-3.2	17"	12"	9¾"	See detail hereon				yes
112+80± Lt.	Springdale St *	20" / 36"	36' / 39½'	5'-0"	9'-6"	-0.35 / -2.8	14⅞" / 25"	10⅞" / 17⅞"	8¼" / 14⅞"	4'-3"	11'-6"	4.5	9"	yes (2)
112+90± Rt.	" " " "	18"	46' / 50½'	3'-6"	6'-6"	-0.8	12⅝"	9¼"	7⅞"	2'-9"	5'-6"	6.0	6"	yes
138+20± Lt.	Edward's St.	18"	46' / 50½'	3'-6"	6'-6"	-0.1	12⅝"	9¼"	7⅞"	2'-9"	5'-6"	2.0	6"	yes
138+20± Rt.	" " " "	18"	69' / 65'	3'-6"	6'-6"	-0.1	12⅝"	9¼"	7⅞"	2'-9"	5'-6"	2.0	6"	yes
139+40± Lt.	" " " "	36"	42' / 46½'	5'-0"	9'-6"	-0.1	25"	17⅝"	14⅞"	4'-3"	11'-6"	2.3	9"	Yes
139+40± Rt.	" " " "	18"	44' / 48½'	3'-6"	6'-6"	-0.1	12⅝"	9¼"	7⅞"	2'-9"	5'-6"	3.3	6"	yes
△ ~~140+78± Rt.~~ 142+60±	———	18"	42' / 46½'	3'-6"	6'-6"	+0.2	12⅝"	9¼"	7⅞"	2'-9"	5'-6"	1.0	6"	yes
164+80± Lt.	Golden West St.	18"	38' / 42½'	3'-6"	4'-8"	+1.3				2'-9"	5'-6"	8.6	6"	no
164+80± Rt.	" " " "	18"	38' / 42½'	3'-6"	4'-8"	+1.3				2'-9"	5'-6"	8.6	6"	no
165+73± Lt.	" " " "	36"	38' / 42½'	5'-0"	7'-0"	+1.3				4'-3"	11'-6"	5.3	9"	no
165+72± Rt.	" " " "	18"	33' / 37½'	3'-6"	4'-9"	+1.3				2'-9"	5'-6"	6.8	6"	no
△ ~~174+50± Lt.~~ 175	———	18"	38' / 42½'	3'-6"	4'-9"	+2.4				2'-9"	5'-6"	7.2	6"	no
174+50± Rt.	———	18"	38' / 42½'	3'-6"	4'-6"	+2.4				2'-9"	5'-6"	7.2	6"	no
191+85± Rt.	P.E. Ry	21"	44' / 49'	—	—	+5.7				3'-0"	6'-6"	18.3	6"	no
191+90± Lt.	" "	30"	41' / 47½'	—	—	+5.7				3'-9"	8'-6"	17.8	9"	no
197+80± Rt.	———	18"	32' / 36½'	3'-6"	4'-9"	+6.8				2'-9"	5'-6"	20.2	6"	no

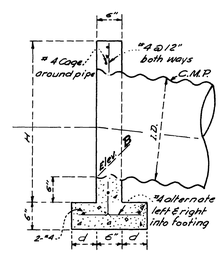
* 20" Bolsa Drainage Dist line, See Section below.



ELEVATION

R.C. HEADWALL

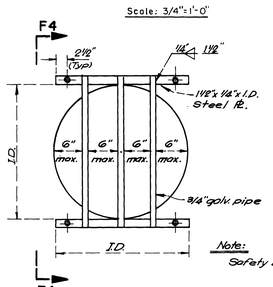
Scale: 3/4"=1'-0"



SECTION F2-F2

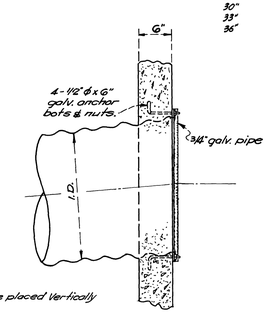
Note: Safety bars shall be installed on all R.C. Headwall except at Sta. 27+20. Number of bars shall be as follows:

Pipe Size.	No. of Bars.
18"	2
21"	3
24"	3
27"	4
30"	4
33"	5
36"	5



SAFETY BAR DETAILS

Note: Safety bars shall be placed Vertically

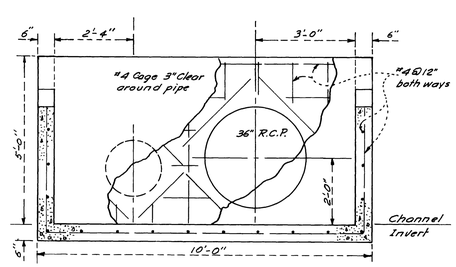


SECTION F4-F4

Scale: 1"=1'-0"

Set structure by ℄ of Bolsa Drainage Dist. 20" line

Flap Gates not shown



SECTION F1-F1

SPRINGDALE INLET STRUCTURE-LEFT

Scale: 1/2"=1'-0"

REVISED	REFERENCE	ORANGE COUNTY FLOOD CONTROL DISTRICT
		EAST GARDEN GROVE-WINTERSBURG CHANNEL
		LOCAL DRAINAGE STRUCTURES
DESIGNED H.E.H.	PREPARED G.M.T.	
CHECKED J.W.H.	SUBMITTED DESIGN ENGR.	DATE: SEPTEMBER 1959 DWG. C05-101-1-A

SHEET 23 OF 30

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C05-101-1-A

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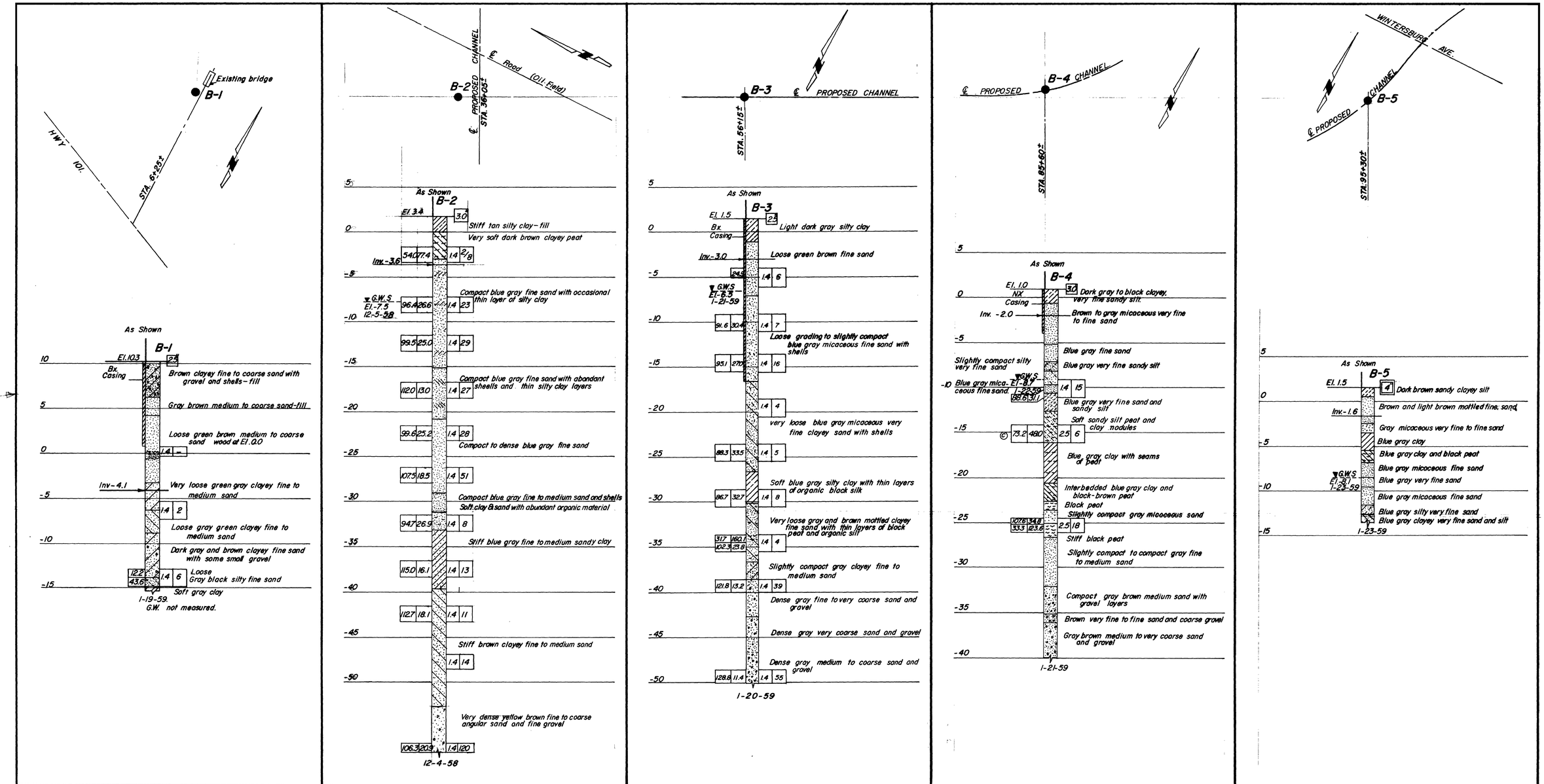

SHEET 24 OF 30

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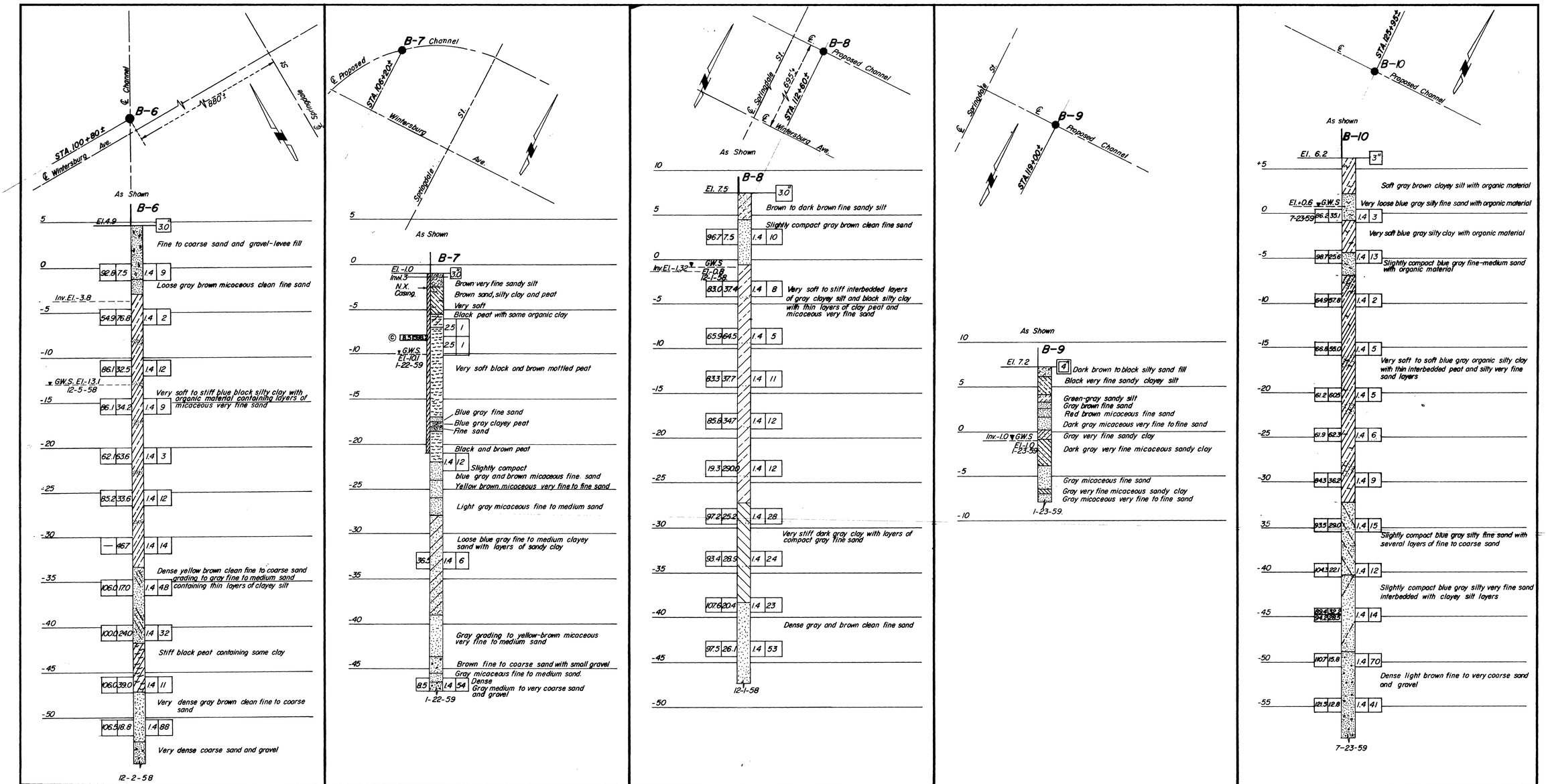


LEGEND OF EARTH MATERIALS

SIZE CLASSIFICATION

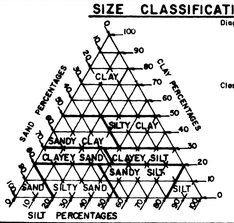


Diagram showing the basis of grainsize distribution used in determination of class names. Size classification is based on the Wentworth grade scale in field classification or the A.S.T.M. grade scale in the laboratory sieve analysis.

Classification of earth material shown on this sheet is based on field inspection and should not be construed to imply mechanical analysis unless so stated.

MATERIAL SYMBOLS

- Gravel
- Sand
- Silt
- Clay
- Sandy clay or clayey sand
- Sandy silt or silty sand
- Silty clay or clayey silt.
- Peat or organic matter
- Fill material
- Shale
- Sandstone
- Limestone
- Metamorphic rock
- Igneous rock

CONSISTENCY CLASSIFICATION

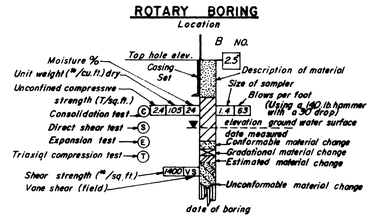
According to the Standard Penetration Test

No. of blows	Granular	Cohesive
0 - 5	very loose	very soft
6 - 10	loose	soft
11 - 20	slightly compact	stiff
21 - 35	compact	very stiff
36 - 70	dense	hard
70+	very dense	very hard

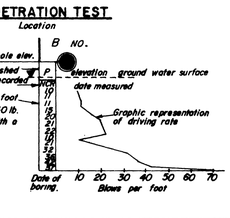
LEGEND OF BORING OPERATIONS

- Plan of any boring
- Flush penetrometer
- 2.5" Cone penetrometer
- Rotary boring
- Auger boring
- Sample. boring
- Jet boring
- Diamond core boring
- Test pit

ROTARY BORING



PENETRATION TEST



REVISED	REFERENCE	ORANGE COUNTY FLOOD CONTROL DISTRICT
		EAST GARDEN GROVE-WINTERSBURG CHANNEL
DESIGNED GEO ENG. Co.	PREPARED G.M.T.	LOG OF TEST BORING
CHECKED G.E.M.	SUBMITTED DESIGN ENGR.	DATE: SEPTEMBER 1959 DWG. C05-101-1-A

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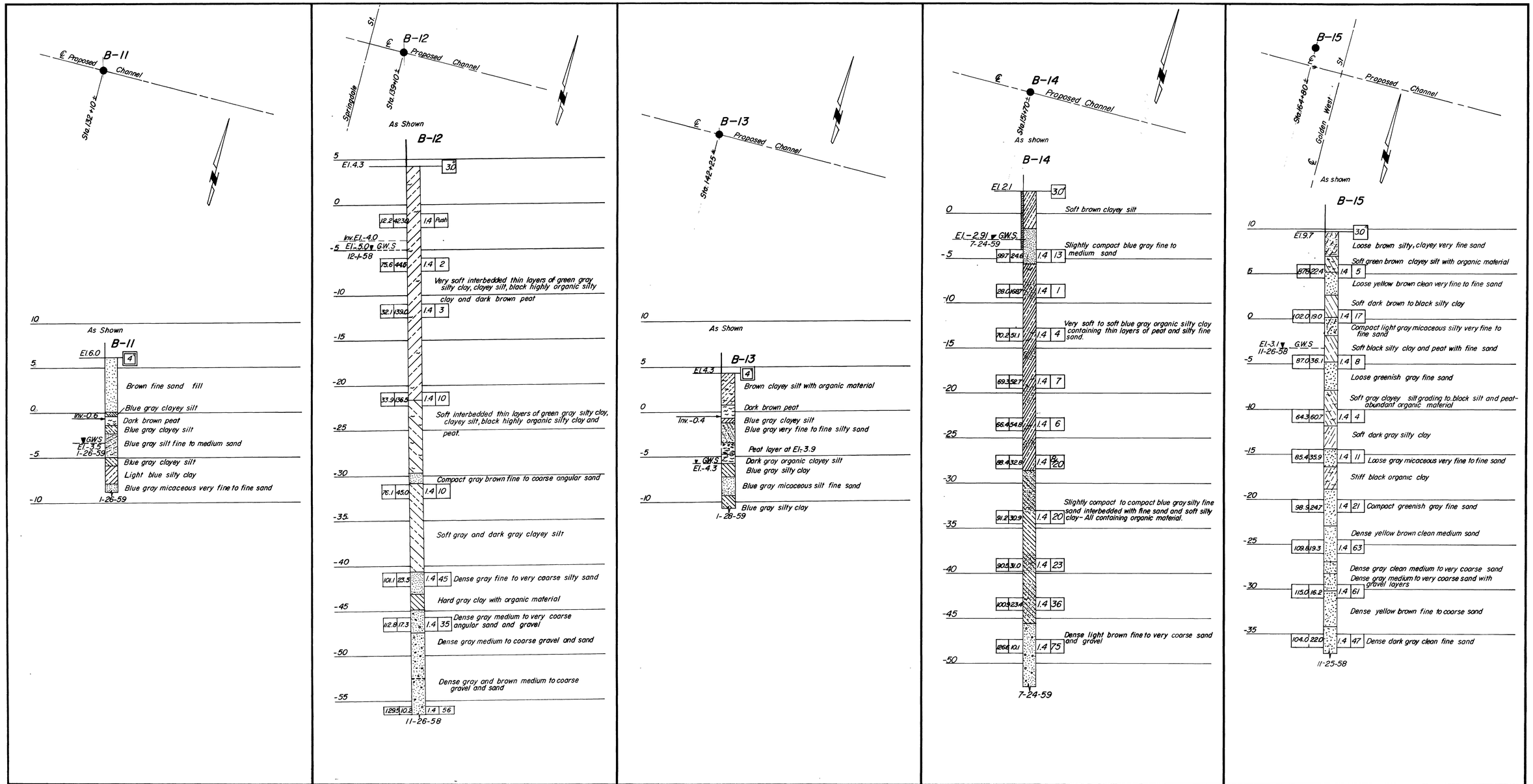

LEGEND OF EARTH MATERIALS

SIZE CLASSIFICATION

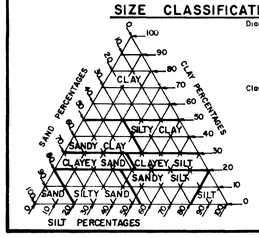

Diagram showing the basis of grainsize distribution used in determination of class names. Size classification is based on the Wentworth grade scale in field classification or the A.S.T.M grade scale in the laboratory sieve analysis.

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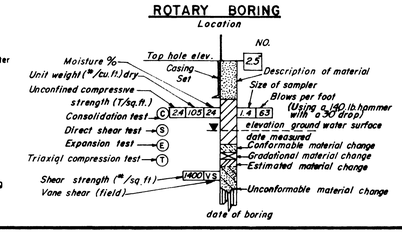
11 - 20	slightly compact	stiff
21 - 35	compact	very stiff
36 - 70	dense	hard
70+	very dense	very hard

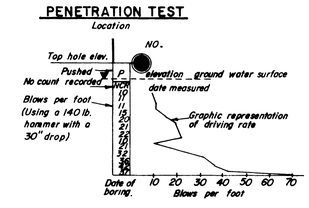
LEGEND OF BORING OPERATIONS

Plan of any boring
Flush penetrometer
2.5" Cone penetrometer
Rotary boring
Auger boring
Sample. boring
Jet boring
Diamond core boring
Test pit

ROTARY BORING



PENETRATION TEST



REVISED	REFERENCE	ORANGE COUNTY FLOOD CONTROL DISTRICT
		EAST GARDEN GROVE-WINTERSBURG CHANNEL
DESIGNED GEO ENG. Co.	PREPARED G.M.T.	LOG OF TEST BORING
CHECKED G.E.M.	SUBMITTED DESIGN ENGR	DATE: SEPTEMBER 1959 DWG. C05 - 101-1-A

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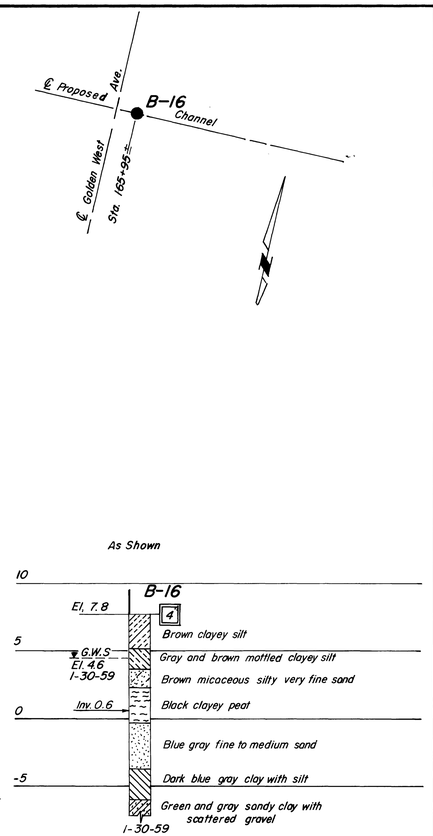
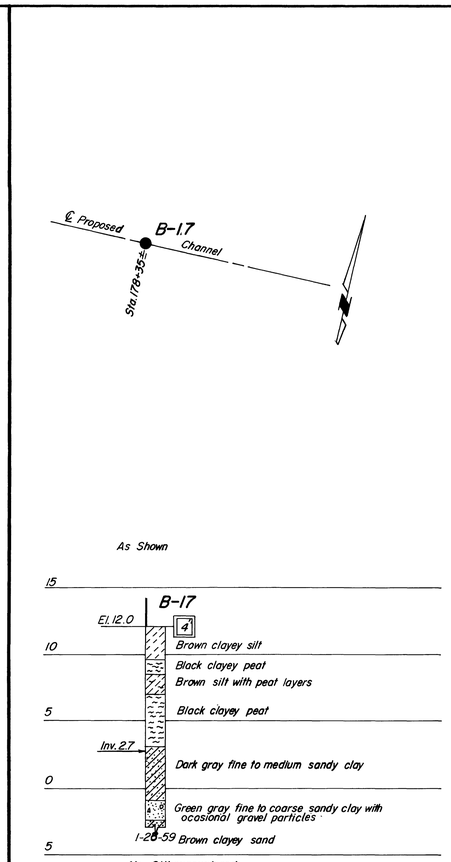
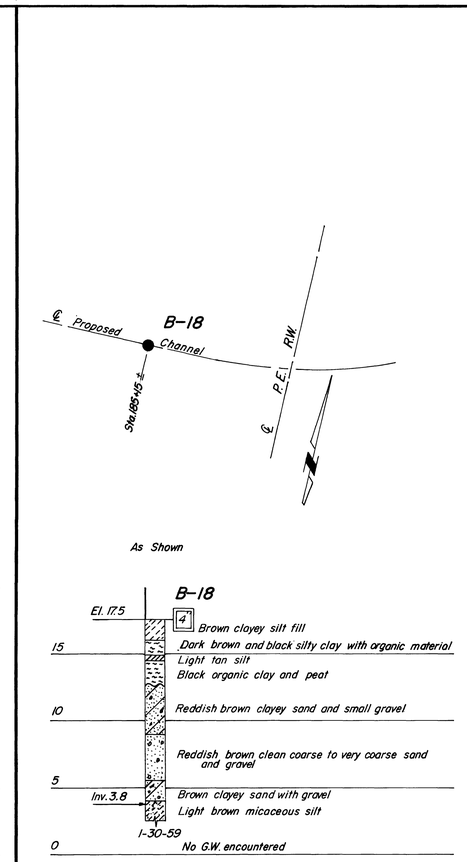
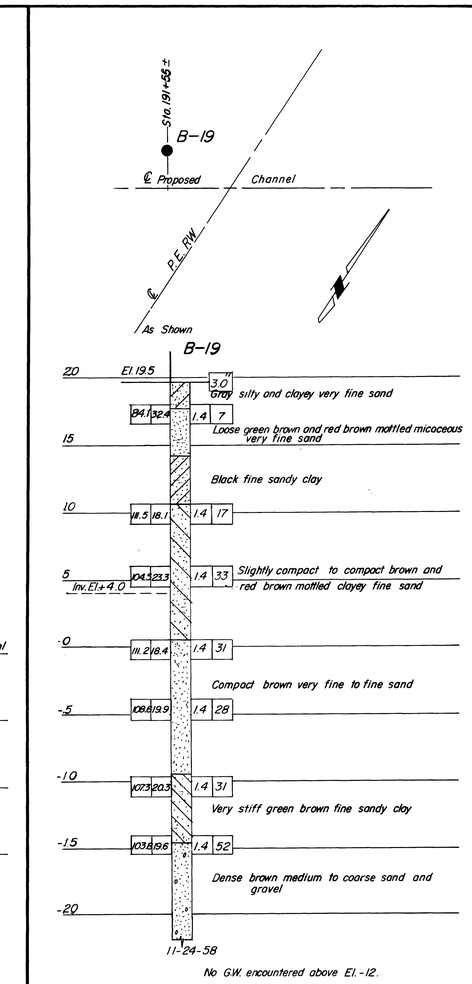
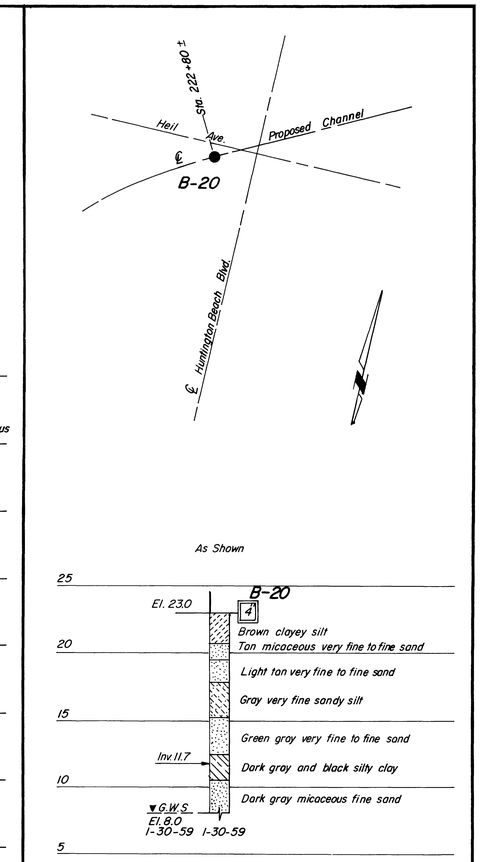










PACIFIC ELECTRIC RAIL ROAD

LEGEND OF EARTH MATERIALS

SIZE CLASSIFICATION

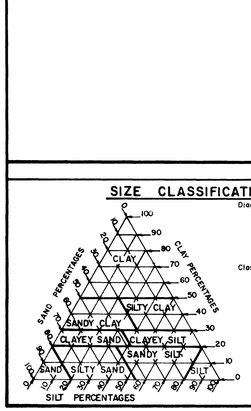


Diagram showing the basis of grainsize distribution used in determination of class names. Size classification is based on the Wentworth grade scale in field classification or the A.S.T.M. grade scale in the laboratory sieve analysis.

Classification of earth material shown on this sheet is based on field inspection and should not be construed to imply mechanical analysis unless so stated.

MATERIAL SYMBOLS

- Gravel
- Sand
- Silt
- Clay
- Sandy clay or clayey sand
- Sandy silt or silty sand
- Silty clay or clayey silt.
- Peat or organic matter
- Fill material
- Shale
- Sandstone
- Limestone
- Metamorphic rock
- Igneous rock

CONSISTENCY CLASSIFICATION

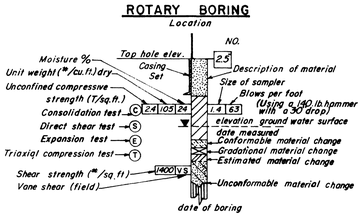
According to the Standard Penetration Test

No. of blows	Granular	Cohesive
0 - 5	very loose	very soft
6 - 10	loose	soft
11 - 20	slightly compact	stiff
21 - 35	compact	very stiff
36 - 70	dense	hard
70+	very dense	very hard

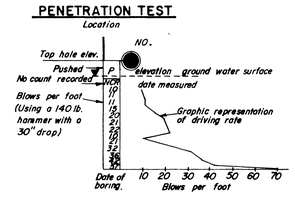
LEGEND OF BORING OPERATIONS

- Plan of any boring
- Size Flush penetrometer
- 2.5" Cone penetrometer
- Size Rotary boring
- Size Auger boring
- Size Sample. boring
- Size Jet boring
- Size Diamond core boring
- Test pit

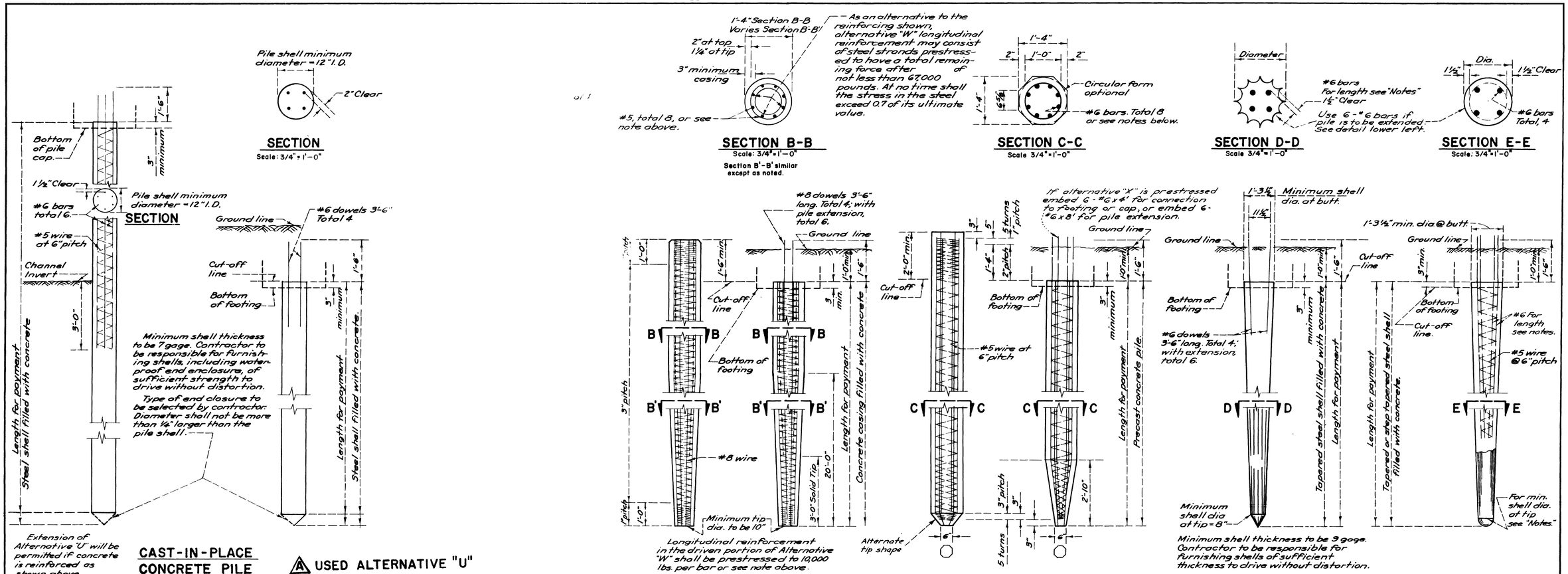
ROTARY BORING



PENETRATION TEST



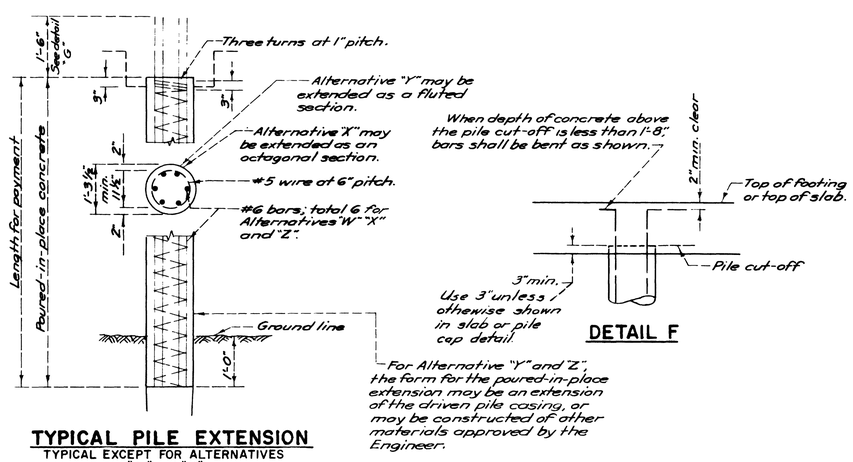
REVISED	REFERENCE	ORANGE COUNTY FLOOD CONTROL DISTRICT
		EAST GARDEN GROVE-WINTERSBURG CHANNEL
DESIGNED GEO. ENG. Co.	PREPARED G.M.T.	LOG OF TEST BORING
CHECKED G.E.M.	SUBMITTED DESIGN ENGR	DATE: SEPTEMBER 1959 DWG. C05-101-1-A



As an alternative to the reinforcement shown, this pile may be prestressed by the use of steel strands to provide a total remaining force after losses of not less than 150,000 pounds. At no time shall the stress in the steel exceed 0.8 of its ultimate value.

PRESTRESSING NOTES

All steel strand to be prestressed shall be high tensile cold-drawn stress relieved wire strand, of a diameter not to exceed 3/8", having an ultimate tensile strength of not less than 200,000 p.s.i. and an elongation at rupture of not less than 3% in 10".



TYPICAL PILE EXTENSION
TYPICAL EXCEPT FOR ALTERNATIVES "U" and "V"

PILE NOTES

For Alternatives "W" and "X" the piles may be driven full length and cut off without extension or they may be extended, as shown, at the option of the Contractor. When Alternatives "Y" and "Z" are extended above ground, the Typical Pile Extension shall be used.

When piles Alternatives "W" "X" "Y" or "Z" are extended, the elevation of cut-off shall be located 1'-0" min below ground line, unless cut off elevation is shown on other sheets.

In Alternative "Y" and "Z" the length of #6 bars shall be either a minimum of 1/3 penetration or 12', whichever is the greater. Penetration shall be measured below the lowest of the following controlling elevations:

1. Bottom of Footing
2. Top of Final ground surface.
3. Top of original ground surface, when piles are driven through fills.
4. Top of bearing strata, when such strata is shown on the plans.

For Alternative "Z", step tapered steel pile shell, the minimum tip diameter shall be determined from the following table:

Given			
Difference in Tip Elev. & Cut-Off Elev.	0 to 24'	24' to 40'	40' and over
Min. Tip Diameter	13"	11"	8"

REVISED	REFERENCES	ORANGE COUNTY FLOOD CONTROL DISTRICT
6-72	As Built	EAST GARDEN GROVE-WINTERSBURG CHANNEL
DESIGNED	PREPARED DICKEY	PILE DETAILS
CHECKED	SUBMITTED DESIGN ENGINEER	DATE: SEPTEMBER 1959 DWG. C05-101-1-A

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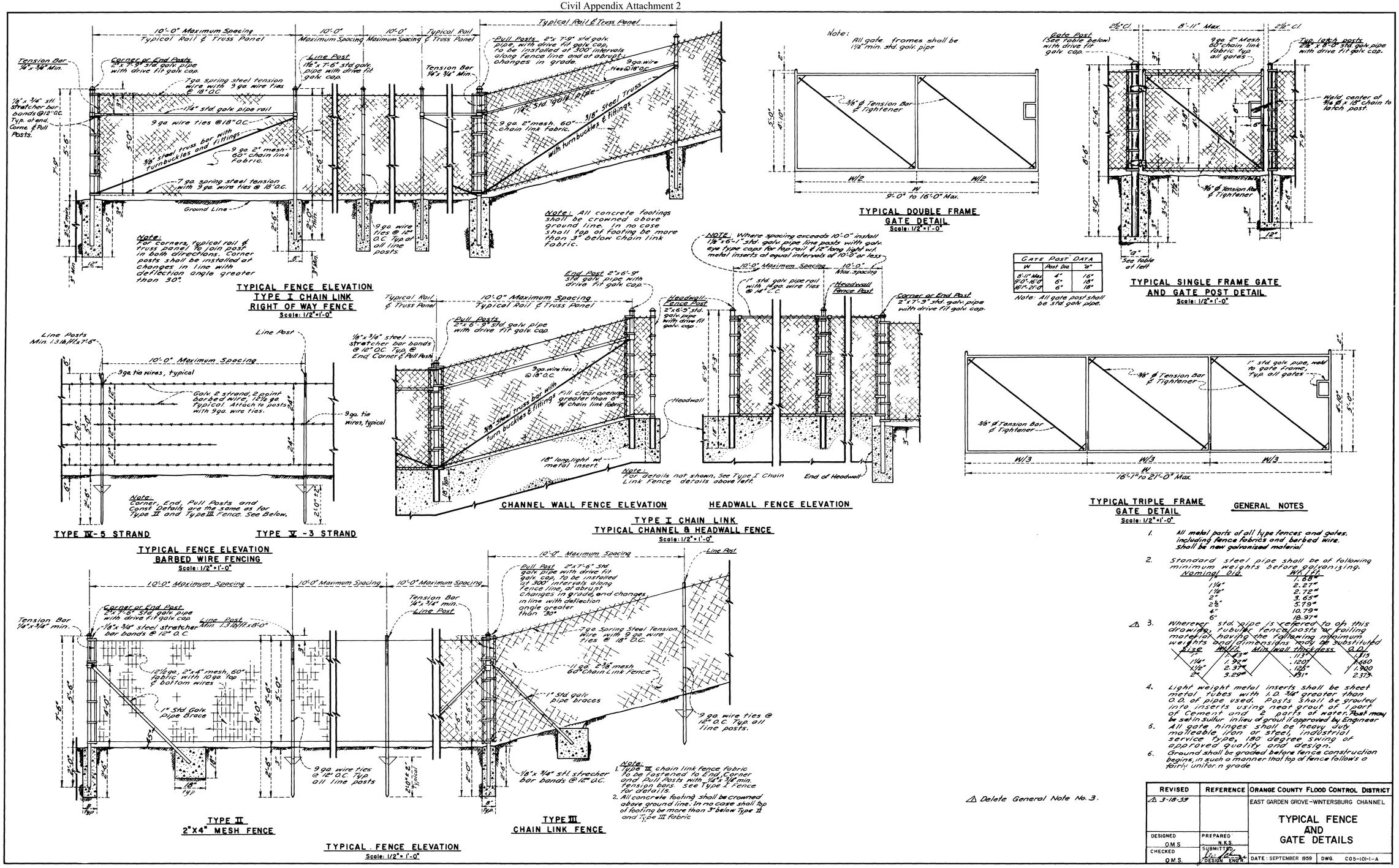
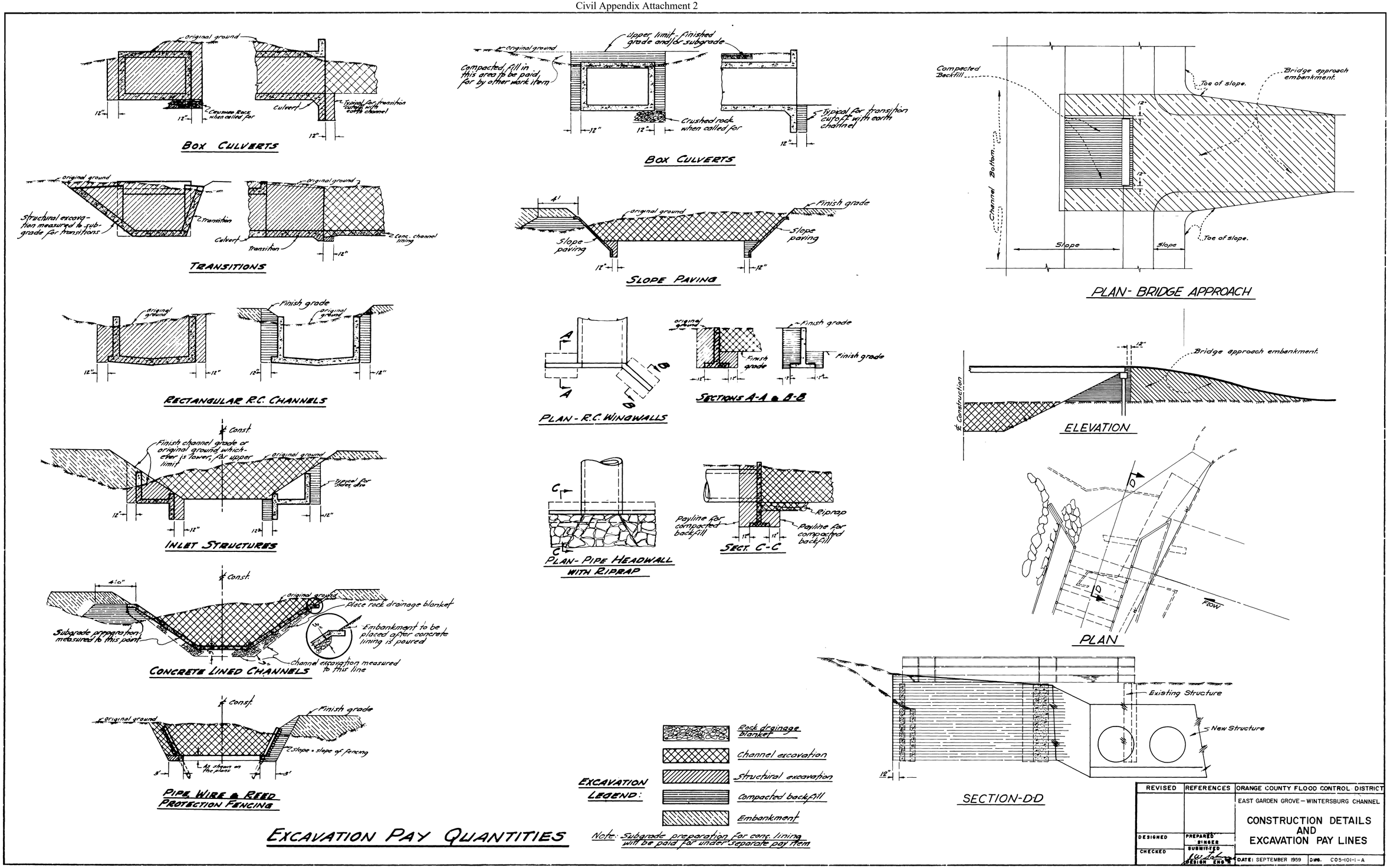


SHEET 29 OF 30


Original ground
Crushed Rock when called for
Culvert
Typical for transition cutoff with earth channel
12"
BOX CULVERTS
Upper limit - finished grade and/or subgrade
Compacted fill in this area to be paid for by other work item
Crushed rock when called for
Typical for transition cutoff with earth channel
BOX CULVERTS
Compacted Backfill
Toe of slope.
Bridge approach embankment.
Channel Bottom
Slope
Slope
Toe of slope.
PLAN- BRIDGE APPROACH
Structural excavation measured to subgrade for transitions
Transition
Culvert
Transition
Conc. channel lining
TRANSITIONS
4'
Finish grade
Slope paving
Slope paving
SLOPE PAVING
Finish grade
RECTANGULAR R.C. CHANNELS
A
B
PLAN - R.C. WINGWALLS
Finish grade
Finish grade
SECTIONS A-A & B-B
Bridge approach embankment.
℄ Construction
ELEVATION
℄ Const.
Finish channel grade or original ground which-ever is lower, for upper limit
Typical for slope, dike
INLET STRUCTURES
C
PLAN- PIPE HEADWALL WITH RIPRAP
Riprap
Payline for compacted backfill
Payline for compacted backfill
SECT. C-C
D
FLOW
PLAN
4'-0"
℄ Const.
Place rock drainage blanket
Embankment to be placed after concrete lining is poured
Subgrade preparation measured to this point
Channel excavation measured to this line
CONCRETE LINED CHANNELS
Existing Structure
New Structure
18"
SECTION-D-D
℄ Const.
Original ground
Finish grade
Slope = slope of fencing
As shown on the plans
3'
PIPE, WIRE & REED PROTECTION FENCING
EXCAVATION LEGEND:
Rock drainage blanket
Channel excavation
Structural excavation
Compacted backfill
Embankment
EXCAVATION PAY QUANTITIES
Note: Subgrade preparation for conc. lining will be paid for under separate pay item
REVISED
REFERENCES
ORANGE COUNTY FLOOD CONTROL DISTRICT
EAST GARDEN GROVE – WINTERSBURG CHANNEL
CONSTRUCTION DETAILS AND EXCAVATION PAY LINES
DESIGNED
CHECKED
PREPARED
SUBMITTED
DATE: SEPTEMBER 1959
DWG. C05-101-1-A

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Appendix B - Civil Engineering

Attachment 3: Quantity Calculations

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For Double-sided Printing

TABLE 1

WESTMINSTER FEASIBILITY QUANTITY CALCULATIONS

CHANNEL CO4-REACH 20 -ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	49,180	54,098	CY
0004	RIPRAP REMOVAL (DISPOSAL)	28,996	31,895	CY
0005	EXCAVATION	34,712	38,183	CY
0006	COMPACTED FILL	14,528	15,981	CY
0007	REINFORCED STEEL	2,956	3,252	TON
0010	OPERATION AND MAINTENANCE PER YEAR	$ 41,516		$

Notes: 10% for contingency is added to quantities
For alternative 1, there are changes in channel linings but not channel dimensions
No changes will be done for spans with culverts.
O&M cost estimate is based on sponsor's historic annual cost for channel averaged over length of channel.

CHANNEL CO4-REACH 21 -ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Maintain Baseline Conditions

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0010	OPERATION AND MAINTENANCE PER YEAR	$ 15,245		$

CHANNEL CO4-REACH 22 -ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	8,380	9,218	CY
0004	RIPRAP REMOVAL (DISPOSAL)	17,193	18,912	CY
0005	EXCAVATION	0	0	CY
0006	COMPACTED FILL	8,813	9,695	CY
0007	REINFORCED STEEL	516	568	TON
0010	OPERATION AND MAINTENANCE PER YEAR	$ 44,706		$

Notes:
-Maintain baseline condiction for channel CO2 alt 1
-The costs in this calculation do not include road crossings, ocean outlet, raising of PCH and modifications to 405 freeway

TABLE 2

WESTMINSTER FEASIBILITY QUANTITY CALCULATIONS

CHANNEL CO5-REACH 1-ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Maintain Baseline Conditions

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0010	OPERATION AND MAINTENANCE PER YEAR	$ 18,620		$

CHANNEL CO5-REACH 2-ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Maintain Baseline Conditions

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0010	OPERATION AND MAINTENANCE PER YEAR	$ 18,620		$

CHANNEL CO5-REACH 3-ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	14,080	15,488	CY
0004	RIPRAP REMOVAL (DISPOSAL)	28,737	31,610	CY
0005	EXCAVATION	0	0	0
0006	COMPACTED FILL	14,657	16,122	CY
0007	REINFORCED STEEL	812	894	TON
0010	OPERATION AND MAINTENANCE PER YEAR	$ 27,911		$

Notes: 10% for contingency is added to quantities

O&M cost estimate is based on sponsor's historic annual cost for channel averaged over length of channel.

