APPENDIX A4

2020 BRIDGE TYPE SELECTION REPORT

Bridge Type Selection Report

OC Loop Segments O, P, and Q Project

Bridges #1 and #6

County of Orange, California

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Bridge Type Selection Report for Bridges 1 & 6

OC Loop Segments O, P, Q

1. Introduction

A gap in the 66-mile regional bikeway corridor, the OC Loop, is along the length of the Coyote Creek flood control channel, upstream and downstream of the Santa Ana Freeway (I-5). This gap is designated as segments O, P, and Q. The OC Loop Segments O, P, Q (proposed project) begins at the existing Coyote Creek Bikeway (cities of Cerritos and La Palma) where the flood channel divides into north and east forks, running 2.7 miles connecting to another portion of the Coyote Creek Bikeway at La Mirada Blvd./ Malvern Ave. in the cities of Buena Park and La Mirada. The Los Angeles County Flood Control District owns the majority of the property required for this project. See Figures 1 and 2 below for Vicinity Map as well as the OC Loop overview & Gap Segment Map.

Six structural sites, including two major control channel crossings are key elements of the project and necessary to traverse existing transportation assets in order to extend and complete the OC Loop bikeway corridor. The two proposed Coyote Creek flood channel crossings will be addressed in this Type Selection report, they are structure No.'s 1 and 6 within the proposed OC Loop limits.