CHANNEL CO5-REACH 4-ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	14,237	15,661	CY
0004	RIPRAP REMOVAL (DISPOSAL)	31,688	34,857	CY
0005	EXCAVATION	0	0	0
0006	COMPACTED FILL	17,451	19,196	CY
0007	REINFORCED STEEL	856	942	TON
0010	OPERATION AND MAINTENANCE PER YEAR	$ 40,053		$

CHANNEL CO5-REACH 5-ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	13,670	15,037	CY
0004	RIPRAP REMOVAL (DISPOSAL)	31,675	34,843	CY
0005	EXCAVATION	0	0	0
0006	COMPACTED FILL	18,005	19,805	CY
0007	REINFORCED STEEL	839	923	TON
0010	OPERATION AND MAINTENANCE PER YEAR	$ 41,682		$

CHANNEL CO5-REACH 6 -ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Maintain Baseline Conditions

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0010	OPERATION AND MAINTENANCE PER YEAR	$ 5,708		$

CHANNEL CO5-REACH 7 -ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Maintain Baseline Conditions

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0010	OPERATION AND MAINTENANCE PER YEAR	$ 4,928		$

CHANNEL CO5-REACH 8 -ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Maintain Baseline Conditions

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit

0010	OPERATION AND MAINTENANCE PER YEAR	$ 19,584		$

CHANNEL CO5-REACH 9 -ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Maintain Baseline Conditions

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0010	OPERATION AND MAINTENANCE PER YEAR	$ 28,578		$

CHANNEL CO5-REACH 10-ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Maintain Baseline Conditions

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0010	OPERATION AND MAINTENANCE PER YEAR	$ 7,015		$

CHANNEL CO5-REACH 11-ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Maintain Baseline Conditions

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0010	OPERATION AND MAINTENANCE PER YEAR	$ 13,504		$

CHANNEL CO5-REACH 12-ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Maintain Baseline Conditions

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0010	OPERATION AND MAINTENANCE PER YEAR	$ 11,135		$

-The costs in this calculation do not include road crossings, ocean outlet, raising of PCH and modifications to 405 freeway

TABLE 3

WESTMINSTER FEASIBILITY QUANTITY CALCULATIONS

CHANNEL CO6-REACH 13-ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	13,208	14,528	0
0004	RIPRAP REMOVAL (DISPOSAL)	28,964	31,861	CY
0005	EXCAVATION	0	0	CY
0006	COMPACTED FILL	15,756	17,332	CY
0007	REINFORCED STEEL	782	861	TON
0010	OPERATION AND MAINTENANCE PER YEAR	$ 18,000		$

Notes: 10% for contingency is added to quantities

For alternative 1, there are changes in channel linings but not channel dimensions

No changes will be done for spans with culverts.

O&M cost estimate is based on sponsor's historic annual cost for channel averaged over length of channel.

CHANNEL CO6-REACH 14 -ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Maintain baseline conditions

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0010	OPERATION AND MAINTENANCE PER YEAR	$ 2,101		$

CHANNEL CO6-REACH 15 -ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Maintain baseline conditions

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0010	OPERATION AND MAINTENANCE PER YEAR	$ 5,385		$

CHANNEL CO6-REACH 16 -ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Maintain baseline conditions

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0010	OPERATION AND MAINTENANCE PER YEAR	$ 4,254		$

CHANNEL CO6-REACH 17-ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	4,647	5,112	CY
0004	RIPRAP REMOVAL (DISPOSAL)	10,834	11,917	CY
0005	EXCAVATION	0	0	CY
0006	COMPACTED FILL	6,187	6,805	CY
0007	REINFORCED STEEL	285	314	TON
0010	OPERATION AND MAINTENANCE PER YEAR	$ 7,218		$

CHANNEL CO6-REACH 18-ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Maintain baseline conditions

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0010	OPERATION AND MAINTENANCE PER YEAR	$ 14,000		$

CHANNEL CO6-REACH 19-ALTERNATIVE 1 MINIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	3,627	3,990	CY
0004	RIPRAP REMOVAL (DISPOSAL)	9,014	9,915	CY
0005	EXCAVATION	0	0	CY
0006	COMPACTED FILL	5,387	5,926	CY
0007	REINFORCED STEEL	229	252	TON
0010	OPERATION AND MAINTENANCE PER YEAR	$ 6,040		$

-The costs in this calculation do not include road crossings, ocean outlet, raising of PCH and modifications to 405 freeway

TABLE 4

WESTMINSTER FEASIBILITY QUANTITY CALCULATIONS

CHANNEL CO4-REACH 20-ALTERNATIVE 3 MAXIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	80,210	88,231	CY
0004	RIPRAP REMOVAL	25,187	27,706	CY
0005	EXCAVATION	254,504	279,955	CY
0006	COMPACTED FILL	24,045	26,450	CY
0007	CONCRETE REMOVAL	0	0	CY
0008	GRAVEL BASE REMOVAL	0	0	CY
0009	REINFORCED STEEL	4,474	4,921	TON
0010	OPERATION AND MAINTENANCE	$ 41,516.12		
0011	TEMPORARY SHORING	1		LS

NOTE 1: 10% for contingency is added to quantities

NOTE 2: Clear site and remove obstruction wherever there are existing natural bottom need to be modified.

CHANNEL CO4-REACH 21-ALTERNATIVE 3 MAXIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	10,174	11,191	CY
0004	RIPRAP REMOVAL	0	0	CY
0005	EXCAVATION	3,548	3,903	CY
0006	COMPACTED FILL	0	0	CY
0007	CONCRETE REMOVAL	14,827	16,310	CY
0008	GRAVEL BASE REMOVAL	3,465	3,812	CY
0009	REINFORCED STEEL	0	0	TON
0010	OPERATION AND MAINTENANCE	$ 15,243.78		
0011	TEMPORARY SHORING	1		LS

NOTE 1: 10% for contingency is added to quantities

NOTE 2: Clear site and remove obstruction wherever there are existing natural bottom need to be modified.

CHANNEL CO4-REACH 22-ALTERNATIVE 3 MAXIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	43,575	47,932	CY
0004	RIPRAP REMOVAL	16,239	17,863	CY
0005	EXCAVATION	82,496	90,746	Culvert
0006	COMPACTED FILL	15,187	16,705	CY
0007	CONCRETE REMOVAL	15,412	16,953	CY
0008	GRAVEL BASE REMOVAL	6,164	6,781	CY
0009	REINFORCED STEEL	2,830	3,114	TON
0010	OPERATION AND MAINTENANCE	$ 44,707.02		
0011	TEMPORARY SHORING	1		LS

NOTE 1: 10% for contingency is added to quantities
NOTE 2: Clear site and remove obstruction wherever there are existing natural bottom need to be modified.

CHANNEL CO2-REACH 23-ALTERNATIVE 3 MAXIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	0	0	CY
0004	RIPRAP REMOVAL	0	0	CY
0005	EXCAVATION	394,978	434,476	CY
0006	COMPACTED FILL	42,944	47,238	CY
0007	CONCRETE REMOVAL	0	0	CY
0008	GRAVEL BASE REMOVAL	0	0	CY
0009	REINFORCED STEEL	0	0	TON
0010	OPERATION AND MAINTENANCE	-		
0011	SHEET PILE	1,234,216	1,357,637	SF

NOTE 1: 10% for contingency is added to quantities
NOTE 2: Clear site and remove obstruction wherever there are existing natural bottom need to be modified.
NOTE 3: These quantity calculations do not include crossings (bridges)
For channel C04 quantities, channel configuration of alt 3A1, 3A2, and 3B are the same.
For channel C04 quantities, crossing (bridge) configuration of alt 3A1, 3A2, and 3B are the same.
NOTE 4: There is no O&M record for channel C02

TABLE 5

Westminster Alternative Analysis
Alternative 3 Maximum Channel Improvements - Existing and Proposed Channel Conditions

Notes:
USACE Alternative 3
No changes will be done on the spans labeled "Maintain Baseline Conditions"
Spans labeled "Bridges" and not labeled "Maintain Baseline Conditions" will still have the channels changed as noted.

Channel: C02/C04

Reach	Measure	Existing		Proposed		US XS	DS XS	XSING Name	Existing					Proposed					Comments	Type			
		Channel Inve	hannel Wa	hannel Inve	hannel Walls				XSing	B	H2	TW2	z	XSing	B	H1	TW1	z		Existing	Proposed	Alternative	Proposed Height Chan
R22		Concrete	Concrete	Concrete	Concrete	520+76.01	513+08.63			4.00	9.50	22.00	0.9		23.0	9.5	23.0	0.0		Trap	Rect	A	0.00
R22		Concrete	Concrete	Concrete	Concrete	513+08.63	512+45.71	Woodbury RD	Bridge	9.50	9.50	9.60	0.0	Bridge	23.0	9.5	23.0	0.0	See attached for bridge dimensions	Rect	Rect	E	0.00
R22		Concrete	Concrete	Concrete	Concrete	512+45.71	510+48.00			4.00	9.50	23.00	1.0		23.0	9.5	23.0	0.0		Trap	Rect	A	0.00
R22		Concrete	Concrete	Concrete	Concrete	510+48.00	510+33.34			4.00	9.50	23.00	1.0		23.0	9.5	23.0	0.0		Trap	Rect	A	0.00
R22		Concrete	Concrete	Concrete	Concrete	510+33.34	509+61.26	Blake St	Bridge	9.50	9.50	9.70	0.0	Bridge	23.0	9.5	23.0	0.0	See attached for bridge dimensions	Rect	Rect	E	0.00
R22		Concrete	Concrete	Concrete	Concrete	509+61.26	502+73.22			4.00	9.00	19.50	0.9		23.0	9.0	23.0	0.0		Trap	Rect	A	0.00
R22		Concrete	Concrete	Concrete	Concrete	502+73.22	502+01.84	Ranney Ave	Bridge	9.50	9.00	9.70	0.0	Bridge	22.0	9.0	22.0	0.0	See attached for bridge dimensions	Rect	Rect	E	0.00
R22		Concrete	Concrete	Concrete	Concrete	502+01.84	498+73.11			4.00	9.00	22.00	1.0		22.0	9.0	22.0	0.0		Trap	Rect	A	0.00
R22		Natural	riprap	Concrete	Concrete	498+73.11	497+54.82	Westminster Ave	Bridge	16.63	9.00	16.80	0.0	Bridge	22.00	9.00	22.00	0.0	See attached for bridge dimensions	Rect	Rect	N/A	0.00
R22		Natural	riprap	Concrete	Concrete	497+54.82	497+51.28			16.60	9.00	16.80	0.0		35.58	9.00	35.58	0.0		Rect	Rect	N/A	0.00
R22		Natural	riprap	Concrete	Concrete	497+51.28	473+28.78			10.00	9.00	40.00	1.7		10.00	9.00	40.00	1.7		Trap	Trap	C	0.00
						473+28.78	472+41.69	Ward St.	Culvert					Culvert					See attached for culvert dimensions	Rect	Rect	N/A	0.00
		Natural	riprap	Concrete	Concrete	472+41.69	453+72.36			10.00	9.50	40.00	1.6		35.00	9.50	35.00	0.0		Trap	Rect	B	0.00
R22		Natural	riprap	Concrete	Concrete	453+72.36	447+00.11			10.00	9.50	22.00	0.6		28.00	9.50	28.00	0.0		Trap	Rect	B	0.00
R22						447+00.11	444+96.08	Brookhurst St	Culvert					Culvert					See attached for culvert dimensions	Rect	Rect	N/A	0.00
R22		Natural	Concrete	Natural	Concrete	444+96.08	440+18.83			24.00	10.00	24.00	0.0		38.00	9.97	38.00	0.0		Rect	Rect	D	-0.03
R22		Maintain Baseline Conditions				440+18.83	419+73.16			35.50	9.00	35.50	0.0		35.00	9.00	35.00	0.0		Rect	Rect	N/A	0.00
R22						419+73.16	418+92.11	Bushard St	Culvert					Culvert					See attached for culvert dimensions	Rect	Rect	N/A	0.00
R22		Maintain Baseline Conditions				418+92.11	397+11.00			35.50	8.00	35.50	0.0		35.50	8.00	35.50	0.0		Rect	Rect	N/A	0.00
		Natural	Concrete	Natural	Concrete	397+11.00	393+28.75			35.50	10.00	35.50	0.0		56.00	10.00	56.00	0.0		Rect	Rect	D	0.00
R22						393+28.75	392+30.61	Magnolia St	Culvert					Culvert					See attached for culvert dimensions	Rect	Rect	N/A	0.00
R22		Concrete	Concrete	Concrete	Concrete	392+30.61	366+59.84			25.50	9.00	25.50	0.0		35.00	12.00	35.00	0.0		Rect	Rect	E	3.00
R22						366+59.84	365+94.21	Newland St	Culvert					Culvert					See attached for culvert dimensions	Rect	Rect	N/A	0.00
R22		Concrete	Concrete	Concrete	Concrete	365+94.21	336+62.66			25.50	8.50	25.50	0.0		55.00	11.50	55.00	0.0		Rect	Rect	E	3.00
R21						336+62.66	334+56.24	Beach Blvd 2	Culvert					Culvert					See attached for culvert dimensions	Rect	Rect	N/A	0.00
R21						334+56.24	333+72.19	Beach Blvd 1	Culvert					Culvert					See attached for culvert dimensions	Rect	Rect	N/A	0.00
R21		Concrete	Concrete	Concrete	Concrete	333+72.19	330+57.00			32.00	8.70	32.00	0.0		37.00	11.50	37.00	0.0	Add 3' floodwall. Note, two adjacent 12' wide underground culverts.	Rect	Rect	F	2.80
		Concrete	Concrete	Concrete	Concrete	330+57.00	308+22.74			37.00	8.50	37.00	0.0		37.00	11.50	37.00	0.0	Add 3' floodwall. Note, two adjacent 12' wide underground culverts.	Rect	Rect	F	3.00
R21						308+22.74	306+59.47	Hoover St	Culvert					Culvert					See attached for culvert dimensions	Rect	Rect	N/A	0.00
R21		Concrete	Concrete	Concrete	Concrete	306+59.47	302+33.34			49.00	10.00	49.00	0.0		49.00	10.00	49.00	0.0		Rect	Rect	F	0.00
R21		Concrete	Concrete	Concrete	Concrete	302+33.34	297+96.11			38.40	12.00	38.90	0.0		38.00	12.00	38.00	0.0		Rect	Rect	F	0.00

R21						297+96.11	297+32.66	Railroad		Culvert				Culvert					See attached for culvert dimensions	Rect	Rect	N/A	0.00
R21		Concrete	Concrete	Concrete	Concrete	297+32.66	290+75.54			38.00	11.50	38.00	0.0		38.00	11.50	38.00	0.0		Rect	Rect	F	0.00
R21						290+75.54	289+91.87	Chestnut St		Culvert				Culvert					See attached for culvert dimensions	Rect	Rect	N/A	0.00
R21		Concrete	Concrete	Concrete	Concrete	289+91.87	273+84.25			39.50	10.50	39.50	0.0		50.00	10.50	39.50	-0.5		Rect	Rect	F	0.00
R20						273+84.25	267+31.44	405 FWY		50.00	8.89	50.00	0.0	Culvert					See attached for culvert dimensions.	Rect	Rect	N/A	-8.89
R20		Concrete	Concrete	Concrete	Concrete	267+31.44	265+93.29			42.00	10.50	42.20	0.0		42.00	10.50	42.00	0.0		Rect	Rect	F	0.00
R20						265+93.29	253+88.07			Culvert				Culvert					See attached for culvert dimensions	Rect	Rect	N/A	0.00
R20						253+88.07	240+87.08	Edwards St		Culvert				Culvert					See attached for culvert dimensions	Rect	Rect	N/A	0.00
R20		Natural	riprap	Concrete	Concrete	240+87.08	240+57.04			43.00	9.80	43.00	0.0		70.00	13.00	70.00	0.0		Rect	Rect	N/A	3.20
R20		Natural	riprap	Concrete	Concrete	240+57.04	223+78.96			27.00	13.50	70.00	1.6		70.00	13.50	70.00	0.0		Trap	Rect	B	0.00
R20		Natural	riprap	Concrete	Concrete	223+78.96	223+42.68			38.00	9.60	38.20	0.0		69.00	13.00	69.00	0.0		Rect	Rect	N/A	3.40
R20						223+42.68	221+97.26	Bolsa Ave		Culvert				Culvert					See attached for culvert dimensions	Rect	Rect	N/A	0.00
R20		Natural	riprap	Concrete	Concrete	221+97.26	221+84.70			38.00	9.40	38.00	0.0		68.00	13.50	68.00	0.0		Rect	Rect	N/A	4.10
R20		Natural	riprap	Concrete	Concrete	221+84.70	191+66.06			25.00	13.50	80.00	2.0		68.00	13.50	68.00	0.0		Trap	Rect	B	0.00
R20						191+66.06	189+17.70	McFadden Ave		Culvert				Culvert					See attached for culvert dimensions	Rect	Rect	N/A	0.00
R20		Natural	Natural	Natural	Concrete	189+17.70	185+10.40			38.50	12.50	38.50	0.0		80.00	13.20	80.00	0.0		Rect	Rect	G	0.70
R20		Natural	Natural	Natural	Concrete	185+10.40	172+75.43			40.00	13.70	85.50	1.7		80.00	13.70	80.00	0.0		Trap	Rect	H	0.00
R20		Natural	Natural	Natural	Concrete	172+75.43	172+10.69	Marina Viking Way	Bridge	40.00	14.00	115.00	2.6	Bridge	80.00	14.00	80.00	0.0	See attached for bridge dimensions	Trap	Rect	H	0.00
R20		Natural	Natural	Natural	Concrete	172+10.69	165+62.93			40.00	14.30	123.90	2.9		80.00	14.00	80.00	0.0		Trap	Rect	H	-0.30
R20		Natural	Natural	Natural	Concrete	165+62.96	164+35.13	HS Walkway	Bridge	48.00	13.00	108.00	2.3	Bridge	80.00	14.00	80.00	0.0	See attached for bridge dimensions	Trap	Rect	H	1.00
R20		Natural	Natural	Natural	Concrete	164+35.13	163+03.71			48.00	13.10	100.00	2.0		80.00	13.20	80.00	0.0		Trap	Rect	H	0.10
R20		Natural	Natural	Natural	Concrete	163+03.71	161+74.62	HS Walkway	Bridge	48.00	13.30	91.00	1.6	Bridge	80.00	13.20	80.00	0.0	See attached for bridge dimensions	Trap	Rect	H	-0.10
R20		Natural	Natural	Natural	Concrete	161+74.62	140+47.80			48.00	13.30	90.00	1.6		80.00	13.50	80.00	0.0		Trap	Rect	H	0.20
R20		Natural	Natural	Concrete	Concrete	140+47.80	139+65.52	Graham St	Bridge	48.00	13.60	82.00	1.3	Bridge	80.00	13.60	80.00	0.0	See attached for bridge dimensions	Trap	Rect	I	0.00
R20		Natural	Natural	Natural	Concrete	139+65.52	113+53.16			48.00	14.00	100.00	1.9		80.00	14.00	80.00	0.0		Trap	Rect	H	0.00
R20		Natural	Natural	Natural	Concrete	113+53.16	112+44.64	Bolsa Chica St	Bridge	48.00	13.20	92.00	1.7	Bridge	80.00	14.20	80.00	0.0	See attached for bridge dimensions	Trap	Rect	H	1.00
R20		Natural	Natural	Natural	Concrete	112+44.64	102+85.13			48.00	14.00	91.50	1.5		80.00	14.00	80.00	0.0		Trap	Rect	H	0.00
R23		Natural	Natural	Natural	Sheet Pile	102+85.13	073+54.66			94.00	11.50	270.00	7.7		230.00	14.00	230.00	0.0		Trap	Rect	J	2.50
R23		Natural	Natural	Natural	Sheet Pile	073+54.66	071+79.54			124.00	11.30	188.20	2.8		230.00	14.00	230.00	0.0		Trap	Rect	J	2.70
R23		Natural	Natural	Natural	Sheet Pile	071+79.54	026+54.52			94.00	11.75	270.00	7.5		230.00	15.00	230.00	0.0		Trap	Rect	J	3.25
R23		Natural	Natural	Natural	Sheet Pile	026+54.52	025+20.87	Edinger Ave	Bridge	94.00	11.75	270.00	7.5	Bridge	200.00	15.00	200.00	0.0	See attached for bridge dimensions	Trap	Rect	J	3.25
R23		Natural	Natural	Natural	Sheet Pile	025+20.87	021+79.51			94.00	12.70	270.00	6.9		230.00	15.00	230.00	0.0		Trap	Rect	J	2.30
R23		Natural	Natural	Natural	Sheet Pile	021+79.51	000+00.00			94.00	12.72	270.00	6.9		270.00	15.00	270.00	0.0		Trap	Rect	J	2.28

TABLE 6

Westminster_Alternative Analysis
Project: Westminster
Objective: Using the existing HEC-RAS models geometry files with artificial levees adjust the geometry to include the channel modifications proposed in each of the respective Alternatives

Hec-Ras Model	Westminster Channel Project
Project Location	P:\Westminster\HEC-RAS_TSP Alts\CO2_CO4_TSP Alts_3
Geometry File	Westmin_C024_Alt3_BR_FD_NO405
	Westmin_C024_Alt3_BR_FD_I405
Alternative	Alternative 3 Maximum Channel Improvements
HEC-RAS River	C02/C04
HEC-RAS Reach	C02/C04

Note:
1. All dimensions are in Feet unless noted otherwise.
2. All crossings, including culverts, were modeled as bridges.
3. Debris was modeled as floating debris on the piers. Space in between box culvert barrels was modeled as piers.
4. Quantity of Debris: Width = 2' on each side of piers + width of pier. Height: 6'.
5. Cross-sections u/s and d/s of crossings were expanded. Crossings were adjusted to maximize cross-sectional flow area using u/s and d/s cross sections as the limit.

	Model		Current Crossings Dimensions							Proposed Adjustment			Proposed Crossings Dimensions						
Bridge	US XS	DS XS	`	Span	Rise	Diameter	# Piers	Pier Width	# Barrels	OC	USACE	Description	Type	Span	Rise	Diameter	# Piers	Pier Width	# Barrels
Hoover Street	308+22.74	306+59.47	Box - Flared wingwall 30 - 75 Deg (1 - 10x9.5, 3 - 12x9.5)	10, 12	9.5	-			4	Add 1 - 10' x 9.5' barrel	3 -12' x 9.5' & 1 - 10' x 9.5'	Crossing: Confirmed with OC that the proposed has been implemented and there should only be 4 barrels 3 - 12' wide and 1 - 10' wide by 9.5 ' high. US & DS XS: Maintain Baseline Dimensions. Add 3' flood wall to both banks	Box - Flared wingwall 30 - 75 Deg (1 - 10'x9.5, 3 - 12'x9.5')	10, 12	9.5				4
Railroad	297+69.11	297+32.66	Box - Flared wingwall 30 - 75 Deg (3 - 12x9.5)	12	9.5	-			3	No Proposed Adjustment		Crossing:Maintain Baseline Conditions. US XS: Maintain Baseline Dimensions. Add 3' flood wall to both banks	Box - Flared wingwall 30 - 75 Deg (3 - 12x9.5)	12	9.5				3
Chestnut Street	290+75.54	289+91.87	Box - Flared wingwall 30 - 75 Deg (3 - 12x9.5)	12	9.5	-			3	No Proposed Adjustment		Crossing:Maintain Baseline Conditions. US XS: Increased H to 10.5' per as-built. TW & B Maintain Baseline Dimensions. Added 3' flood wall to both banks. DS XS: Increased H to 10.5' per as-built. Increased TW & B to 50' (max allowed leaving 12' to right side and 3' to left side). Extend right bank but maintain baseline centerline. Added 3' flood wall to both banks.	Box - Flared wingwall 30 - 75 Deg (3 - 12x9.5)	12	9.5				3
405 Fwy	273+84.25	267+31.44	Box - Flared wingwall 30 - 75 Deg (2 - 12x9.25) Circular - Concrete pipe culvert (2 - 9' dia.)	12	9.5	9			4	No Proposed Adjustment		Crossing and XS US & DS: Maintain Baseline Conditions	Box - Flared wingwall 30 - 75 Deg (2 - 12x9.25) Circular - Concrete pipe culvert (2 - 9' dia.)	12	9.5	9			4
Bolsa Avenue	265+44.18	242+31.96	Box - Flared wingwall 30 - 75 Deg (3 - 14x9.5)	14	9.5				3	No Proposed Adjustment	4 -14' x 9.5	Crossing and XS US & DS: Maintain Baseline Conditions	Box - Flared wingwall 30 - 75 Deg (4 - 14x9.5)	14	9.5				4
Edwards Street	241+97.05	240+87.08	Box - Flared wingwall 30 - 75 Deg (4 - 10x9.5)	10	9.5				4	No Proposed Adjustment	4 -14' x 9.5	Crossing: Change from Bridge w/ piers to crossing with 4 - 14' x 9.5' box barrels. XS US & DS: TW and B Widen	Box - Flared wingwall 30 - 75 Deg (4 - 14x9.5)	14	9.5				4

Bolsa Avenue	223+42.68	221+97.26	Box - Flared wingwall 30 - 75 Deg (3 - 12x9)	12	9				3	Add 1 - 16' wide barrel	Used OC Model	Crossing and XS US & DS: The existing 3 barrel spans was 12' each and the original proposed was to add a barrel sized 16' wide. The current dimensions were taken from the OC RAS Model including the height of 9'.	Box - Flared wingwall 30 - 75 Deg (4 - 13x9)	13	9				4
McFadden Avenue	191+66.06	189+17.70	Box - Flared wingwall 30 - 75 Deg (3 - 12x9)	12	9				3	Add 1 - 16' wide barrel	Used OC Model	Crossing and XS US & DS: The existing 3 barrel spans was 12' each and the original proposed was to add a barrel sized 16' wide. The current dimensions were taken from the OC RAS Model including the height of 9'. TW and B Widen	Box - Flared wingwall 30 - 75 Deg (4 - 16.25x9)	16.25	9				4
Marina Viking Way	172+75.43	172+10.69	Bridge w/ 2 - 2' piers (Trap w/ b = 40, TW = 72.18)	-	5	-	2	2	-	No Proposed Adjustment		Crossing: Replace structure widened deck. Channel under crossing changed from trap to rect. XS US & DS: Reduce TW on both banks to match US XS. Change from Trap to Rect; Increase B to match TW.	Bridge w/ 2 - 2' piers	80	12		2	2	1
HS Walkway w/ 1 pier	165+62.96	164+35.13	Bridge w/ 1 - 2' pier (Trap w/ b = 48, TW = 85.18)	-	6.5	-	1	2	-	No Proposed Adjustment		Crossing: Replace structure widened deck. Channel under crossing changed from trap to rect. XS US & DS: Reduce TW on both banks to match US XS. Change from Trap to Rect; Increase B to match TW.	Bridge w/ 1 - 2' pier	80	10.5		1	2	1
HS Walkway w/ 2 pier	163+03.71	161+74.62	Bridge w/ 2 - 2' piers (Trap w/ b = 48, TW = 73.31)	-	5.7	-	2	2	-	No Proposed Adjustment		Crossing: Replace structure widened deck. Channel under crossing changed from trap to rect. XS US & DS: Reduce TW on both banks to match US XS. Change from Trap to Rect; Increase B to match TW.	Bridge w/ 2 - 2' piers	80	10.5		2	2	1
Graham Street	140+47.80	139+65.52	Bridge w/ 2 - 2' piers (Trap w/ b = 48, TW = 74.58)	-	7.5	-	2	2	-	No Proposed Adjustment		Crossing: Replace structure widened deck. Channel under crossing changed from trap to rect. and XS US & DS: B widen to match TW.	Bridge w/ 2 - 2' piers	80	10.5		2	2	1
Bolsa Chica Street	113+53.16	112+44.64	Bridge w/ 2 - 2' piers (Trap w/ b = 48, TW = 88.91)	-	9.5	-	2	2	-	No Proposed Adjustment		Crossing: Replace structure widened deck. Channel under crossing changed from trap to rect. XS US & DS: Reduce TW on both banks to match US XS. Change from Trap to Rect; Increase B to match TW.	Bridge w/ 2 - 2' piers	80	10.5		2	2	1
Edinger Avenue	026+54.52	025+20.87	Bridge w/ 16 - 1' piers	135	15.5	-	16	1	1	No Proposed Adjustment	Used OC Model	Crossing and US XS: Superposition of OC RAS-Model STA. 11+34.04 and USACE Proposed	Bridge w/ 3 - 1' piers	200	8.46		3	4	1

TABLE 7

WESTMINSTER FEASIBILITY QUANTITY CALCULATIONS

CHANNEL CO5-REACH 1-ALTERNATIVE 3 MAXIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	31,440	34,584	CY
0004	SHEET PILE REMOVAL	411,001	452,101	SF
0005	EXCAVATION	366,963	403,660	CY
0006	COMPACTED FILL	72,525	79,778	CY
0007	CONCRETE REMOVAL	9,589	10,548	CY
0008	GRAVEL BASE REMOVAL	0	0	CY
0009	REINFORCED STEEL	1,840	2,024	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)	$ 68,402		
0011	TEMPORARY SHORING	1		LS
0012	SHEET PILE	548,002	602,802	SF

NOTE 1: 10% for contingency is added into the calculated quantities

NOTE 2: Clear site and remove obstruction wherever there are existing natural bottom need to be modified.

CHANNEL CO5-REACH 2-ALTERNATIVE 3 MAXIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	35,217	38,739	CY
0004	RIPRAP REMOVAL	0	0	CY
0005	EXCAVATION	41,679	45,846	CY
0006	COMPACTED FILL	9,024	9,927	CY
0007	CONCRETE REMOVAL	8,297	9,127	CY
0008	GRAVEL BASE REMOVAL	2,418	2,660	CY
0009	REINFORCED STEEL	2,223	2,445	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)	$ 18,622		
0011	TEMPORARY SHORING	1		LS

NOTE 1: 10% for contingency is added into the calculated quantities

NOTE 2: Clear site and remove obstruction wherever there are existing natural bottom need to be modified.

CHANNEL CO5-REACH 3-ALTERNATIVE 3 MAXIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	38,083	41,891	CY
0004	RIPRAP REMOVAL	23,888	26,277	CY
0005	EXCAVATION	57,355	63,090	CY
0006	COMPACTED FILL	2,046	2,250	CY
0007	CONCRETE REMOVAL	5,181	5,699	CY
0008	GRAVEL BASE REMOVAL	2,733	3,006	CY
0009	REINFORCED STEEL	2,224	2,447	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)	$ 27,908		

0011	TEMPORARY SHORING	1		LS

NOTE 1: 10% for contingency is added into the calculated quantities

NOTE 2: Clear site and remove obstruction wherever there are existing natural bottom need to be modified.

CHANNEL CO5-REACH 4-ALTERNATIVE 3 MAXIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	33,644	37,009	CY
0004	RIPRAP REMOVAL	33,742	37,116	CY
0005	EXCAVATION	75,301	82,831	CY
0006	COMPACTED FILL	6,996	7,695	CY
0007	CONCRETE REMOVAL	0	0	CY
0008	GRAVEL BASE REMOVAL	0	0	CY
0009	REINFORCED STEEL	2,105	2,316	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)	$ 40,052		
0011	TEMPORARY SHORING	1		LS

NOTE 1: 10% for contingency is added into the calculated quantities

NOTE 2: Clear site and remove obstruction wherever there are existing natural bottom need to be modified.

CHANNEL CO5-REACH 5-ALTERNATIVE 3 MAXIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	36,753	40,428	CY
0004	RIPRAP REMOVAL	33,439	36,783	CY
0005	EXCAVATION	79,929	87,922	CY
0006	COMPACTED FILL	8,007	8,808	CY
0007	CONCRETE REMOVAL	1,613	1,774	CY
0008	GRAVEL BASE REMOVAL	576	633	CY
0009	REINFORCED STEEL	2,417	2,659	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)	$ 41,684		
0011	TEMPORARY SHORING	1		LS

NOTE 1: 10% for contingency is added into the calculated quantities

NOTE 2: Clear site and remove obstruction wherever there are existing natural bottom need to be modified.

CHANNEL CO5-REACH 6-ALTERNATIVE 3 MAXIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	5,501	6,051	CY
0004	RIPRAP REMOVAL	0	0	CY
0005	EXCAVATION	10,993	12,093	CY
0006	COMPACTED FILL	3,801	4,181	CY
0007	CONCRETE REMOVAL	2,295	2,525	CY
0008	GRAVEL BASE REMOVAL	959	1,055	CY
0009	REINFORCED STEEL	334	367	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)	$ 5,708		

0011	TEMPORARY SHORING	1		LS

NOTE 1: 10% for contingency is added into the calculated quantities

NOTE 2: Clear site and remove obstruction wherever there are existing natural bottom need to be modified.

CHANNEL CO5-REACH 7-ALTERNATIVE 3 MAXIMUM CHANNEL MODIFICATIONS

Maintain Baseline Conditions

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	0		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	0		LS
0003	CONCRETE VOLUME	0	0	CY
0004	RIPRAP REMOVAL	0	0	CY
0005	EXCAVATION	0	0	CY
0006	COMPACTED FILL	0	0	CY
0007	CONCRETE REMOVAL	0	0	CY
0008	GRAVEL BASE REMOVAL	0	0	CY
0009	REINFORCED STEEL	0	0	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)	$ -		

NOTE 1: 10% for contingency is added into the calculated quantities

NOTE 2: Clear site and remove obstruction wherever there are existing natural bottom need to be modified.

CHANNEL CO5-REACH 8-ALTERNATIVE 3 MAXIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	15,771	17,349	CY
0004	RIPRAP REMOVAL	0	0	CY
0005	EXCAVATION	20,052	22,057	CY
0006	COMPACTED FILL	1,695	1,864	CY
0007	CONCRETE REMOVAL	5,347	5,881	CY
0008	GRAVEL BASE REMOVAL	1,167	1,284	CY
0009	REINFORCED STEEL	950	1,045	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)	$ 19,582		
0011	TEMPORARY SHORING	1		LS

NOTE 1: 10% for contingency is added into the calculated quantities

NOTE 2: Clear site and remove obstruction wherever there are existing natural bottom need to be modified.

CHANNEL CO5-REACH 9-ALTERNATIVE 3 MAXIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	2,221	2,443	CY
0004	RIPRAP REMOVAL	0	0	CY
0005	EXCAVATION	15,316	16,848	CY
0006	COMPACTED FILL	3,130	3,443	CY
0007	CONCRETE REMOVAL	10,914	12,005	CY
0008	GRAVEL BASE REMOVAL	1,213	1,334	CY
0009	REINFORCED STEEL	174	191	TON

0010	OPERATION AND MAINTENANCE (ANNUAL)	$ 28,580		
0011	TEMPORARY SHORING	1		LS

NOTE 1: 10% for contingency is added into the calculated quantities

NOTE 2: Clear site and remove obstruction wherever there are existing natural bottom need to be modified.

CHANNEL CO5-REACH 10-ALTERNATIVE 3 MAXIMUM CHANNEL MODIFICATIONS

Maintain Baseline Conditions

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	0		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	0		LS
0003	CONCRETE VOLUME	0	0	CY
0004	RIPRAP REMOVAL	0	0	CY
0005	EXCAVATION	0	0	CY
0006	COMPACTED FILL	0	0	CY
0007	CONCRETE REMOVAL	0	0	CY
0008	GRAVEL BASE REMOVAL	0	0	CY
0009	REINFORCED STEEL	0	0	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)	$ -		

NOTE 1: 10% for contingency is added into the calculated quantities

NOTE 2: Clear site and remove obstruction wherever there are existing natural bottom need to be modified.

CHANNEL CO5-REACH 11-ALTERNATIVE 3 MAXIMUM CHANNEL MODIFICATIONS

Maintain Baseline Conditions

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	0		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	0		LS
0003	CONCRETE VOLUME	0	0	CY
0004	RIPRAP REMOVAL	0	0	CY
0005	EXCAVATION	0	0	CY
0006	COMPACTED FILL	0	0	CY
0007	CONCRETE REMOVAL	0	0	CY
0008	GRAVEL BASE REMOVAL	0	0	CY
0009	REINFORCED STEEL	0	0	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)	$ -		

NOTE 1: 10% for contingency is added into the calculated quantities

NOTE 2: Clear site and remove obstruction wherever there are existing natural bottom need to be modified.

CHANNEL CO5-REACH 12-ALTERNATIVE 3 MAXIMUM CHANNEL MODIFICATIONS

Maintain Baseline Conditions

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	0		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	0		LS
0003	CONCRETE VOLUME	0	0	0
0004	RIPRAP REMOVAL	0	0	0
0005	EXCAVATION	0	0	0
0006	COMPACTED FILL	0	0	0
0007	CONCRETE REMOVAL	0	0	CY
0008	GRAVEL BASE REMOVAL	0	0	CY

0009	REINFORCED STEEL	0	0	0
0010	OPERATION AND MAINTENANCE (ANNUAL)	$ -		

NOTE 1: 10% for contingency is added into the calculated quantities

NOTE 2: Clear site and remove obstruction wherever there are existing natural bottom need to be modified.

NOTE 3: These quantity calculations do not include crossings (bridges)

NOTE 4: -For channel C05 quantities, channel configuration of alt 3A1, 3A2, and 3B are the same.

-For channel C05 quantities, crossing (bridge) configuration of alt 3A1, 3A2, and 3B are the same.

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TABLE 8

Westminster Alternative Analysis
Alternative 3 Maximum Channel Modifications: Existing and Proposed Channel Conditions

Notes:

No changes will be done on the spans labeled "Maintain Baseline Conditions"
No changes will be done for spans with culverts.
Spans labeled "Bridges" and not labeled "Maintain Baseline Conditions" will still have the channels changed as noted.

Channel: US C05

Reach	Measure	Existing		Proposed		US XS	DS XS	XSING Name	Existing					Proposed					Comments	Type			Height Change
		hannel Inve	hannel Wa	hannel Inve	hannel Wa				XSing	b	h	TW	z	XSing	b	h	TW	z		Existing	Proposed	Alternative	
		Maintain Baseline Conditions.				626+05.59	621+19.01			6.0	9.0	30.0	1.5		20.0	8.0	20.0	0.0		Trap	Rect	Maintain	-1.0
						621+19.01	620+53.20	Allard			Culvert			Culvert					See attached for culvert dimensions	Rect	Rect	Culvert	0.0
		Maintain Baseline Conditions.				620+53.20	611+71.00			6.0	11.5	34.5	1.5		20.0	9.5	20.0	0.0		Trap	Rect	Maintain	-2.0
						611+71.00	596+80.80	Underground Culvert			Culvert			Culvert					See attached for culvert dimensions	Rect	Rect	Culvert	0.0
		Maintain Baseline Conditions.				596+80.80	596+61.00			9.0	15.0	27.0	1.5		36	18	36	0		Trap	Rect	Maintain	3.0

Channel: C05

Reach	Measure	Existing		Proposed		US XS	DS XS	XSING Name	Existing					Proposed					Comments				
		hannel Inve	hannel Wa	hannel Inve	hannel Wa				XSing	b	h	TW	z	XSing	b	h	TW	z					
R10						578+46.00	578+16.00	DS Haster Basin			Culvert					Culvert			See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R10						578+16.00	564+39.00	DS Aspenwood			Culvert					Culvert			See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R10						564+38.00	563+00.00	US Garden Grove Blvd			Culvert					Culvert			See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R9		concrete	concrete	concrete	concrete	563+00.00	552+93.50			6.0	8.4	26.0	1.2		12.0	8.4	12.0	0.0		Trap	Rect	3A	0.0
R9						552+93.50	550+41.67				Culvert					Culvert			See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R9		concrete	concrete	concrete	concrete	550+41.67	547+95.50			12.0	8.4	12.0	0.0		20.0	8.5	20.0	0.0		Rect	Rect	3E	0.1
R9		concrete	concrete	concrete	concrete	547+95.50	546+49.50			6.0	8.0	30.0	1.5		20.0	8.5	20.0	0.0		Trap	Rect	3A	0.5
R9						546+49.50	545+81.20	Pearce St			Culvert					Culvert			See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R9		concrete	concrete	concrete	concrete	545+81.20	545+51.70			12.0	5.0	12.0	0.0		29.0	7.7	29.0	0.0		Rect	Rect	Transition	2.7
R9		concrete	concrete	concrete	concrete	545+51.70	535+58.60			6.0	7.7	29.0	1.5		20.0	7.7	20.0	0.0		Trap	Rect	3A	0.0
R9						535+58.60	534+34.10	Trask Ave			Culvert					Culvert			See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R9		concrete	concrete	concrete	concrete	534+34.10	534+04.20			12.0	8.5	12.0	0.0		25.0	9.5	25.0	0.0		Rect	Rect	Transition	1.0
R9		concrete	concrete	concrete	concrete	534+04.20	530+71.20			6.0	9.0	33.0	1.5		25.0	9.5	25.0	0.0		Trap	Rect	3A	0.5
R9		concrete	concrete	concrete	concrete	530+71.20	530+61.30	Pedestrian Bridge	Bridge	6.0	10.0	33.0	1.4	Bridge	25.0	10.0	25.0	0.0	See attached for bridge dimensions	Trap	Rect	3A	0.0
R9		concrete	concrete	concrete	concrete	530+61.30	515+38.10			6.0	9.0	33.0	1.5		25.0	9.0	25.0	0.0		Trap	Rect	3A	0.0
R9						515+38.10	514+11.80	Harbor Blvd			Culvert					Culvert			See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R9		concrete	concrete	concrete	concrete	514+11.80	513+82.60			12.0	7.7	12.0	0.0		25.0	8.0	25.0	0.0		Rect	Rect	Transition	0.3
R9		concrete	concrete	concrete	concrete	513+82.60	503+04.60			6.0	8.0	30.0	1.5		25.0	8.0	25.0	0.0		Trap	Rect	3A	0.0
R9						503+04.60	500+01.50	OCTD Yard			Culvert					Culvert			See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R8		concrete	concrete	concrete	concrete	500+01.50	499+69.40			20.8	10.0	20.8	0.0		25.0	10.0	25.0	0.0		Rect	Rect	Transition	0.0
R8		concrete	concrete	concrete	concrete	499+69.40	487+80.70			8.0	11.7	43.0	1.5		30.0	11.7	30.0	0.0		Trap	Rect	3A	0.0
R8						487+80.70	486+54.70	Westminster Ave			Culvert					Culvert			See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R8		concrete	concrete	concrete	concrete	486+54.70	486+25.60			18.7	11.5	18.7	0.0		40.0	11.5	40.0	0.0		Rect	Rect	Transition	0.0
R8		concrete	concrete	concrete	concrete	486+25.60	475+96.40			8.0	11.0	41.0	1.5		40.0	11.0	40.0	0.0		Trap	Rect	3A	0.0

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R8						475+96.40	475+29.60	Morningside Ave		Culvert					Culvert				See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R8		concrete	concrete	concrete	concrete	475+29.60	475+05.90			18.7	10.3	18.7	0.0		40.0	10.3	40.0	0.0		Rect	Rect	Transition	0.0
R8		concrete	concrete	concrete	concrete	475+05.90	467+47.00			8.0	12.0	44.0	1.5		40.0	12.0	40.0	0.0		Trap	Rect	3A	0.0
R8						467+47.00	466+81.60	W Fay Circle		Culvert					Culvert				See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R8		concrete	concrete	concrete	concrete	466+81.60	466+48.90			18.7	9.9	18.7	0.0		40.0	9.9	40.0	0.0		Rect	Rect	Transition	0.0
R8		concrete	concrete	concrete	concrete	466+48.90	456+86.00			8.0	12.0	44.0	1.5		40.0	12.0	40.0	0.0		Trap	Rect	3A	0.0
R7						456+86.00	445+99.90	Hazard		Culvert					Culvert				See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R6		concrete	concrete	concrete	concrete	445+99.90	444+59.36			29.0	11.0	39.0	0.5		40.0	12.0	40.0	0.0		Trap	Rect	3A	1.0
R6		concrete	concrete	concrete	concrete	444+59.36	438+50.90			21.0	11.0	54.0	1.5		30.0	12.0	30.0	0.0		Trap	Rect	3A	1.0
R6						438+50.90	437+72.30	Fifth St		Culvert					Culvert				See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R6		concrete	concrete	concrete	concrete	437+72.30	437+45.50			18.7	13.0	18.7	0.0		40.0	13.0	40.0	0.0		Rect	Rect	Transition	0.0
R6		concrete	concrete	concrete	concrete	437+45.50	430+85.00			10.0	12.0	46.0	1.5		40.0	12.0	40.0	0.0		Trap	Rect	3A	0.0
R5		riprap	riprap	concrete	concrete	430+85.00	425+12.20			10.0	12.0	46.0	1.5		40.0	11.7	40.0	0.0		Trap	Rect	3K	-0.3
R5						425+12.20	423+86.40	Bolsa St		Culvert					Culvert				See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R5		riprap	riprap	concrete	concrete	423+86.40	423+57.10			20.7	11.0	20.7	0.0		40.0	11.7	40.0	0.0		Rect	Rect	Transition	0.7
R5		riprap	riprap	concrete	concrete	423+57.10	397+01.00			10.0	11.7	45.0	1.5		40.0	11.7	40.0	0.0		Trap	Rect	3K	0.0
R5						397+01.00	395+93.00	Euclid St		Culvert					Culvert				See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R5		riprap	riprap	concrete	concrete	395+93.00	395+62.67			20.0	11.0	22.6	0.1		48.0	11.0	48.0	0.0		Trap	Rect	Transition	0.0
R5		riprap	riprap	concrete	concrete	395+62.67	387+49.00			12.0	10.7	44.0	1.5		48.0	10.7	48.0	0.0		Trap	Rect	3K	0.0
R5						387+49.00	386+85.00	Deming		Culvert					Culvert				See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R5		riprap	riprap	concrete	concrete	386+85.00	386+56.00			20.8	11.0	20.8	0.0		50.0	11.0	50.0	0.0		Rect	Rect	Transition	0.0
R5		riprap	riprap	concrete	concrete	386+56.00	370+48.00			12.0	10.0	42.0	1.5		50.0	10.0	50.0	0.0		Trap	Rect	3K	0.0
R5						370+48.00	369+63.00	Ward St.		Culvert					Culvert				See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R5		riprap	riprap	concrete	concrete	369+63.00	369+34.00			24.8	10.5	24.8	0.0		50.0	10.5	50.0	0.0		Rect	Rect	Transition	0.0
R5		riprap	riprap	concrete	concrete	369+34.00	355+13.40			14.0	10.7	44.0	1.4		45.0	10.7	45.0	0.0		Trap	Rect	3K	0.0
R5		concrete	concrete	concrete	concrete	355+13.40	355+03.50	Pedestrian Bridge	Bridge	14.0	10.7	44.0	1.4	Bridge	45.0	12.0	45.0	0.0	See attached for bridge dimensions	Trap	Rect	3A	1.3
R5		concrete	concrete	concrete	concrete	355+03.50	344+03.30			14.0	10.7	44.0	1.4		45.0	10.7	45.0	0.0		Trap	Rect	3A	0.0
R5						344+03.30	341+55.60	McFadden/ Brookhurst		Culvert					Culvert				See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R4		riprap	riprap	concrete	concrete	341+55.60	341+25.60			24.8	10.5	24.8	0.0		45.0	11.0	45.0	0.0		Rect	Rect	Transition	0.5
R4		riprap	riprap	concrete	concrete	341+25.60	313+68.64			16.0	11.0	49.0	1.5		50.0	11.0	50.0	0.0		Trap	Rect	3K	0.0
R4						313+68.64	312+74.64	Bushard St		Culvert					Culvert				See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R4		riprap	riprap	concrete	concrete	312+74.64	312+44.64			28.8	11.5	28.8	0.0		50.0	11.5	50.0	0.0		Rect	Rect	Transition	0.0
R4		riprap	riprap	concrete	concrete	312+44.64	307+60.50			16.0	11.5	51.0	1.5		50.0	11.5	50.0	0.0		Trap	Rect	3K	0.0
R4		riprap	riprap	concrete	concrete	307+60.50	307+50.60	Pedestrian Bridge	Bridge	16.0	14.0	51.0	1.3	Bridge	50.0	14.0	50.0	0.0	See attached for bridge dimensions	Trap	Rect	3K	0.0
R4		riprap	riprap	concrete	concrete	307+50.60	307+25.95			16.0	11.5	51.0	1.5		50.0	11.5	50.0	0.0		Trap	Rect	3K	0.0
R4		riprap	riprap	concrete	concrete	307+25.95	285+04.14			16.0	11.5	51.0	1.5		50.0	11.5	50.0	0.0		Trap	Rect	3K	0.0
R4						285+04.14	282+44.14	Magnolia		Culvert					Culvert				See attached for culvert dimensions	Rect	Rect	Culvert	0.0
R4		riprap	riprap	concrete	concrete	282+44.14	281+95.14			24.8	11.5	24.8	0.0		60.0	12.5	60.0	0.0		Rect	Rect	Transition	1.0
R4		riprap	riprap	concrete	concrete	281+95.14	271+32.70			18.0	10.0	48.0	1.5		60.0	12.5	60.0	0.0		Trap	Rect	3K	2.5

R4						271+32.70	270+78.00	Quartz St	Culvert					Culvert				See attached for culvert dimensions	Rect	Rect	Culvert	0.0	
R4		concrete	concrete	concrete	concrete	270+78.00	255+41.68			60.0	13.0	60.0	0.0		60.0	13.0	60.0	0.0		Rect	Rect	Maintain	0.0	
R4						255+41.68	253+28.90	405 FWY	Culvert					Culvert				See attached for culvert dimensions	Rect	Rect	Culvert	0.0	
R3		concrete	concrete	concrete	concrete	253+28.90	250+77.72			63.0	11.0	63.0	0.0		63.0	12.0	63.0	0.0		Rect	Rect	3E	1.0	
		concrete	concrete	concrete	concrete	250+77.72	248+47.70			60.0	12.0	60.0	0.0		60.0	12.0	60.0	0.0		Rect	Rect	Maintain	0.0	
R3						248+47.70	247+97.70	Woodruff	Culvert					Culvert				See attached for culvert dimensions	Rect	Rect	Culvert	0.0	
R3		riprap	riprap	concrete	concrete	247+97.70	247+47.70			60.0	12.2	60.0	0.0		60.0	12.2	60.0	0.0		Rect	Rect	Transition	0.0	
R3		riprap	riprap	concrete	concrete	247+47.70	225+93.00			18.0	12.0	53.0	1.5		60.0	12.0	60.0	0.0		Trap	Rect	3K	0.0	
R3						225+93.00	223+50.00	Beach	Culvert					Culvert				See attached for culvert dimensions	Rect	Rect	Culvert	0.0	
R3		concrete	concrete	concrete	concrete	223+50.00	222+03.32			31.3	11.4	31.3	0.0		60.0	14.0	60.0	0.0		Rect	Rect	3E	2.6	
R3		riprap	riprap	concrete	concrete	222+03.32	201+66.90			20.0	13.0	59.0	1.5		60.0	14.0	60.0	0.0		Trap	Rect	3K	1.0	
R3		riprap	riprap	concrete	concrete	201+66.90	201+46.90	Pedestrian Bridge	Bridge	20.0	13.0	59.0	1.5	Bridge	60.0	14.0	60.0	0.0	See attached for bridge dimensions	Trap	Rect	3K	1.0	
R3		concrete	concrete	concrete	concrete	201+46.90	198+77.69			31.0	14.0	59.0	1.0		60.0	14.0	60.0	0.0		Trap	Rect	3A	0.0	
R3		concrete	concrete	concrete	concrete	198+77.69	191+78.45			59.0	16.5	59.0	0.0		60.0	16.5	60.0	0.0		Rect	Rect	3E	0.0	
R2		Maintain Baseline Conditions.				191+78.45	191+55.45	Railroad Bridge	Bridge	62.0	15.0	62.0	0.0	Bridge	62.0	15.0	62.0	0.0	See attached for bridge dimensions	Rect	Rect	Maintain	0.0	
R2		Natural	concrete	concrete	concrete	191+55.45	185+43.98			60.0	14.5	60.0	0.0		60.0	14.5	60.0	0.0		Rect	Rect	3L	0.0	
R2		Natural	concrete	concrete	concrete	185+43.98	184+63.98	Gothard St	Bridge	60.0	15.4	60.0	0.0	Bridge	60.0	15.4	60.0	0.0	See attached for bridge dimensions	Rect	Rect	3L	0.0	
R2		Natural	concrete	concrete	concrete	184+63.98	173+84.28			59.0	14.4	59.0	0.0		75.0	14.4	75.0	0.0		Rect	Rect	3L	0.0	
R2		Natural	concrete	concrete	concrete	173+84.28	165+72.43			75.0	14.0	75.0	0.0		75.0	17.0	75.0	0.0		Rect	Rect	3L	3.0	
R2		Natural	concrete	concrete	concrete	165+72.43	164+72.43	Golden West st	Bridge	75.0	14.0	75.0	0.0	Bridge	83.0	17.0	83.0	0.0	See attached for bridge dimensions	Rect	Rect	3L	3.0	
R2		Natural	concrete	concrete	concrete	164+72.43	150+74.53			75.0	14.0	75.0	0.0		83.0	17.0	83.0	0.0		Rect	Rect	3L	3.0	
R1		Natural	concrete	Natural	concrete	150+74.53	139+22.21			70.0	12.0	118.0	2.0		166.0	16.0	166.0	0.0		Trap	Rect	3M	4.0	Existing Levee Conditic
R1		Natural	concrete	Natural	concrete	139+22.21	138+38.21	Edward St	Bridge	70.0	12.0	118.0	2.0	Bridge	166.0	16.0	166.0	0.0	See attached for bridge dimensions	Trap	Rect	3M	4.0	Existing Levee Conditic
R1		Natural	concrete	Natural	concrete	138+38.21	112+90.43			70.0	12.0	118.0	2.0		177.0	16.0	177.0	0.0		Trap	Rect	3M	4.0	Existing Levee Conditic
R1		Natural	concrete	Natural	concrete	112+90.43	111+87.43	Springdale St	Bridge	70.0	12.0	118.0	2.0	Bridge	177.0	16.0	177.0	0.0	See attached for bridge dimensions	Trap	Rect	3M	4.0	Existing Levee Conditic
R1		Natural	concrete	Natural	concrete	111+87.43	101+35.39			70.0	12.0	118.0	2.0		168.0	16.0	168.0	0.0		Trap	Rect	3M	4.0	Existing Levee Conditic
R1		Maintain Baseline Conditions.				101+35.39	101+21.39			146.0	16.0	146.0	0.0		146.0	16.0	146.0	0.0		Rect	Rect	Maintain	0.0	
R1		Maintain Baseline Conditions.				101+21.39	099+91.39	Warner Ave	Bridge	140.0	16.0	146.0	0.2	Bridge	140.0	16.0	140.0	0.0	See attached for bridge dimensions	Trap	Rect	Maintain	0.0	
R1		Maintain Baseline Conditions.				099+91.39	097+11.11			134.0	16.0	134.0	0.0		134.0	16.0	134.0	0.0		Rect	Rect	Maintain	0.0	
R1		Maintain Baseline Conditions.				097+11.11	074+57.01			146.0	15.5	146.0	0.0		146.0	15.5	146.0	0.0		Rect	Rect	Maintain	0.0	
R1		Maintain Baseline Conditions.				074+57.01	073+29.01	Graham St	Bridge	146.0	15.5	146.0	0.0	Bridge	146.0	15.5	146.0	0.0	See attached for bridge dimensions	Rect	Rect	Maintain	0.0	
R1		Maintain Baseline Conditions.				073+92.01	057+93.87			146.0	15.0	146.0	0.0		146.0	15.0	146.0	0.0		Rect	Rect	Maintain	0.0	
R1		Maintain Baseline Conditions.				057+93.87	057+63.87	Slater	Bridge	146.0	15.0	146.0	0.0	Bridge	146.0	15.0	146.0	0.0	See attached for bridge dimensions	Rect	Rect	Maintain	0.0	
R1		Maintain Baseline Conditions.				057+63.87	051+92.55			146.0	15.0	146.0	0.0		146.0	15.0	146.0	0.0		Rect	Rect	Maintain	0.0	
R1		Natural Bo	Natural Bo	Natural Bo	Sheet Pile	051+92.55	036+47.63			70.0	13.0	122.0	2.0		146.0	16.0	146.0	0.0		Trap	Rect	3N	3.0	
R1		Natural Bo	Natural Bo	Natural Bo	Sheet Pile	036+47.63	036+22.63	Oil Field Bridge	Bridge	70.0	13.0	122.0	2.0	Bridge	146.0	16.0	146.0	0.0	See attached for bridge dimensions	Trap	Rect	3N	3.0	
R1		Natural Bo	Natural Bo	Natural Bo	Sheet Pile	036+22.63	009+90.87			70.0	13.0	122.0	2.0		146.0	16.0	146.0	0.0		Trap	Rect	3N	3.0	
R1		Natural Bo	Natural Bo	Natural Bo	Sheet Pile	009+90.87	006+25.87			120.0	14.5	178.0	2.0		146.0	16.0	146.0	0.0		Trap	Rect	3N	1.5	
R1						006+25.87	006+05.87	Outlet	Culvert					Culvert				See attached for culvert dimensions	Rect	Rect	Culvert	0.0	
R1		Maintain Baseline Conditions.				006+05.87	000+00.00			120.0	14.5	178.0	2.0		120.0	14.5	178.0	2.0		Trap	Trap	Maintain	0.0	

TABLE 9

Westminster_Alternative Analysis

Project: Westminster

Objective: Using the existing HEC-RAS models geometry files with artificial levees adjust the geometry to include the channel modifications proposed in each of the respective Alternatives

Hec-Ras Model	Westminster Channel Project
Project Location	P:\Westminster\HEC-RAS_TSP Alts\C05_C06_TSP_Alt_3
Geometry File	Westmin_C05C06_Alt3_BR_FD_ADJ_NO405MOD (.g03)
Alternative	Alternative 3 Maximum Channel Modifications No 405 MODS
HEC-RAS River	Westminster C06, Westminster
HEC-RAS Reach	C05, C05

Note:
1. All dimensions are in Feet unless noted otherwise.
2. Crossings were adjusted by modifying span and maintaining rise constant.
3. All crossings, including culverts, were modeled as bridges,
4. Debris was modeled as floating debris on the piers. Space in between box culvert barrels was modeled as piers.
5. Quantity of Debris: Width = 2' on each side of piers + width of pier. Height: 6'.
6. Cross-sections u/s and d/s of crossings were expanded. Crossings were adjusted to maximize cross-sectional flow area using u/s and d/s cross sections as the limit.

	Model		Current Dimensions of Crossing							Proposed Crossing Adjustment	Proposed Dimensions of Crossing						
Bridge	US XS	DS XS	Type	Span	Rise	# Piers	Pier Width	Diameter	# Barrels	Description	Type	Span	Rise	# Piers	Pier Width	Diameter	# Barrels
D/S Haster Basin	578+46.00	578+16.00	Box - Flared wingwall 30 - 75 Deg	10	5.5				1	Crossing and XS US and DS: Maintain Baseline Conditions	Box - Flared wingwall 30 - 75 Deg	10	5.5				1
Upstream of Aspenwood	576+80.00	576+08.00	Box - Flared wingwall 30 - 75 Deg	10	4				1	Crossing and XS US and DS: Maintain Baseline Conditions	Box - Flared wingwall 30 - 75 Deg	10	4				1
D/S Aspenwood	576+07.00	564+39.00	Box - Flared wingwall 30 - 75 Deg	11	6				1	Crossing and XS US and DS: Maintain Baseline Conditions	Box - Flared wingwall 30 - 75 Deg	11	6				1
U/S of Garden Grove Blvd	564+38.00	563+39.00	Box - Flared wingwall 30 - 75 Deg	10	5.5				1	Crossing: US End - maintain baseline conditions. DS End, expand deck, maintain baseline culvert. XS DS: Increase B and TW. XS US: Maintain Baseline Conditions.	Box - Flared wingwall 30 - 75 Deg	10	5.5				1
Pearce st	546+49.50	545+81.20	Box - Flared wingwall 30 - 75 Deg	12	5				1	Crossing: Replace structure with 2- 14' x 5' box barrels. XS DS & US: Increase B, TW, and H.	Box - Flared wingwall 30 - 75 Deg	14.5	5				2
Trask	535+58.60	534+34.10	Box - Flared wingwall 30 - 75 Deg	12	6.5				1	Crossing: Replace structure with 2 - 9' x 6.5' barrels. XS US: Maintain baseline H. Increase B and TW. XS DS: Increase B, H, & TW to match DS XS.	Box - Flared wingwall 30 - 75 Deg	9	6.5				2
Pedestrian Bridge	530+71.20	530+61.30	Clear span bridge - Trap b = 6.3 TW = 33		10					Crossing: Replace bridge. Adjust channel below crossing to match US & DS geometry. XS US and DS: Decrease TW. Change from Trap to Rect.	Clear span bridge	25	10				1
Harbor Blvd	515+38.10	514+11.80	Box - Flared wingwall 30 - 75 Deg	12	6.5				1	Crossing: Add 1 - 12' x 6.5' barrel. XS US: Maintain baseline H. Increase TW & B. XS DS: Increase B, TW, & H.	Box - Flared wingwall 30 - 75 Deg	12	6.5				2
OCTD Yard	503+04.60	500+01.50	Box - Flared wingwall 30 - 75 Deg	10	8				2	Crossing: Replace structure with 2 - 10' x 8' barrels. XS US & DS: Maintain baseline H. Increase B & TW.	Box - Flared wingwall 30 - 75 Deg	10	8				2
Westminster Ave	487+80.70	486+54.70	Box - Flared wingwall 30 - 75 Deg	9	9.5				2	Crossing: Replace structure with 3 - 12' x 9.5' barrels. XS US & DS: Maintain baseline H. Increase B & TW.	Box - Flared wingwall 30 - 75 Deg	12	9.5				3
Morningside Ave	475+96.40	475+29.60	Box - Flared wingwall 30 - 75 Deg	9	9				2	Crossing: Replace structure with 3 - 12' x 9' barrels. XS US & DS: Maintain baseline H. Increase B & TW.	Box - Flared wingwall 30 - 75 Deg	12	9				3
W. Fay Circle	467+47.00	466+81.60	Box - Flared wingwall 30 - 75 Deg	9	8.5				2	Crossing: Replace structure with 3 - 12' x 8.5' barrels. XS US & DS: Maintain baseline H. Increase B & TW.	Box - Flared wingwall 30 - 75 Deg	12	8.5				3
Hazard/ New Hope	456+86.00	445+99.90	Bridge with 1-0.67' pier at center	18.5	12				1	Crossing: Replace structure with extended bridge. XS US: Maintain baseline H. Increase B & TW. XS DS: Increase TW & B. Increase H.	Bridge with 1-0.67' pier at center	40	12	1	0.67		
Fifth st.	438+50.90	437+72.30	Box - Flared wingwall 30 - 75 Deg	9	8.5				2	Crossing: Replace structure with 3 - 12' x 8.5' barrels. XS US & DS: Maintain baseline H. Increase B & TW.	Box - Flared wingwall 30 - 75 Deg	12	8.5				3
Bolsa st.	425+12.20	423+86.40	Box - Flared wingwall 30 - 75 Deg	10	8.5				2	Crossing: Replace structure with 3 - 13' x 8.5' barrels. XS US: Maintain baseline H. Increase B & TW. XS DS: Increase B, H, & TW. Change from natural riprap lining to concrete lining.	Box - Flared wingwall 30 - 75 Deg	13	8.5				3
Euclid st.	397+01.00	395+93.00	Box - Flared wingwall 30 - 75 Deg	11	6.5				2	Crossing: Replace structure with 4 - 11' x 8.5' barrels. XS US: Maintain baseline H. Increase B & TW. XS DS: Maintain baseline H. Increase TW &B.. Change from riprap lining to concrete lining.	Box - Flared wingwall 30 - 75 Deg	11	8.5				4
Deming	387+49.00	386+85.00	Box - Flared wingwall 30 - 75 Deg	10	8.5				2	Crossing: Replace structure with 4 - 11' x 8.5' barrels. XS US: Maintain baseline H. Increase B & TW. XS DS: Maintain baseline H. Increase B & TW. Change from riprap lining to concrete lining.	Box - Flared wingwall 30 - 75 Deg	11	8.5				4
Ward st.	370+48.00	369+63.00	Box - Flared wingwall 30 - 75 Deg	12	9.5				2	Crossing: Replace structure with 4 - 12' x 9.5' barrels. XS US: Maintain baseline H. Increase B & TW. XS DS: Maintain baseline H. Increase B & TW. Change from riprap lining to concrete lining.	Box - Flared wingwall 30 - 75 Deg	12	9.5				4
Pedestrian Bridge	355+13.40	355+03.50	Clear span bridge - Rectangular	44	12					Crossing: Replace structure with widened deck to account for widened channel US and DS. Channel under XS changed from trap to rect. XS US & DS: Change from trap to rect. Maintain baseline H. Increase TW.	Clear span bridge - Rectangular		12				
McFadden / Brookhurst	344+03.30	341+55.60	Box - Flared wingwall 30 - 75 Deg	12	9.5				2	Crossing: Replace structure with 3 - 14' x 9.5' barrels. XS US: Maintain baseline H. Increase B & TW. XS DS: Increase B, H, & TW. Change from riprap lining to concrete lining.	Box - Flared wingwall 30 - 75 Deg	14	9.5				3
Bushard st.	313+68.64	312+74.64	Box - Flared wingwall 30 - 75 Deg	14	11				2	Crossing: Replace structure with 3 - 15' x 11' barrels. XS US: Maintain baseline H. Increase B & TW. XS DS: Maintain baseline H. Increase B & TW. Change from riprap lining to concrete lining.	Box - Flared wingwall 30 - 75 Deg	15	11				3

Pedestrian Bridge	307+60.50	307+50.60	Clear span bridge- Trap b = 16 TW = 51		14					Crossing: Replace structure. Channel under xsing changed from Trap to Rect. XS US & DS: Maintain baseline H. Decrease TW. Change from Trap to Rect. Change from riprap lining to concrete lining.	Clear span bridge- Trap b = 50 TW = 50		14				
Magnolia/Edinger	285+04.14	282+44.14	Box - Flared wingwall 30 - 75 Deg	12	9.5				2	Crossing: Replace structure with 4 - 12' x 9.5' barrels. XS US: Maintain baseline H. Increase B & TW. XS DS: Increase B, H, & TW. Change from riprap lining to concrete lining.	Box - Flared wingwall 30 - 75 Deg	12	9.5				4
Quartz st.	271+32.70	270+78.00	Box - Side tapered; Less favorable Edges	14.25	10				4	Crossing and XS US & DS: Maintain baseline conditions.	Box - Side tapered; Less favorable Edges	14.25	10				4
405 FWY	255+41.68	253+28.90	Culver 1: Ellipse: Concrete	10	6.4				2	Crossing XS: Maintain baseline conditions. US: Add 3' floodwalls. XS DS: Maintain existing TW & B. Increase H.	Culver 1: Ellipse: Concrete	10	6.4				2
			Culver 2: Box - Flared wingwall 30 - 75 De	10	9.3				3		Culver 2: Box - Flared wingwall 30 - 75 Deg	10	9.3				3
Woodruff	248+47.70	247+97.70	Box - Side tapered; Less favorable Edges	14.25	10				4	Crossing: Maintain baseline conditions. XS US: Maintain baseline conditions. XS DS: Maintain baseline dimensions. Change from riprap lining to concrete lining.	Box - Side tapered; Less favorable Edges	14.25	10				4
Beach	225+93.00	223+50.00	Box - Side tapered; Less favorable Edges	10	10				3	Crossing: Replace structure with 5 - 11' x 10' barrels. XS US: Maintain baseline H. Increase TW & B. XS DS: Increase B, H, & TW. Change from riprap lining to concrete lining.	Box - Side tapered; Less favorable Edges	11	10				5
Pedestrian Bridge	201+66.90	201+46.90	ear span bridge: Trap. B = 29.26 TW= 59		14					Crossing: Replace structure. Channel under crossing changed from Trap to Rect. Maintain baseline conditions. XS US & DS: Maintain baseline H. Increase TW. Change from trap to rect. Change from riprap lining to concrete lining.	Clear span bridge: TW= 60	60	14				
Railroad Bridge	191+78.45	191+55.45	Bridge with 2-1' piers.	62	15	2	1			Crossing and XS US & DS: Maintain baseline conditions.	Bridge with 2-1' piers.		15	2	1		
Gothard St.	185+43.98	184+63.98	Bridge with 1-1.3' pier	59	13.74	1	1.3			Crossing and XS US &DS: Maintain baseline conditions	Bridge with 1-1.3' pier		13.74	1	1.3		
Golden West St.	165+72.43	164+72.43	Bridge with 1-1.3' pier	75	16.5	1	1.3			Crossing: Replace bridge with raised bridge and extended deck. XS US: Increase b and TW by extending both banks. Add 3' floodwalls. XS DS: Increase TW, b, and add 2' floodwalls. 14' remain for access roads on both sides of channel.	Bridge with 1-1.3' pier		16.5	1	1.3		
Edward st.	139+22.21	138+38.21	ridge with 3-1' piers. Trap b=70 TW=118		11.9	3	1			Crossing: Replace structure- Extend deck, add 2 piers. XS US & DS: Add 3' floodwalls. Increase TW by extending both top of banks. Change from Trap to Rect; Increase B to match TW.	Bridge with 5-1' piers. TW=146		11.9	5	1		
Springdale St.	112+90.43	111+87.43	idge with 3-1' piers. Trap b=70 TW=114.4		11.1	3	1			Crossing: Replace structure- Extend deck, add 2 piers. Channel under crossing changed from Trap to Rect. XS US :Add 3' floodwalls. Increase TW by extending both top of banks. Change from Trap to Rect; Increase B to match TW. XS DS: Add 3' floodwalls. Increase TW by extending right and left top of banks 25'. Maintain 14' access road on either side. Change from Trap to Rect; Increase B to match TW.	Bridge with 5-1' piers. TW=146		11.1	5	1		
Warner Ave.	101+21.39	099+91.39	Bridge with 3-1' piers.	140	11.6	3	1			Crossing: Maintain baseline conditions. XS US & DS: Maintain Baseline Conditions. .	Bridge with 3-1' piers. TW=146		11.6	3	1		
Graham St.	074+57.01	073+29.01	Bridge with 3-1.3' piers.	146	13.5	3	1.3			Crossing: Maintain baseline conditions. XS US & DS: Maintain baseline conditions.	Bridge with 3-1.3' piers.		13.5	3	1		
Slater	057+93.87	057+63.87	Bridge with 3-1' piers.	146	11.9	3	1			Crossing: Remove bridge. XS US & DS: Maintain baseline conditions.			11.9				
Oil Field Bridge	036+47.63	036+22.63	Bridge with 4-1' piers.	146	11.95	4	1			Crossing: Remove bridge XS US & DS: Maintain baseline H. Increase TW. Change from trap to rect..			11.95				
Outlet	006+25.87	006+05.87	Concrete Pipe Culvert					7	12	Crossing: Maintain baseline conditions. XS US & DS: Decrease TW. Increase H. Change from trap to rect.	Concrete Pipe Culvert		0				

Appendix B - Civil Engineering

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TABLE 10

WESTMINSTER FEASIBILITY QUANTITY CALCULATION

CHANNEL CO6-REACH 13-ALTERNATIVE 3B MAXIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	21,269	23,396	CY
0004	RIPRAP REMOVAL	31,657	34,822	CY
0005	EXCAVATION	46,123	50,735	CY
0006	COMPACTED FILL	3,419	3,761	CY
0007	CONCRETE REMOVAL	0	0	CY
0008	GRAVEL BASE REMOVAL	0	0	CY
0009	REINFORCED STEEL	1,295	1,424	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)	$ 17,999		

NOTE 1: 10% for contingency is added to quantities

CHANNEL CO6-REACH 14-ALTERNATIVE 3B MAXIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	455	500	CY
0004	RIPRAP REMOVAL	0	0	CY
0005	EXCAVATION	0	0	CY
0006	COMPACTED FILL	0	0	CY
0007	CONCRETE REMOVAL	325	357	CY
0008	GRAVEL BASE REMOVAL	126	138	CY
0009	REINFORCED STEEL	28	31	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)	$ 2,102		
0011	TEMPORARY SHORING	1		LS

NOTE 1: 10% for contingency is added to quantities

CHANNEL CO6-REACH 15-ALTERNATIVE 3B MAXIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	7,632	8,395	CY
0004	RIPRAP REMOVAL	0	0	CY
0005	EXCAVATION	20,136	22,149	CY
0006	COMPACTED FILL	0	0	CY
0007	CONCRETE REMOVAL	3,036	3,339	CY
0008	GRAVEL BASE REMOVAL	1,248	1,373	CY
0009	REINFORCED STEEL	470	517	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)	$ 5,385		
0011	TEMPORARY SHORING	1		LS

NOTE 1: 10% for contingency is added to quantities

CHANNEL CO6-REACH 16-ALTERNATIVE 3B MAXIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	269	296	CY
0004	RIPRAP REMOVAL	0	0	CY
0005	EXCAVATION	711	782	CY
0006	COMPACTED FILL	0	0	CY
0007	CONCRETE REMOVAL	107	118	CY
0008	GRAVEL BASE REMOVAL	44	48	CY
0009	REINFORCED STEEL	17	19	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)	$ 4,255		
0011	TEMPORARY SHORING	1		LS

NOTE 1: 10% for contingency is added to quantities

CHANNEL CO6-REACH 17-ALTERNATIVE 3B MAXIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS
0003	CONCRETE VOLUME	11,882	13,070	CY
0004	RIPRAP REMOVAL	9,947	10,941	CY
0005	EXCAVATION	14,419	15,861	CY
0006	COMPACTED FILL	1,652	1,817	CY
0007	CONCRETE REMOVAL	0	0	CY
0008	GRAVEL BASE REMOVAL	0	0	CY
0009	REINFORCED STEEL	788	867	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)	$ 7,218		

NOTE 1: 10% for contingency is added to quantities

CHANNEL CO6-REACH 18-ALTERNATIVE 3B MAXIMUM CHANNEL MODIFICATIONS

MAINTAIN BASELINE CONDITIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0010	OPERATION AND MAINTENANCE (ANNUAL)	$ 14,000		

NOTE 1: 10% for contingency is added to quantities

CHANNEL CO6-REACH 19-ALTERNATIVE 3B MAXIMUM CHANNEL MODIFICATIONS

Item Number	Description	Quantity Before Adding 10% for Contingency	Quantity After Adding 10% for Contingency	Unit
0001	DIVERSION OF WATER	1		LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1		LS

0003	CONCRETE VOLUME	3,775	4,153	CY
0004	RIPRAP REMOVAL	8,332	9,165	CY
0005	EXCAVATION	640	704	CY
0006	COMPACTED FILL	4,592	5,052	CY
0007	CONCRETE REMOVAL	0	0	CY
0008	GRAVEL BASE REMOVAL	0	0	CY
0009	REINFORCED STEEL	376	414	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)	$ 6,039		

NOTE 1: 10% for contingency is added into the bid schedule

NOTE 2: These quantity calc. do not include crossings (bridges)

NOTE 3: -Channel C06 has 3 sub alternatives which are alt 3A1, 3A2 and 3B
-For C06, alternative 3A1 has the same channel configuration as alternative 3A2.
-Therefore, for C06, alt 3A1 and 3A2 together are called alt 3A
-For C06, Alt 3B with no 405 Modifications will be used.

NOTE 4: Riprap will not be reused for all 4 channels and all alternatives.

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TABLE 11

Westminster Alternative Analysis

Alternative 3 Maximum Channel Modifications: Existing and Proposed Channel Conditions

Notes:

No changes will be done on the spans labeled "Maintain Baseline Conditions"
No changes will be done for spans with culverts.
Spans labeled "Bridges" and not labeled "Maintain Baseline Conditions" will still have the channels changed as noted.

Channel: C06

Reach	Measure	Existing		Proposed		US XS	DS XS	XSING Name	Existing					Proposed					Comments					
		Channel Inver	Channel Walls	Channel Invert	Channel Walls				XSing	b	h	TW	z	XSing	b	h	TW	z						
R19		Natural	Riprap	Concrete	Concrete	217+31.98	194+29.30			4	9	35	1.7		5	9	32	1.5		Trap	Trap	3C	0.0	
R18						194+29.30	193+20.10	Euclid	Culvert					Culvert					See attached for culvert dimensions	Rect	Rect	Culvert	0.0	
R18		Natural	Riprap	Concrete	Concrete	193+20.10	192+65.50			16.75	9	16.75	0.0		16.75	9	16.75	0.0		Rect	Rect	Maintain	0.0	
R18		Concrete	Concrete	Concrete	Concrete	192+65.50	140+91.30			10	7	10	0.0		10	7	10	0.0		Rect	Rect	Maintain	0.0	
R17						140+91.30	139+62.00	Brookhurst	Culvert					Culvert					See attached for culvert dimensions	Rect	Rect	Culvert	0.0	
R17		Natural	Riprap	Concrete	Concrete	139+62.00	139+07.30			20.75	10.05	20.75	0.0		50	14.05	50	0.0		Rect	Rect	Transition	4.0	
R17		Natural	Riprap	Concrete	Concrete	139+07.30	114+29.00			10	10	46	1.8		28	14	50	0.8		Trap	Trap	3C	4.0	
R17						114+29.00	113+39.30	Bushard	Culvert					Culvert					See attached for culvert dimensions	Rect	Rect	Culvert	0.0	
R16		concrete	concrete	Concrete	Concrete	113+39.30	112+84.00			21.5	10.5	21.5	0.0		47	13	47	0.0		Rect	Rect	F	2.5	
R15		concrete	concrete	Concrete	Concrete	112+84.00	097+17.00			21.5	10.5	21.5	0.0		47	13	47	0.0		Rect	Rect	3E	2.5	
R15						097+17.00	076+63.78	405	Culvert					Culvert					See attached for culvert dimensions	Rect	Rect	Culvert	0.0	
R14		concrete	concrete	Concrete	Concrete	076+63.78	074+94.34			20	11	20	0.0		20	11	20	0.0		Rect	Rect	3E	0.0	
R14						074+94.34	074+39.99	Asari Ln	Culvert					Culvert					See attached for culvert dimensions	Rect	Rect	Culvert	0.0	
R14		concrete	concrete	Concrete	Concrete	074+39.99	072+42.00			19.5	12	19.5	0.0		19.5	12	19.5	0.0		Rect	Rect	Maintain	0.0	
		concrete	concrete	Concrete	Concrete	072+42.00	069+87.45			19	11	19	0.0		19	11	19	0.0		Rect	Rect	Maintain	0.0	
R14		concrete	concrete	Concrete	Concrete	069+87.45	069+32.47			19	11	19	0.0		19	11	19	0.0		Rect	Rect	Maintain	0.0	
R14						069+32.47	068+62.50	Ross	Culvert					Culvert					See attached for culvert dimensions	Rect	Rect	Culvert	0.0	
R13		concrete	concrete	concrete	concrete	068+62.50	068+07.52			19	13.75	19	0.0		19	13.75	19	0.0		Rect	Rect	Maintain	0.0	
R13		riprap	riprap	concrete	concrete	068+07.52	053+16.13			8	13.8	51.5	1.6		14.5	14.5	57	1.5		Trap	Trap	3P	0.7	
R13						053+16.13	052+41.32	Newland	Culvert					Culvert					See attached for culvert dimensions	Rect	Rect	Culvert	0.0	
R13		riprap	riprap	concrete	concrete	052+41.32	051+86.46			20.75	15	20.75	0.0		57	15	57	0.0		Rect	Rect	Transition	0.0	
R13		riprap	riprap	concrete	concrete	051+86.46	027+42.07			8	15	51.5	1.5		13	14.5	57	1.5		Trap	Trap	3P	-0.5	
R13						027+42.07	026+12.58	Beach Blvd	Culvert					Culvert					See attached for culvert dimensions	Rect	Rect	Culvert	0.0	
R13		Natural Bottom	riprap	Natural Bottom	riprap	026+12.58	025+57.79			18.66	15	18.66	0.0		58.5	15	58.5	0.0		Rect	Rect	Transition	0.0	
R13		Natural Bottom	riprap	Natural Bottom	riprap	025+57.79	004+90.00			8	15	53	1.5		13.5	15	58.5	1.5		Trap	Trap	3Q	0.0	
R13		Maintain Baseline Conditions.				004+90.00	000+00.00			56.5	16.36	56.5	0.0		56.5	16.36	56.5	0.0		Rect	Rect	Maintain	0.0	

3A
B
3C
D
3E
F
G
H
I
J
3K
3L
3M
3N
3O
3P
3Q

TABLE 12

Westminster_Alternative Analysis

Project: Westminster

Objective: Using the existing HEC-RAS models geometry files with artificial levees adjust the geometry to include the channel modifications proposed in each of the respective Alternatives

Hec-Ras Model	Westminster Channel Project
Project Location	P:\Westminster\HEC-RAS_TSP Alts\C05_C06_TSP_Alt_3
Geometry File	Westmin_C05C06_Alt3_BR_FD_ADJ_NO405MOD (.g03)
Alternative	Alternative 3 Maximum Channel Modifications, No 405 MODS
HEC-RAS River	C06
HEC-RAS Reach	1

Note:
1. All dimensions are in Feet unless noted otherwise.
2. Crossings were adjusted by modifying span and maintaining rise constant.
3. All crossings, including culverts, were modeled as bridges,
4. Debris was modeled as floating debris on the piers. Space in between box culvert barrels was modeled as piers.
5. Quantity of Debris: Width = 2' on each side of piers + width of pier. Height: 6'.
6. Cross-sections u/s and d/s of crossings were expanded. Crossings were adjusted to maximize cross-sectional flow area using u/s and d/s cross sections as the limit.

	Model		Current Crossing Dimensions					Proposed Crossing Adjustment	Proposed Crossing Dimensions					
Bridge	US XS	DS XS	Type	Span	Rise	Diameter	# Barrels	Description	Type	Span	Rise	Diameter	# Barrels	
Euclid St	194+29.30	193+20.10	Box - Flared Wingwall 30 to 75 Deg	8	6		2	Crossing: Replace structure with 3 - 10' x 6' barrels. XS US and DS: Maintain baseline H. Increase TW and B. TW increased to match US XS. Banks extended equally in both directions. No access roads altered.	Box - Flared wingwall 30 - 75 Deg	10	6		3	
Brookhurst	140+91.30	139+62.00	Box - Flared Wingwall 30 to 75 Deg	10	8		2	Crossing: Replace structure with 4 - 12' x 8' barrels. XS US & DS: Increase TW and B. TW is increased to match DS XS concrete area. Change from riprap lined to concrete lined.	Box - Flared wingwall 30 - 75 Deg	12	8		4	
Bushard	114+29.00	113+39.30	Box - Flared Wingwall 30 to 75 Deg	10.5	8		2	Crossing: Change structure from 2 - 10' x 8' barrels to 4 - 11' x 8' barrels. XS US: Maintain baseline conditions. XS DS: Hold H. Increase downstream TW and B to match downstream of crossing.	Box - Flared wingwall 30 - 75 Deg	11	8		4	
405 FWY	097+17.00	092+95.41	Box - Flared Wingwall 30 to 75 Deg	11	9		2	Baseline model has one culvert spanning from 97+17 - 76+63.78. USACE Alt 3 calls for 4 culverts with diff dimensions throughout this span. Baseline culvert was split up into 4 culverts. Crossing: Decrease length. Maintain baseline dimensions. XS US: Hold H. Increase TW and B while holding right bank. XS DS: XS was not in baseline model. Added for Alt 3. Change compared to baseline culvert: Increase B and TW. Maintain baseline H.	Box - Flared wingwall 30 - 75 Deg	11	9		2	No Mod

Culvert DS 405 #1	092+89.89	086+47.57	Box - Flared Wingwall 30 to 75 Deg	11	9		2	Baseline model has one culvert spanning from 97+17 - 76+63.78. USACE Alt 3 calls for 4 culverts with diff dimensions throughout this span. Baseline culvert was split up into 4 culverts. Crossing: Change from 2 - 11' x 9' barrels to 2 - 14' x 9' barrels. XS US & DS: XS was not in baseline model. Added for Alt 3. Change compared to baseline culvert: Increase B and TW. Maintain baseline H.	Box - Flared wingwall 30 - 75 Deg	14	9		2	No Mod
Culvert DS 405 #2	086+44.43	085+43.46	Box - Flared Wingwall 30 to 75 Deg	11	9		2	Baseline model has one culvert spanning from 97+17 - 76+63.78. USACE Alt 3 calls for 4 culverts with diff dimensions throughout this span. Baseline culvert was split up into 4 culverts. Crossing: Change from 2 - 11' x 9' barrels to 2 - 14' x 9' barrels. XS US & DS: XS was not in baseline model. Added for Alt 3. Change compared to baseline culvert: Increase B and TW. Maintain baseline H.	Box - Flared wingwall 30 - 75 Deg	14	9		2	No Mod
Culvert DS 405 #3	085+40.35	076+72.54	Box - Flared Wingwall 30 to 75 Deg	11	9		2	Baseline model has one culvert spanning from 97+17 - 76+63.78. USACE Alt 3 calls for 4 culverts with diff dimensions throughout this span. Baseline culvert was split up into 4 culverts. Crossing: Change from 2 - 11' x 9' barrels to 2 - 15' x 9' barrels. XS US & DS: XS was not in baseline model. Added for Alt 3. Change compared to baseline culvert: Increase B and TW. Maintain baseline H.	Box - Flared wingwall 30 - 75 Deg	15	9		2	No Mod
Asari Ln	074+94.34	074+39.99	Box - 10-90 degree headwall, Inlet edges chamfered 3/4 in	20	10		1	Crossing and XS US and DS: Maintain Baseline Conditions	Clear span bridge		10		
Ross	069+32.47	068+62.50	Box - Flared Wingwall 90 or 15 Deg	9	10.5		2	Crossing: Maintain baseline conditions. XS US: Maintain baseline dimensions. XS DS: Maintain baseline dimensions. Change from riprap lining to concrete lining.	Box - Flared wingwall 30 - 75 Deg	9	10.5		2
Newland	053+16.13	052+41.32	Box - Flared Wingwall 30 to 75 Deg	10	10		2	Crossing: Replace structure with 4 - 13' x 10' barrels. XS US: Increase H, B, and TW. Change from Rect to Trap. TW and H increased to match US XS. XS DS: Increase TW and B. Maintain Baseline H. TW increased to match DS XS. Change from natural bottom invert with riprap on channels walls to concrete invert and channel walls.	Box - Flared wingwall 30 - 75 Deg	13	10		4
Beach Blvd	027+42.07	026+12.58	Box - Flared Wingwall 30 to 75 Deg	9	10		2	Crossing: Change from 2 - 9 x 10 barrels to 4 - 13 x 10 barrels. XS US: Increase TW, H, and B. TW & H increased to match US XS. XS DS: Maintain baseline H. Increase TW and B. TW increased to match DS XS.	Box - Flared wingwall 30 - 75 Deg	13	10		4

Appendix B - Civil Engineering

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Appendix B - Civil Engineering

Attachment 4: Plates

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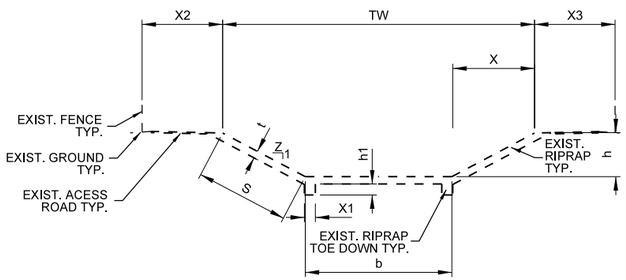
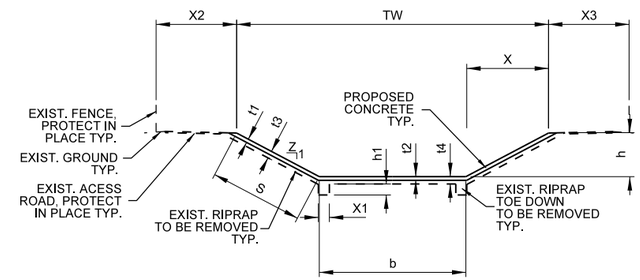
EXISTING



EXIST. TRAPIZODAL RIPRAP TYPICAL SECTION
N.T.S.

ALTERNATIVE 1 CROSS SECTION A



FROM EXIST. TRAPIZOIDAL RIPRAP TO TRAP. CONCRETE TYP. SECTION
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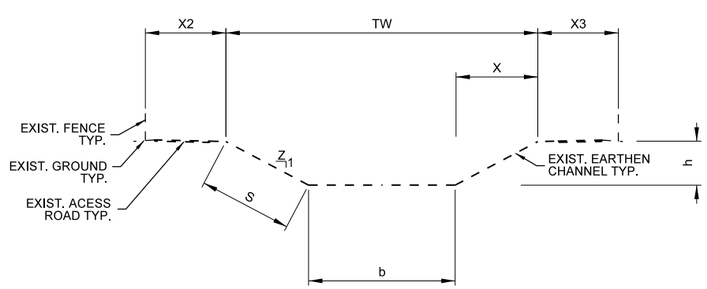
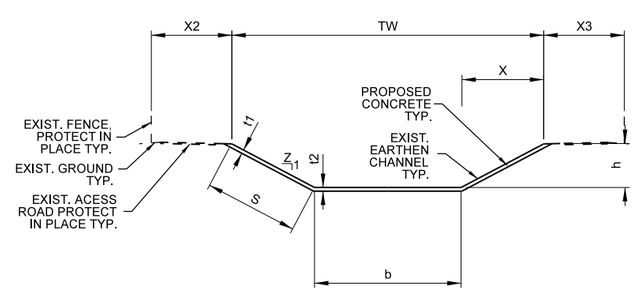
EXISTING



EXIST. TRAPIZODAL EARTHEN TYPICAL SECTION
N.T.S.

ALTERNATIVE 1 CROSS SECTION B



FROM EXIST. TRAPIZODAL EARTHEN CHANNEL TO TRAP. CONCRETE SECTION
N.T.S.

DESIGNED BY: TA
DRAWN BY: TA
CHECKED BY: EK/RK
FILE NAME: WF PLATE 2.DGN

WESTMINSTER FEASIBILITY STUDY
ORANGE COUNTY, CALIFORNIA

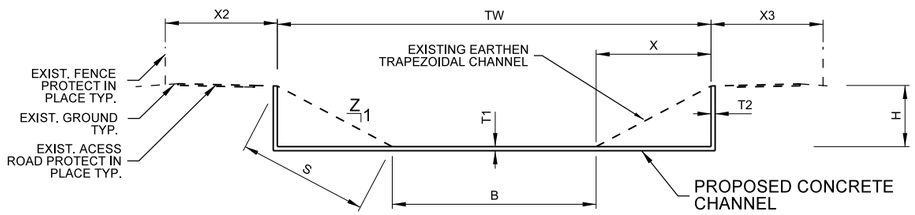
ALTERNATIVE 1- CHANNEL CROSS SECTIONS

US Army Corps of Engineers
Los Angeles District

Scale: AS SHOWN
PLATE
2

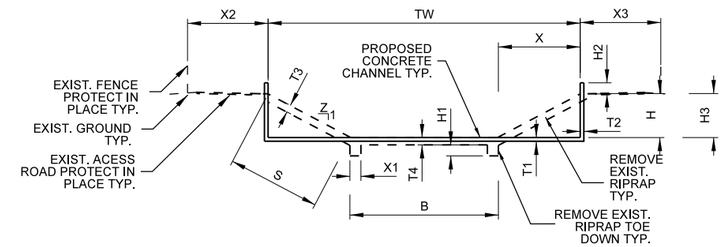
Plot Date: $date$

ALT 2-CROSS SECTION A



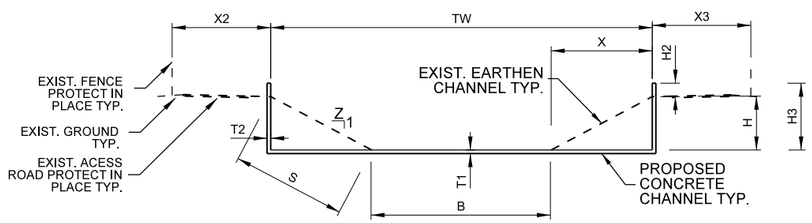
ALT. 2-CROSS SECTION A- FROM EXIST. TRAPEZOIDAL EARTHEN TYPICAL SECTION TO RECTANGULAR CONCRETE SECTION
N.T.S.

ALT 2-CROSS SECTION B



ALT 2-CROSS SECTION B- EXIST. TRAPEZOIDAL RIPRAP TO RECTANGULAR CONCRETE WITH 3' FLOODWALL TYPICAL SECTION
N.T.S.

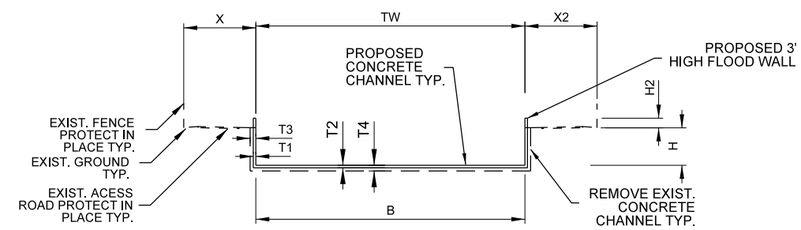
ALT 2-CROSS SECTION C



ALT 2-CROSS SECTION C- FROM EXIST. TRAPIZODAL EARTHEN TYPICAL SECTION TO RECTANGULAR CONCRETE WITH 3' FLOODWALL TYPICAL SECTION
N.T.S.

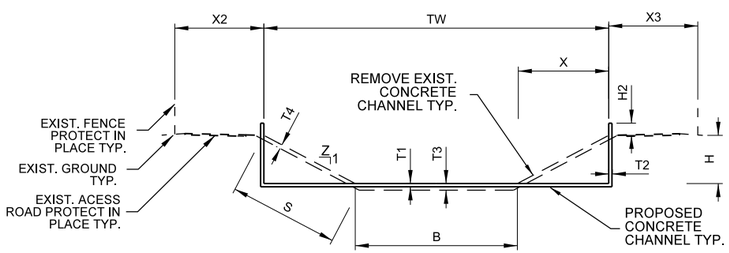
ALT 2-CROSS SECTION E

NOTE: T1 & T2 = PROPOSED THICKNESS
T3 & T4 = EXISTING THICKNESS



ALT 2-CROSS SECTION E- EXIST. RECTANGULAR CONCRETE TYPICAL SECTION TO PROPOSED RECTANGULAR CONCRETE WITH 3' FLOOD WALL SECTION
N.T.S.

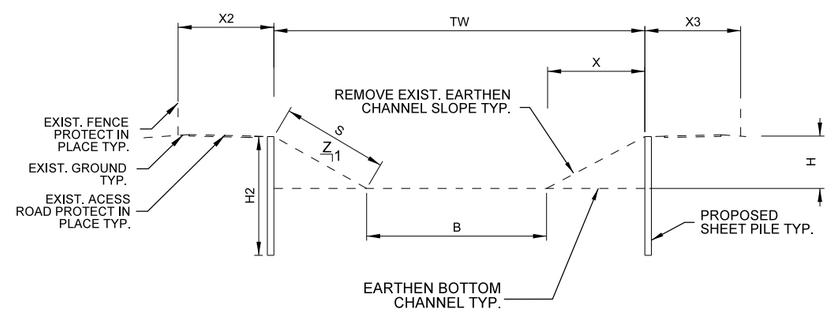
ALT 2-CROSS SECTION F



ALT 2-CROSS SECTION F- FROM EXIST. CONCRETE TRAPEZOIDAL TYPICAL SECTION TO RECTANGULAR CONCRETE WITH 3' FLOOD WALL SECTION
N.T.S.

ALT 2-CROSS SECTION G

NOTE: T1 & T2 = PROPOSED THICKNESS
T3 & T4 = EXISTING THICKNESS



ALT 2-CROSS SECTION G- FROM EXIST. TRAPIZODAL EARTHEN TYPICAL SECTION TO RECTANGULAR EARTHEN BOTTOM WITH SHEET PILE WALLS
N.T.S.

DESIGNED BY: TA
DRAWN BY: TA /AD
CHECKED BY: EK/RK
FILE NAME: WF PLATE 3.DGN

WESTMINSTER FEASIBILITY STUDY
ORANGE COUNTY, CALIFORNIA

ALTERNATIVE 2- CHANNEL CROSS SECTIONS 1

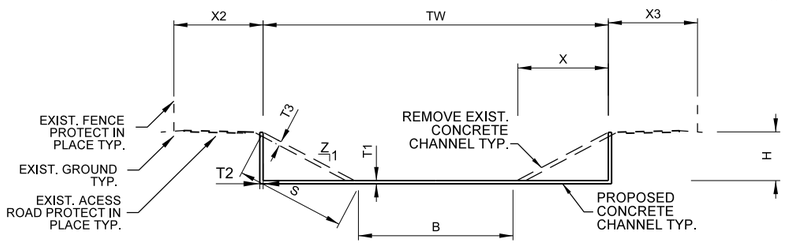
US Army Corps of Engineers
Los Angeles District

Scale: AS SHOWN
PLATE 3

Plot Date: $date$

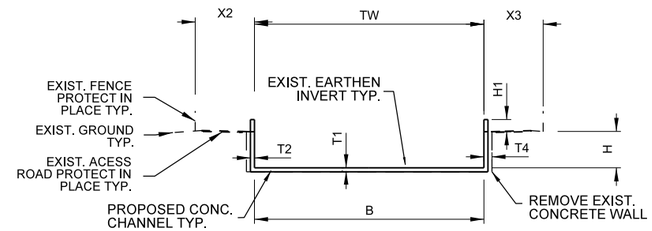
ALT 2-CROSS SECTION J

NOTE: T1 & T2 = PROPOSED THICKNESS
T3 = EXISTING THICKNESS



ALT 2-CROSS SECTION J- FROM TRAPEZOIDAL EARTHEN INVERT AND CONCRETE WALLS TO RECTANGULAR CONCRETE SECTION
N.T.S.

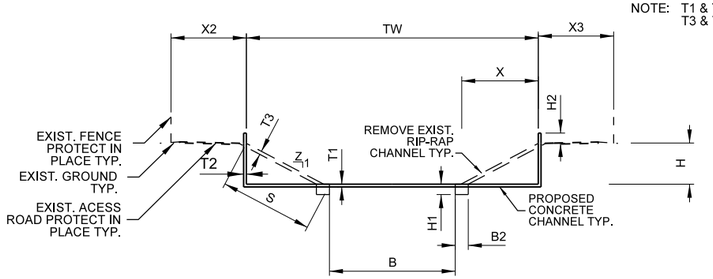
ALT 2-CROSS SECTION L



ALT 2-CROSS SECTION L- FROM EXIST. RECTANGULAR EARTHEN BASE WITH CONCRETE WALL TYPICAL SECTION TO RECTANGULAR CONCRETE CHANNEL WITH 3' FLOODWALL SECTION
N.T.S.

ALT 2-CROSS SECTION M

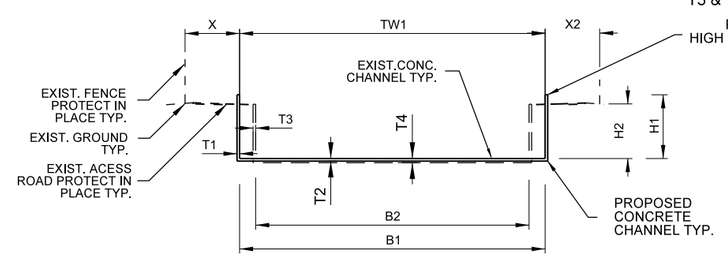
NOTE: T1 & T2 = PROPOSED THICKNESS
T3 & T4 = EXISTING THICKNESS



ALT 2-CROSS SECTION M- FROM TRAPEZOIDAL EARTHEN INVERT AND RIP-RAP WALLS TO RECTANGULAR CONCRETE WITH 3' FLOODWALL SECTION
N.T.S.

ALT 2-CROSS SECTION E-1

NOTE: T1 & T2 = PROPOSED THICKNESS
T3 & T4 = EXISTING THICKNESS



ALT 2-CROSS SECTION E-1- EXIST. RECTANGULAR CONCRETE TYPICAL SECTION TO PROPOSED RECTANGULAR CONCRETE WITH 3' FLOOD WALL SECTION
N.T.S.

DESIGNED BY: TA
DRAWN BY: TA / AD
CHECKED BY: EK/RK
FILE NAME: WF PLATE 4

WESTMINSTER FEASIBILITY STUDY
ORANGE COUNTY, CALIFORNIA

ALTERNATIVE 2- CHANNEL CROSS SECTIONS 2

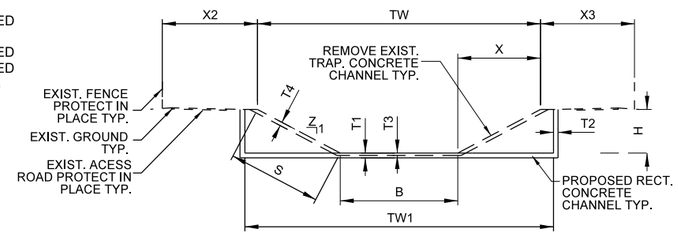
US Army Corps of Engineers
Los Angeles District

Scale: AS SHOWN
PLATE
4

Plot Date: $date$

ALT 3 CROSS SECTION A-1

TW = EXISTING
TW1 = PROPOSED
B = EXISTING
B1 = PROPOSED
H = EXISTING
H1 = PROPOSED
T1, T2 = PROPOSED
T3, T4 = EXISTING

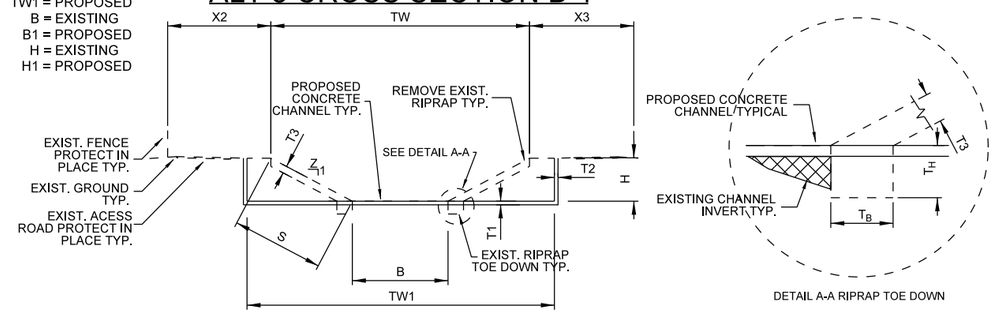


ALT 3 CROSS SECTION A-1 - FROM EXIST. TRAPEZOIDAL CONCRETE TYPICAL SECTION TO RECTANGULAR CONCRETE SECTION

N.T.S.

ALT 3 CROSS SECTION B-1

TW = EXISTING
TW1 = PROPOSED
B = EXISTING
B1 = PROPOSED
H = EXISTING
H1 = PROPOSED

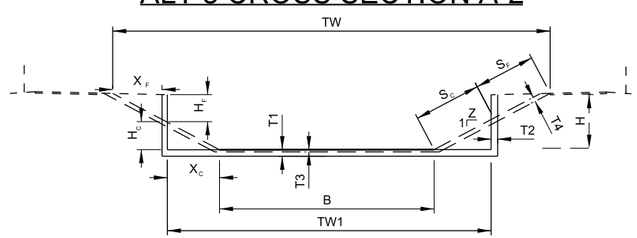


ALT 3 CROSS SECTION B-1 - FROM EXIST. TRAPEZOIDAL RIPRAP WALLS WITH EARTHEN INVERT TYPICAL SECTION TO RECTANGULAR CONCRETE TYPICAL SECTION

N.T.S.

ALT 3 CROSS SECTION A-2

TW = EXISTING
TW1 = PROPOSED
B = EXISTING
B1 = PROPOSED
H = EXISTING
H1 = PROPOSED
T1, T2 = PROPOSED
T3, T4 = EXISTING

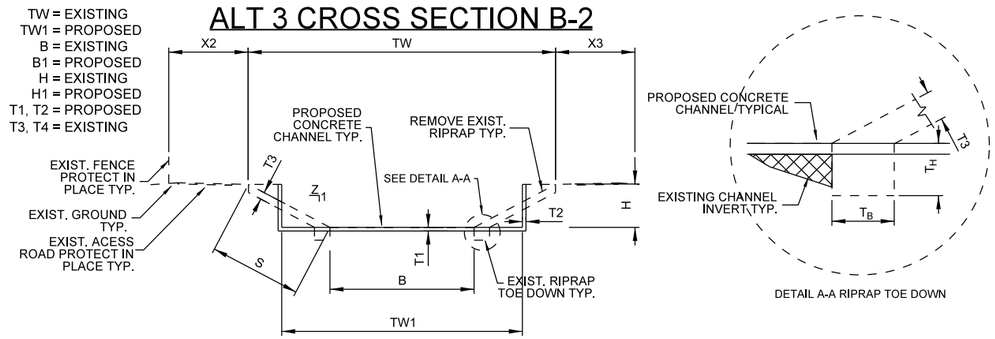


ALT 3 CROSS SECTION A-2 - FROM EXIST. TRAPEZOIDAL CONCRETE TYPICAL SECTION TO RECTANGULAR CONCRETE SECTION

N.T.S.

ALT 3 CROSS SECTION B-2

TW = EXISTING
TW1 = PROPOSED
B = EXISTING
B1 = PROPOSED
H = EXISTING
H1 = PROPOSED
T1, T2 = PROPOSED
T3, T4 = EXISTING



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N.T.S.

ALT 3 CROSS SECTION C

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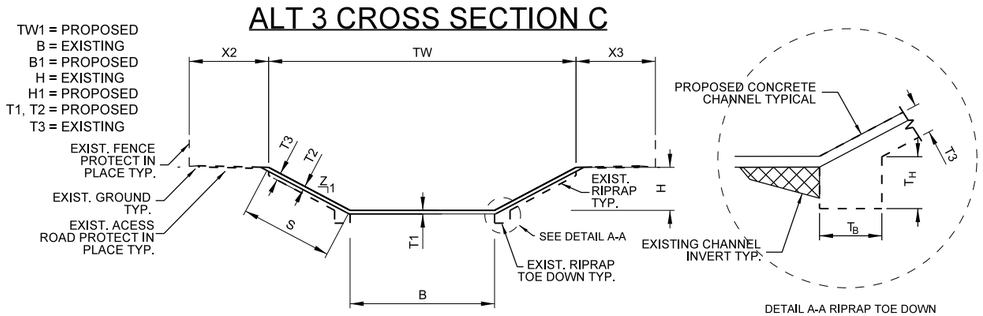
B = EXISTING
B1 = PROPOSED
H = EXISTING
H1 = PROPOSED
T1, T2 = PROPOSED
T3 = EXISTING



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N.T.S.

ALT 3 CROSS SECTION D

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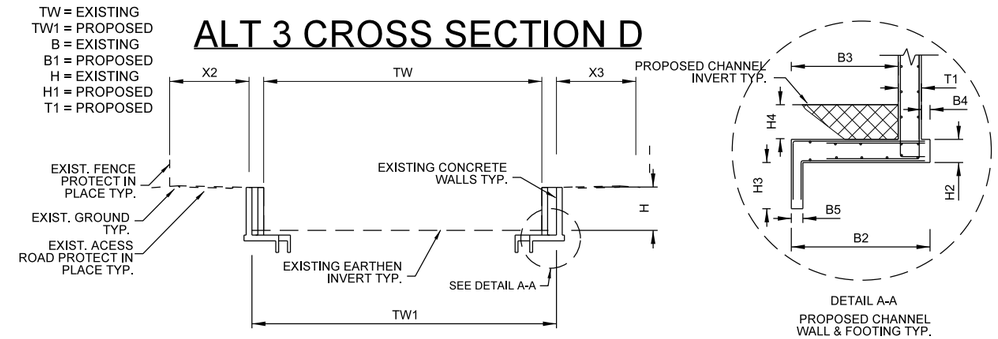
B1 = PROPOSED
H = EXISTING
H1 = PROPOSED
T1 = PROPOSED



ALT 3 CROSS SECTION D- EXIST. RECTANGULAR CONCRETE WALL AND EARTHEN INVERT TO WIDENED CONCRETE CHANNEL WITH EARTHEN INVERT TYPICAL SECTION

N.T.S.

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FILE NAME: WF PLATE 5.DGN

WESTMINSTER FEASIBILITY STUDY
ORANGE COUNTY, CALIFORNIA

ALTERNATIVE 3- CHANNEL CROSS SECTIONS 1

US Army Corps of Engineers
Los Angeles District

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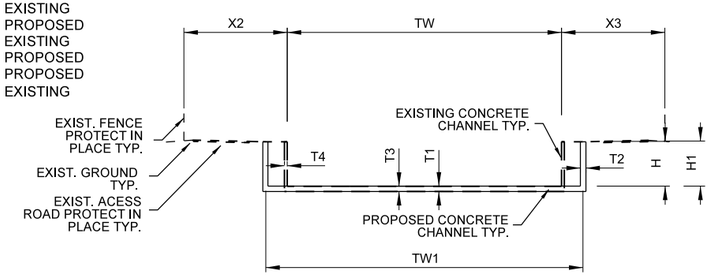
PLATE 5

Plot Date: $date$

ALT 3 CROSS SECTION E

TW = EXISTING
TW1 = PROPOSED
B = EXISTING
B1 = PROPOSED
H = EXISTING
H1 = PROPOSED
T1, T2 = PROPOSED
T3, T4 = EXISTING



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N.T.S.

Area of Concrete Removal Area of Fill

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B1 = PROPOSED
H = EXISTING
H1 = PROPOSED
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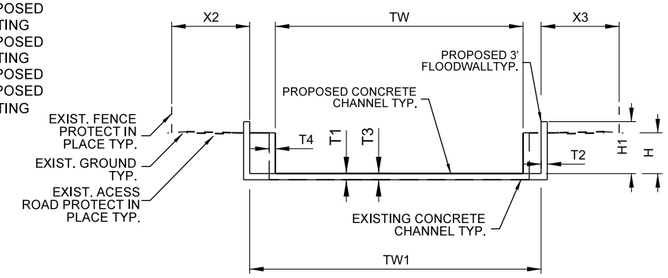

ALT 3 CROSS SECTION F- EXIST. RECTANGULAR CONCRETE CHANNEL TYPICAL SECTION TO PROPOSED RECTANGULAR CONCRETE CHANNEL WITH 3' FLOOD WALL SECTION

N.T.S.

ALT 3 CROSS SECTION G

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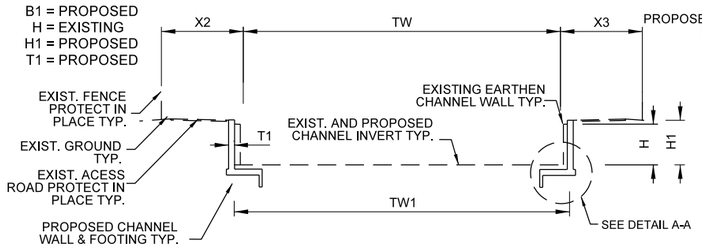
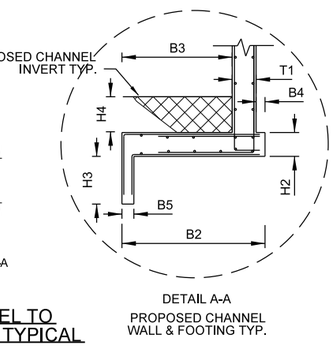
H1 = PROPOSED
T1 = PROPOSED





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N.T.S.

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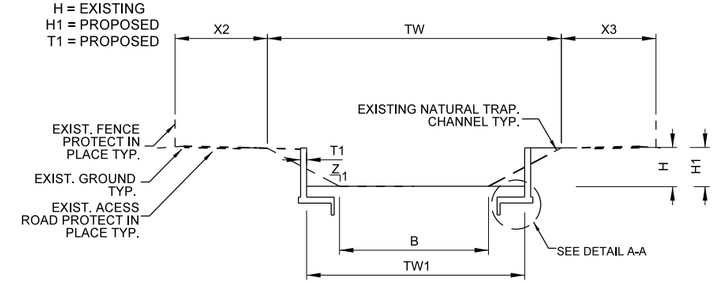
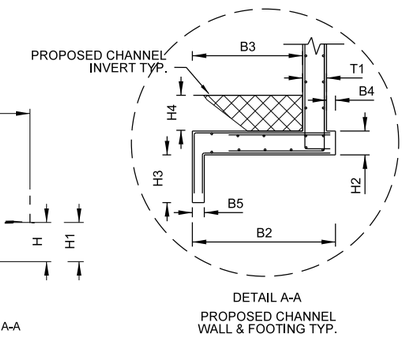
B1 = PROPOSED
H = EXISTING
H1 = PROPOSED
T1 = PROPOSED





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N.T.S.

ALT 3 CROSS SECTION I

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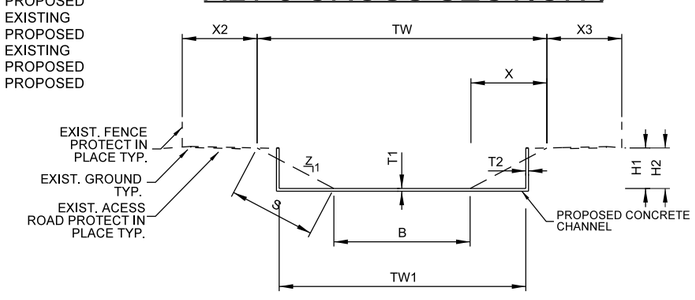

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N.T.S.

ALT 3 CROSS SECTION J-1

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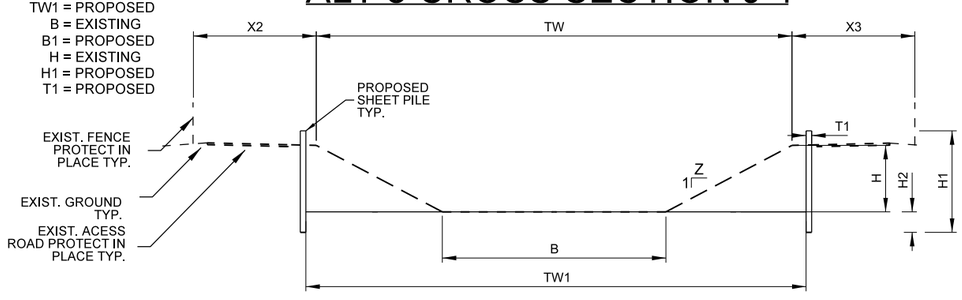
TW1 = PROPOSED
B = EXISTING
B1 = PROPOSED
H = EXISTING
H1 = PROPOSED
T1 = PROPOSED



ALT 3 CROSS SECTION J-1 - EXIST. TRAPEZOIDAL EARTHEN CHANNEL TYP. TO EARTHEN BOTTOM SHEET PILE WALL TYPICAL SECTION

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FILE NAME: WF PLATE 6.DGN

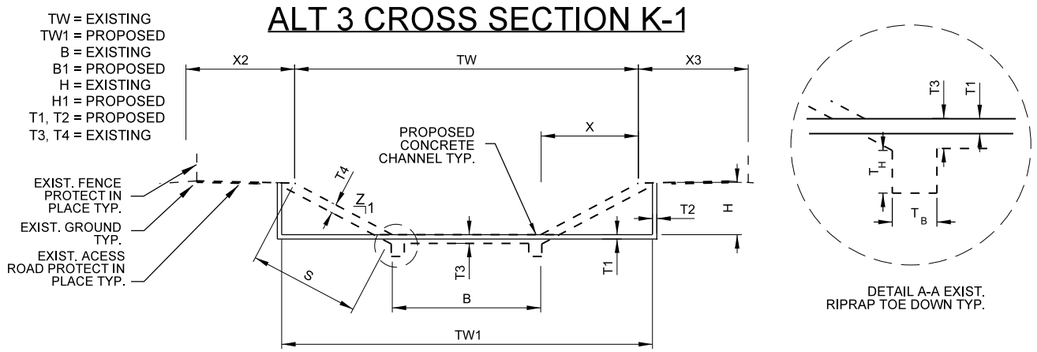
WESTMINSTER FEASIBILITY STUDY
ORANGE COUNTY, CALIFORNIA

ALTERNATIVE 3- CHANNEL CROSS SECTIONS 2

US Army Corps of Engineers
Los Angeles District

Scale: AS SHOWN
PLATE
6

ALT 3 CROSS SECTION K-1



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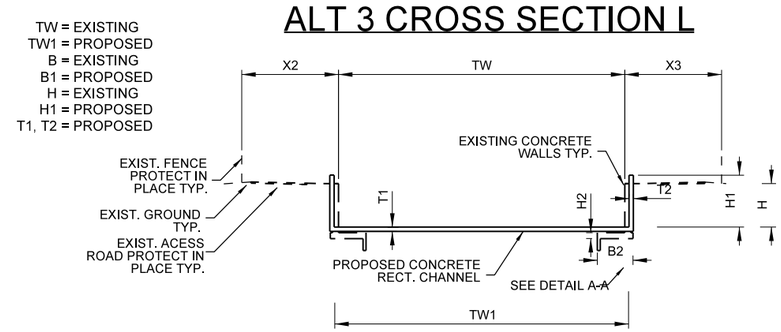
N.T.S.

ALT 3 CROSS SECTION L



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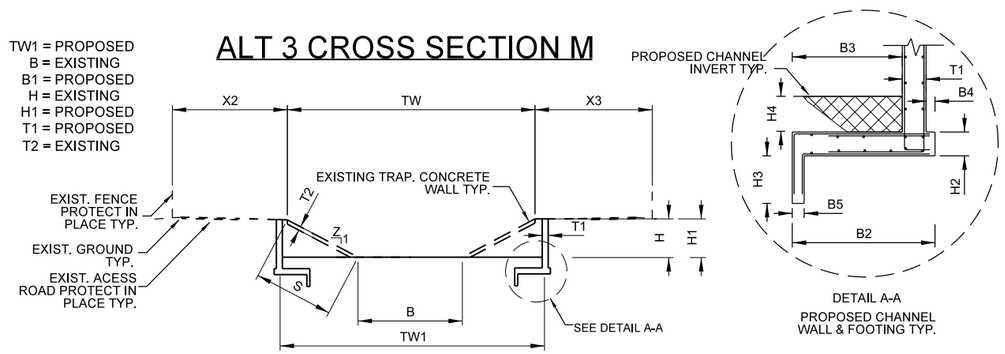
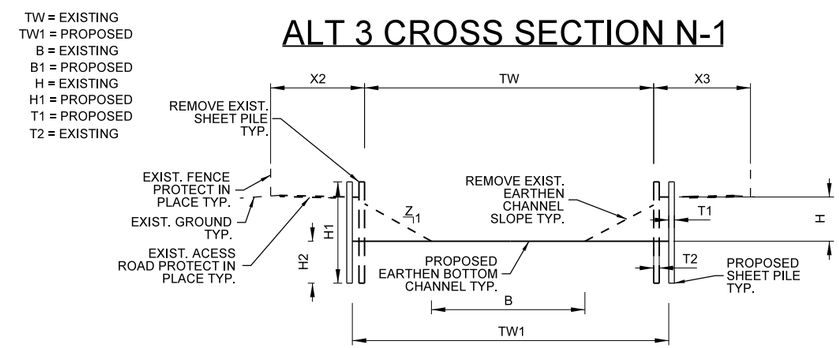


ALT 3 CROSS SECTION M- EXIST. TRAPEZOIDAL EARTHEN INVERT AND CONCRETE WALLS TO RECTANGULAR EARTHEN INVERT AND CONCRETE WALLED CHANNEL TYPICAL SECTION

N.T.S.

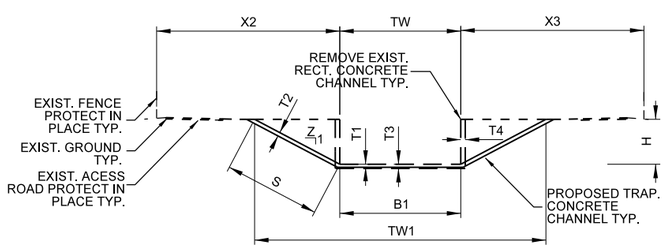
ALT 3 CROSS SECTION N-1



ALT 3 CROSS SECTION N-1 - FROM EXIST. TRAPIZODAL EARTHEN TYPICAL SECTION WITH SHEET PILES WALLS TO RECTANGULAR EARTHEN INVERT WITH SHEET PILE WALLS

N.T.S.

ALT 3 CROSS SECTION O



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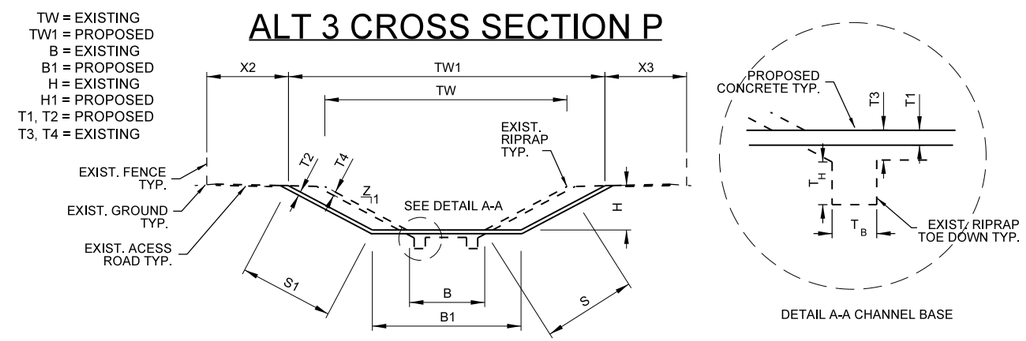

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N.T.S.

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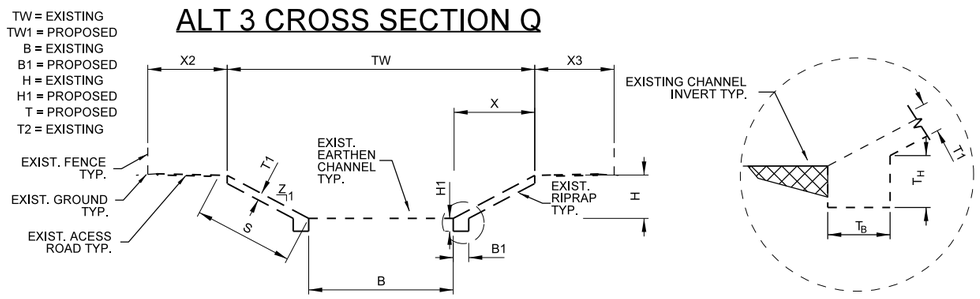
WESTMINSTER FEASIBILITY STUDY
ORANGE COUNTY, CALIFORNIA

ALTERNATIVE 3- CHANNEL CROSS SECTIONS 3

US Army Corps of Engineers
Los Angeles District

Scale: AS SHOWN
PLATE 7

ALT 3 CROSS SECTION Q



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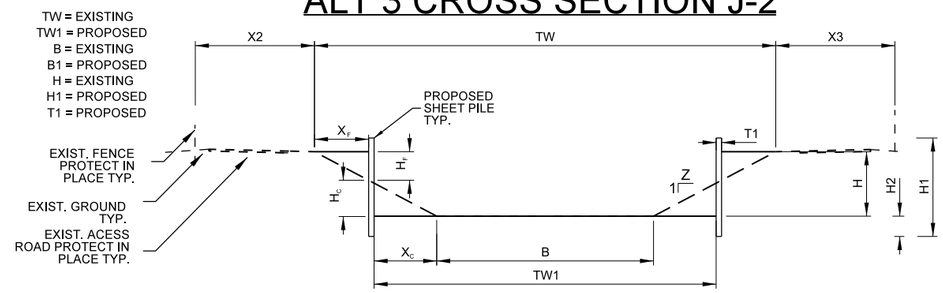
N.T.S.

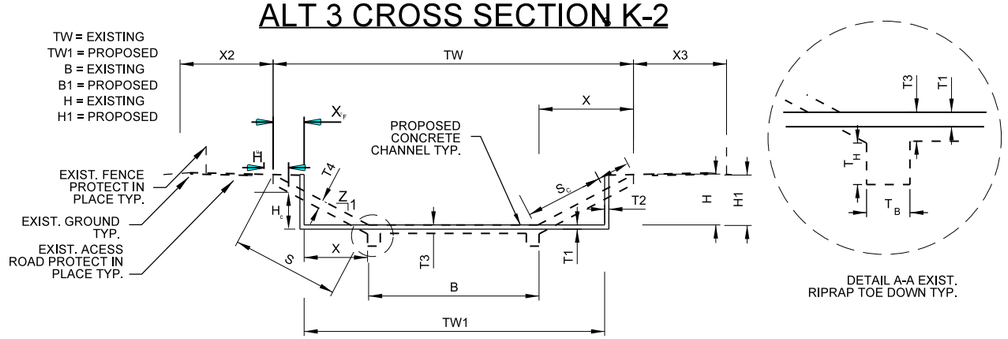
ALT 3 CROSS SECTION J-2



ALT 3 CROSS SECTION J-2 - EXIST. TRAPEZOIDAL EARTHEN CHANNEL TYP. TO EARTHEN BOTTOM SHEET PILE WALL TYPICAL SECTION

N.T.S.

ALT 3 CROSS SECTION K-2



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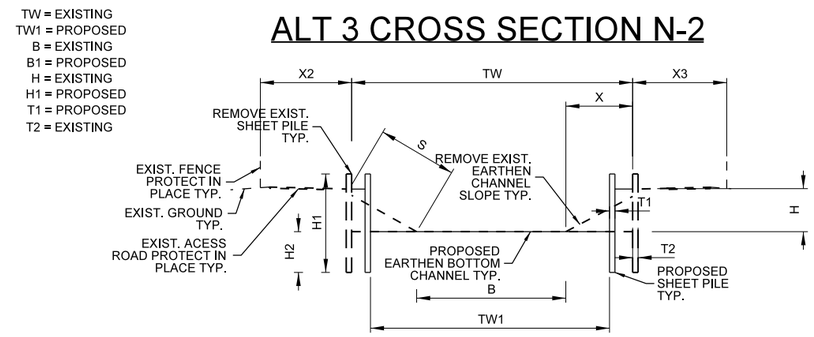

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FILE NAME: WF PLATE 8.DGN

WESTMINSTER FEASIBILITY STUDY
ORANGE COUNTY, CALIFORNIA

ALTERNATIVE 3- CHANNEL CROSS SECTIONS 4

US Army Corps of Engineers
Los Angeles District

Scale: AS SHOWN
PLATE
8

Plot Date: $date$

Appendix B - Civil Engineering

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Appendix B - Civil Engineering

Attachment 5: Diversion at Westminster Mall

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Alternative 3 Design (C02/04 Channel) for Westminster East Garden Grove Flood Risk Management for the USACE Feasibility Study

Orange County, California

July 2018

Prepared for:
Orange County Public Works
300 N Flower Street
Santa Ana, California 92703

Prepared by:

TETRA TECH

17885 Von Karman Ave, Suite 500
Irvine, California 92614

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Alternative 3 Design (C02/04 Channel) for Westminster East Garden Grove Flood Risk Management for the USACE Feasibility Study

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July 2018

Prepared for:

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300 N Flower Street
Santa Ana, California 92703

Prepared by:

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1. Introduction

1.1. Study Overview

The Westminster East Garden Grove Flood Risk Management Study is a cost shared feasibility study in which Orange County Public Works (OCPW) is the non-Federal sponsor with the Army Corps of Engineers (Corps).

The study area includes the Westminster watershed within western Orange County, California. Cities in the watershed include Anaheim, Stanton, Cypress, Garden Grove, Westminster, Fountain Valley, Los Alamitos, Seal Beach, and Huntington Beach (see **Figure 1**). The purpose of the study is to evaluate residual flood risk within the Westminster Watershed after the completion of channelization improvements of the Santa Ana River and the subsequent removal of the Westminster Watershed from the Santa Ana River floodplain. The region within the floodplain is the most significant region within Orange County still within the FEMA 1% Floodplain, and analysis shows that approximately 20,000 structures are at risk of flooding.

Alternative 3 is the locally preferred plan being evaluated as part of the feasibility study currently underway with the Corps and includes modifications recommended by OCPW. Through hydraulic modeling it was determined that there is not sufficient capacity in the C04 channel near Westminster Mall to convey floodwaters when there is a 1% (100-year flood) or greater discharge. The purpose of this effort is to evaluate alternative alignments that reduce the flooding and improve conveyance within the areas between Hoover and Edwards Streets and incorporate those modifications into Alternative 3 in the feasibility study.

Two alternative alignments and methods to improve the flood conveyance are investigated. One alternative alignment will be recommended based on these results and will consider costs, right-of-way, and existing structures.

2. Hydraulic Design

2.1. Overview

The existing Westminster Channel from Hoover Street down to Edwards Street consists of the following facility elements. At the immediate upstream face of Hoover Street there is a confluence of an existing open box channel (Hazard Channel), as well as a parallel box culvert (Hazard Culvert). These merge to combine with each other as well as storm drains for both Hoover Street and Hazard Street. This combined flow passes through a quadruple box culvert under Hoover Street. Upstream of the Interstate 405 freeway (I-405) to Hoover Street, the channel is an open box 40-feet wide by 10-feet deep near I-405 and 38-feet wide by 12-feet deep near Hoover Street. There are three crossings along this reach; two with triple box culverts, and a third with a single span bridge. The I-405 crossing consists of two 12’ x 9.25’ reinforced concrete box (RCB) and two 121” x 77” reinforced concrete pipes (RCPs). Under Goldenwest Street these become two 12’ x 9.25’ RCBs and two 108” RCPs. These facilities briefly daylight and merge into a 40-foot wide by 13-foot deep RCB that then goes underground again into triple 14-foot x 9.5-foot RCBs. These daylight at Edwards street into an open trapezoidal rip-rap lined channel. A fourth box daylights at Edwards Street as well where an existing 66-inch storm drain enters the channel.

2.2. Assumptions

In choosing the design alternatives, the alignment was a primary driver for the design in terms of cost, feasibility, and simplicity. Assumptions made regarding these factors included the avoidance of the acquisition of private property, particularly residences. This effectively drives a preference for public rights of way, including existing streets, utility or infrastructure easements, but also vacant lots and other property with minimal buildings. Another assumption was to avoid or minimize the relocation of utilities, particularly gravity flow lines such as sewer. This also included an assumption to protect in place where possible. Also, an assumption on impacts to the Interstate 405 freeway required consideration. Any alterations that require excavating the freeway would have a disproportionate impact on cost and traffic. Lastly, with much of the area urbanized, it was assumed the system improvements would be underground due to overlapping existing roadways or infrastructure, and with plans for parcels. With these assumptions in mind, hydraulic design to meet those needs followed. Hydraulically, the existing model flow amounts and change locations were assumed to be correct and correspond with local storm drain networks entering the existing and/or proposed systems.

2.3. Previous Studies

The Westminster East Garden Grove Watershed Management Feasibility Study has been ongoing for a number of years. The Alternatives Milestone was completed in February 2014 and the next major milestone is the Tentatively Selected Plan Milestone. At this point in time there is an array of 5 alternatives (including No Action) under consideration.

Hydraulic models of the system were previously developed using HEC-RAS and FLO-2D. It was decided modeling would be revised using the current version of HEC-RAS which includes 2D modeling. Tetra Tech was contracted by OCPW to complete revisions to the 1-D channel modeling, with the Corps- Chicago District performing the 2D modeling.

Through hydraulic modeling conducted by Tetra Tech and concluded in April 2018, it was determined that there is not sufficient capacity in the C04 channel near Westminster Mall to convey floodwaters when there is a 1% (100-year flood) or greater discharge.

An off-channel retention/detention basin option was considered to provide additional flood flow storage basin(s) without modifications of the existing channel system from Edwards Street to Hoover Street. It was estimated that forty percent (40%) of the 100-year peak flow needed to be diverted at upstream of Hoover Street to remove the 100-year floodplain from Edwards Street to Hoover Street. The estimated 100-year runoff volume was 1,160 acre-feet. For a basin with flow depths of 8-10 feet, the minimum required surface area would be 116 acre-feet without considering freeboard and other flood control apparatus. The estimated cost for acquisition of the land required to construct this basin was $250-300 million. Based on that cost estimate, this option was abandoned due to the cost of land acquisition alone. Without a detention basin alternative to consider, all the alternatives to address conveyance near Westminster Mall focused on channel configurations and alignments.

2.4. Alternative Alignments

Two main alignments were considered to provide 100-year capacity along the C02/04 channel. The first is the northern alignment along the existing railroad tracks. This alignment was developed to minimize changes to the existing system, specifically the culverts at the I-405 crossing. The second alternative follows the existing channel alignment and was developed to maximize use of the existing facilities and right-of-way.

2.4.1. Alternative 3A - Railroad Alignment to Edwards

A cursory review of the landscape in the project area identifies a potential alignment quickly, via an abandoned railway alignment and along local major roads. The first alignment would take

advantage of this open route, which has an overpass from the 405 freeway and thus potentially no impact on the highway, and then down a public road. The features of this path would potentially minimize right of way and infrastructure impacts and costs when looked at together. The alignment of the route for Alternative 3A begins immediately downstream of Hoover Street crossing (see **Figure 2**). To prevent overtopping flows in the existing system that begin at Hoover Street and extend downstream through the C04 channel system, discharge is diverted here. The diversion would funnel 40% of the combined flow passing under Hoover Street, with the remaining 60% utilizing the existing channel system. The diversion relieves pressure on the downstream system, allowing the existing four box/pipe structure under Hoover Street to pass the existing 100-yr peak flow of 4,090 cfs through the combined system. The diverted flow would progress down the new alignment along the abandoned Naval Railway right of way. Right of way requirements are discussed further in **Section 3.3.3**. The diversion route would flow under Goldenwest Street and then turn south upon reaching Edwards Street. It would then progress south along Edwards Street, where it would replace and pick up the discharge from an existing storm drain before re-joining the C04 channel in a confluence where the current storm drain daylights. The split flow ratio, configurations of the diversion structure, and proposed underground culvert need to be determined and optimized if this alternative is selected as the final improvements. Two variations of this alignment along Edwards Street were considered.

2.4.1.1. Centerline of Edwards Alignment

The first alignment along Edwards Street that was considered was a route that would follow and replace an existing storm drain line down Edwards Street. The benefit of this route would be to avoid acquiring an easement along the edge of the Westminster Mall street side landscaping and parking lot, as well as utilizing and occupying an existing storm drain facility's footprint. The downside to using this alignment however is that the proposed boxes, with a combined width of 31-feet, are much wider than the existing 66-inch storm drain and will require additional right of way within the street that would not only require replacing the existing storm drain, but relocate or protect in place some utilities for both the cities of Huntington Beach and Westminster. Most of the utilities in the street (see Figure 9 and Figure 10) however can likely be avoided except for those crossing at the bend from the railroad right of way, as well as an existing gas line that runs down the center of much of Edwards Street.

2.4.1.2. East of Edwards Alignment

The second alignment considered along Edwards Street would be immediately next to the street within the landscaping and parking lot beside the road. The benefit of this route is that there would

be no need to replace the existing 66-inch storm drain, and the route avoids many utilities on the Huntington Beach (west) side of Edwards Street. The utilities for Westminster mostly serve the mall and are less extensive. These lines do not extend along the entire reach of Edwards Street. The downside to utilizing this alignment is the utilities affected include sewer and water lines servicing businesses of the Westminster Mall. Due to the gravity flow of sewer lines, these are more difficult to design around as changes in their grade lines may not be feasible during possible relocation. The need to acquire a right of way easement through the landscaping and parking lot of the mall may also be prohibitively expensive compared to right of way in the street.

2.4.1.3. Alignment Selection

The centerline of Edwards Street alignment was chosen due to the location of utilities and their type, and to the likely cost of purchasing private property right of way. The east of Edwards alignment encompassed water and sewer lines that may need to be protected in place due to gravity drainage, and may interfere with the placement of the designed diversion system. Additionally, the costs of purchasing privately owned land for right of way would add significantly more cost than using public right of way in Edwards Street. The Edwards Street alignment will fit the proposed design while primarily only impacting gas lines that can be moved.

2.4.2. Alternative 3B - Edwards to Hoover Additional Capacity

The route along the Alternative 3B alignment corresponds mainly with the existing C04 system from just downstream of Hoover Street, extending all the way to just downstream of Edwards Street (see **Figure 3**). Although this alignment does not change from the existing system, changes and modifications required for expanding the system capacity will require additional right of way. From I-405 to Goldenwest Street, underground right of way is required to add capacity. Similarly, capacity increases from Goldenwest Street to Edwards Street will require right of way along Bolsa Avenue. Right of way requirements are discussed further in **Section 3.3.3**.

2.5. Proposed Alternative Descriptions

2.5.1. Alternative 3A Description

Alternative 3A includes constructing two underground 14-ft wide by 8.5-ft high reinforced concrete box culverts along the diversion route from Hoover Street to Edwards Street, transitioning to 14-ft wide by 9.5-ft along Edwards Street, as well as the diversion structure itself. It begins at the downstream end of Hoover Street and ends at the downstream end of the Edwards Street crossing of the C04 existing channel as seen in **Figure 2**. The alternate route assumes a diversion of forty percent (40%) of the peak flow existing under Hoover Street. A summary of the flow rates

in the Alternative A system are found in **Table 1**. The box culverts maintain a slope of 0.1%, matching the energy grade of the hydraulics, down to Edwards Street. The boxes then drop under utilities crossing at Edwards and continue to follow the slope of 0.1% under the street until the confluence. Additional flow enters the diversion at Goldenwest Street where it is assumed that the storm drain running along that street is captured by the new culverts. Similarly, additional flow enters the diversion at Edwards Street where the storm drain running along that street is captured by the new culverts. The two culverts will daylight at the same location downstream of Edwards Street as the culverts that run underground along Bolsa Ave adjacent to Westminster Mall.

Table 1: Alternative 3A Flow Rates

	Model Station	Location Description	Flow Rate (cfs)
Existing Channel	288+68.42	Hoover Crossing	4,090
	288+38.4	D/S of Hoover	2,454
	249+66.54	U/S of 405 (Storm Drain Inflows)	2,474
Diversion Culverts	76+18.00	D/S of Hoover	1,636
	49+18.00	Goldenwest Street	1,806
	79+18.00	Edwards Street	2,096

Consideration was given for utilizing three boxes rather than two, but the system was oversized upstream, with the additional box reducing velocities and creating backwater effects in the boxes at the downstream end. Consideration was also given for three boxes along Edwards Street, with only two boxes upstream, but the results were similar in that with three boxes for the entire length, even if additional flow from the Edwards Street 66-inch storm drain was included.

2.5.2. Alternative 3A Hydraulic Results

The results for the Alternative 3A diversion show no overtopping of the existing C04 system while the diversion itself flows near capacity with approximately 0.5-ft of freeboard from the WSEL to soffit in the Edwards Street reach. Along the railroad right of way, there is approximately 0.5 to 1.0 feet of freeboard. Throughout the system the water surface elevation (WSEL) is controlled by the downstream confluence with the existing channel. **Figure 5** shows the water surface elevation (WSEL) profile for the existing system model from Hoover Street to the downstream end of the C04 system at Edwards Street. **Figure 5** shows the same profile but for the diversion from Hoover Street to the downstream end of the C04 system at Edwards Street. The matching of the invert and energy grade slope from Edwards to Hoover allows the upstream WSEL of the existing channel and the diversion channel to align. The existing system WSEL is at 30.07-ft, with the diversion

WSEL at 29.74-ft. The diversion culverts provide sufficient capacity to the existing system, passing the remaining flow with no overtopping through the existing system reaches covered by the scope of this project. The estimated average RCB flow velocity is between 7.5-9 feet per second (fps). The underground closed conduit does not become pressurized with depths ranging between 7.5-8 feet in the 14x8.5" boxes, and approximately 9" in the 14x9.5" boxes. The estimated existing facilities average velocity and flow depth from Hoover Street to Edwards Street vary between 6-8 fps, with some spikes around culverts and bridges, and 8-9.5 feet deep. A tabulated summary of the results can be found in the hydraulic results in **Appendix A**.

2.5.3. Alternative 3B Description

Many channel and culvert configurations had been investigated in developing a final Alternative 3B. The three most feasible configurations are presented in the order of recommendation.

2.5.3.1. Replacements of I-405 Crossings and Chestnut Street and Naval Railway Culverts

The proposed Alternative 3B (see **Figure 3**) includes replacing existing Naval Railway and Chestnut Street culverts by free span bridges, replacing existing I-405 crossing with five 14' x 9.5' RCBs. Three of the proposed RCBs on the northside will be connecting to the existing three 14' x 9.5' RCBs that are through Westminster Mall Parking lot and the other two proposed RCBs will be transiting into two 14' x 6' RCBs along the Bolsa Avenue and joining the open channel at downstream of Edwards Street. Vertical walls are needed to meet the OCPW channel freeboard requirements and its height varies from approximate 1.5 feet at the upstream of I-405 to 0.5 feet at downstream of Chestnut Street.

2.5.3.2. Replacements of I-405 Crossings and Adding RCB between Chestnut Street and Hoover Street

One of the considerations analyzed was to add a 15' x 9.5' RCB from upstream of Chestnut Street to downstream of Hoover Street and leaving the existing Chestnut Street and Naval Railway culverts in-place. Instead of widening the existing open channel, the proposed underground RCB is to preserve the ground surface for existing usage per instructions from OCPW. This option required an additional 1-foot of vertical walls from Chestnut Street to Hoover Street along the top of existing channel to meet the channel freeboard requirements

2.5.3.3. Retaining Part of the Existing I-405 Crossing and Widening the Channel between I-405 and Hoover Street

Another consideration also analyzed was to utilize as many of the existing I-405 crossing facilities as possible due to the complexity of making changes at the I-405 crossing (e.g., removing existing facilities and/or connecting to proposed facilities, etc.). This resulted in a much wider channel from Hoover Street to I-405 crossing (i.e., widening existing 38 feet wide channel to 65 feet wide channel), in addition to changes to culverts immediately downstream of the freeway that would have required additional transition structures, or a separate set of diversion pipes may have been needed to cross the I-405. Both considerations analyzed were discarded as being impractical due to the constructability at I-405 and additional right-of-way cost from I-405 to Hoover Street.

2.5.4. Alternative 3B Hydraulic Results

The hydraulic results for the Alternative 3B show no overtopping from downstream of Hoover Street to Edwards Street. **Figure 6** shows the water surface elevation (WSEL) profile for the entire C02-C04 proposed system. The estimated average channel flow velocity is approximately 7.6 feet per second (fps) from upstream of Edwards Street to downstream of Goldenwest Street and the underground closed conduit is pressurized. The estimated channel flow velocities vary from 5.8 to 12.5 fps and the estimated channel flow depths vary for 8.5 to 10.0 feet within the reach from upstream of I-405 to downstream of Chestnut Street. The estimated channel flow velocities vary from 7.3 to 11.6 fps and the estimated channel flow depths vary for 9.7 to 10.9 feet within the reach from upstream of Chestnut Street to downstream of Hoover Street. A tabulated summary of the results can be found in the hydraulic results in **Appendix A**.

It should be noted there is still channel overtopping from Hoover Street to Beach Boulevard with the current proposed improvements. The overtopping flow depths vary from 0.5 feet at 500 feet upstream of Hoover Street to 1.0 foot at the upstream end of Hoover Street crossing. By replacing the existing 10’ x 9.5’ RCB with 15’ x 9.5’ RCB will eliminate the flow overtopping the Hoover Street but will only decrease the maximum overtopping of 1 foot to approximately 0.5 feet within the reach. Detailed and in-depth analysis is recommended during the final design due to the complexities of confluence with open channel and various sizes of underground conduits at the upstream of Hoover Street crossing which could not be properly modeled by the HEC-RAS 1D approach.

3. Civil Design and Cost Estimating

3.1. Alternative 3A - Railroad Alignment to Edwards

3.1.1. Utilities

A review of utilities identified clusters of existing utilities along the Alternative 3A route in two distinct locations. The first is at Goldenwest Street at the Naval Railway right of way crossing where a full range of utility and oil industry lines crosses the railroad right of way (see **Figure 8**). The second are the utilities that run within Edwards Street for both the Cities of Huntington Beach and Westminster (see **Figure 9** and **Figure 10**). The west side and center of Edwards Street hosts water, sewer, gas, and electrical lines for the city of Huntington Beach. Edwards Street has an existing 63-inch/66-inch storm drain on the Westminster side of the Street, and to a lesser extent sewer and water lines servicing businesses of Westminster Mall. The proposed alignment for Alternative 3A occupies the footprint of the existing storm drain line and avoids most except for where the culverts turn off the Naval Railroad right of way and onto Edwards Street, and a gas line that runs near to the center of Edwards Street. The existing 63-inch/66-inch storm drain which is affected by the project footprint would be removed.

3.1.2. Design Limitations and Assumptions

For utility crossings over the proposed alignment, it was assumed that these pressurized gas and water lines and electrical lines would be adequately relocated either over or under the proposed system.

No geotechnical or structural analysis was performed for the project. Therefore, wall and slab thicknesses of a proposed RCB structure were assumed based on recent and similar projects by Tetra Tech. Also, temporary excavation slope was assumed based on available subsurface information from adjacent facilities.

I-405 crosses the proposed alignment as an overpass bridge with piers. The gap between the piers was wide enough to accommodate the project RCB structure. It was assumed that excavation and construction of the proposed structure between the piers would not affect the structural integrity of the freeway overpass.

3.1.3. Description

The selection process of the horizontal alignment for this alternative is described in Section 2.4, *Alternative Alignments*. The alignment was further adjusted along Edwards Street to either avoid or minimize the impacts by the proposed system to the existing utilities that run along the street.

At OCPW's request, the footprint of the proposed structure was at least 5 feet away from the existing curb and gutter along the street.

A potential alignment that extends through the mall parking lot, along the private access roads, was also considered to avoid the closure of Edwards street and reduce the need for temporary shoring. However, at this time, it is assumed that the alignment along public right of way was preferred. Thus, construction of an alignment through the mall property was not incorporated into the alternative. Should this alternative 3A be selected, a more detailed analysis of this potential alignment revision may be investigated further in detailed design

According to the hydraulic analysis in Section 2.5, *Proposed Alternative Description*, the proposed system would include double 14.5-ft wide by 9.5-ft high RCB culvert along Edwards Street (**Figure 11)** and double 14.5-ft wide by 8.5-ft high RCB culvert along the railroad right-of-way (**Figure 12**). The proposed system would also include a junction structure for a 63-inch/66-inch storm drain along Edwards Street at the bend near the railroad right-of-way.

3.1.4. Alternative Approach – Open Channel

As assumed, Alternative 3A includes an underground culvert along the Naval Railroad right of way in order to accommodate future installation of park facilities within the right of way. However, the possibility of an open channel in this reach that provides natural park qualities that the agencies are looking for while serving the same flood control purposes was also assessed qualitatively. Due to the limited right of way width, a trapezoidal channel that provides the same flow capacity as the culvert is not feasible. The open channel is likely to be a rectangular channel or a combination of vertical wall and side slope. The rectangular channel could be reinforced concrete walls with a vegetated soft bottom or soldier pile walls with a vegetated soft bottom. The walls would need to receive aesthetic treatments on the exposed surfaces to look more natural.

It should be noted that while the open channel may provide the qualities of a natural-looking stream, it may reduce available area for public use as a larger footprint of the right of way would be used as a flow conveying channel.

3.1.5. Temporary Shoring

Without any subsurface investigation for this study or existing boring information available along the project alignment, the boring logs from the as-built plans of existing Westminster Channel were used to determine allowable temporary excavation geometry. Based on the information available and Tetra Tech's experiences from similar projects, a temporary excavation should include 4-foot high vertical cut at the bottom and 1.5 horizontal to 1 vertical slope cut above to the

daylight as shown in **Figure 12**. This geometry should be verified in the construction-level study when a subsurface investigation is performed for the project site.

Along Edwards Street, open slope cut for excavation would likely encroach into existing sidewalks on both sides of the street, limiting a contractor's access to the site and requiring removal and replacement of the existing features such as curb and gutter, sidewalk, and trees. This type of excavation would also expose more existing utilities during construction, requiring extensive utility protection measures. Due to limited space available for construction and to avoid adverse impacts to existing facilities, temporary shoring using beams and lagging would be used along Edwards Street.

Along the railroad right-of-way which is wider than the street width, open slope cut would be allowed without temporary shoring.

3.1.6. Constructability

During construction, Edwards Street would likely be closed in both traffic directions. To avoid complete shutdown of the entire street during construction, this alternative would require multiple phases or segmentation of construction along the street.

3.2. Alternative 3B - Edwards to Hoover Additional Capacity

3.2.1. Utilities

Utilities located along the Alternative 3B existing route are mostly utility crossings for the existing channel and culverts. The expansion of the existing route facilities will require re-routing or protecting in place these existing utilities. **Figure 13** highlights these utilities at Goldenwest, but also highlights the lack of utilities that extend down Bolsa Avenue where expansion of the culverts along Westminster Mall would be required.

3.2.2. Design Limitations and Assumptions

For utility crossings over the proposed alignment, it was assumed that these utility lines would be adequately relocated either over or under the proposed system.

No geotechnical or structural analysis was performed for the project. Therefore, wall and slab thicknesses of a proposed RCB structure were assumed based on recent and similar projects by Tetra Tech.

Construction of RCB under I-405 would require creating an open trench through the freeway embankment. It is likely that a RCB would be constructed in multiple segments along the

alignment and with one or two barrels at a time to reduce the open trench footprint at any time during construction. It is also likely that the open trench would be covered with temporary bridges to allow construction underneath. It is possible that Caltrans would require construction at night time only to ensure construction safety. Based on the discussion with OCPW, tunneling of culverts at the freeway was assumed not to be feasible considering lack of cover below the freeway embankment. This method of open trench would be perceived by the public as very difficult, due to required complete or partial shutdown of I-405, one of the busiest freeways in the region.

For raising of channel walls, the existing channel walls were assumed to be structurally sound to receive wall extension.

3.2.3. Description

The selection process of the horizontal alignment for this alternative is described in Section 2.4, *Alternative Alignments*, and generally follows the alignment of the existing C04 channel.

According to the hydraulic analysis in Section 2.5, *Proposed Alternative Description*, the proposed system would include construction of following features:

- Along Bolsa Ave between Edwards Street (downstream limit) and Goldenwest Street - double 14-ft wide by 6-ft high RCB culverts along Bolsa Avenue (**Figure 14**), running parallel to existing C04 channel which would remain in place
- I-405 area between Goldenwest Street and upstream face of freeway – five 14-ft wide by 6-ft high RCB culverts (**Figure 15**) to replace existing two RCBs and two RCPs.
- From upstream of I-405 to Chestnut Street – raising channel walls by 0.5 or 1.0 foot on both sides of the channel by adding reinforced concrete wall sections with dowels on the top of existing walls (**Figure 16**)
- Replacement of 2 existing culverts at Chestnut Street and Naval railway with free span bridges

3.2.4. Temporary Shoring

Along Bolsa Avenue, shoring on the south edge of RCB would be required to limit the impacts of construction to a westbound direction roadway. Temporary shoring using beams and lagging would be used.

On the north edge of RCB, the existing RCB would provide support for excavation, making temporary shoring unnecessary (**Figure 14**).

3.2.5. Constructability

During construction, Bolsa Avenue would likely be closed in a westbound direction, limiting the mall access from south. To avoid complete shutdown of the westbound street during construction, this alternative would require multiple phases or segmentation of construction along the street.

Complete or partial shutdown of I-405 during construction would require extensive planning and implementation in freeway traffic detour plan, construction schedule, and safety plan to work on freeway. If permitted, it is likely that construction would occur during nighttime hours.

3.3. Cost Estimates

Conceptual level cost estimates have been developed for the two options discussed above. Detailed quantity take-offs were developed for the primary construction components (i.e. earthwork, concrete and shoring) and other assumptions were made to follow with the conceptual level design. The cost estimates were developed to be consistent with USACE Feasibility Study requirements. The cost estimate back-up information, which includes detailed cost estimates, unit prices, quantity calculations, and abbreviated risk analysis for contingency development, can be found in Attachment C.

3.3.1. Unit Prices

Unit prices for most of the cost items were taken from the RS Means construction costbook. The unit prices were adjusted with local multipliers that modified the base costs to reflect localized labor, equipment and material prices.

3.3.2. Non-Construction Costs

Project costs for non-construction elements have been included in the estimates. These costs include planning, engineering and design (PED) and construction management (CM) costs. These items are based on percentages of the overall construction costs, and currently the estimate assumes 10.0% for PED and 6.0% for CM, which are consistent with typical percentages used by the USACE.

3.3.3. Real Estate Costs

Estimated areas have been developed that can be used to determine the costs to acquire necessary lands for construction of both alternatives. These include temporary construction easements, and permanent easements for underground structures as indicated in Table 2 and displayed in **Figure 17**. The estimated cost for the new easement associated with Alternative 3A is $6 million.

Table 2: Alternative Right of Way Estimates

Alternative	Ownership	Detail	Acres
3A	Private	Permanent Private Purchased Easement (Underground)	3.83
	Private	Temporary Construction Easement	3.74
	Public	Permanent Expanded Public Easement (Underground)	1.70
	Public	Temporary Construction Easement	0.32
3B	Private	Existing Private Easement (Underground)	0.12
	Private	Permanent Private Purchased Easement (Underground)	0.06
	Private	Temporary Construction Easement	0.03
	Public	Existing Public Easement	1.61
	Public	Existing Public Easement (Underground)	0.77
	Public	Permanent Expanded Public Easement (Underground)	2.21
	Public	Temporary Construction Easement	1.02

3.3.4. Contingencies

Contingencies represent allowances to cover unknowns, uncertainties and/or unanticipated conditions that are not possible to adequately evaluate from the data on hand at the time the cost estimate is prepared, but must be represented by a sufficient cost to cover the identified risks. An abbreviated risk analysis (ARA) has been prepared for this project to determine alternative specific contingencies.

3.3.5. Alternative Cost Summaries

The following tables reflect summaries of the construction cost estimates (see Appendix C for detailed cost estimates).

Table 3: Alternative 3A Summary Cost Estimate

Item Description	Quantity	UOM	First Cost	Contingency	Total Cost
Mob/Demob and Site Prep	1	LS	$3,060,000	32.9%	$4,066,000
Earthwork	1	LS	$5,582,000	40.4%	$7,838,000
Culverts and Channels	1	LS	$28,985,000	40.4%	$40,698,000
Demolition and Relocations	1	LS	$1,330,000	36.8%	$1,819,000
Traffic Control	1	LS	$100,000	38.7%	$139,000
Planning, Engineering and Design	1	LS	$3,906,000	34.8%	$5,265,000
Construction Management	1	LS	$2,344,000	34.8%	$3,159,000
Real Estate	1	LS	$-	25.0%	$-
Alternative 3A Total Cost:			**$45,307,000**	**39.0%**	**$62,984,000**

Table 4: Alternative 3B Summary Cost Estimate

Item Description	Quantity	UOM	First Cost	Contingency	Total Cost
Mob/Demob and Site Prep	1	LS	$2,792,000	32.9%	$3,710,000
Earthwork	1	LS	$2,416,000	40.4%	$3,392,000
Culverts	1	LS	$16,458,000	40.4%	$23,109,000
Demolition and Relocations	1	LS	$4,363,000	36.8%	$5,967,000
Traffic Control	1	LS	$9,600,000	72.1%	$16,524,000
Planning, Engineering and Design	1	LS	$3,563,000	34.8%	$4,803,000
Construction Management	1	LS	$2,138,000	34.8%	$2,882,000
Real Estate	1	LS	$-	25.0%	$-
Alternative 3B Total Cost:			**$41,330,000**	**46.1%**	**$60,387,000**

4. Alternative Comparisons and Recommendation

Two separate options for Alternative 3 were evaluated in this effort. Since there is not sufficient capacity within the C04 channel near Westminster Mall these options considered means to reduce flooding and improve conveyance though the reach between Hoover and Edwards Streets.

Alternative 3A includes a diversion structure along the abandoned Navy Railway alignment and continues down Edwards Street to the same location of the existing culverts on Bolsa Avenue. A diversion structure diverts approximately 40% of the flow downstream of Hoover into two underground 14-ft wide by 8.5-ft high RCB's. These transition to 14-ft wide by 9.5-ft RCB's along Edwards Street and include flows from the existing 63" RCP that conveys flow from areas to the north.

Alternative 3B includes modifications to the existing C04 channel. This includes replacing two existing culverts (Naval Railway and Chestnut Street) with free span bridges and replacing the existing I-405 crossing with five 14' x 9.5' RCBs. Three of the proposed RCBs on the northside will be connecting to the existing three 14' x 9.5' RCBs that are located in the Westminster Mall Parking lot. The other two proposed RCBs will be transiting into two 14' x 6' RCBs along Bolsa Avenue and joining the open channel downstream of Edwards Street. Between Chestnut Street and the I-405 the channel walls will be raised from between 0.5 to 1.5 feet to meet OCPW freeboard requirements.

Both alternatives meet the objective of reducing overbank flooding and improving conveyance. Differences in the alternatives are compared below.

4.1. Costs

Cost estimates for the two alternatives are described in Section 3.3 above and detailed in Appendix C. Not including land costs, Alternative 3A is approximately $62.9 million and Alternative 3B is approximately $60.4 million.

Most of the costs for 3A are attributed to the length of the diversion route and associated excavation and culverts to be installed. Since Alternative 3B follows the existing alignment and modifies culverts the costs associated with the culverts are much less but still make up a substantial portion of the overall cost. Traffic control associated with modifications to the I-405 are also a substantial portion of the cost ($16.5 million) of Alternative 3B.

4.1. Right of Way

The right of way required to implement Alternative 3A includes approximately 10 acres. Most of this is along the Navy Railway alignment and the rest within public right of way along Edwards. The estimated cost to acquire right of way along this route is $6 million.

Right of way requirements to construct Alternative 3B is less because it is largely within existing project right of way. Approximately 4.25 acres of additional right of way including temporary construction easements and easements within both public and private property are required for this alternative. This includes a temporary construction easement associated with construction under the I-405.

4.2. Construction

Construction of Alternative 3B will be more complicated than that of Alternative 3A due to the crossing at the I-405. There is minimal cover where the existing culverts pass under the freeway and therefore removal of existing structures and placement of new ones will require open cut. If this can be approved by CALTRANS it will require significant traffic controls and likely nighttime construction.

Other options at this crossing may include construction of a slab bridge for construction, or a siphon design. It is assumed that slab bridge for construction would have a similar cost to what is estimated. A siphon at this location would allow lowering the invert to allow for enough cover for jack and bore construction. However, a siphon would likely cost more and require a pump.

4.2.1. Traffic delays

Both alternatives would have similar impacts to traffic on surface streets. Alternative 3A construction would impact traffic on Edwards Street and Alternative 3B traffic on Bolsa Avenue. The impacts of these would likely be similar.

Traffic delays on the I-405 associated with Alternative 3B could be significant. According to CALTRANS 2016 Traffic Volumes[1] the average annual daily traffic on this part of the I-405 is approximately 264,000. This is a large volume of traffic and one of the busiest freeways in the

[1] http://www.dot.ca.gov/trafficops/census/volumes2016/Route280-405.html

region. Therefore, delays to traffic during construction could have a significant impact that should be considered.

4.3. Draft Recommendation

Based on hydraulic modeling the existing system of culverts passing under the I-405 and continuing along Bolsa Avenue are a bottleneck that restrict the ability of the C02-C04 system to pass flood flows. For Alternative 3B this report recommends removal of the existing culverts and replacement with a more efficient configuration that meets the objective of passing the 1% discharge and reducing overtopping of the upstream channel.

There is minimal cover over the culverts where they pass the I-405. That combined with the fact that this is a very busy section of freeway with an AADT of approximately 264,000 at this location complicates construction. Construction would either need to be accomplished through open cut or construction of a temporary bridge type structure. This would require coordination and approval by CALTRANS, and if approved would likely require construction during night time hours to reduce traffic impacts.

Alternative 3A avoids construction on the I-405 by implementing a diversion along the abandoned Navy Railway alignment. This alternative is slightly costlier than 3B largely due to its length and amount of excavation and concrete required. In addition, the right of way has an estimated cost of $6 million for acquisition. Including the cost of the Navy Railway alignment it is approximately $9 million more than modifying the I-405.

Although Alternative 3A costs more than Alternative 3B it is recommended that alignment be considered for Alternative 3. It is not certain that CALTRANS will allow the removal and replacement of the existing culvert systems through the I-405. If the freeway had to be closed or traffic were to be delayed the economic costs of delays to that much traffic would be significant, likely millions of dollars in lost time. Therefore, it seems prudent to avoid the challenges of modifications to this location and seek an alternate route.

FIGURES

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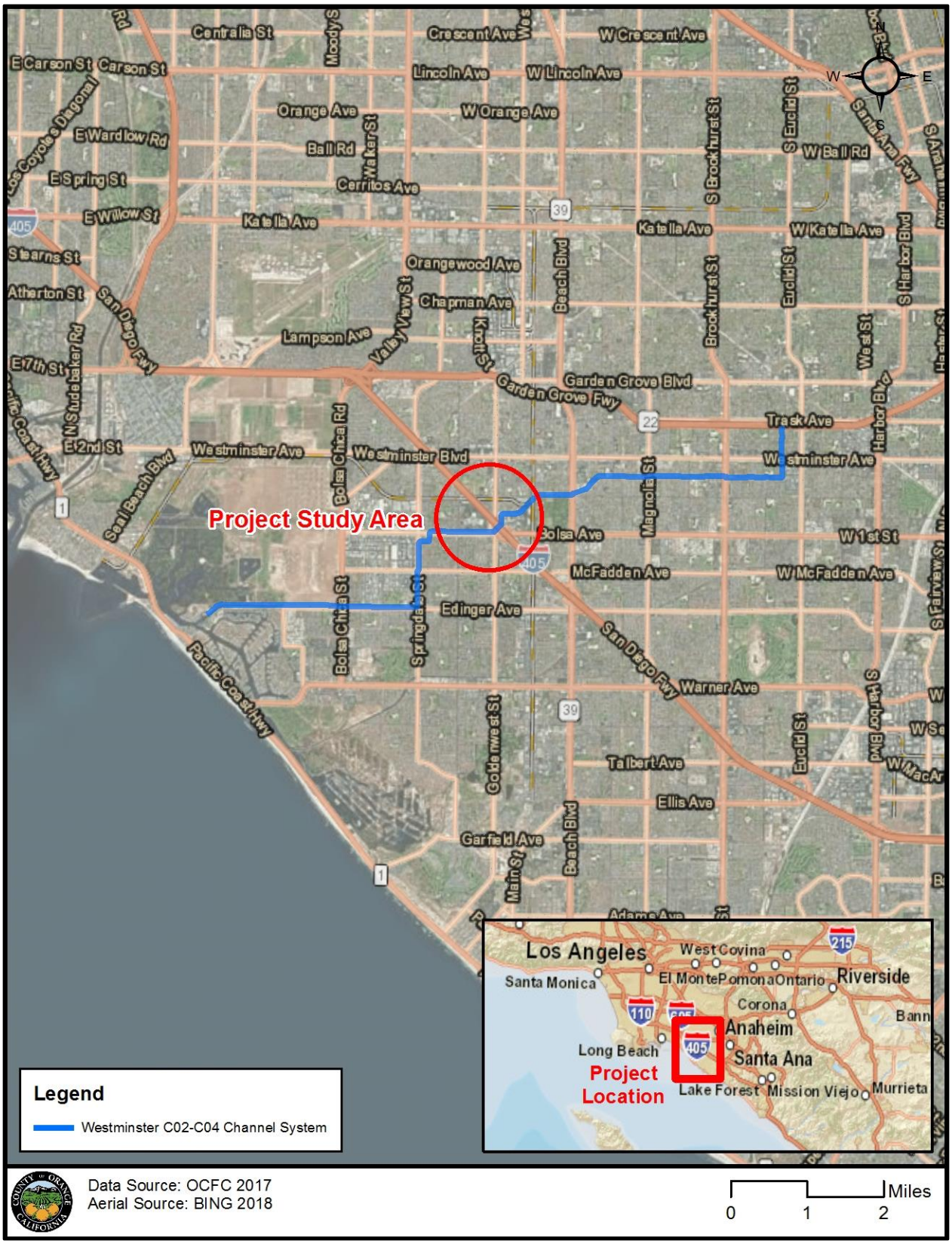

Figure 1: Project Location Map

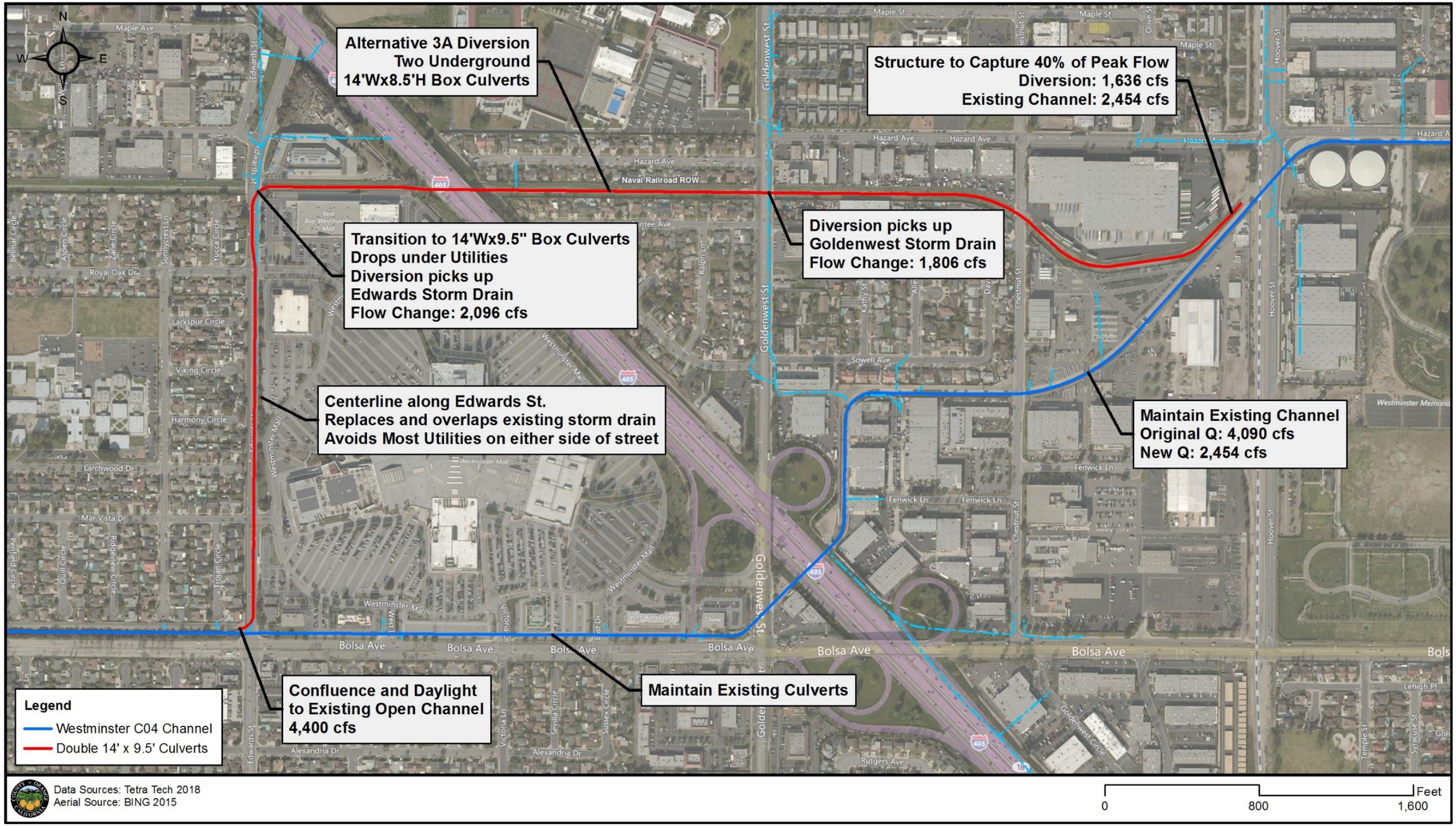

Figure 2: Alternative 3A Overview Map

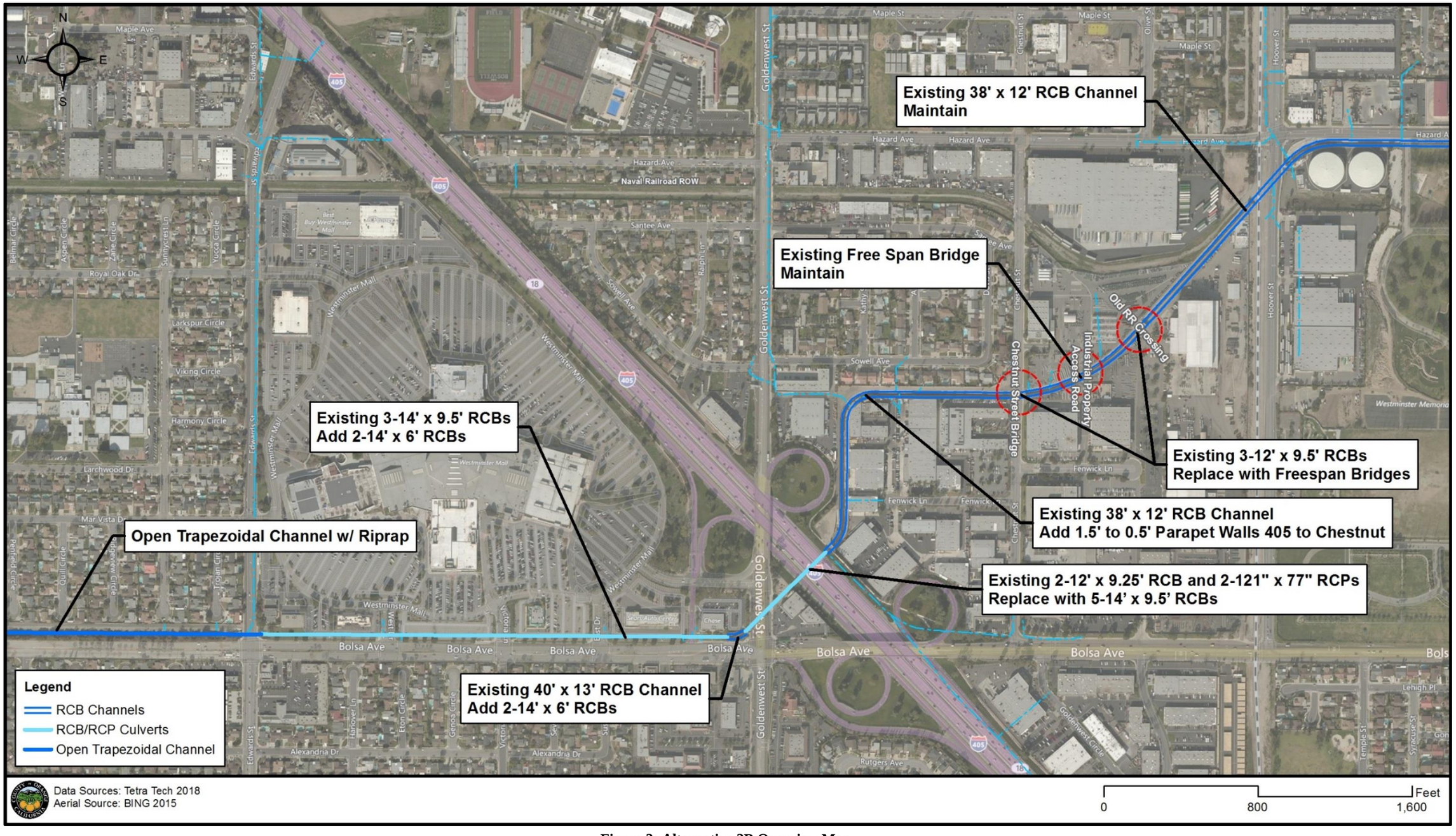

Figure 3: Alternative 3B Overview Map

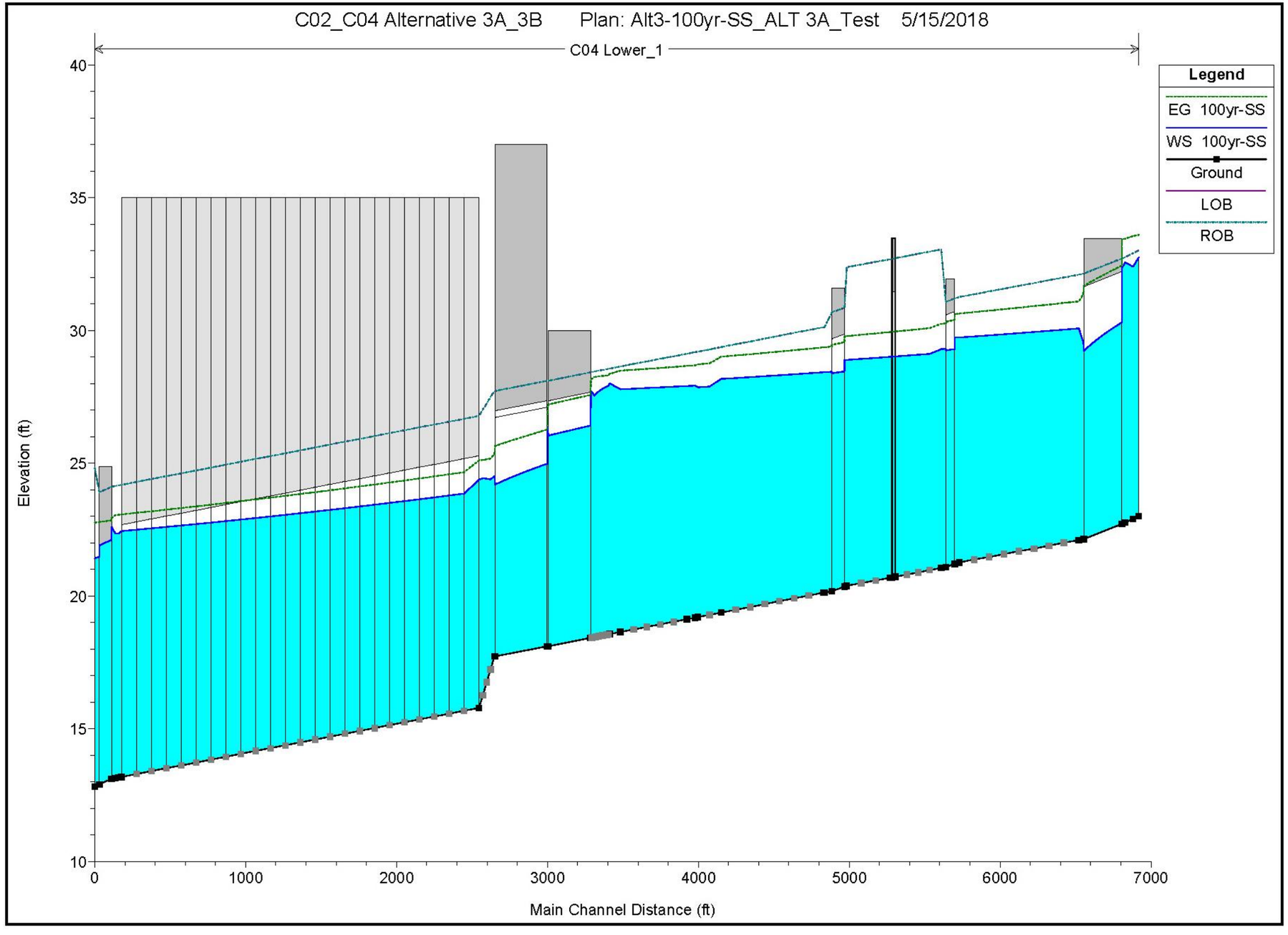

Figure 4: Alternative 3A Profile Results – Main Channel (Hoover to Edwards)

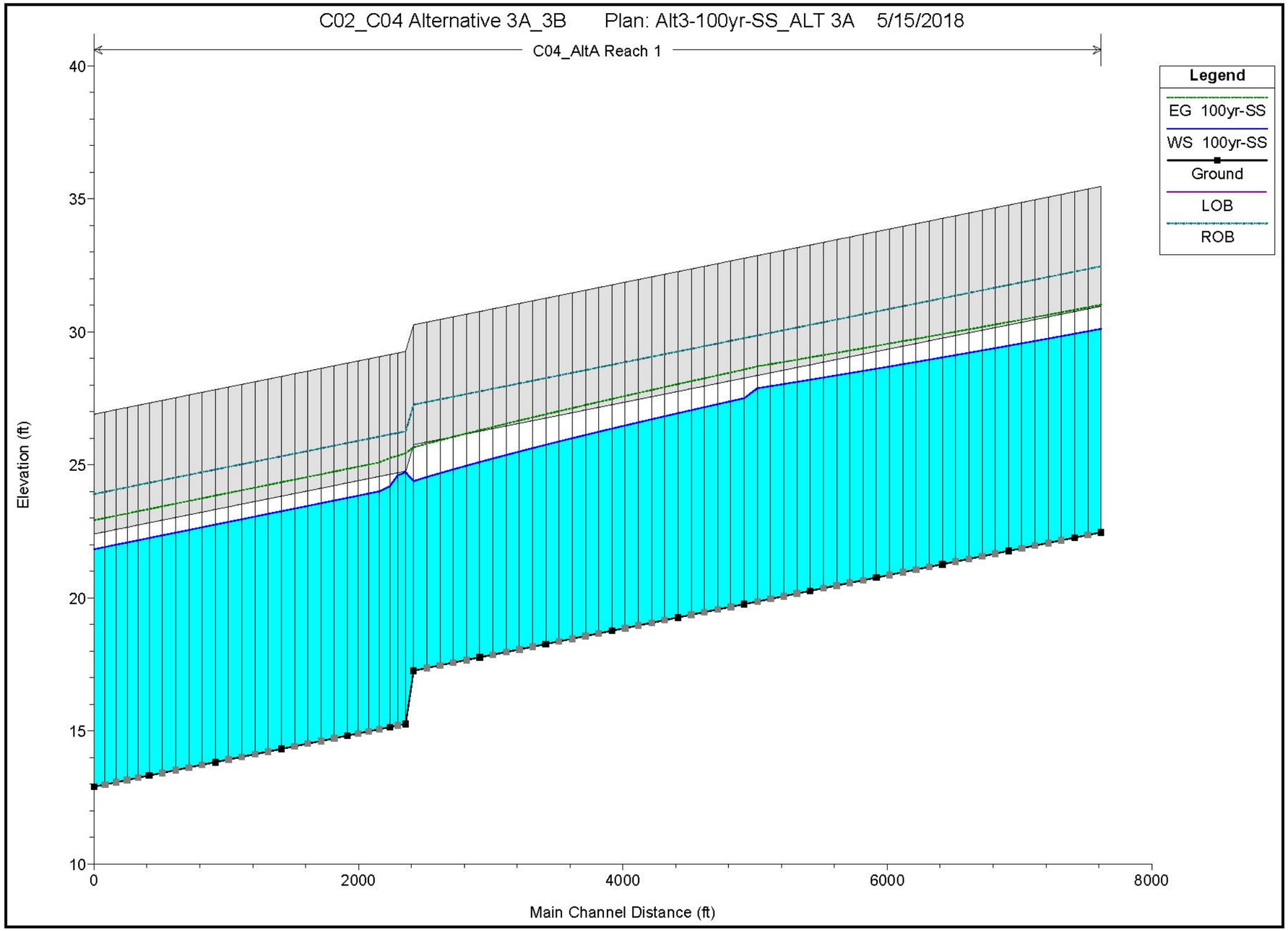

Figure 5: Alternative 3A Profile Results – Diversion Route (Hoover to Bolsa & Edwards)

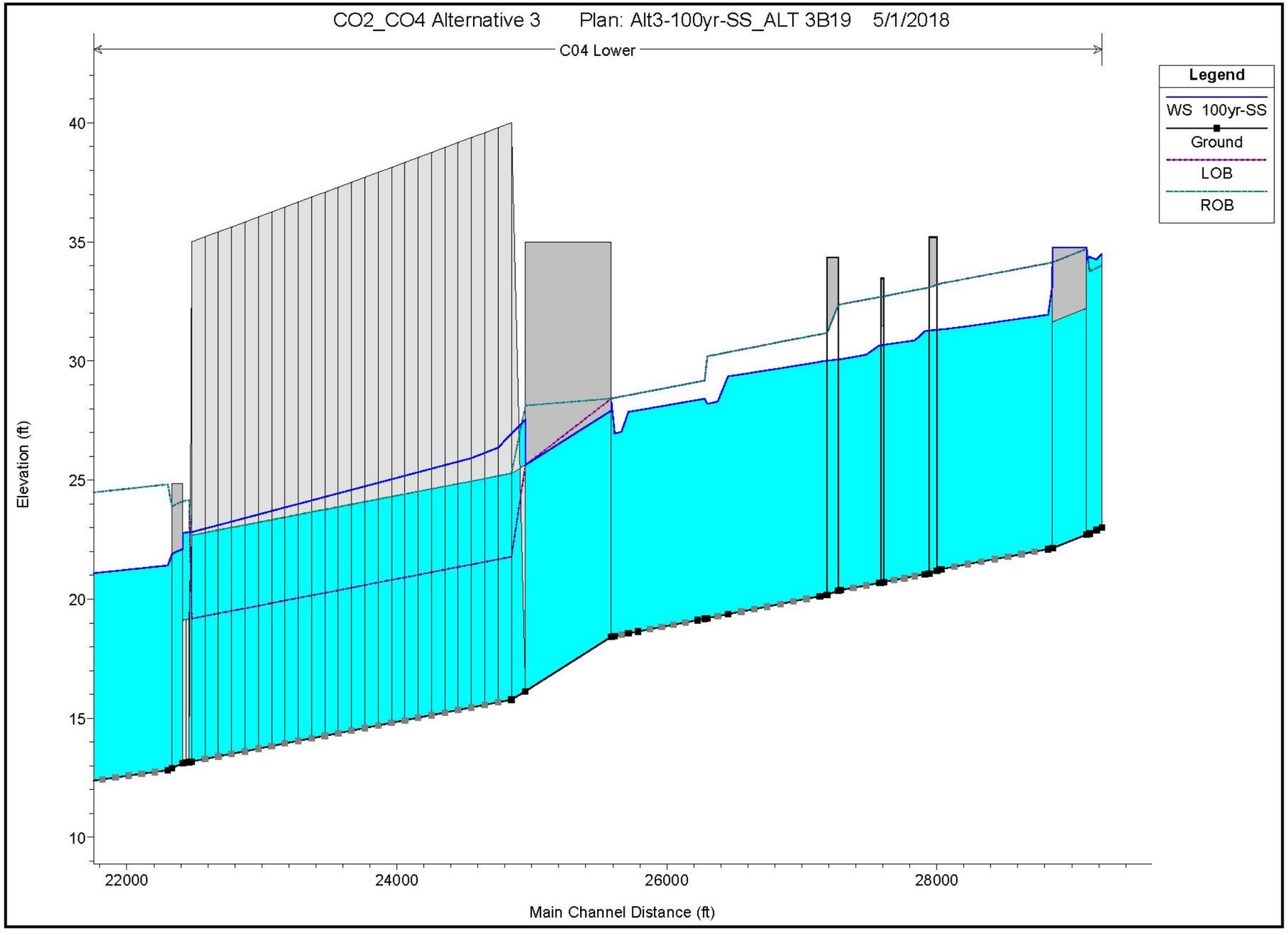

Figure 6: Alternative 3B Profile Results

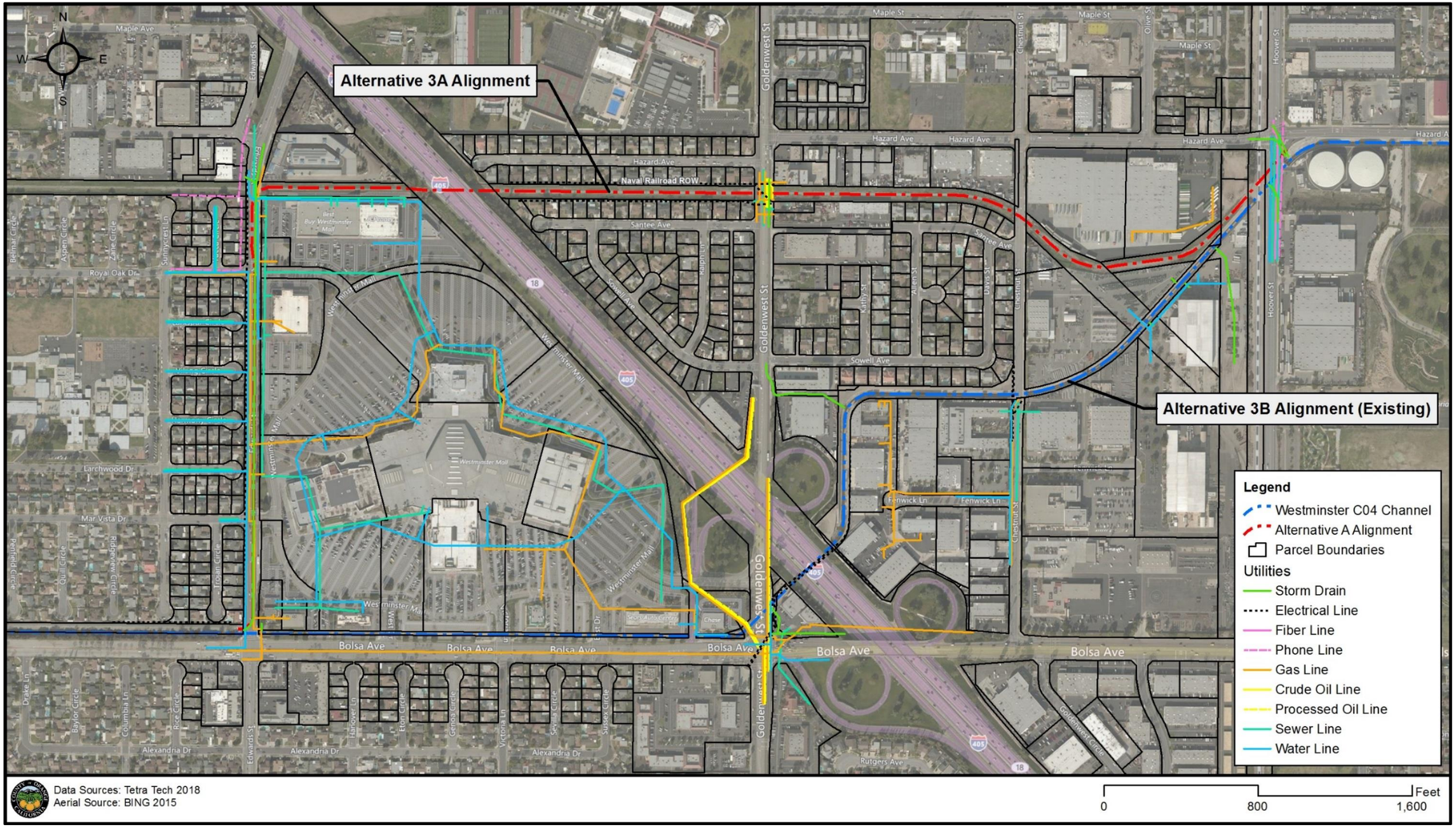

Figure 7: Utilities Overview Map

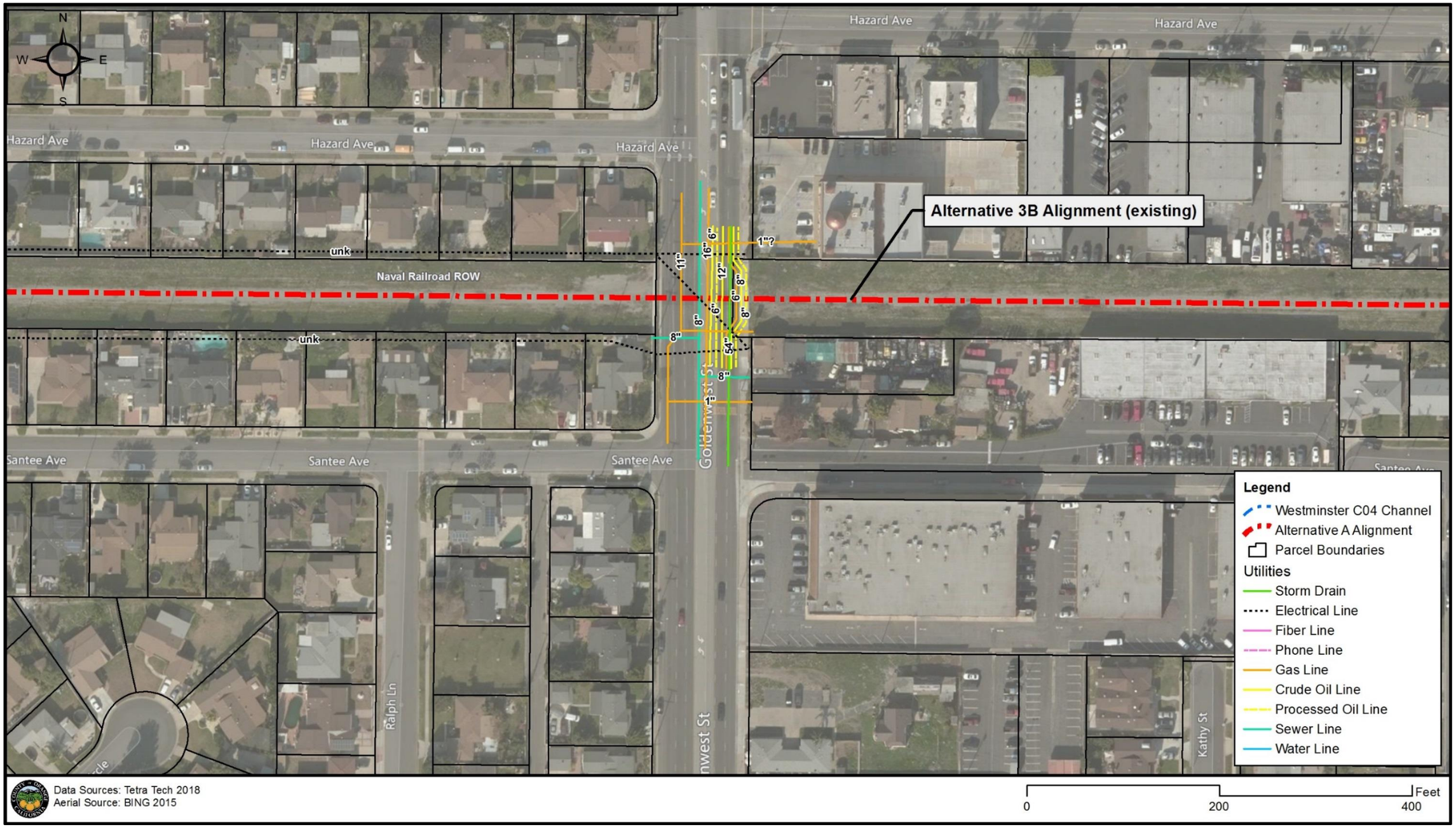

Figure 8: Utilities at Goldenwest (Alt 3A)

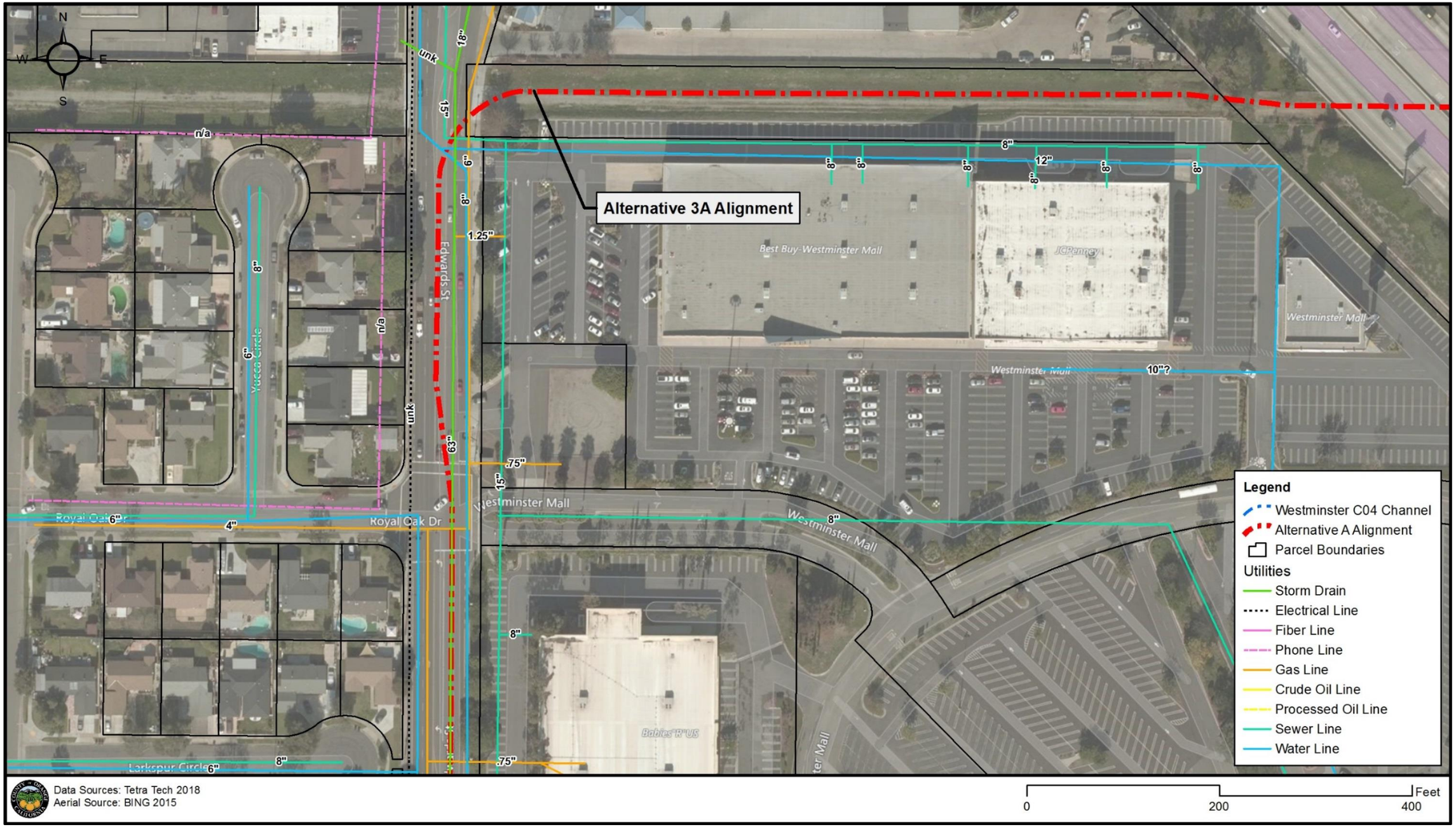

Figure 9: Utilities at Edwards 1 of 2 (Alt3A)

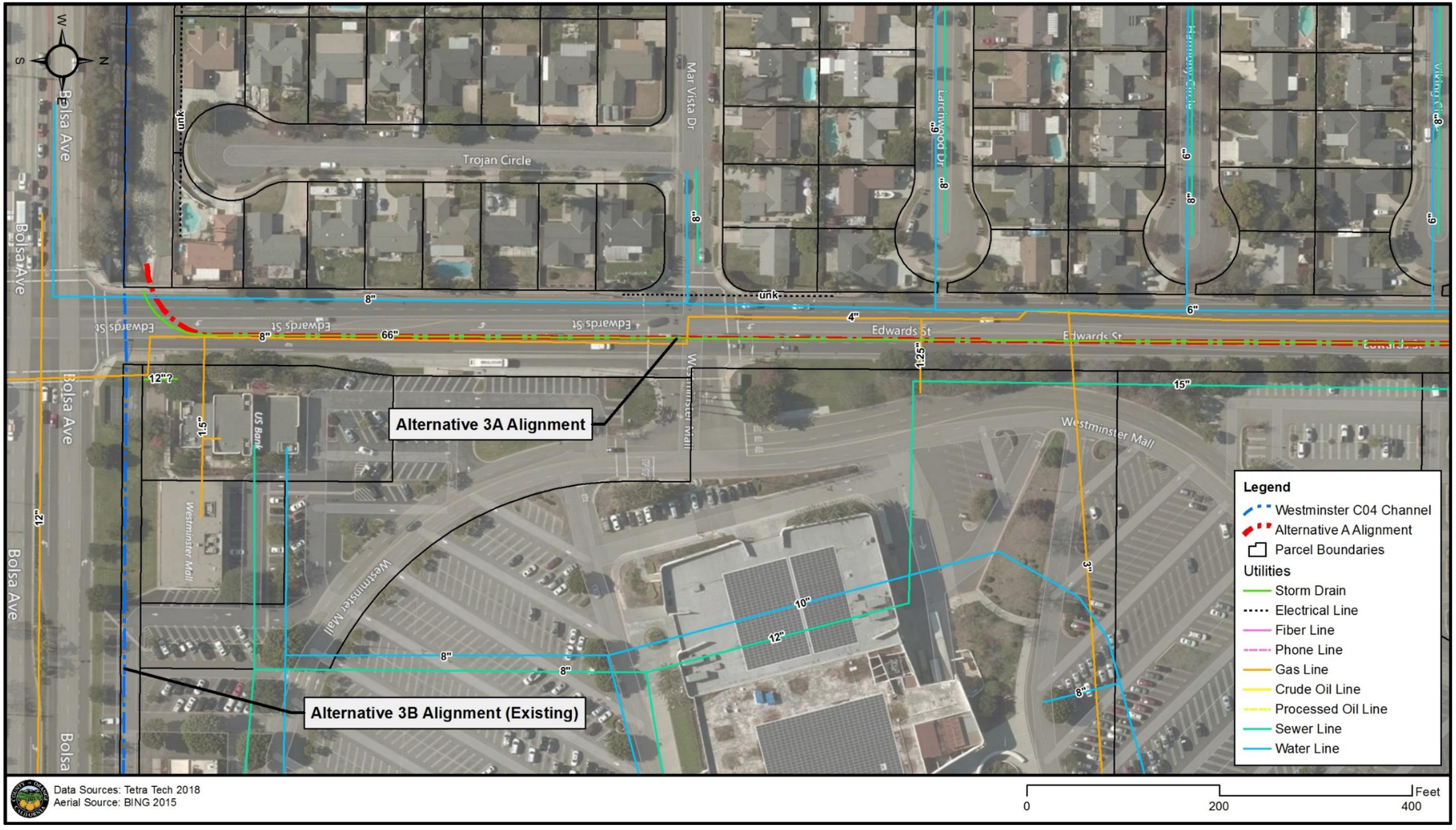

Figure 10: Utilities at Edwards 2 of 2 (Alt3A)

Appendix B – Civil Engineering

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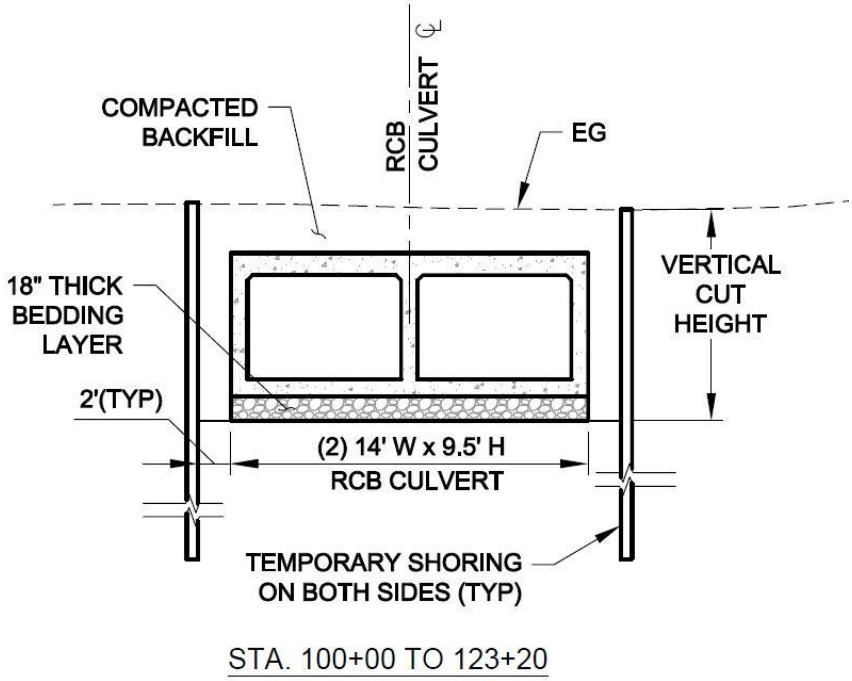

Figure 11: Typical Section along Edwards Street (Alt3A)

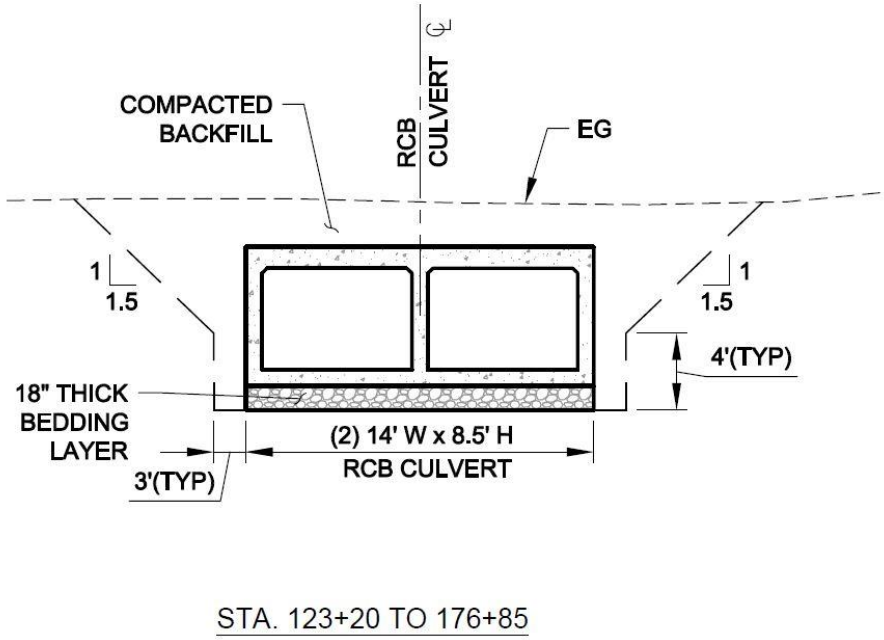

Figure 12: Typical Section along Railroad Right-of-Way (Alt3A)

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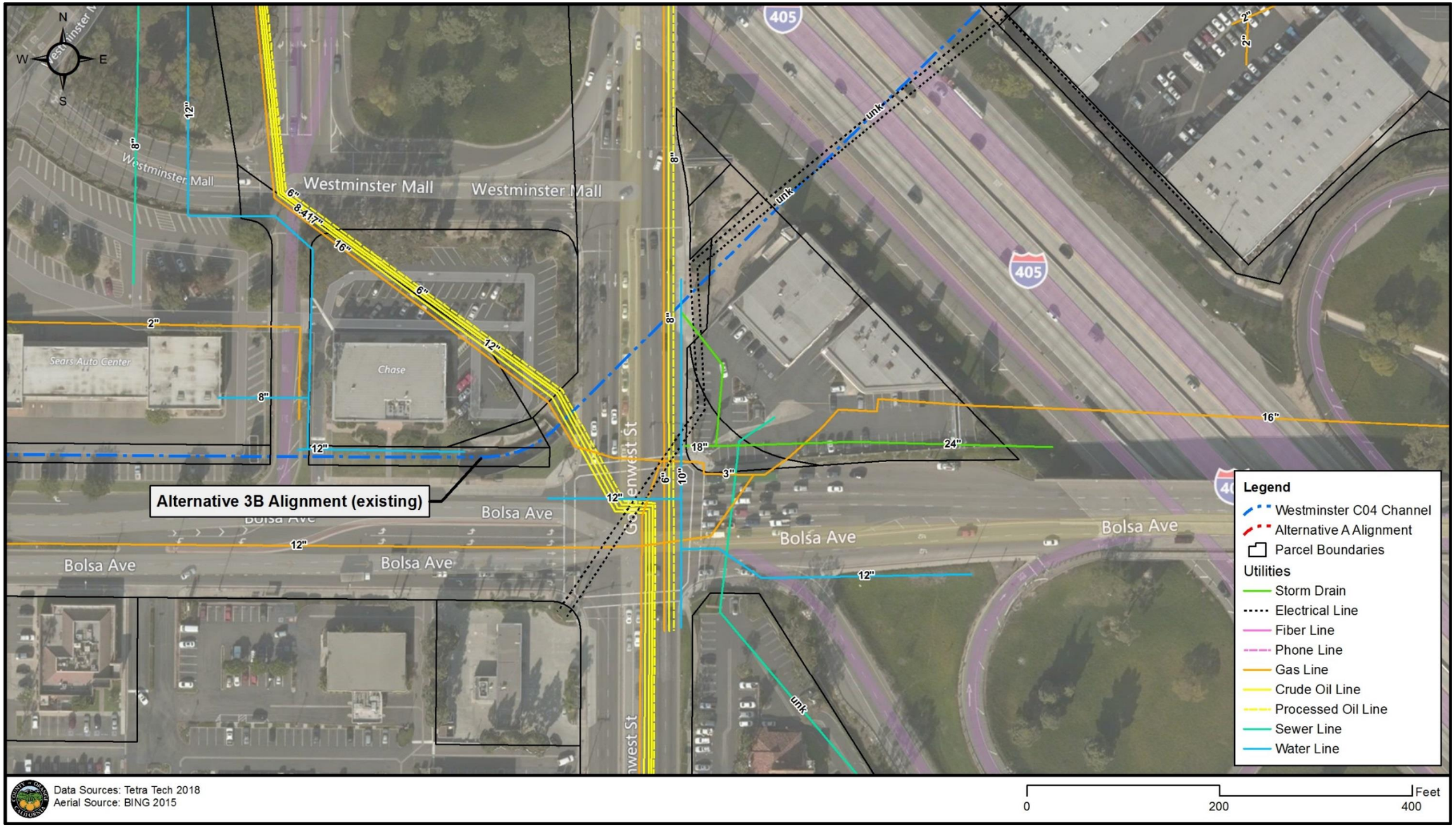

Figure 13: Utilities at Goldenwest/Bolsa (Alt3B)

Appendix B – Civil Engineering

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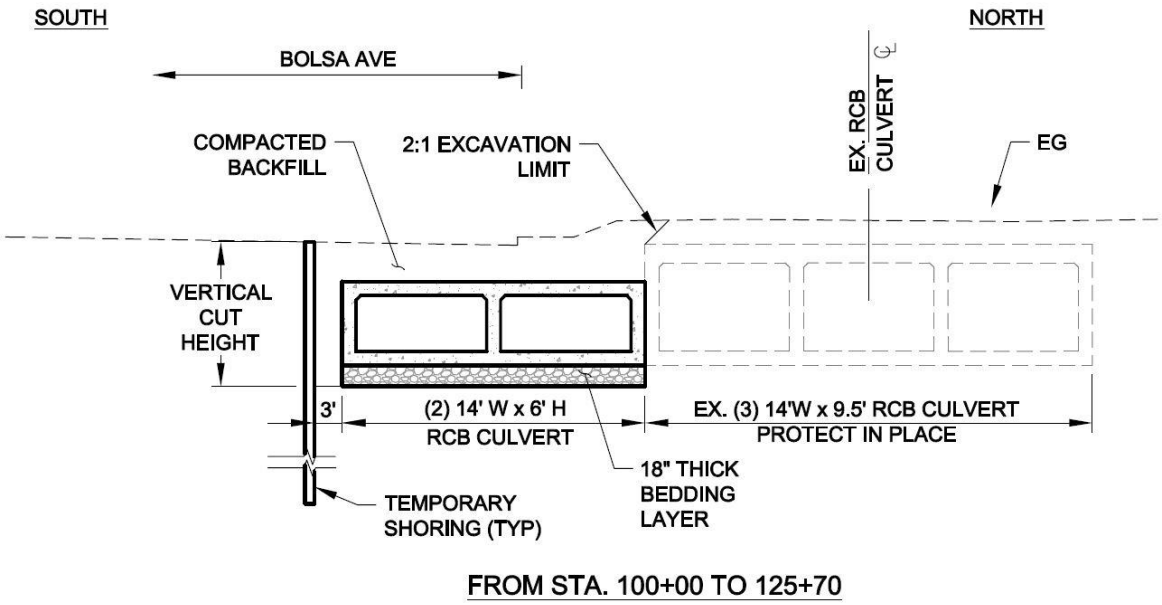


Figure 14: Typical Section along Bolsa Avenue (Alt3B)

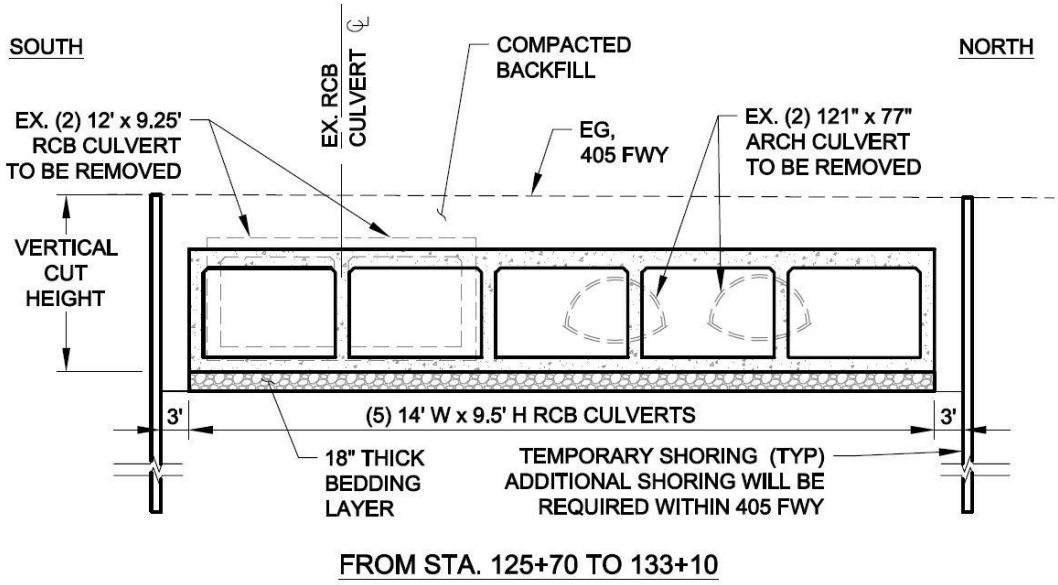


Figure 15: Typical Section under I-405 (Alt3B)

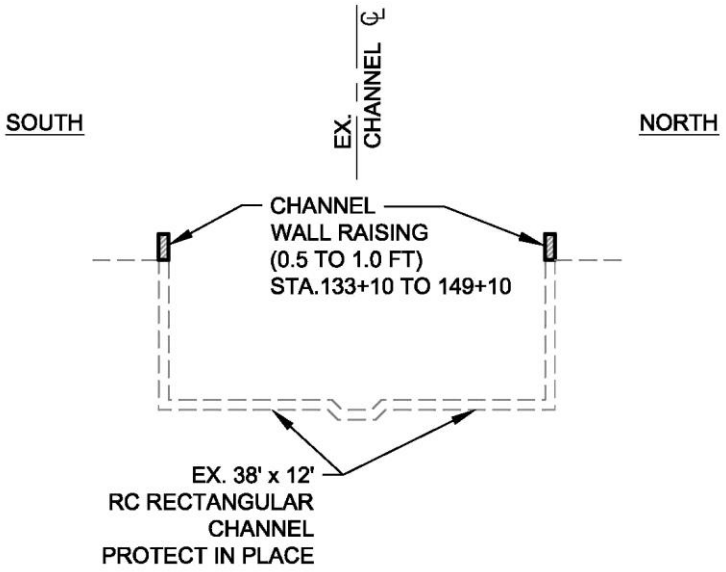
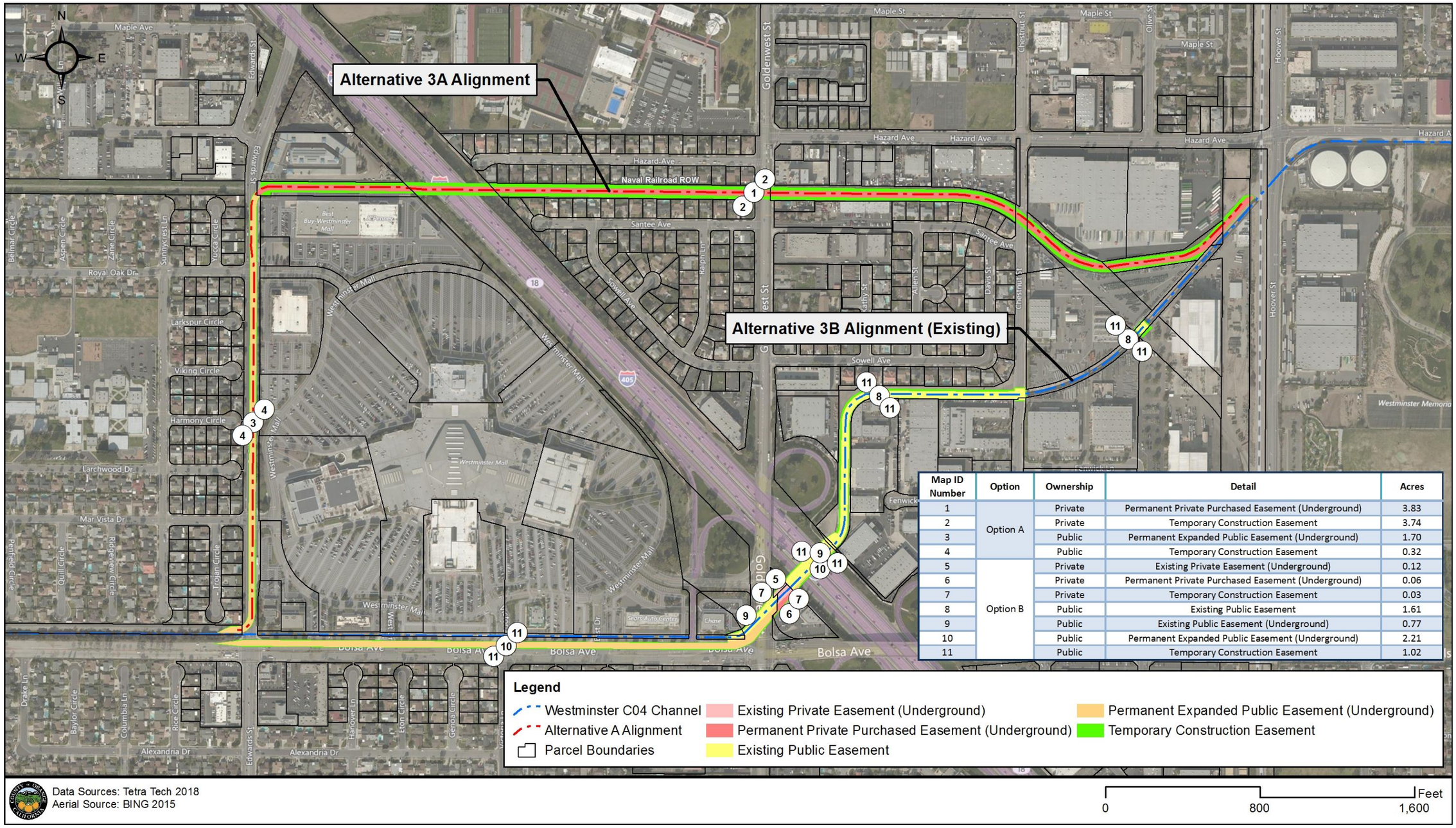


Figure 16: Typical Section for Channel Wall Raising (Alt3B)



Map ID Number	Option	Ownership	Detail	Acres
1	Option A	Private	Permanent Private Purchased Easement (Underground)	3.83
2		Private	Temporary Construction Easement	3.74
3		Public	Permanent Expanded Public Easement (Underground)	1.70
4		Public	Temporary Construction Easement	0.32
5	Option B	Private	Existing Private Easement (Underground)	0.12
6		Private	Permanent Private Purchased Easement (Underground)	0.06
7		Private	Temporary Construction Easement	0.03
8		Public	Existing Public Easement	1.61
9		Public	Existing Public Easement (Underground)	0.77
10		Public	Permanent Expanded Public Easement (Underground)	2.21
11		Public	Temporary Construction Easement	1.02

Figure 17: Estimated Right of Way Requirements for Each Alternative Alignment

Appendix B – Civil Engineering

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APPENDIX A

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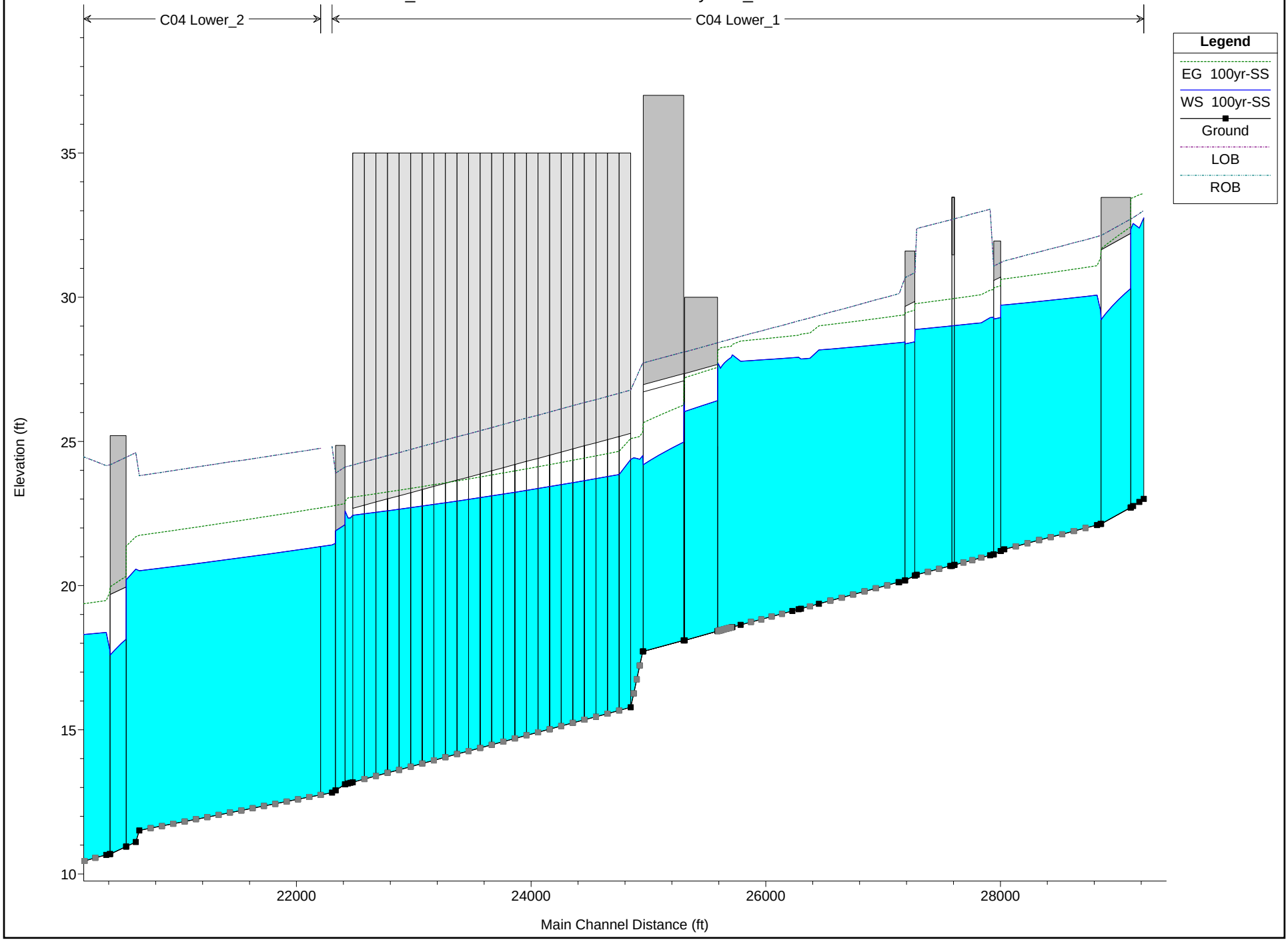
C02-C04 Alternative 3 Option A									
		Channel	Top of	Minimum	Computed Water	Actual	Freeboard	Minimum	Additional
River Station	Q_{100}	Invert	Bank	Freeboard	Surface Elevation	Freeboard	Deficiency	TOB	Improvement
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	Item No.
0+13.01	12,100	-1.57	12.42	1.50	8.02	4.40	--	12.42	1
7+75.75	12,100	-1.17	12.42	4.00	8.24	4.18	--	12.42	1
820.3363 Edinger/Sunset B									
8+61.69	12,100	-1.12	12.42	4.00	8.35	4.07	--	12.42	1
14+04.8	12,100	-0.84	12.42	3.00	8.81	3.61	--	12.42	1
42+88.34	12,100	0.69	12.42	3.00	9.89	2.53	-0.47	12.89	1
52+88.34	12,100	1.22	13.42	3.00	10.31	3.11	--	13.42	1
55+88.34	12,100	1.38	13.42	3.00	10.44	2.98	-0.02	13.44	1
65+88.34	12,100	1.91	14.42	3.00	10.87	3.55	--	14.42	1
77+88.34	12,100	2.54	14.42	2.00	11.42	3.00	--	14.42	1
85+18.34	12,100	2.93	14.92	2.00	11.76	3.16	--	14.92	1
89+10.72	12,100	3.13	13.63	1.50	11.76	1.87	--	13.63	1
C02/C04 Confluence									
90+68.55	4,320	3.20	13.70	1.50	12.25	1.45	-0.05	13.75	
94+48.13	4,320	3.35	13.85	1.50	12.33	1.52	--	13.85	
94+58.13	4,580	3.35	13.85	1.50	11.86	1.99	--	13.85	
9528.456 Bolsa Chica Rd									
96+00.38	4,580	3.41	13.91	1.50	12.26	1.65	--	13.91	2
96+10.38	4,580	3.41	13.91	1.50	12.88	1.03	-0.47	14.38	2
121+78.9	4,580	4.45	14.95	1.50	13.45	1.50	0.00	14.95	2
121+88.95	4,610	4.45	14.95	1.50	13.03	1.92	--	14.95	2
12244.95 Graham St									
122+95.04	4,610	4.49	14.99	1.50	13.40	1.59	--	14.99	2
123+05.	4,610	4.49	14.99	1.50	13.99	1.00	-0.50	15.49	2
143+99.5	4,610	5.33	15.83	1.50	14.45	1.38	-0.12	15.95	2
144+09.55	4,610	5.33	15.83	1.50	14.08	1.75	--	15.83	2
14433.18 Access Rd									
144+62.67	4,610	5.35	15.85	1.50	14.28	1.57	--	15.85	2
144+72.6	4,610	5.35	15.85	1.50	14.87	0.98	-0.52	16.37	2
146+02.79	4,610	5.41	15.91	1.50	14.89	1.02	-0.48	16.39	2
146+47.67	4,610	5.43	15.93	1.50	14.90	1.03	-0.47	16.40	2
146+71.8	4,610	5.44	15.94	1.50	14.91	1.03	-0.47	16.41	2
146+81.89	4,610	5.45	15.95	1.50	14.59	1.36	-0.14	16.09	2
14695.86 Ped Bridge									
147+09.71	4,610	5.46	15.96	1.50	14.66	1.30	-0.20	16.16	2
147+19.7	4,610	5.47	15.97	1.50	15.19	0.78	-0.72	16.69	2
147+52.95	4,610	5.49	15.99	1.50	15.19	0.80	-0.70	16.69	2
148+73.69	4,610	5.55	16.05	1.50	15.37	0.68	-0.82	16.87	2
154+18.5	4,650	5.82	16.32	1.50	15.46	0.86	-0.64	16.96	2
154+28.58	4,650	5.82	16.32	1.50	14.86	1.46	-0.04	16.36	2
15460.84 HS Driveway									
154+96.21	4,650	5.86	17.36	1.50	15.25	2.11	--	17.36	2
155+06.2	4,650	5.87	17.37	1.50	16.14	1.23	-0.27	17.64	2
171+54.45	4,650	6.69	18.19	1.50	16.41	1.78	--	18.19	2
171+84.29	4,650	6.70	18.20	1.50	15.90	2.30	--	18.20	2
17303.46 McFadden									
173+96.35	4,650	7.10	18.60	1.50	16.06	2.54	--	18.60	2
174+26.35	4,650	7.27	18.77	1.50	16.68	2.09	--	18.77	2
190+99.18	4,460	9.18	20.68	1.50	17.20	3.48	--	20.68	2
191+28.35	4,460	9.21	20.71	1.50	17.21	3.50	--	20.71	2
192+68.41	4,460	9.37	21.62	1.50	17.26	4.36	--	21.62	2
193+84.38	4,430	9.51	22.51	1.50	17.66	4.85	--	22.51	2
198+25.43	4,430	10.01	24.51	1.50	17.81	6.70	--	24.51	2
199+35.21	4,430	10.13	24.63	1.50	17.85	6.78	--	24.63	2
200+24.98	4,430	10.24	24.74	1.50	18.24	-6.50	-9.50	24.74	2
203+92.89	4,430	10.66	24.16	1.50	18.38	5.78	--	24.16	2
204+22.89	4,430	10.69	24.19	1.50	17.78	6.41	--	24.19	2

C02-C04 Alternative 3 Option A									
		Channel	Top of	Minimum	Computed Water	Actual	Freeboard	Minimum	Additional
River Station	Q_{100}	Invert	Bank	Freeboard	Surface Elevation	Freeboard	Deficiency	TOB	Improvement
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	Item No.
20501.89 Bolsa Ave									
205+63.2	4,430	10.95	24.45	1.50	20.20	4.25	--	24.45	
206+44.91	4,430	11.11	24.61	1.50	20.57	4.04	--	24.61	
206+74.92	4,400	11.51	23.81	1.50	20.52	3.29	--	23.81	
223+17.64	4,400	12.82	24.82	1.50	21.41	3.41	--	24.82	
223+47.66	4,400	12.90	23.90	1.50	21.47	2.43	--	23.90	
22391.01 Edwards									
224+29.4	2,474	13.11	24.11	1.50	22.59	1.52	--	24.11	
224+54.4	2,474	13.14	24.14	1.50	22.34	1.80	--	24.14	
224+74.63	2,474	13.16	24.16	1.50	22.35	1.81	--	24.16	
22494.86 Mall Parking D/S	2,474	13.18	--	--	22.44	--	--	--	
24863.5 Mall Parking U/S	2,474	15.78	--	--	24.37	--	--	--	
249+66.54	2,474	17.72	27.72	1.50	24.51	3.21	--	27.72	
25127.63 GoldenWest									
253+16.61	2,454	18.10	28.10	1.50	26.35	1.75	--	28.10	
253+17.6	2,454	18.10	28.10	1.50	26.35	1.75	--	28.10	
25467.11 405									
256+04.6	2,454	18.42	28.42	1.50	27.72	0.70	-0.80	29.22	
256+27.64	2,454	18.45	28.45	1.50	27.54	0.91	-0.59	29.04	
257+29.47	2,454	18.56	28.56	1.50	28.00	0.56	-0.94	29.50	
258+00.4	2,454	18.64	28.64	1.50	27.78	0.86	-0.64	29.28	
262+41.53	2,454	19.12	29.12	1.50	27.90	1.22	-0.28	29.40	
262+94.94	2,454	19.18	29.18	1.50	27.92	1.26	-0.24	29.42	
263+14.91	2,454	19.20	29.20	1.50	27.86	1.34	-0.16	29.36	
264+68.02	2,454	19.37	29.37	1.50	28.17	1.20	-0.30	29.67	
271+46.36	2,454	20.12	30.12	1.50	28.42	1.70	--	30.12	
271+51.9	2,454	20.12	30.12	1.50	28.42	1.70	--	30.12	
272+01.9	2,454	20.18	30.68	1.50	28.44	2.24	--	30.68	
27249.02 Chestnut St									
272+85.79	2,454	20.35	30.85	1.50	28.88	1.97	--	30.85	
273+00.87	2,454	20.38	32.38	1.50	28.89	3.49	--	32.38	
275+87.65	2,454	20.68	32.68	1.50	29.00	3.68	--	32.68	
27606.35 Br U/S Chestnut									
276+22.95	2,454	20.72	32.72	1.50	29.02	3.70	--	32.72	
279+26.78	2,454	21.05	33.05	1.50	29.29	3.76	--	33.05	
279+56.8	2,454	21.08	31.08	1.50	29.31	1.77	--	31.08	
27989.95 RR Bridge									
280+17.27	2,454	21.20	31.20	1.50	29.73	1.47	-0.03	31.23	
280+47.27	2,454	21.26	31.26	1.50	29.73	1.53	--	31.26	
288+38.4	2,454	22.10	32.10	1.50	30.07	2.03	--	32.10	
288+68.42	4,090	22.14	32.14	1.50	29.54	2.60	--	32.14	
28999.99 Hoover St									
291+25.12	4,090	22.71	32.71	1.50	32.35	0.36	-1.14	33.85	
291+45.13	4,090	22.76	32.76	1.50	32.56	0.20	-1.30	34.06	
291+97.87	4,090	22.90	32.90	1.50	32.40	0.50	-1.00	33.90	
29236.62 Hazard Culvert D	3,600	23.01	33.01	0.00	32.75	0.26	--	33.01	
293+85.19	377	23.42	29.42	1.50	33.65	-4.23	-7.23	35.15	
294+11.1	377	23.49	29.49	1.50	33.69	-4.20	-7.20	35.19	
294+61.1	377	24.84	30.84	1.50	33.76	-2.92	-5.92	35.26	
297+28.7	377	25.36	31.36	1.50	34.17	-2.81	-5.81	35.67	
298+20.6	377	25.56	31.56	1.50	34.32	-2.76	-5.76	35.82	
303+39.9	377	26.14	32.14	1.50	35.11	-2.97	-5.97	36.61	
314+72.3	377	27.32	33.32	1.50	36.91	-3.59	-6.59	38.41	
293+85.19	3,223	23.42	31.92	1.50	32.73	-0.81	-2.81	34.23	
294+11.1	3,223	23.49	31.99	1.50	32.73	-0.74	-2.74	34.23	
294+61.1	3,223	24.84	33.34	1.50	32.26	1.08	-0.42	33.76	
297+28.7	3,223	25.36	33.86	1.50	32.52	1.34	-0.16	34.02	

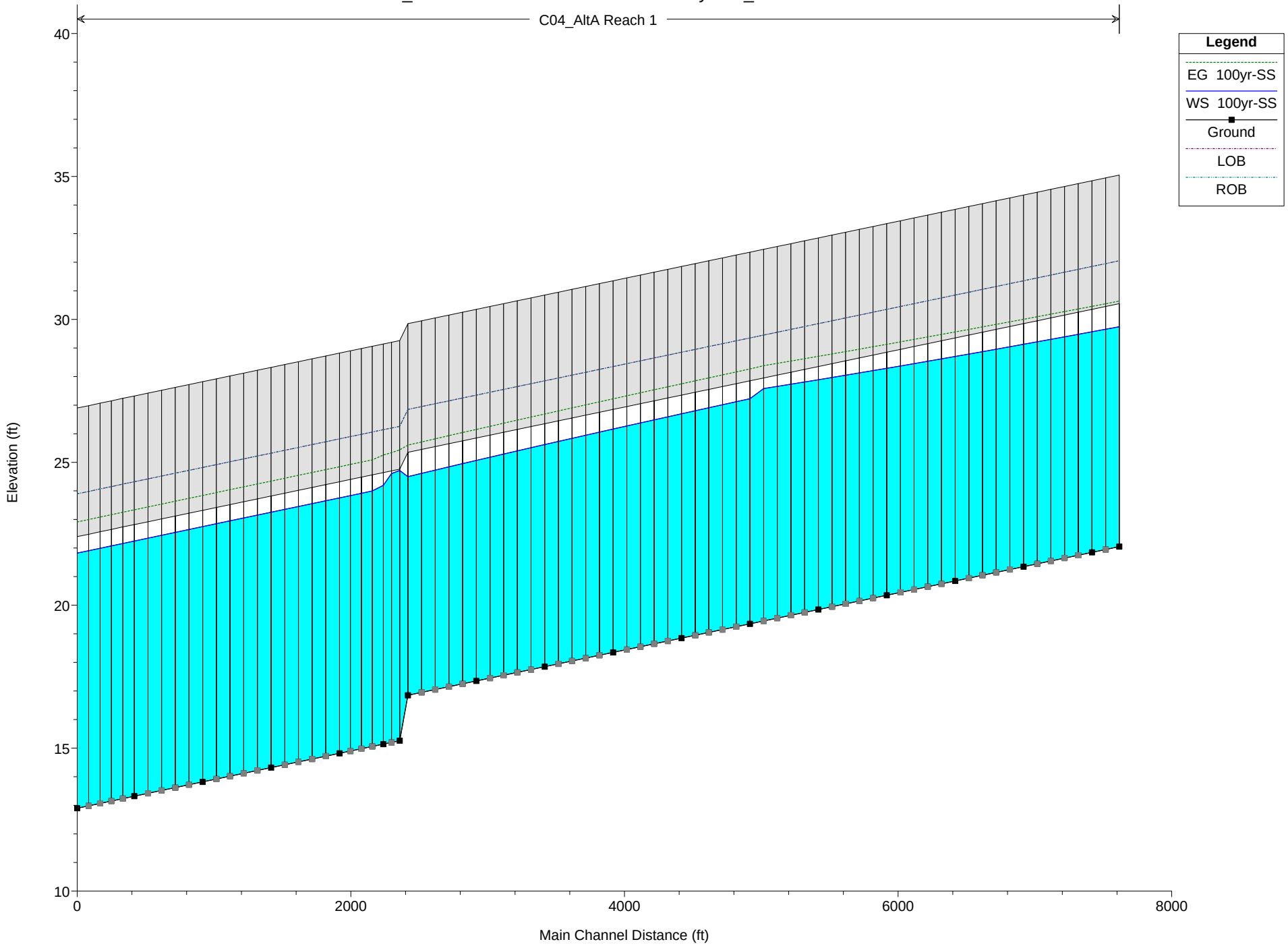
C02-C04 Alternative 3 Option A									
		Channel	Top of	Minimum	Computed Water	Actual	Freeboard	Minimum	Additional
River Station	Q_{100}	Invert	Bank	Freeboard	Surface Elevation	Freeboard	Deficiency	TOB	Improvement
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	Item No.
298+20.6	3,223	25.56	34.06	1.50	32.60	1.46	-0.04	34.10	
303+39.9	3,223	26.14	34.64	1.50	33.54	1.10	-0.40	35.04	
314+72.3	3,223	27.32	35.82	1.50	35.07	0.75	-0.75	36.57	
315+22.47	3,240	27.49	35.99	1.50	36.30	-0.31	-2.31	37.80	
31779.18 Hazard/Beach U/S									
318+67.74	3,240	29.21	39.71	1.50	38.00	1.71	--	39.71	
319+16.8	3,240	29.46	39.96	1.50	37.45	2.51	--	39.96	
327+11.89	3,240	31.06	45.06	1.50	38.27	6.79	--	45.06	
327+56.19	3,240	31.15	45.15	1.50	38.33	6.82	--	45.15	
327+85.65	3,240	31.21	45.21	1.50	38.74	6.47	--	45.21	
32792.51 Mobile Home Br									
327+99.44	3,240	31.25	45.25	1.50	41.99	3.26	--	45.25	
328+29.45	3,240	31.61	45.61	1.50	42.12	3.49	--	45.61	
331+17.8	3,240	32.19	46.19	1.50	42.20	3.99	--	46.19	
334+02.87	3,210	32.76	46.76	1.50	42.32	4.44	--	46.76	
338+71.95	3,210	33.70	47.70	1.50	42.52	5.18	--	47.70	
340+28.57	3,210	34.02	48.02	1.50	43.04	4.98	--	48.02	
347+71.4	3,210	35.51	49.51	1.50	43.49	6.02	--	49.51	
347+81.48	2,890	35.53	49.53	1.50	44.36	5.17	--	49.53	
34826.08 Newland St									
348+74.27	2,890	35.78	49.28	1.50	45.03	4.25	--	49.28	
348+84.2	2,890	35.81	49.31	1.50	44.96	4.35	--	49.31	
353+94.36	2,890	37.19	50.69	1.50	45.07	5.62	--	50.69	
363+85.86	2,890	39.15	52.65	1.50	45.95	6.70	--	52.65	
373+84.29	2,890	41.13	54.63	1.50	47.53	7.10	--	54.63	
374+09.55	1,800	43.90	53.90	1.50	48.77	5.13	--	53.90	
37474.7 Magnolia St									
375+27.21	1,800	44.90	54.90	1.50	48.87	6.03	--	54.90	
375+44.92	1,800	45.05	55.05	1.50	52.29	2.76	--	55.05	
376+39.84	1,800	45.86	55.86	1.50	52.28	3.58	--	55.86	
383+96.56	1,800	47.09	57.09	1.50	53.56	3.53	--	57.09	
393+92.79	1,800	48.70	56.70	1.50	55.20	1.50	0.00	56.70	
400+78.95	1,800	49.81	57.81	1.50	56.75	1.06	-0.44	58.25	
40125.21 Bushard St									
401+61.66	1,800	49.93	57.93	1.50	57.29	0.64	-0.86	58.79	
403+91.62	1,800	50.18	58.18	1.50	57.63	0.55	-0.95	59.13	
404+86.2	1,800	50.28	58.28	1.50	57.73	0.55	-0.95	59.23	
406+86.2	1,800	50.49	60.49	1.50	57.95	2.54	--	60.49	
413+59.91	1,800	51.22	61.22	1.50	58.77	2.45	--	61.22	
41369.91 Ped Bridge									
413+75.07	1,800	51.24	61.24	1.50	58.84	2.40	--	61.24	
426+41.94	1,800	52.61	62.61	1.50	60.18	2.43	--	62.61	
426+78.99	1,800	52.65	62.65	1.50	60.20	2.45	--	62.65	
42793.37 Brookhurst St									
428+93.64	1,800	53.91	63.91	1.50	60.35	3.56	--	63.91	
429+18.6	1,800	54.06	63.56	1.50	59.62	3.94	--	63.56	
433+59.6	1,800	54.63	64.13	1.50	60.64	3.49	--	64.13	
454+10.68	1,580	57.30	66.80	1.50	63.29	3.51	--	66.80	
454+33.98	1,580	57.33	67.33	1.50	63.23	4.10	--	67.33	
45479.91 Ward St									
455+16.07	1,580	57.83	67.83	1.50	66.52	1.31	-0.19	68.02	
455+38.54	1,580	57.97	67.97	1.50	66.23	1.74	--	67.97	
459+94.	1,580	58.56	68.56	1.50	66.63	1.93	--	68.56	
465+94.06	1,440	59.34	69.34	1.50	67.40	1.94	--	69.34	
468+27.13	1,440	59.64	69.64	1.50	67.95	1.69	--	69.64	
479+28.15	1,190	61.84	71.84	1.50	68.79	3.05	--	71.84	
479+62.03	1,110	62.25	71.25	1.50	69.70	1.55	--	71.25	

C02-C04 Alternative 3 Option A									
		Channel	Top of	Minimum	Computed Water	Actual	Freeboard	Minimum	Additional
River Station	Q_{100}	Invert	Bank	Freeboard	Surface Elevation	Freeboard	Deficiency	TOB	Improvement
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	Item No.
48008.02 Westminster D/S									
480+47.75	1,110	63.28	72.28	1.50	69.81	2.47	--	72.28	
480+63.49	1,110	63.47	72.47	1.50	69.79	2.68	--	72.47	
48100.04 Westminster U/S									
481+28.48	1,110	64.26	73.26	1.50	69.90	3.36	--	73.26	
481+53.55	1,110	64.56	73.56	1.50	69.46	4.10	--	73.56	
483+89.95	1,110	65.20	74.20	1.50	70.37	3.83	--	74.20	
484+14.96	1,110	65.30	74.30	1.50	71.23	3.07	--	74.30	
48446.8 Ranney St									
484+78.84	1,110	65.52	74.52	1.50	73.21	1.31	-0.19	74.71	
485+03.87	1,110	65.62	74.62	1.50	73.10	1.52	--	74.62	
491+52.98	1,110	67.37	76.37	1.50	73.55	2.82	--	76.37	
491+77.99	1,110	67.47	76.47	1.50	73.90	2.57	--	76.47	
49211.87 Blake St									
492+39.47	1,110	67.69	77.19	1.50	75.38	1.81	--	77.19	
492+64.54	1,110	67.79	77.29	1.50	75.27	2.02	--	77.29	
494+28.64	1,110	68.24	77.74	1.50	75.36	2.38	--	77.74	
494+53.64	1,110	68.34	77.84	1.50	75.58	2.26	--	77.84	
49485.41 Woodbury St									
495+15.11	1,110	68.55	78.05	1.50	76.28	1.77	--	78.05	
495+40.11	1,110	68.65	78.15	1.50	76.18	1.97	--	78.15	
497+29.52	1,110	69.16	78.66	1.50	76.28	2.38	--	78.66	
497+54.53	1,110	69.26	78.76	1.50	76.50	2.26	--	78.76	
49784.9 Teal St									
498+15.	1,110	69.48	78.98	1.50	77.19	1.79	--	78.98	
498+40.	1,110	69.58	79.08	1.50	77.09	1.99	--	79.08	
500+28.14	1,110	70.09	79.59	1.50	77.19	2.40	--	79.59	
500+53.15	1,110	70.19	79.69	1.50	77.33	2.36	--	79.69	
50085.25 Mallard St									
501+13.59	1,110	70.40	79.90	1.50	78.08	1.82	--	79.90	
501+38.63	1,110	70.50	80.00	1.50	78.01	1.99	--	80.00	
502+19.64	1,110	70.72	80.22	1.50	78.05	2.17	--	80.22	
Alt3A Diversion 0+01.	2,096	12.90	--	--	21.82	0.58	--	22.40	3
Alt3A Diversion 4+18.	2,096	13.32	--	--	22.25	0.57	--	22.82	3
Alt3A Diversion 19+18.	2,096	14.82	--	--	23.76	0.56	--	24.32	3
Alt3A Diversion 22+38.	2,096	15.14	--	--	24.19	0.45	--	24.64	3
Alt3A Diversion 23+58.	1,806	15.26	--	--	24.71	0.05	--	24.76	3
Alt3A Diversion 24+18.	1,806	16.85	--	--	24.50	1.85	--	26.35	3
Alt3A Diversion 29+18.	1,806	17.35	--	--	25.07	1.78	--	26.85	3
Alt3A Diversion 34+18.	1,806	17.85	--	--	25.62	1.73	--	27.35	3
Alt3A Diversion 39+18.	1,806	18.35	--	--	26.16	1.69	--	27.85	3
Alt3A Diversion 44+18.	1,806	18.85	--	--	26.70	1.65	--	28.35	3
Alt3A Diversion 49+18.	1,806	19.35	--	--	27.22	1.63	--	28.85	3
Alt3A Diversion 54+18.	1,636	19.85	--	--	27.89	1.46	--	29.35	3
Alt3A Diversion 59+18.	1,636	20.35	--	--	28.29	1.56	--	29.85	3
Alt3A Diversion 64+18.	1,636	20.85	--	--	28.70	1.65	--	30.35	3
Alt3A Diversion 69+18.	1,636	21.35	--	--	29.13	1.72	--	30.85	3
Alt3A Diversion 74+18.	1,636	21.85	--	--	29.56	1.79	--	31.35	3
Alt3A Diversion 76+18.	1,636	22.05	--	--	29.74	1.81	--	31.55	3
Additional Improvement Items:									
1. 230' wide double sheet piles soft-bottom channel									
2. Concrete lined channel bottom from Bolsa Chica Rd to Bolsa Ave.									
3. Double 8.5'Hx14'W Box culvert diversion from Hoover to Edwards. Double 9.5'Hx14'W Box culvert diversion along Edwards to Bolsa. Intercepts flow from systems draining from north of existing channel.									

C02_C04 Alternative 3 Plan: Alt3-100yr-SS_ALT 3A 5/16/2018



C02_C04 Alternative 3 Plan: Alt3-100yr-SS_ALT 3A 5/16/2018



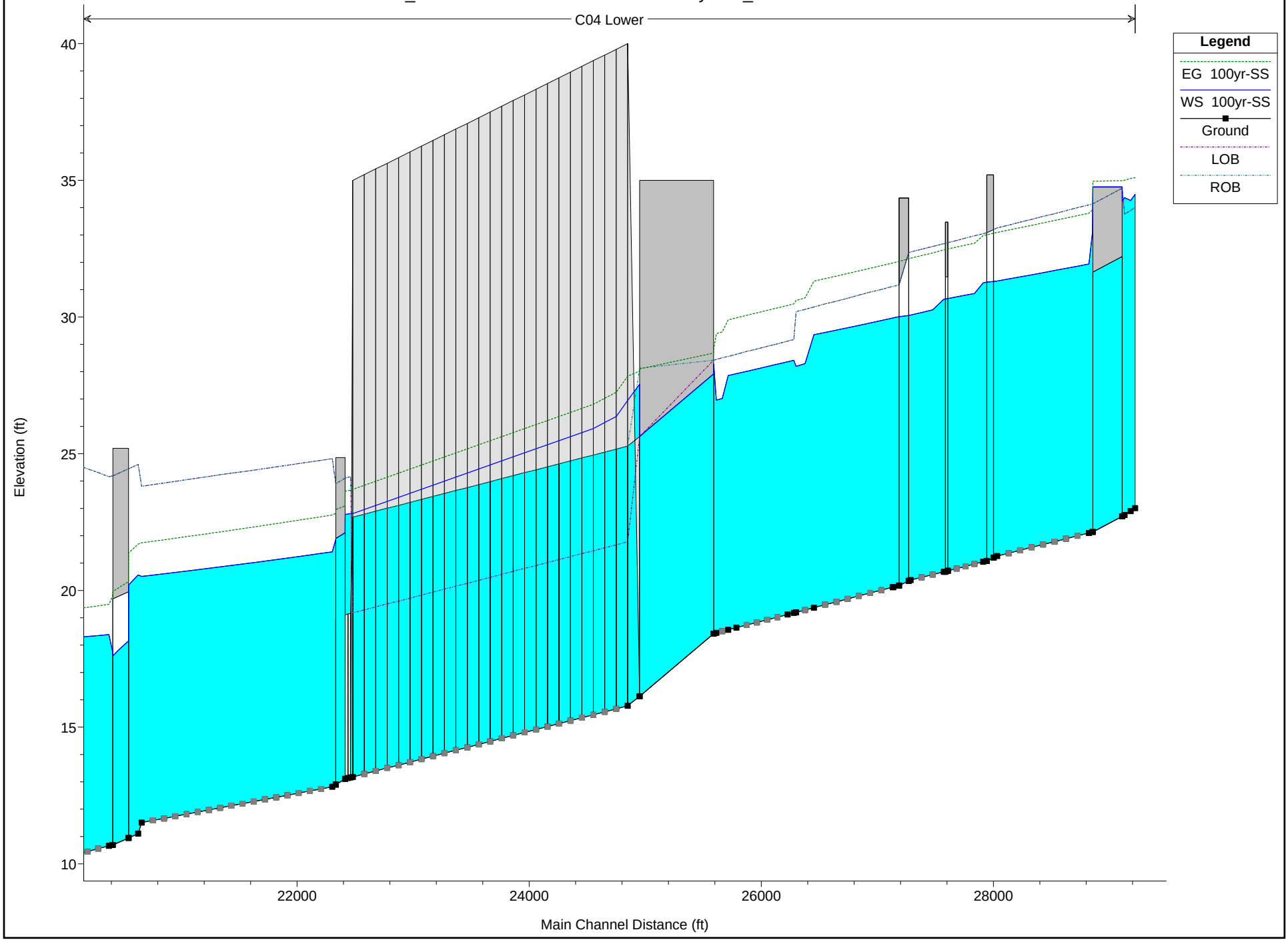
C02-C04 Alternative 3 Option B									
		Channel	Top of	Minimum	Computed Water	Actual	Freeboard	Minimum	Additional
River Station	Q_{100}	Invert	Bank	Freeboard	Surface Elevation	Freeboard	Deficiency	TOB	Improvement
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	Item No.
0+13.01	12100	-1.57	12.42	1.50	8.02	4.40	--	12.42	1
7+75.75	12100	-1.17	12.42	4.00	8.24	4.18	--	12.42	1
820.3363 Edinger/Sunset B	Bridge								
8+61.69	12100	-1.12	12.42	4.00	8.35	4.07	--	12.42	1
14+04.8	12100	-0.84	12.42	3.00	8.81	3.61	--	12.42	1
42+88.34	12100	0.69	12.42	3.00	9.89	2.53	-0.47	12.89	1
52+88.34	12100	1.22	13.42	3.00	10.31	3.11	--	13.42	1
55+88.34	12100	1.38	13.42	3.00	10.44	2.98	-0.02	13.44	1
65+88.34	12100	1.91	14.42	3.00	10.87	3.55	--	14.42	1
77+88.34	12100	2.54	14.42	2.00	11.42	3.00	--	14.42	1
85+18.34	12100	2.93	14.92	2.00	11.76	3.16	--	14.92	1
89+10.72	12100	3.13	13.63	1.50	11.76	1.87	--	13.63	1
C02/C04 Confluence									
90+68.55	4320	3.20	13.70	1.50	12.28	1.42	-0.08	13.78	
94+48.13	4320	3.35	13.85	1.50	12.50	1.35	-0.15	14.00	
94+58.13	4580	3.35	13.85	1.50	12.06	1.79	--	13.85	
9528.456 Bolsa Chica Rd	Bridge								
96+00.38	4580	3.41	13.91	1.50	12.41	1.50	--	13.91	2
96+10.38	4580	3.41	13.91	1.50	13.00	0.91	-0.59	14.50	2
121+78.9	4580	4.45	14.95	1.50	13.55	1.40	-0.10	15.05	2
121+88.95	4610	4.45	14.95	1.50	13.15	1.80	--	14.95	2
12244.95 Graham St	Bridge								
122+95.04	4610	4.49	14.99	1.50	13.49	1.50	--	14.99	2
123+05.	4610	4.49	14.99	1.50	14.06	0.93	-0.57	15.56	2
143+99.5	4610	5.33	15.83	1.50	14.51	1.32	-0.18	16.01	2
144+09.55	4610	5.33	15.83	1.50	14.15	1.68	--	15.83	2
14433.18 Access Rd	Bridge								
144+62.67	4610	5.35	15.85	1.50	14.34	1.51	--	15.85	2
144+72.6	4610	5.35	15.85	1.50	14.91	0.94	-0.56	16.41	2
146+02.79	4610	5.41	15.91	1.50	14.94	0.97	-0.53	16.44	2
146+47.67	4610	5.43	15.93	1.50	14.95	0.98	-0.52	16.45	2
146+71.8	4610	5.44	15.94	1.50	14.95	0.99	-0.51	16.45	2
146+81.89	4610	5.45	15.95	1.50	14.64	1.31	-0.19	16.14	2
14695.86 Ped Bridge	Bridge								
147+09.71	4610	5.46	15.96	1.50	14.71	1.25	-0.25	16.21	2
147+19.7	4610	5.47	15.97	1.50	15.23	0.74	-0.76	16.73	2
147+52.95	4610	5.49	15.99	1.50	15.23	0.76	-0.74	16.73	2
148+73.69	4610	5.55	16.05	1.50	15.40	0.65	-0.85	16.90	2
154+18.5	4650	5.82	16.32	1.50	15.49	0.83	-0.67	16.99	2
154+28.58	4650	5.82	16.32	1.50	14.90	1.42	-0.08	16.40	2
15460.84 HS Driveway	Bridge								
154+96.21	4650	5.86	17.36	1.50	15.29	2.07	--	17.36	2
155+06.2	4650	5.87	17.37	1.50	16.16	1.21	-0.29	17.66	2
171+54.45	4650	6.69	18.19	1.50	16.43	1.76	--	18.19	2
171+84.29	4650	6.70	18.20	1.50	15.92	2.28	--	18.20	2
17303.46 McFadden	Culvert								
173+96.35	4650	7.10	18.60	1.50	16.08	2.52	--	18.60	2
174+26.35	4650	7.27	18.77	1.50	16.70	2.07	--	18.77	2
190+99.18	4460	9.18	20.68	1.50	17.21	3.47	--	20.68	2
191+28.35	4460	9.21	20.71	1.50	17.23	3.48	--	20.71	2
192+68.41	4460	9.37	21.62	1.50	17.28	4.34	--	21.62	2
193+84.38	4430	9.51	22.51	1.50	17.67	4.84	--	22.51	2
198+25.43	4430	10.01	24.51	1.50	17.82	6.69	--	24.51	2
199+35.21	4430	10.13	24.63	1.50	17.87	6.76	--	24.63	2
200+24.98	4430	10.24	24.74	1.50	18.25	6.49	--	24.74	2
203+92.89	4430	10.66	24.16	1.50	18.39	5.77	--	24.16	2
204+22.89	4430	10.69	24.19	1.50	17.79	6.40	--	24.19	2
20501.89 Bolsa Ave	Culvert								

C02-C04 Alternative 3 Option B									
		Channel	Top of	Minimum	Computed Water	Actual	Freeboard	Minimum	Additional
River Station	Q_{100}	Invert	Bank	Freeboard	Surface Elevation	Freeboard	Deficiency	TOB	Improvement
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	Item No.
205+63.2	4430	10.95	24.45	1.50	20.20	4.25	--	24.45	
206+44.91	4430	11.11	24.61	1.50	20.57	4.04	--	24.61	
206+74.92	4400	11.51	23.81	1.50	20.52	3.29	--	23.81	
223+17.64	4400	12.82	24.82	1.50	21.41	3.41	--	24.82	
223+47.66	4400	12.90	23.90	1.50	21.87	2.03	--	23.90	
22391.01 Edwards	Culvert								3
224+29.4	4400	13.11	24.11	1.50	22.78	1.33	-0.17	24.28	3
224+54.4	4400	13.14	24.14	1.50	22.80	1.34	-0.16	24.30	3
224+74.63	4400	13.16	24.16	1.50	22.81	1.35	-0.15	24.31	3
22494.86 Mall Parking D/S	4280	13.18			22.81				3
24966.54 D/S of 405	4280	16.13	28.13	1.50	27.54	0.59	-0.91	29.04	4
25467.11 I - 405	Culvert								4
25604.6 U/S of 405	4260	18.42	28.42	1.50	28.28	0.14	-1.36	29.78	
256+27.64	4260	18.45	28.45	1.50	26.96	1.49	-0.01	28.46	
257+29.47	4260	18.56	28.56	1.50	27.86	0.70	-0.80	29.36	
258+00.4	4260	18.64	28.64	1.50	27.93	0.71	-0.79	29.43	
262+41.53	4260	19.12	29.12	1.50	28.36	0.76	-0.74	29.86	
262+94.94	4260	19.18	29.18	1.50	28.42	0.76	-0.74	29.92	
263+14.91	4260	19.20	30.20	1.50	28.20	2.00	--	30.20	
264+68.02	4260	19.37	30.37	1.50	29.35	1.02	-0.48	30.85	
271+46.36	4260	20.12	31.12	1.50	29.96	1.16	-0.34	31.46	
271+51.9	4260	20.12	31.12	1.50	29.97	1.15	-0.35	31.47	
272+01.9	4260	20.18	31.18	1.50	30.01	1.17	-0.33	31.51	
27249.02 Chestnut St	Culvert								5
272+85.79	4260	20.35	32.35	1.50	30.06	2.29	--	32.35	
273+00.87	4260	20.38	32.38	1.50	30.07	2.31	--	32.38	
275+87.65	4090	20.68	32.68	1.50	30.65	2.03	--	32.68	
27606.35 Br U/S Chestnut	Bridge								
276+22.95	4090	20.72	32.72	1.50	30.68	2.04	--	32.72	
279+26.78	4090	21.05	33.05	1.50	31.25	1.80	--	33.05	
279+56.8	4090	21.08	33.08	1.50	31.28	1.80	--	33.08	
27989.95 RR Bridge	Culvert								5
280+17.27	4090	21.20	33.20	1.50	31.30	1.90	--	33.20	
280+47.27	4090	21.26	33.26	1.50	31.31	1.95	--	33.26	
288+38.4	4090	22.10	34.10	1.50	31.94	2.16	--	34.10	
288+68.42	4090	22.14	34.14	1.50	33.08	1.06	-0.44	34.58	
28999.99 Hoover St	Culvert								6
291+25.12	4090	22.71	34.71	1.50	34.24	0.47	-1.03	35.74	
291+45.13	4090	22.76	33.76	1.50	34.37	-0.61	-2.61	35.87	
291+97.87	4090	22.90	33.90	1.50	34.26	-0.36	-2.36	35.76	
29236.62 Hazard Culvert D	3600	23.01	34.01	1.50	34.49	-0.48	-2.48	35.99	
293+85.19	3223.17	23.42	33.42	1.50	34.45	-1.03	-3.03	35.95	
294+11.1	3223.17	23.49	33.49	1.50	34.45	-0.96	-2.96	35.95	
294+61.1	3223.17	24.84	33.34	1.50	34.22	-0.88	-2.88	35.72	
297+28.7	3223.17	25.36	33.86	1.50	34.33	-0.47	-2.47	35.83	
298+20.6	3223.17	25.56	34.06	1.50	34.36	-0.30	-2.30	35.86	
303+39.9	3223.17	26.14	34.64	1.50	34.76	-0.12	-2.12	36.26	
314+72.3	3223.17	27.32	35.82	1.50	35.76	0.06	-1.44	37.26	
315+22.47	3240	27.49	35.82	1.50	36.82	-1.00	-3.00	38.32	
31779.18 Hazard/Beach U/S	Culvert								
318+67.74	3240	29.21	39.71	1.50	38.58	1.13	-0.37	40.08	
319+16.8	3240	29.46	39.96	1.50	38.13	1.83	--	39.96	
327+11.89	3240	31.06	45.06	1.50	38.72	6.34	--	45.06	
327+56.19	3240	31.15	45.15	1.50	38.76	6.39	--	45.15	
327+85.65	3240	31.21	45.21	1.50	39.04	6.17	--	45.21	
32792.51 Mobile Home Br	Culvert								
327+99.44	3240	31.25	45.25	1.50	41.99	3.26	--	45.25	
328+29.45	3240	31.61	45.61	1.50	42.12	3.49	--	45.61	

C02-C04 Alternative 3 Option B									
		Channel	Top of	Minimum	Computed Water	Actual	Freeboard	Minimum	Additional
River Station	Q_{100}	Invert	Bank	Freeboard	Surface Elevation	Freeboard	Deficiency	TOB	Improvement
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	Item No.
331+17.8	3240	32.19	46.19	1.50	42.20	3.99	--	46.19	
334+02.87	3210	32.76	46.76	1.50	42.32	4.44	--	46.76	
338+71.95	3210	33.70	47.70	1.50	42.52	5.18	--	47.70	
340+28.57	3210	34.02	48.02	1.50	43.04	4.98	--	48.02	
347+71.4	3210	35.51	49.51	1.50	43.49	6.02	--	49.51	
347+81.48	2890	35.53	49.53	1.50	44.36	5.17	--	49.53	
34826.08 Newland St	Culvert								
348+74.27	2890	35.78	49.28	1.50	45.03	4.25	--	49.28	
348+84.2	2890	35.81	49.31	1.50	44.96	4.35	--	49.31	
353+94.36	2890	37.19	50.69	1.50	45.07	5.62	--	50.69	
363+85.86	2890	39.15	52.65	1.50	45.95	6.70	--	52.65	
373+84.29	2890	41.13	54.63	1.50	47.53	7.10	--	54.63	
374+09.55	1800	43.90	53.90	1.50	48.77	5.13	--	53.90	
37474.7 Magnolia St	Culvert								
375+27.21	1800	44.90	54.90	1.50	48.87	6.03	--	54.90	
375+44.92	1800	45.05	55.05	1.50	52.29	2.76	--	55.05	
376+39.84	1800	45.86	55.86	1.50	52.28	3.58	--	55.86	
383+96.56	1800	47.09	57.09	1.50	53.56	3.53	--	57.09	
393+92.79	1800	48.70	56.70	1.50	55.20	1.50	--	56.70	
400+78.95	1800	49.81	57.81	1.50	56.75	1.06	-0.44	58.25	
40125.21 Bushard St	Culvert								
401+61.66	1800	49.93	57.93	1.50	57.29	0.64	-0.86	58.79	
403+91.62	1800	50.18	58.18	1.50	57.63	0.55	-0.95	59.13	
404+86.2	1800	50.28	58.28	1.50	57.73	0.55	-0.95	59.23	
406+86.2	1800	50.49	60.49	1.50	57.95	2.54	--	60.49	
413+59.91	1800	51.22	61.22	1.50	58.77	2.45	--	61.22	
41369.91 Ped Bridge	Bridge								
413+75.07	1800	51.24	61.24	1.50	58.84	2.40	--	61.24	
426+41.94	1800	52.61	62.61	1.50	60.18	2.43	--	62.61	
426+78.99	1800	52.65	62.65	1.50	60.20	2.45	--	62.65	
42793.37 Brookhurst St	Culvert								
428+93.64	1800	53.91	63.91	1.50	60.35	3.56	--	63.91	
429+18.6	1800	54.06	64.06	1.50	59.62	4.44	--	64.06	
433+59.6	1800	54.63	64.63	1.50	60.64	3.99	--	64.63	
454+10.68	1580	57.30	67.30	1.50	63.29	4.01	--	67.30	
454+33.98	1580	57.33	67.33	1.50	63.23	4.10	--	67.33	
45479.91 Ward St	Culvert								
455+16.07	1580	57.83	67.83	1.50	66.52	1.31	-0.19	68.02	
455+38.54	1580	57.97	67.97	1.50	66.23	1.74	--	67.97	
459+94.	1580	58.56	68.56	1.50	66.63	1.93	--	68.56	
465+94.06	1440	59.34	69.34	1.50	67.40	1.94	--	69.34	
468+27.13	1440	59.64	69.64	1.50	67.95	1.69	--	69.64	
479+28.15	1190	61.84	71.84	1.50	68.79	3.05	--	71.84	
479+62.03	1110	62.25	71.25	1.50	69.70	1.55	--	71.25	
48008.02 Westminster D/S	Culvert								
480+47.75	1110	63.28	71.25	1.50	69.81	1.44	-0.06	71.31	
480+63.49	1110	63.47	71.25	1.50	69.79	1.46	-0.04	71.29	
48100.04 Westminster U/S	Culvert								
481+28.48	1110	64.26	73.26	1.50	69.90	3.36	--	73.26	
481+53.55	1110	64.56	73.56	1.50	69.46	4.10	--	73.56	
483+89.95	1110	65.20	74.20	1.50	70.37	3.83	--	74.20	
484+14.96	1110	65.30	74.30	1.50	71.23	3.07	--	74.30	
48446.8 Ranney St	Culvert								
484+78.84	1110	65.52	74.52	1.50	73.21	1.31	-0.19	74.71	
485+03.87	1110	65.62	74.62	1.50	73.10	1.52	--	74.62	
491+52.98	1110	67.37	76.37	1.50	73.55	2.82	--	76.37	
491+77.99	1110	67.47	76.47	1.50	73.90	2.57	--	76.47	
49211.87 Blake St	Culvert								

C02-C04 Alternative 3 Option B									
		Channel	Top of	Minimum	Computed Water	Actual	Freeboard	Minimum	Additional
River Station	Q_{100}	Invert	Bank	Freeboard	Surface Elevation	Freeboard	Deficiency	TOB	Improvement
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	Item No.
492+39.47	1110	67.69	77.19	1.50	75.38	1.81	--	77.19	
492+64.54	1110	67.79	77.29	1.50	75.27	2.02	--	77.29	
494+28.64	1110	68.24	77.74	1.50	75.36	2.38	--	77.74	
494+53.64	1110	68.34	77.84	1.50	75.58	2.26	--	77.84	
49485.41 Woodbury St	Culvert								
495+15.11	1110	68.55	78.05	1.50	76.28	1.77	--	78.05	
495+40.11	1110	68.65	78.15	1.50	76.18	1.97	--	78.15	
497+29.52	1110	69.16	78.66	1.50	76.28	2.38	--	78.66	
497+54.53	1110	69.26	78.76	1.50	76.50	2.26	--	78.76	
49784.9 Teal St	Culvert								
498+15.	1110	69.48	78.98	1.50	77.19	1.79	--	78.98	
498+40.	1110	69.58	79.08	1.50	77.09	1.99	--	79.08	
500+28.14	1110	70.09	79.59	1.50	77.19	2.40	--	79.59	
500+53.15	1110	70.19	79.69	1.50	77.33	2.36	--	79.69	
50085.25 Mallard St	Culvert								
501+13.59	1110	70.40	79.90	1.50	78.08	1.82	--	79.90	
501+38.63	1110	70.50	80.00	1.50	78.01	1.99	--	80.00	
502+19.64	1110	70.72	80.22	1.50	78.05	2.17	--	80.22	
Additional Improvement Items:									
1. 230' wide double sheet piles soft-bottom channel									
2. Concrete lined channel bottom from Bolsa Chica Rd to Bolsa Ave.									
3. Add 2-14'x6' RCBs from Edwards to D/S of Goldwest St.									
4. Replace existing facilities by 5- 14'x9.5' RCBs from Goldwest St to D/S of I-405									
5. Replace Chestnut St. and RR Culverts with free span bridges									
6. Nee to improve Hoover crossing.									
Notes: Leveed conditions from STA 6+80 to STA 85+18 approximately and from STA 129+03 to STA 136+01 approximately									

C02_C04 Alternative 3 Plan: Alt3-100yr-SS_ALT 3B 5/15/2018



Appendix B – Civil Engineering

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APPENDIX B

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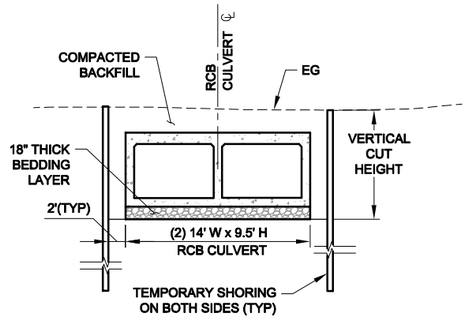
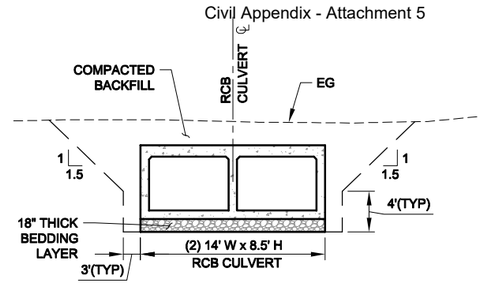


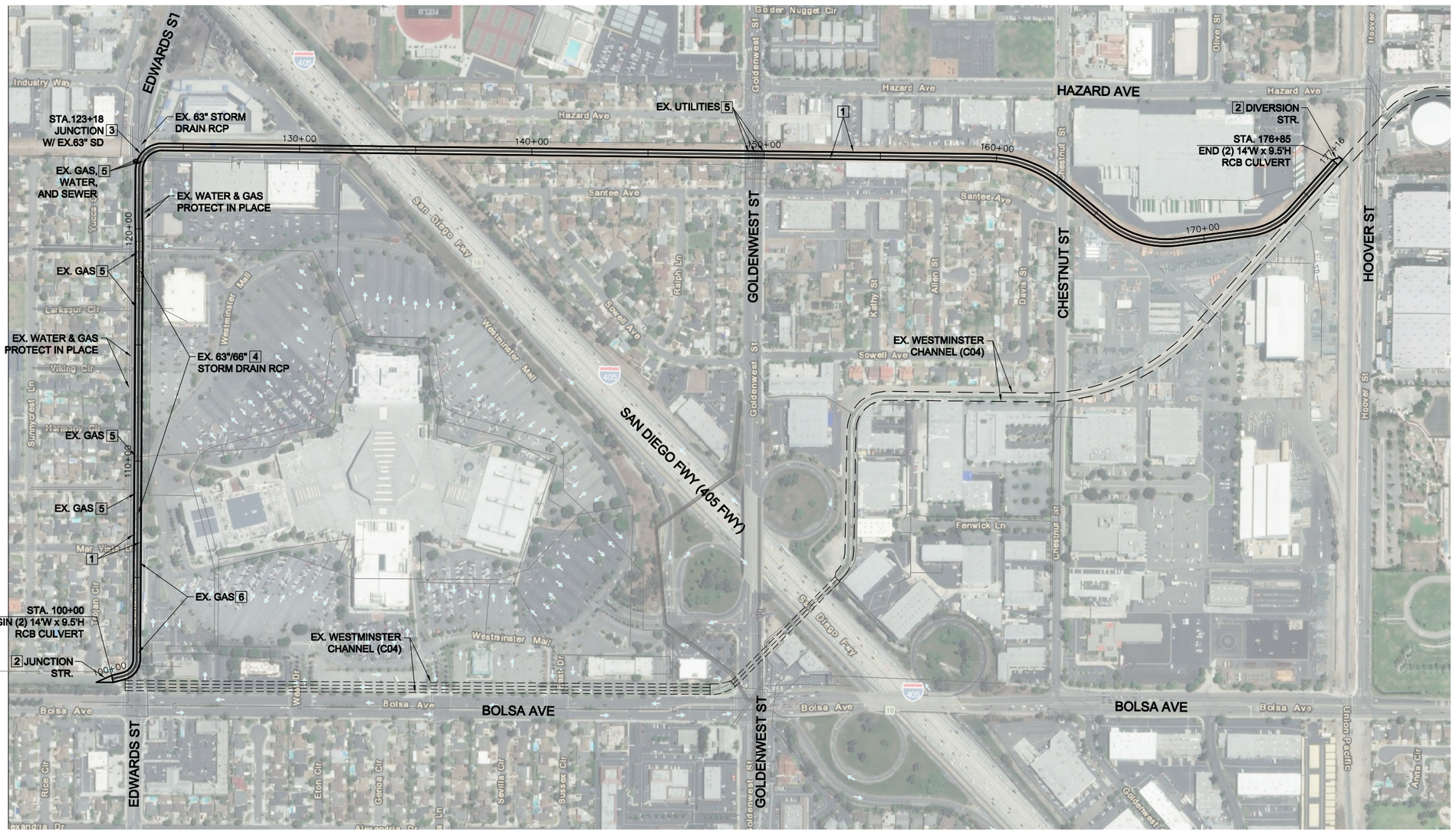
STA. 100+00 TO 123+20
TYPICAL RCB CULVERT SECTION
N.T.S.



STA. 123+20 TO 176+85
TYPICAL RCB CULVERT SECTION
N.T.S.

CONSTRUCTION NOTES

1. CONSTRUCT RCB CULVERT PER PLAN AND TYPICAL SECTION HEREON.
2. CONSTRUCT A DIVERSION OR JUNCTION STRUCTURE BETWEEN NEW RCB CULVERT AND EXISTING CHANNEL PER PLAN.
3. CONSTRUCT A JUNCTION STRUCTURE TO CONNECT WITH EXISTING EDWARDS STORM DRAIN PER PLAN.
4. DEMO AND REMOVE EXISTING 63"/66" DIAMETER STORM DRAIN RCP WITHIN FOOTPRINT OF NEW RCB CULVERT PER PLAN.
5. PROVIDE UTILITY CROSSING EXISTING UTILITY PER PLAN.
6. RELOCATE EXISTING UTILITY TO OUTSIDE OF NEW RCB CULVERT FOOTPRINT PER PLAN.



PLAN
1" = 250'

250' 125' 0 250' 500'

MARK	DESCRIPTION	DATE	APPR.

PREPARED UNDER THE RESPONSIBLE CHARGE OF: DATE

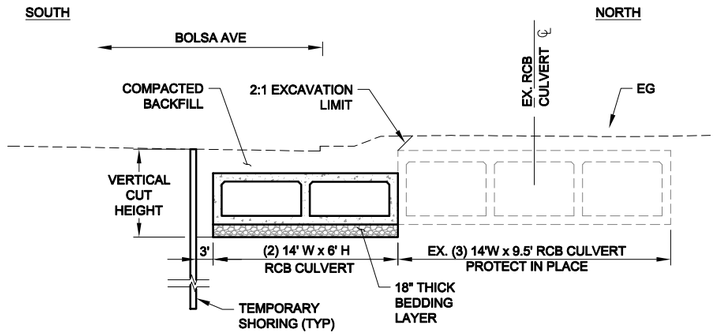
DESIGNED BY: J.S.
DRAWN BY: J.S.
CHECKED BY: Y.HC
DRAWING NO.: XX-XXX-X
FILE NAME: XXXXX
PLOT DATE: 2020/0X/XX
SCALE: AS SHOWN

County of Orange
PublicWorks
PREPARED BY: TETRA TECH

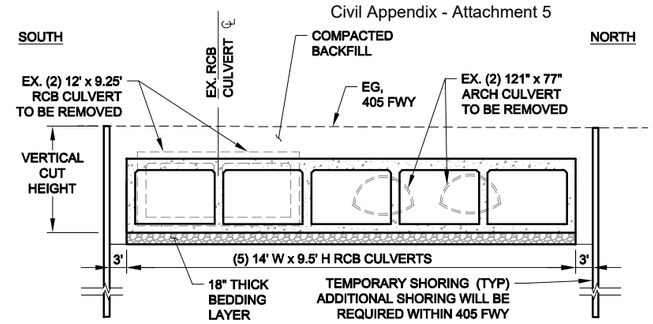
WESTMINSTER WATERSHED STUDY
OC FACILITY NO. C02 & C04

PLAN
ALTERNATIVE A

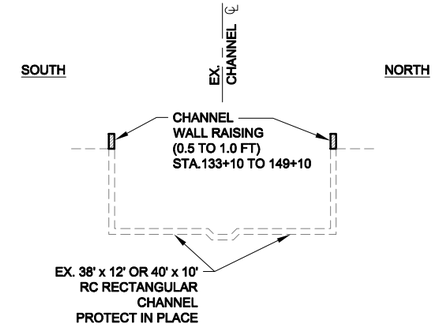
SHEET
1
OF 2



FROM STA. 100+00 TO 125+70



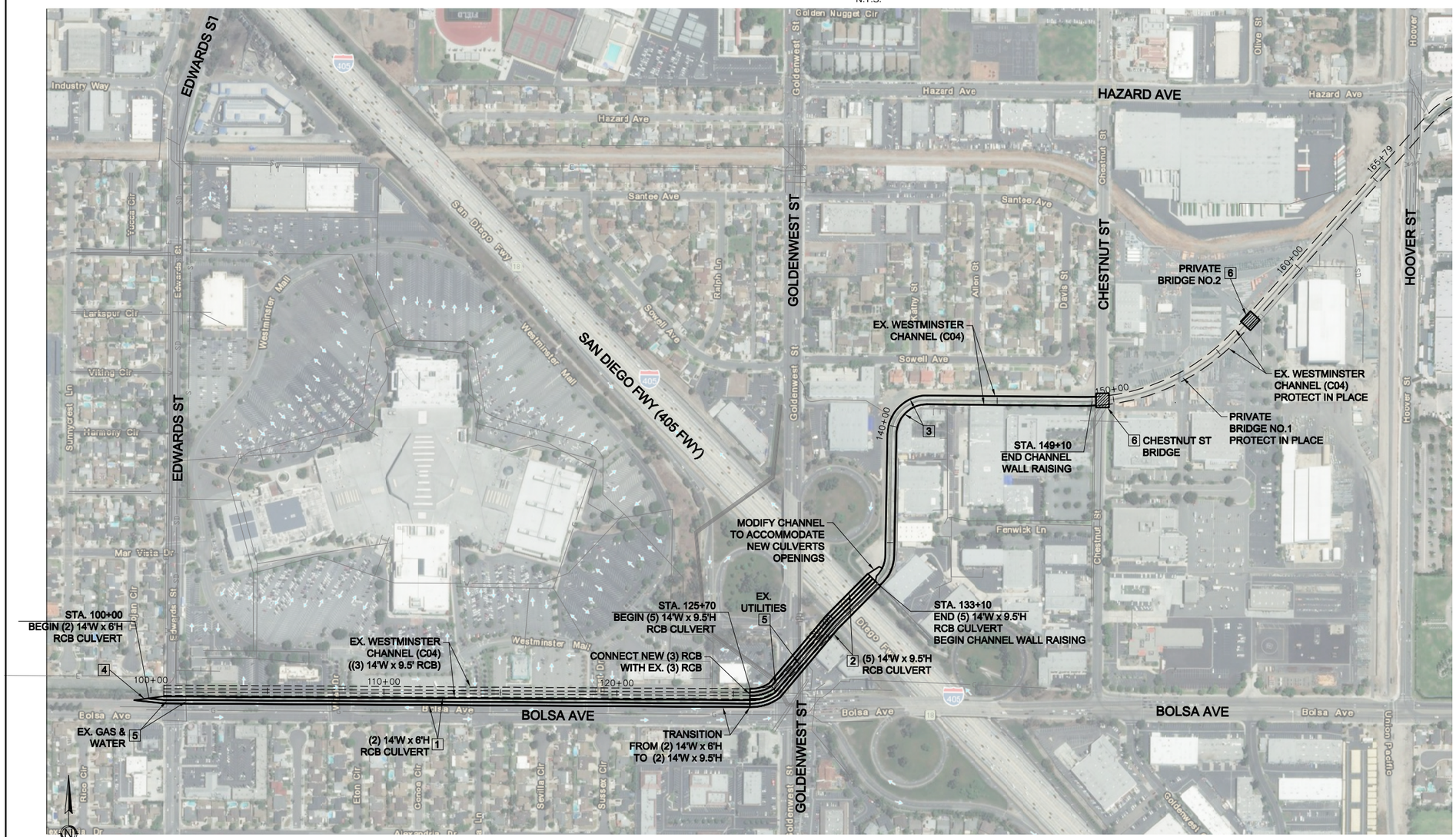
FROM STA. 125+70 TO 133+10



FROM STA. 133+10 TO 149+10

TYPICAL RCB CULVERT SECTION

N.T.S.



PLAN
1" = 250'

250' 125' 0 250' 500'

CONSTRUCTION NOTES

1. CONSTRUCT RCB CULVERT PER PLAN AND TYPICAL SECTION HEREON.
2. REPLACE EXISTING CULVERTS WITH (5) 14' W x 9.5' H RCB CULVERT UNDER FREEWAY PER PLAN AND TYPICAL SECTION HEREON.
3. CONSTRUCT RC CHANNEL WALL RAISING ON TOP OF EXISTING CHANNEL WALLS PER PLAN AND TYPICAL SECTION.
4. CONSTRUCT A DIVERSION OR JUNCTION STRUCTURE BETWEEN NEW RCB CULVERT AND EXISTING CHANNEL PER PLAN.
5. PROVIDE UTILITY CROSSING FOR EXISTING UTILITY PER PLAN.
6. REPLACE EXISTING BRIDGE CULVERT WITH A FREE-SPAN BRIDGE PER PLAN.

COUNTY OF ORANGE CALIFORNIA

MARK	DESCRIPTION	DATE	APPR.

PREPARED UNDER THE RESPONSIBLE CHARGE OF: DATE

DESIGNED BY: J.S.
DRAWN BY: J.S.
CHECKED BY: Y.HC
DRAWING NO.: XX-XXX-X
FILE NAME: XXXXX
PLOT DATE: 2020/04/XX
SCALE: AS SHOWN

County of Orange PublicWorks

PREPARED BY: TETRA TECH

WESTMINSTER WATERSHED STUDY
OC FACILITY NO. C02 & C04

PLAN
ALTERNATIVE B

SHEET 2 OF 2

APPENDIX C

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WESTMINSTER EAST GARDEN GROVE FLOOD RISK MANAGEMENT

ALTERNATIVE SUMMARY

Alternative	Quantity	UOM	First Cost	Contingency	Total Cost
Alternative 3A	1	LS	$ 45,307,000	$ 17,677,000	$ 62,984,000
Alternative 3B	1	LS	$ 41,330,000	$ 19,060,000	$ 60,390,000

Alternative 3A

Item Description	Quantity	UOM	First Cost	Contingency	Total Cost
Mob/Demob and Site Prep	1	LS	$ 3,060,000	32.9%	$ 4,066,000
Earthwork	1	LS	$ 5,582,000	40.4%	$ 7,838,000
Culverts and Channels	1	LS	$ 28,985,000	40.4%	$ 40,698,000
Demolition and Relocations	1	LS	$ 1,330,000	36.8%	$ 1,819,000
Traffic Control	1	LS	$ 100,000	38.7%	$ 139,000
Planning, Engineering and Design	1	LS	$ 3,906,000	34.8%	$ 5,265,000
Construction Management	1	LS	$ 2,344,000	34.8%	$ 3,159,000
Real Estate	1	LS	$ -	25.0%	$ -
Alternative 3A Total Cost:			**$ 45,307,000**	**39.0%**	**$ 62,984,000**

Alternative 3B

Item Description	Quantity	UOM	First Cost	Contingency	Total Cost
Mob/Demob and Site Prep	1	LS	$ 2,792,000	32.9%	$ 3,710,000
Earthwork	1	LS	$ 2,416,000	40.4%	$ 3,392,000
Culverts and Channels	1	LS	$ 16,458,000	40.4%	$ 23,109,000
Demolition and Relocations	1	LS	$ 4,363,000	36.8%	$ 5,967,000
Traffic Control	1	LS	$ 9,600,000	72.1%	$ 16,524,000
Planning, Engineering and Design	1	LS	$ 3,563,000	34.8%	$ 4,803,000
Construction Management	1	LS	$ 2,138,000	34.8%	$ 2,882,000
Real Estate	1	LS	$ -	25.0%	$ -
Alternative 3B Total Cost:			**$ 41,330,000**	**46.1%**	**$ 60,387,000**

WESTMINSTER EAST GARDEN GROVE FLOOD RISK MANAGEMENT

Alternative 3 Design (C02/04 Channel) - Alternative A

Date: 9-May-18

ITEM NO.	DESCRIPTION	UOM	QUANTITY	UNIT COST	TOTAL COST
	Alternative 3A				
	Mob, Demob. and Site Prepation				
1.	Mobilization / Demobilization	LS	1.0	$ 1,800,000	$ 1,800,000
2.	Site Preparation	LS	1.0	$ 720,000	$ 720,000
3.	Diversion and Control of Water	LS	1.0	$ 540,000	$ 540,000
	Earthwork				
4.	Clearing and Grubbing	ACR	8.5	$ 5,000.00	$ 43,000
5.	Excavation	CY	185,009	$ 7.50	$ 1,388,000
6.	Compacted Fill	CY	83,539	$ 6.25	$ 523,000
7.	Excess Material Disposal	CY	101,470	$ 35.75	$ 3,628,000
	Culverts				
8.	RCB Culvert ((2) 14'W x 9.5'H)	CY	25,165	$ 1,000.00	$ 25,166,000
9.	RCB Bedding	CY	13,261	$ 47.50	$ 630,000
10.	Temporary Shoring	LF	4,680	$ 675.00	$ 3,159,000
11.	Junction Structures (U/S and D/S Ends)	EA	2	$ 15,000.00	$ 30,000
	Demolition and Relocations				
12.	Remove and Replace Ex. Pavement	SY	10,200	$ 105.00	$ 1,071,000
13.	Relocate Ex. 15" Dia. Sewer Line	LF	2,250	$ 45.00	$ 102,000
14.	Demo and Remove Existing 63"/66" RCP	LF	1,000	$ 75.00	$ 75,000
15.	Utility Crossings	EA	17	$ 2,600.00	$ 45,000
16.	Relocate Existing Utility (Gas)	LF	400	$ 92.50	$ 37,000
	Traffic Control				
17.	Edwards St. Traffic Control	LS	1	$ 100,000.00	$ 100,000
				Sub-Total (1):	*$ 39,057,000*

18.	Planning, Engineering and Design - 10.0% of Sub-Total (2)	$ 3,906,000
19.	Construction Management - 6.0% of Sub-Total (2)	$ 2,344,000
	Sub-Total (3):	*$ 45,307,000*

20.	Estimating and Construction Contingency - 39.0% of Sub-Total (3)	$ 17,677,000
	Sub-Total (4):	*$ 62,984,000*

21.	Real Estate Costs	ACR	-	$ -	$ -
22.	Real Estate Contingency - 25.0% of Real Estate Costs				$ -
				Total Real Estate Costs:	*$ -*

Total Alternative Costs	**$ 62,984,000**

WESTMINSTER EAST GARDEN GROVE FLOOD RISK MANAGEMENT

Alternative 3 Design (C02/04 Channel) - Alternative B

Date: 9-May-18

ITEM NO.	DESCRIPTION	UOM	QUANTITY	UNIT COST	TOTAL COST
	Alternative 3B				
	Mob, Demob. and Site Prepation				
1.	Mobilization / Demobilization	LS	1.0	$ 1,642,000	$ 1,642,000
2.	Site Preparation	LS	1.0	$ 657,000	$ 657,000
3.	Diversion and Control of Water	LS	1.0	$ 493,000	$ 493,000
	Earthwork				
4.	Clearing and Grubbing	ACR	0.33	$ 5,000.00	$ 2,000
5.	Excavation	CY	73,447	$ 7.50	$ 551,000
6.	Compacted Fill	CY	25,887	$ 6.25	$ 162,000
7.	Excess Material Disposal	CY	47,560	$ 35.75	$ 1,701,000
	Culverts and Channels				
8.	RCB Culvert ((2) 14'W x 6'H)	CY	7,615	$ 1,000.00	$ 7,615,000
9.	RCB Culvert ((5) 14'W x 9.5'H)	CY	5,728	$ 1,000.00	$ 5,729,000
10.	RCB Bedding	CY	7,551	$ 47.50	$ 359,000
11.	Temporary Shoring	LF	4,050	$ 675.00	$ 2,734,000
12.	Channel Wall Raising	CY	119	$ 45.00	$ 6,000
13.	Junction Structures (U/S and D/S Ends)	LS	1	$ 15,000.00	$ 15,000
	Demolition and Relocations				
14.	Remove and Replace Ex. Pavement	SY	7,511	$ 105.00	$ 789,000
15.	Bridge Replacement (Chestnut St.)	SF	3,000	$ 350.00	$ 1,050,000
16.	Bridge Replacement (Private Bridge)	SF	3,000	$ 350.00	$ 1,050,000
17.	Utility Crossings	EA	17	$ 2,600.00	$ 45,000
18.	Demo RCB Culvert ((2) 12' x 9.25')	LF	740	$ 1,400.00	$ 1,036,000
19.	Demo RCP Culvert ((2) 121" x 77")	LF	740	$ 530.00	$ 393,000
	Traffic Control				
20.	405 Freeway Diversion, Demo and Reconstruction	LS	1	$ 9,500,000.00	$ 9,500,000
21.	Bolsa Ave. Traffic Control	LS	1	$ 100,000.00	$ 100,000
				Sub-Total (1):	*$ 35,629,000*

22.	Planning, Engineering and Design - 10.0% of Sub-Total (2)	$ 3,563,000
23.	Construction Management - 6.0% of Sub-Total (2)	$ 2,138,000
	Sub-Total (3):	*$ 41,330,000*

24.	Estimating and Construction Contingency - 46.1% of Sub-Total (3)	$ 19,060,000
	Sub-Total (4):	*$ 60,390,000*

25.	Real Estate Costs	ACR	-	$ -	$ -
26.	Real Estate Contingency - 25.0% of Real Estate Costs				$ -
				Total Real Estate Costs:	*$ -*

Total Alternative Costs	**$ 60,390,000**

WESTMINSTER EAST GARDEN GROVE FLOOD RISK MANAGEMENT

UNIT COST CALCULATIONS

Date: 9-May-18

ITEM NO.	DESCRIPTION	UOM	QUANTITY	UNIT COST	TOTAL COST
1	Clearing and Grubbing	ACR	10	$ 5,000.00	$ 50,000
a)	Clearing and Grubbing	ACR	10.0	$ 5,000	$ 50,000
					Unit Cost Used:
				Clearing and Grubbing	**$5,000.00/ACR**
2	Earthwork - Excavation	CY	1,000	$ 7.41	$ 7,410
a)	Hydraulic Excavation	CY	1,000	$ 4.65	$ 4,650
b)	Push to Stockpile	CY	1,150	$ 2.40	$ 2,760
					Unit Cost Used:
				Earthwork - Excavation	**$7.50/CY**
3	Earthwork - Compacted Fill	CY	1,000	$ 6.10	$ 6,095
a)	Push from Stockpile	CY	1,150	$ 2.40	$ 2,760
b)	Backfill	CY	1,150	$ 2.25	$ 2,588
c)	Compaction	CY	1,150	$ 0.65	$ 748
					Unit Cost Used:
				Earthwork - Compacted Fill	**$6.25/CY**
4	Earthwork - Disposal Offsite	CY	1,000	$ 35.65	$ 35,650
a)	Load Material Into Trucks	CY	1,150	$ 1.40	$ 1,610
b)	Truck Hauling	CY	1,150	$ 12.00	$ 13,800
c)	Tipping Fee	CY	1,150	$ 17.60	$ 20,240
					Unit Cost Used:
				Earthwork - Disposal Offsite	**$35.75/CY**
5	RCB Culvert ((2) 14'W x 9.5'H)	CY	1,000	$ 1,000.00	$ 1,000,000
a)	Reinforced Concrete (CIP)	CY	1,000	$ 1,000.00	$ 1,000,000
					Unit Cost Used:
				RCB Culvert ((2) 14'W x 9.5'H)	**$1,000.00/CY**
6	RCB Bedding	CY	1,000	$ 46.86	$ 46,863
a)	Reinforced Concrete (CIP)	CY	1,150	$ 40.75	$ 46,863
					Unit Cost Used:
				RCB Bedding	**$47.50/CY**
7	Temporary Shoring	LF	1,500	$ 676.00	$ 1,014,000
a)	Steel Piles	EA	300	$ 2,520.00	$ 756,000
b)	Wood Lagging	SF	21,000	$ 10.50	$ 220,500
c)	Demo Shoring	LF	1,500	$ 25.00	$ 37,500
					Unit Cost Used:
				Temporary Shoring	**$675.00/LF**

WESTMINSTER EAST GARDEN GROVE FLOOD RISK MANAGEMENT

UNIT COST CALCULATIONS

Date: 9-May-18

ITEM NO.	DESCRIPTION	UOM	QUANTITY	UNIT COST	TOTAL COST
8	Remove and Replace Ex. Pavement	SY	5,000	$ 104.15	$ 520,750
a)	Demo Existing Pavement	CY	1,667	$ 155.00	$ 258,333
b)	Load Material Into Trucks	CY	1,667	$ 1.40	$ 2,333
c)	Truck Hauling	CY	1,667	$ 12.00	$ 20,000
d)	Tipping Fee	CY	1,667	$ 17.60	$ 29,333
e)	8" Base Layer	SY	5,000	$ 11.40	$ 57,000
f)	Asphalt Binder Course	SY	5,000	$ 14.50	$ 72,500
g)	Asphalt Wear Course	SY	5,000	$ 16.25	$ 81,250
					Unit Cost Used:
		Remove and Replace Ex. Pavement			**$105.00/SY**
9	Relocate Ex. 15" Dia. Sewer Line	LF	1,000	$ 44.06	$ 44,063
a)	Cut Existing Pipe	EA	2	$ 390.00	$ 780
b)	Demo 15" Pipe	LF	1,000	$ 16.85	$ 16,850
c)	Aggregate Base	SY	222	$ 11.40	$ 2,533
d)	Replace 15" Pipe	LF	1,000	$ 23.90	$ 23,900
					Unit Cost Used:
		Relocate Ex. 15" Dia. Sewer Line			**$45.00/LF**
10	Junction Structures	EA	1	$ 22,500.00	$ 22,500
a)	CIP Concrete	CY	20	$ 1,000.00	$ 20,000
b)	Miscellaneous Metals	LS	1	$ 2,500.00	$ 2,500
					Unit Cost Used:
		Junction Structures			**$15,000.00/EA**
11	Bridge Replacement	SF	3,000	$ 323.00	$ 969,000
a)	Demo Existing Bridge	SF	3,000	$ 28.00	$ 84,000
b)	Install New Bridge	SF	3,000	$ 295.00	$ 885,000
					Unit Cost Used:
		Bridge Replacement			**$350.00/SF**
12	Demo and Remove Existing 63"/66" RCP	LF	1,000	$ 73.28	$ 73,280
a)	Cut Existing Pipe	EA	2	$ 390.00	$ 780
b)	Demo 66" RCP	LF	1,000	$ 66.75	$ 66,750
c)	Dispose of Pipe	LF	1,000	$ 5.75	$ 5,750
					Unit Cost Used:
		Demo and Remove Existing 63"/66" RCP			**$75.00/LF**
13	Utility Crossings	EA	1	$ 2,570.00	$ 2,570
a)	Cut Existing Pipe	EA	2	$ 390.00	$ 780
b)	Demo Pipe	LF	50	$ 12.00	$ 600
c)	Reinstall Pipe	LF	50	$ 23.80	$ 1,190
					Unit Cost Used:
		Utility Crossings			**$2,600.00/EA**
14	Relocate Existing Utility (Gas)	LF	400	$ 92.32	$ 36,928
a)	Cut Existing 8" Pipe	EA	2	$ 63.75	$ 128
b)	Demo 8" Pipe	LF	400	$ 7.00	$ 2,800
c)	Reinstall 8" Pipe	LF	400	$ 85.00	$ 34,000
					Unit Cost Used:

WESTMINSTER EAST GARDEN GROVE FLOOD RISK MANAGEMENT

UNIT COST CALCULATIONS

Date: 9-May-18

ITEM NO.	DESCRIPTION	UOM	QUANTITY	UNIT COST	TOTAL COST
				Relocate Existing Utility (Gas)	**$92.50/LF**
15	Demo RCB Culvert ((2) 12' x 9.25')	LF	740	$ 1,404.00	$ 1,038,960
a)	Demo RCB Culvert (x2)	CY	2,960	$ 320.00	$ 947,200
b)	Load Material Into Trucks	CY	2,960	$ 1.40	$ 4,144
c)	Truck Hauling	CY	2,960	$ 12.00	$ 35,520
d)	Tipping Fee	CY	2,960	$ 17.60	$ 52,096
					Unit Cost Used:
				Demo RCB Culvert ((2) 12' x 9.25')	**$1,400.00/LF**
16	Demo RCP Culvert ((2) 121" x 77")	LF	740	$ 526.50	$ 389,610
a)	Demo RCP Culvert (x2)	CY	1,110	$ 320.00	$ 355,200
b)	Load Material Into Trucks	CY	1,110	$ 1.40	$ 1,554
c)	Truck Hauling	CY	1,110	$ 12.00	$ 13,320
d)	Tipping Fee	CY	1,110	$ 17.60	$ 19,536
					Unit Cost Used:
				Demo RCP Culvert ((2) 121" x 77")	**$530.00/LF**
17	405 Freeway Diversion and Demo	LS	1	$ 9,430,416.67	$ 9,430,417
a)	Divert Traffic (Phase 1)	LS	1	$ 2,500,000	$ 2,500,000
b)	Demo Freeway Concrete (Phase 1)	CY	3,750	$ 155.00	$ 581,250
c)	Truck Loading (Phase 1)	CY	5,625	$ 1.40	$ 7,875
d)	Truck Hauling (Phase 1)	CY	5,625	$ 12.00	$ 67,500
e)	Tipping Fee (Phase 1)	CY	5,625	$ 17.60	$ 99,000
l)	Reconstruct Freeway - Agg. Base (Phase 1)	SY	7,500	$ 12.00	$ 90,000
f)	Reconstruct Freeway - Concrete (Phase 1)	CY	2,917	$ 365.00	$ 1,064,583
g)	Divert Traffic (Phase 2)	LS	1	$ 2,500,000	$ 2,500,000
h)	Demo Freeway Concrete (Phase 2)	CY	3,750	$ 155.00	$ 581,250
i)	Truck Loading (Phase 2)	CY	5,625	$ 1.40	$ 7,875
j)	Truck Hauling (Phase 2)	CY	5,625	$ 12.00	$ 67,500
k)	Tipping Fee (Phase 2)	CY	5,625	$ 17.60	$ 99,000
l)	Reconstruct Freeway - Agg. Base (Phase 2)	SY	7,500	$ 60.00	$ 450,000
l)	Reconstruct Freeway - Concrete (Phase 2)	CY	2,917	$ 365.00	$ 1,064,583
m)	Misc. Signage, Barriers, Cones, etc.	LS	1	$ 250,000.00	$ 250,000
					Unit Cost Used:
				405 Freeway Diversion and Demo	**$9,500,000.00/LS**
18	Edwards St. Traffic Control	LS	1	$ 80,000.00	$ 80,000
a)	Sings, Barricades, Cones, Etc.	LS	1	$ 20,000.00	$ 20,000
b)	Traffic Control Labor	DAY	150	$ 400.00	$ 60,000
					Unit Cost Used:
				Edwards St. Traffic Control	**$100,000.00/LS**
19	Bolsa Ave. Traffic Control	LS	1	$ 90,000.00	$ 90,000
a)	Sings, Barricades, Cones, Etc.	LS	1	$ 20,000.00	$ 20,000
b)	Traffic Control Labor	DAY	175	$ 400.00	$ 70,000
					Unit Cost Used:
				Bolsa Ave. Traffic Control	**$100,000.00/LS**

Civil Appendix - Attachment 5

* Note: All costs are from RS Means, and have been adjusted with local multipliers for labor, equipment and material, unless noted otherwise.

Item Description	RSM # / Source	UOM	Raw RS Means			Localized			Totals		
			Material	Labor	Equipment	Material	Labor	Equipment	Total	Toal O&P	Value in Estimate
Clearing and Grubbing	31 11 10 0160	ACRE	$ -	$ 1,950.00	$ 1,675.00	$ -	$ 2,242.50	$ 1,926.25	$ 4,168.75	**$ 5,002.50**	**$ 5,000.00**
Excavation - Hydraulic	31 23 16 1344	CY	$ -	$ 1.05	$ 2.31	$ -	$ 1.21	$ 2.66	$ 3.86	**$ 4.64**	**$ 4.65**
Excavation - Hydraulic	31 23 16.16 5000	CY	$ -	$ 0.93	$ 0.80	$ -	$ 1.07	$ 0.92	$ 1.99	**$ 2.39**	**$ 2.40**
Backfill	31 23 23.14 4400	LCY	$ -	$ 0.46	$ 1.14	$ -	$ 0.53	$ 1.31	$ 1.84	$ 2.21	**$ 2.25**
Compaction	31 23 23.23 5100	ECY	$ -	$ 0.22	$ 0.22	$ -	$ 0.25	$ 0.25	$ 0.51	$ 0.61	**$ 0.65**
Truck Loading, FE Loader	31 23 16.44 0245	CY	$ -	$ 0.55	$ 0.43	$ -	$ 0.63	$ 0.49	$ 1.13	$ 1.35	**$ 1.40**
12-cy Truck Hauling (20 miles)	31 23 23.20 1068	CY	$ -	$ 2.88	$ 5.75	$ -	$ 3.31	$ 6.61	$ 9.92	$ 11.91	**$ 12.00**
Tipping Fee	Estimate	CY	$ 15.00	$ -	$ -	$ 14.63	$ -	$ -	$ 14.63	$ 17.55	**$ 17.60**
CIP Concrete	03 30 53.40 2500	CY	$ 330.00	$ 418.38	$ 33.99	$ 321.75	$ 481.14	$ 39.09	$ 841.98	$ 1,010.37	**$ 1,000.00**
8" Base Course	32 11 23.23 0303	SY	$ 8.10	$ 0.71	$ 0.65	$ 7.90	$ 0.82	$ 0.75	$ 9.46	$ 11.35	**$ 11.40**
Asphalt, 3" Binder Course	32 12 16.13 0160	SY	$ 11.15	$ 0.83	$ 0.33	$ 10.87	$ 0.95	$ 0.38	$ 12.21	$ 14.65	**$ 14.50**
Asphalt, 3" Wear Course	32 12 16.13 0460	SY	$ 12.25	$ 0.92	$ 0.42	$ 11.94	$ 1.06	$ 0.48	$ 13.48	$ 16.18	**$ 16.25**
Bedding Stone	31 23 23.16 0100	CY	$ 24.00	$ 6.650	$ 2.440	$ 23.40	$ 7.648	$ 2.806	$ 33.85	$ 40.62	**$ 40.75**
Steel H Pile	31 62 16.13 1100 (material -50% salv.)	VLF	$ 41.00	$ 6.42	$ 1.88	$ 39.98	$ 7.38	$ 2.16	$ 49.52	$ 59.42	**$ 60.00**
24" Drilling	33 21 13.10 0230	VLF	$ -	$ 41.450	$ 48.520	$ -	$ 47.668	$ 55.798	$ 103.47	$ 124.16	**$ 125.00**
Concrete Fill	03 31 13.70 0800	CY	$ 120.00	$ 31.90	$ 10.50	$ 117.00	$ 36.69	$ 12.08	$ 165.76	$ 198.91	**$ 200.00**
Wood Lagging	31 52 16.10 2350 (material -25% salv.)	SF	$ 1.94	$ 5.840	$ 0.110	$ 1.89	$ 6.716	$ 0.127	$ 8.73	$ 10.48	**$ 10.50**
Demo Temporary Piles and Lagging	Estimate	LF	$ -	$ 12.50	$ 5.00	$ -	$ 14.38	$ 5.75	$ 20.13	$ 24.15	**$ 25.00**
Freeway Concrete Paving	03 30 53.40 4050	CY	$ 184.00	$ 104.41	$ 0.62	$ 179.40	$ 120.07	$ 0.71	$ 300.18	$ 360.22	**$ 365.00**
Demo Pavement	02 41 13.17 5500	CY	$ -	$ 78.70	$ 32.11	$ -	$ 90.51	$ 36.93	$ 127.43	$ 152.92	**$ 155.00**
Concrete Paving w/ Base	32 12 16.14 0045	SF	$ 3.15	$ 0.23	$ 0.27	$ 3.07	$ 0.26	$ 0.31	$ 3.65	$ 4.38	**$ 4.40**
Demo 15" Sewer	02 41 13.38 3400	LF	$ -	$ 12.20	$ -	$ -	$ 14.03	$ -	$ 14.03	$ 16.84	**$ 16.85**
Place 15" Sewer	33 31 13.25 2200	LF	$ 13.00	$ 5.57	$ 0.66	$ 12.68	$ 6.41	$ 0.76	$ 19.84	$ 23.81	**$ 23.90**
Bridge Demolition	RS Means + 50% for haul and disposal	SF	$ -	$ 15.75	$ 4.50	$ -	$ 18.11	$ 5.18	$ 23.29	$ 27.95	**$ 28.00**
New Bridge	RS Means + 40% for heavy vehicle rated	SF	$ 203.00	$ 33.50	$ 6.90	$ 197.93	$ 38.53	$ 7.94	$ 244.39	$ 293.26	**$ 295.00**
Demo 66" RCP	02 41 13.38 0200	LF	$ -	$ 32.06	$ 16.20	$ -	$ 36.87	$ 18.63	$ 55.50	$ 66.60	**$ 66.75**
Dispose of Pipe	Estimate	LF	$ 2.50	$ 1.50	$ 0.50	$ 2.44	$ 1.73	$ 0.58	$ 4.74	$ 5.69	**$ 5.75**
Pipe Cut	22 11 13.44 9154	EA	$ -	$ 281.17	$ -	$ -	$ 323.35	$ -	$ 323.35	$ 388.01	**$ 390.00**
Demo 18" Pipe	02 41 13.38 0490	LF	$ -	$ 7.35	$ 1.20	$ -	$ 8.45	$ 1.38	$ 9.83	$ 11.80	**$ 12.00**
Place 18" Pipe	33 31 13.20 3120	LF	$ 13.90	$ 4.86	$ 0.57	$ 13.55	$ 5.59	$ 0.66	$ 19.80	$ 23.76	**$ 23.80**
Pipe Cut 8"	22 11 13.44 9140	EA	$ -	$ 46.05	$ -	$ -	$ 52.96	$ -	$ 52.96	$ 63.55	**$ 63.75**
Demo 8" Pipe	02 41 13.51 0200	LF	$ -	$ 4.06	$ 0.99	$ -	$ 4.67	$ 1.14	$ 5.81	$ 6.97	**$ 7.00**
Place 8" Pipe	33 51 13.20 4280	LF	$ 47.50	$ 18.71	$ 2.38	$ 46.31	$ 21.52	$ 2.74	$ 70.57	$ 84.68	**$ 85.00**
Demo Concrete Culvert	03 05 05.10 0070	CY	$ -	$ 213.95	$ 16.77	$ -	$ 246.04	$ 19.29	$ 265.33	$ 318.39	**$ 320.00**
Dispose of Culvert	Estimate	LF	$ 25.00	$ 2.50	$ 4.00	$ 24.38	$ 2.88	$ 4.60	$ 31.85	$ 38.22	**$ 38.25**
Demo Concrete Pipe Culvert	02 41 13.38 0300	LF	$ -	$ 32.06	$ 16.20	$ -	$ 36.87	$ 18.63	$ 55.50	$ 66.60	**$ 66.75**
Dispose of Culvert	Estimate	LF	$ 25.00	$ 2.50	$ 4.00	$ 24.38	$ 2.88	$ 4.60	$ 31.85	$ 38.22	**$ 38.50**
Freeway Demolition	02 41 13.17 5500	CY	$ -	$ 78.70	$ 32.11	$ -	$ 90.51	$ 36.93	$ 127.43	$ 152.92	**$ 155.00**

Long Beach Multipliers	
105.2%	Total
97.5%	Materials
115.0%	Installation
20.0%	OH and Profit

Civil Appendix - Attachment 5

Note:
1. Representative cross sections were prepared using the AutoCAD Civil 3D.
2. Because the design is only conceptual level, the values from the representative sections were applied over a long distances.
3. The average end area method was not used to calculate volume because there is a significant descrepancy in cut/fill surface areas between the section. Being the conceptual leve study, a limited number of sections were prepared to represent the similar cut/fill condition.

Cost Estimates - Alternative 3 Option A

		Representative Xsection		Surface Area (SF)				C&G	Temp Shoring (Beam & Lagging)		Volume (CY)				C&G	Shoring	
Station	Distance	Station	Improvement	Excavation	Backfill	Fill	Conc	Top width	Beam Ht (ft)	Lagging Ht (ft)	Excavation	Backfill	Fill	Conc	Top width (SF)	Lagging Face x 2 (SF)	# of Beams
10000																	
11500	1500	11000	(2) 14'x 9.5'RCB	530	173.5		90.5		42	14	29444	9639	0	5028	0	42000	600
12340	840	12000	(2) 14'x 9.5'RCB	541	184.5		90.5		42	14	16831	5740	0	2816	0	23520	336
13250	910	12500	(2) 14'x 9.5'RCB	703	346.5	35	87.5	60		0	23694	11678	1180	2949	54600	0	
14910	1660	14500	(2) 14'x 9.5'RCB	730	373.5	38	87.5	74		0	44881	22963	2336	5380	122840	0	
16300	1390	15500	(2) 14'x 9.5'RCB	750	393.5	38	87.5	74		0	38611	20258	1956	4505	102860	0	
17685	1385	17000	(2) 14'x 9.5'RCB	615	258.5	38	87.5	65		0	31547	13260	1949	4488	90025	0	

Total: **185,009** **83,539** **7,421**

370325 (SF)

Compacted Fill: **90,960** (CY) **8.50** (Acre)
(=Backfill + Fill) **65,520** (SF)

RCB: **25,165** (CY)
RC Channel: (CY)

Cost Estimates - Alternative 3 Option B1

		Representative Xsection		Surface Area (SF)				C&G	Temp Shoring (Beam & Lagging)		Volume (CY)				C&G	Shoring	
Station	Distance	Station	Improvement	Excavation	Backfill	Fill	Conc	Top width	Beam Ht (ft)	Lagging Ht (ft)	Excavation	Backfill	Fill	Conc	Top width (SF)	Lagging Face x 2 (SF)	# of Beams
10000																	
11500	1500	11000	(2) 14'x 6'RCB	450	202		80		42	14	25000	11222	0	4444	0	21000	300
12570	1070	12000	(2) 14'x 6'RCB	450	202		80		42	14	17833	8005	0	3170	0	14980	214
13310	740	13000	(5) 14'x 9.5'RCB	1117	243		209		42	14	30614	6660	0	5728	0	20720	296
14910	1600		Wall Raising				2				0	0	0	119	0	0	
15750	840										0	0	0	0	0	0	
17986.5	2236.5										0	0	0	0	0	0	

Total: **73,447** **25,887** **-**

0 (SF)

Compacted Fill: **25,887** (CY) **0.00** (Acre)
(=Backfill + Fill) **56,700** (SF)

(2) 14'x 6'RCB **7,615** (CY)
(5) 14'x 9.5'RCB **5,728** (CY)
Wall Raising **119** (CY)

WESTMINSTER EAST GARDEN GROVE FLOOD RISK MANAGEMENT

Alternative 3 Design Options Contingency Calculations

Item Description	Contingency		Alternative 3A			Alternative 3B	
			Costs	Contingency		Costs	Contingency
Mob, Demob and Site Prep.	32.89%		$ 3,060,000	$ 1,007,000		$ 2,792,000	$ 919,000
Traffic Control (Option A)	38.69%		$ 100,000	$ 39,000		$ -	$ -
Traffic Control (Option B)	72.12%		$ -	$ -		$ 9,600,000	$ 6,924,000
Earthwork (Option A)	40.41%		$ 5,582,000	$ 2,256,000		$ -	$ -
Earthwork (Option B)	40.41%		$ -	$ -		$ 2,416,000	$ 977,000
Demolition and Relocations (Option A)	36.77%		$ 1,330,000	$ 490,000		$ -	$ -
Demolition and Relocations (Option B)	36.77%		$ -	$ -		$ 4,363,000	$ 1,605,000
Culverts and Channels (Option A)	40.41%		$ 28,985,000	$ 11,713,000		$ -	$ -
Culverts and Channels (Option B)	40.41%		$ -	$ -		$ 16,458,000	$ 6,651,000
Planning, Engineering, & Design	34.79%		$ 3,906,000	$ 1,359,000		$ 3,563,000	$ 1,240,000
Construction Management	34.79%		$ 2,344,000	$ 816,000		$ 2,138,000	$ 744,000
		Totals:	$ 45,307,000	$ 17,680,000		$ 41,330,000	$ 19,060,000
		Total Project Contingency:		39.0%			46.1%

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Abbreviated Risk Analysis

Project (less than $40M): **Westminster East Garden Grove - Alternative 3** **Alternative: N/A**

Project Development Stage/Alternative: **Feasibility (Alternatives)**

Risk Category: **Moderate Risk: Typical Project Construction Type** **Meeting Date: 5/9/2018**

Total Estimated Construction Contract Cost = $ 9,000,000

	CWWBS	Feature of Work	Estimated Cost		% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate	$ -		0.0%	$ -	$ -
1	09 01 CHANNELS	**Mob, Demob and Site Prep.**	$ 1,000,000		32.9%	$ 328,902	$ 1,328,902
2	09 01 CHANNELS	**Traffic Control (Alt A)**	$ 1,000,000		38.7%	$ 386,919	$ 1,386,919
3	09 01 CHANNELS	**Traffic Control (Alt B)**	$ 1,000,000		72.1%	$ 721,223	$ 1,721,223
4	09 01 CHANNELS	**Earthwork (Alt A)**	$ 1,000,000		40.4%	$ 404,121	$ 1,404,121
5	09 01 CHANNELS	**Earthwork (Alt B)**	$ 1,000,000		40.4%	$ 404,121	$ 1,404,121
6	09 01 CHANNELS	**Demolition and Relocations (Alt A)**	$ 1,000,000		36.8%	$ 367,682	$ 1,367,682
7	09 01 CHANNELS	**Demolition and Relocations (Alt B)**	$ 1,000,000		36.8%	$ 367,682	$ 1,367,681.67
8	09 01 CHANNELS	**Culverts and Channels (Alt A)**	$ 1,000,000		40.4%	$ 404,121	$ 1,404,121.20
9	09 01 CHANNELS	**Culverts and Channels (Alt B)**	$ 1,000,000		40.4%	$ 404,121	$ 1,404,121.20
10			$ -		0.0%	$ -	$ -
11			$ -		0.0%	$ -	$ -
12	All Other	**Remaining Construction Items**	$ -	*0.0%*	0.0%	$ -	$ -
13	30 PLANNING, ENGINEERING, AND DESIGN	**Planning, Engineering, & Design**	$ 1,000,000		34.8%	$ 347,938	$ 1,347,938
14	31 CONSTRUCTION MANAGEMENT	**Construction Management**	$ 1,000,000		34.8%	$ 347,938	$ 1,347,938
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)					$ -	

Totals					
Real Estate	$ -	0.0%	$ -	$ -	
Total Construction Estimate	$ 9,000,000	42.1%	$ 3,788,892	$ 12,788,892	
Total Planning, Engineering & Design	$ 1,000,000	34.8%	$ 347,938	$ 1,347,938	
Total Construction Management	$ 1,000,000	34.8%	$ 347,938	$ 1,347,938	
Total Excluding Real Estate	**$ 11,000,000**	**40.8%**	**$ 4,484,768**	**$ 15,484,768**	
		Base	**50%**	**80%**	
Confidence Level Range Estimate ($000's)		$11,000k	$13,691k	$15,485k	

* 50% based on base is at 5% CL.

Fixed Dollar Risk Add: (Allows for additional risk to be added to the risk analsyis. Must include justification. Does not allocate to Real Estate.	

Westminster East Garden Grove - Alternative 3 N/A

Feasibility (Alternatives)
Abbreviated Risk Analysis
Meeting Date: 9-May-18

Risk Level

	Negligible	Marginal	Moderate	Significant	Critical
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3

Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Project Management & Scope Growth				**Maximum Project Growth**		**75%**
PS-1	Mob, Demob and Site Prep.	Scope growth; funding difficulties	There is some risk of further scope growth, as project progresses. Also, due to size of project there could be funding concerns that delay and push back schedule, which also could result in cost increases.	Moderate	Possible	2
PS-2	Traffic Control (Alt A)	See concern above.	See discussion above.	Moderate	Possible	2
PS-3	Traffic Control (Alt B)	See concern above.	See discussion above.	Moderate	Possible	2
PS-4	Earthwork (Alt A)	See concern above.	See discussion above.	Moderate	Possible	2
PS-5	Earthwork (Alt B)	See concern above.	See discussion above.	Moderate	Possible	2
PS-6	Demolition and Relocations (Alt A)	See concern above.	See discussion above.	Moderate	Possible	2
PS-7	Demolition and Relocations (Alt B)	See concern above.	See discussion above.	Moderate	Possible	2
PS-8	Culverts and Channels (Alt A)	See concern above.	See discussion above.	Moderate	Possible	2
PS-9	Culverts and Channels (Alt B)	See concern above.	See discussion above.	Moderate	Possible	2
PS-10	0			Negligible	Unlikely	0
PS-11	0			Negligible	Unlikely	0
PS-12	Remaining Construction Items			Negligible	Unlikely	0
PS-13	Planning, Engineering, & Design	See concern above.	See discussion above.	Moderate	Possible	2
PS-14	Construction Management	See concern above.	See discussion above.	Moderate	Possible	2
Acquisition Strategy				**Maximum Project Growth**		**30%**

AS-1	Mob, Demob and Site Prep.	Typical contracting plan	Estimates assume typical contracting plan with one prime contractor being awarded, and using subs as necessary. Concern could be due to the 405 work on option B, and therefore higher contingencies should be expected for that work.	Marginal	Possible	1
AS-2	Traffic Control (Alt A)	See concern above.	See discussion above.	Marginal	Possible	1
AS-3	Traffic Control (Alt B)	See concern above.	See discussion above.	Significant	Possible	3
AS-4	Earthwork (Alt A)	See concern above.	See discussion above.	Marginal	Possible	1
AS-5	Earthwork (Alt B)	See concern above.	See discussion above.	Marginal	Possible	1
AS-6	Demolition and Relocations (Alt A)	See concern above.	See discussion above.	Marginal	Possible	1
AS-7	Demolition and Relocations (Alt B)	See concern above.	See discussion above.	Marginal	Possible	1
AS-8	Culverts and Channels (Alt A)	See concern above.	See discussion above.	Marginal	Possible	1
AS-9	Culverts and Channels (Alt B)	See concern above.	See discussion above.	Marginal	Possible	1
AS-10	0			Negligible	Unlikely	0
AS-11	0			Negligible	Unlikely	0
AS-12	Remaining Construction Items			Negligible	Unlikely	0
AS-13	Planning, Engineering, & Design	See concern above.	See discussion above.	Marginal	Possible	1
AS-14	Construction Management	See concern above.	See discussion above.	Marginal	Possible	1
Construction Elements				**Maximum Project Growth**		**25%**
CE-1	Mob, Demob and Site Prep.	None	No significant risks or concerns anticipated for this item.	Negligible	Unlikely	0
CE-2	Traffic Control (Alt A)	None	No significant risks or concerns anticipated for this item.	Marginal	Possible	1
CE-3	Traffic Control (Alt B)	405 freeway work	Diverting traffic to build the culverts under the 405 freeway are a high risk element. There would need to be significant diversion lanes constructed, and the construction would be phased. Freeway would require demo and rebuilding.	Significant	Possible	3
CE-4	Earthwork (Alt A)	No detailed water control plan; shoring methods	Costs for water control have been included, but no significant details have been developed. But this is a low risk given construction would likely occur mostly outside of wet seasons. Sheetpile shoring could require additional costs if further analysis shows sheetpiles need to be larger, or require other shoring techniques.	Moderate	Possible	2

CE-5	Earthwork (Alt B)	No detailed water control plan; shoring methods	Costs for water control have been included, but no significant details have been developed. But this is a low risk given construction would likely occur mostly outside of wet seasons. Sheetpile shoring could require additional costs if further analysis shows sheetpiles need to be larger, or require other shoring techniques.	Moderate	Possible	2
CE-6	Demolition and Relocations (Alt A)	Utility demo and relocations	Small risk of cost increases due to unexpected conditions of existing utilities that may cause delays and or more difficult replacement.	Marginal	Possible	1
CE-7	Demolition and Relocations (Alt B)	Utility demo and relocations	Small risk of cost increases due to unexpected conditions of existing utilities that may cause delays and or more difficult replacement.	Marginal	Possible	1
CE-8	Culverts and Channels (Alt A)	No detailed water control plan; shoring methods	Costs for water control have been included, but no significant details have been developed. But this is a low risk given construction would likely occur mostly outside of wet seasons. Sheetpile shoring could require additional costs if further analysis shows sheetpiles need to be larger, or require other shoring techniques.	Moderate	Possible	2
CE-9	Culverts and Channels (Alt B)	No detailed water control plan; shoring methods	Costs for water control have been included, but no significant details have been developed. But this is a low risk given construction would likely occur mostly outside of wet seasons. Sheetpile shoring could require additional costs if further analysis shows sheetpiles need to be larger, or require other shoring techniques.	Moderate	Possible	2
CE-10	0			Negligible	Unlikely	0
CE-11	0			Negligible	Unlikely	0
CE-12	Remaining Construction Items			Negligible	Unlikely	0
CE-13	Planning, Engineering, & Design	None	No significant risks or concerns anticipated for this item.	Marginal	Possible	1
CE-14	Construction Management	None	No significant risks or concerns anticipated for this item.	Marginal	Possible	1
Specialty Construction or Fabrication				**Maximum Project Growth**		**65%**
SC-1	Mob, Demob and Site Prep.	None	No specialty construction techniques or specialty fabrications are required on this project.	Negligible	Unlikely	0
SC-2	Traffic Control (Alt A)	See concern above.	See discussion above.	Negligible	Unlikely	0
SC-3	Traffic Control (Alt B)	See concern above.	See discussion above.	Negligible	Unlikely	0
SC-4	Earthwork (Alt A)	See concern above.	See discussion above.	Negligible	Unlikely	0
SC-5	Earthwork (Alt B)	See concern above.	See discussion above.	Negligible	Unlikely	0
SC-6	Demolition and Relocations (Alt A)	See concern above.	See discussion above.	Negligible	Unlikely	0
SC-7	Demolition and Relocations (Alt B)	See concern above.	See discussion above.	Negligible	Unlikely	0

SC-8	Culverts and Channels (Alt A)	See concern above.	See discussion above.	Negligible	Unlikely	0
SC-9	Culverts and Channels (Alt B)	See concern above.	See discussion above.	Negligible	Unlikely	0
SC-10	0			Negligible	Unlikely	0
SC-11	0			Negligible	Unlikely	0
SC-12	Remaining Construction Items			Negligible	Unlikely	0
SC-13	Planning, Engineering, & Design	See concern above.	See discussion above.	Negligible	Unlikely	0
SC-14	Construction Management	See concern above.	See discussion above.	Negligible	Unlikely	0
Technical Design & Quantities				**Maximum Project Growth**		**30%**
T-1	Mob, Demob and Site Prep.	None	No significant quantities in this item, therefore no added risk to project.	Negligible	Unlikely	0
T-2	Traffic Control (Alt A)	Quantity assumptions	General assumptions were maded on traffic control needs for surface street work. There is a likelihood that these vary from what contractor requires.	Moderate	Possible	2
T-3	Traffic Control (Alt B)	405 Freeway Quantity Assumptions		Significant	Possible	3
T-4	Earthwork (Alt A)	Low design level	Quantities are calculated based on limited design levels. Earthwork quantities have been calculated based on all current information, but there is a chance that these will change with further design.	Moderate	Possible	2
T-5	Earthwork (Alt B)	Low design level	Quantities are calculated based on limited design levels. Earthwork quantities have been calculated based on all current information, but there is a chance that these will change with further design.	Moderate	Possible	2
T-6	Demolition and Relocations (Alt A)	Utility demo and relocation quantities	A detailed review of utility locations was completed, but no field survey work has been completed. Therefore there is some chance that more utilities are encountered during construction, but not anticipated to be significant cost risk	Marginal	Possible	1
T-7	Demolition and Relocations (Alt B)	Utility demo and relocation quantities	A detailed review of utility locations was completed, but no field survey work has been completed. Therefore there is some chance that more utilities are encountered during construction, but not anticipated to be significant cost risk	Marginal	Possible	1
T-8	Culverts and Channels (Alt A)			Moderate	Possible	2
T-9	Culverts and Channels (Alt B)			Moderate	Possible	2
T-10	0			Negligible	Unlikely	0
T-11	0			Negligible	Unlikely	0

T-12	Remaining Construction Items			Negligible	Unlikely	0
T-13	Planning, Engineering, & Design	None	No significant quantities in this item, therefore no added risk to project.	Negligible	Unlikely	0
T-14	Construction Management	None	No significant quantities in this item, therefore no added risk to project.	Negligible	Unlikely	0
Cost Estimate Assumptions				**Maximum Project Growth**		**35%**
EST-1	Mob, Demob and Site Prep.	Assumed percentages	Estimate is based on assumed percentages for mob/demob, site prep, and diversion and control of water. These percentages are based on previous projects of similar cost and scope. But there is still a risk of these being different than contractors assumptions and bid price.	Moderate	Possible	2
EST-2	Traffic Control (Alt A)	Traffic control assumptions	Rough order of magnitude assumptions were made on traffic control along surface roads. Risk of there needing to be more is possible, but likely road will simply be fully shut down during construction.	Moderate	Possible	2
EST-3	Traffic Control (Alt B)	405 Freeway assumptions	Work required for 405 freeway detour and reconstruction is a significant effort. There is no details on what would be required to complete. General assumptions regarding quantities and cost items were developed, but high risk of more costs being required to complete 405 efforts.	Significant	Likely	4
EST-4	Earthwork (Alt A)	Productivity assumptions	Earthwork cost is going to be heavily reliant on productivity assumptions, which could vary from actual contractor production rates.	Moderate	Possible	2
EST-5	Earthwork (Alt B)	Productivity assumptions	Earthwork cost is going to be heavily reliant on productivity assumptions, which could vary from actual contractor production rates.	Moderate	Possible	2
EST-6	Demolition and Relocations (Alt A)	Utility unknowns	General unknowns regarding utility information. Estimate has general locations and lengths, but actual depths and verification of utilities is needed through surveying. Therefore some risk of cost increases compared to assumptions currently used in estimate.	Moderate	Possible	2
EST-7	Demolition and Relocations (Alt B)	Utility unknowns	General unknowns regarding utility information. Estimate has general locations and lengths, but actual depths and verification of utilities is needed through surveying. Therefore some risk of cost increases compared to assumptions currently used in estimate.	Moderate	Possible	2
EST-8	Culverts and Channels (Alt A)	Material cost assumptions; productivity assumptions	Culvert and channel work is driven by cost of concrete as well as productivity of placement. These items could be different at time of construction, which could lead to increased costs.	Moderate	Possible	2
EST-9	Culverts and Channels (Alt B)	Material cost assumptions; productivity assumptions	Culvert and channel work is driven by cost of concrete as well as productivity of placement. These items could be different at time of construction, which could lead to increased costs.	Moderate	Possible	2
EST-10	0			Negligible	Unlikely	0
EST-11	0			Negligible	Unlikely	0
EST-12	Remaining Construction Items			Negligible	Unlikely	0

EST-13	Planning, Engineering, & Design	Assumed percentages	PED cost is based on standard percent for PED in this region. Actual cost could vary.	Moderate	Possible	2
EST-14	Construction Management	Assumed percentages	CM cost is based on standard percent fo CM in this region. Actual cost to complete could vary.	Moderate	Possible	2
External Project Risks				**Maximum Project Growth**		**40%**
EX-1	Mob, Demob and Site Prep.	Funding constraints; polititcal lack of support; unanticipated inflations in key materials;	There are many external risks that could arise between now, and a reasonable estimated construction start date. Funding will be a huge risk, as this project is relatively large and obtaining all requisite funding could be difficult. Convincing all necessary stakeholders involved could also cause delays. Lastly, significant material items (concrete, steel) are required, and potential increases to these material costs would greatly impact the bottom line.	Significant	Possible	3
EX-2	Traffic Control (Alt A)	See concern above.	See discussion above.	Significant	Possible	3
EX-3	Traffic Control (Alt B)	See concern above.	See discussion above.	Significant	Possible	3
EX-4	Earthwork (Alt A)	See concern above.	See discussion above.	Significant	Possible	3
EX-5	Earthwork (Alt B)	See concern above.	See discussion above.	Significant	Possible	3
EX-6	Demolition and Relocations (Alt A)	See concern above.	See discussion above.	Significant	Possible	3
EX-7	Demolition and Relocations (Alt B)	See concern above.	See discussion above.	Significant	Possible	3
EX-8	Culverts and Channels (Alt A)	See concern above.	See discussion above.	Significant	Possible	3
EX-9	Culverts and Channels (Alt B)	See concern above.	See discussion above.	Significant	Possible	3
EX-10	0			Negligible	Unlikely	0
EX-11	0			Negligible	Unlikely	0
EX-12	Remaining Construction Items			Negligible	Unlikely	0
EX-13	Planning, Engineering, & Design	See concern above.	See discussion above.	Significant	Possible	3
EX-14	Construction Management	See concern above.	See discussion above.	Significant	Possible	3

Westminster East Garden Grove - Alternative 3 N/A
Feasibility (Alternatives)
Abbreviated Risk Analysis

Risk Evaluation

WBS	Potential Risk Areas	Project Management & Scope Growth	Acquisition Strategy	Construction Elements	Specialty Construction or Fabrication	Technical Design & Quantities	Cost Estimate Assumptions	External Project Risks	Cost in Thousands
01 LANDS AND DAMAGES	**Real Estate**								$0
09 01 CHANNELS	**Mob, Demob and Site Prep.**	2	1	0	0	0	2	3	$1,000
09 01 CHANNELS	Traffic Control (Alt A)	2	1	1	0	2	2	3	$1,000
09 01 CHANNELS	Traffic Control (Alt B)	2	3	3	0	3	4	3	$1,000
09 01 CHANNELS	Earthwork (Alt A)	2	1	2	0	2	2	3	$1,000
09 01 CHANNELS	Earthwork (Alt B)	2	1	2	0	2	2	3	$1,000
09 01 CHANNELS	Demolition and Relocations (Alt A)	2	1	1	0	1	2	3	$1,000
09 01 CHANNELS	**Demolition and Relocations (Alt B)**	2	1	1	0	1	2	3	$1,000
09 01 CHANNELS	**Culverts and Channels (Alt A)**	2	1	2	0	2	2	3	$1,000
09 01 CHANNELS	**Culverts and Channels (Alt B)**	2	1	2	0	2	2	3	$1,000
0	**0**	0	0	0	0	0	0	0	$0
0	**0**	0	0	0	0	0	0	0	$0
All Other	Remaining Construction Items	0	0	0	0	0	0	0	$0
30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	2	1	1	0	0	2	3	$1,000
31 CONSTRUCTION MANAGEMENT	Construction Management	2	1	1	0	0	2	3	$1,000
									$11,000
Risk		$ 619	$ 883	$ 1,079	$ -	$ 311	$ 586	$ 1,006	**$4,485**
Fixed Dollar Risk Allocation		$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$0**
	Risk	$ 619	$ 883	$ 1,079	$ -	$ 311	$ 586	$ 1,006	**$4,485**
								Total	**$15,485**