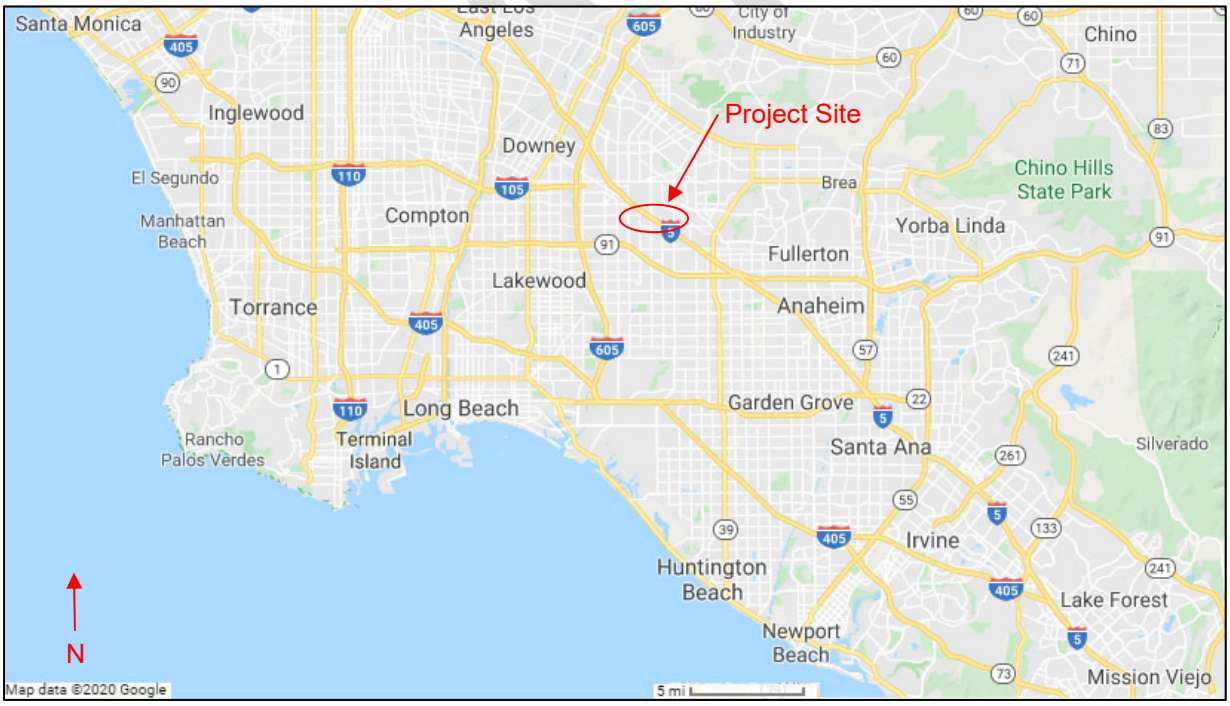


Figure 1: Vicinity Map

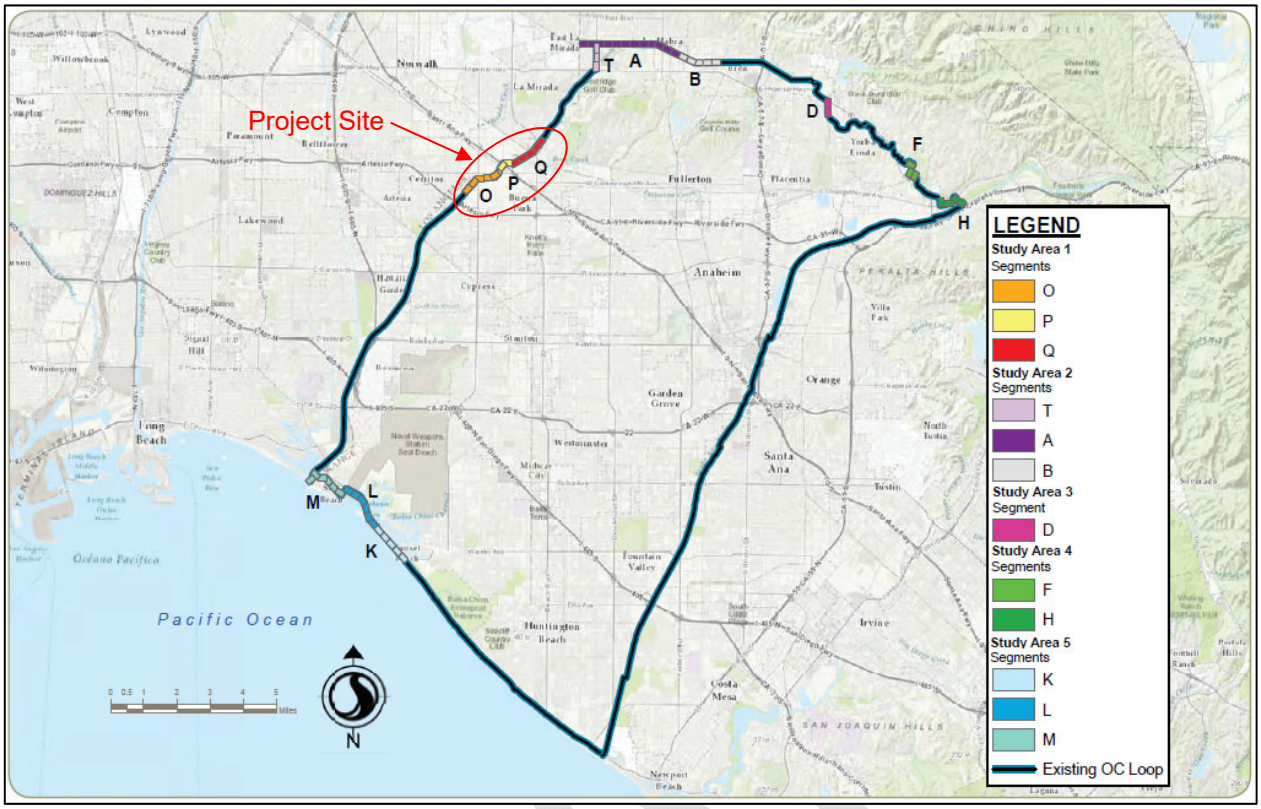


Figure 2: OC Loop Overview & Gap Segment Map

Bridge #1: Coyote Creek Bikeway 1

Bridge #6: Coyote Creek Bikeway 3

Figure 3: Project Location Map – OC Loop segments O, P, Q

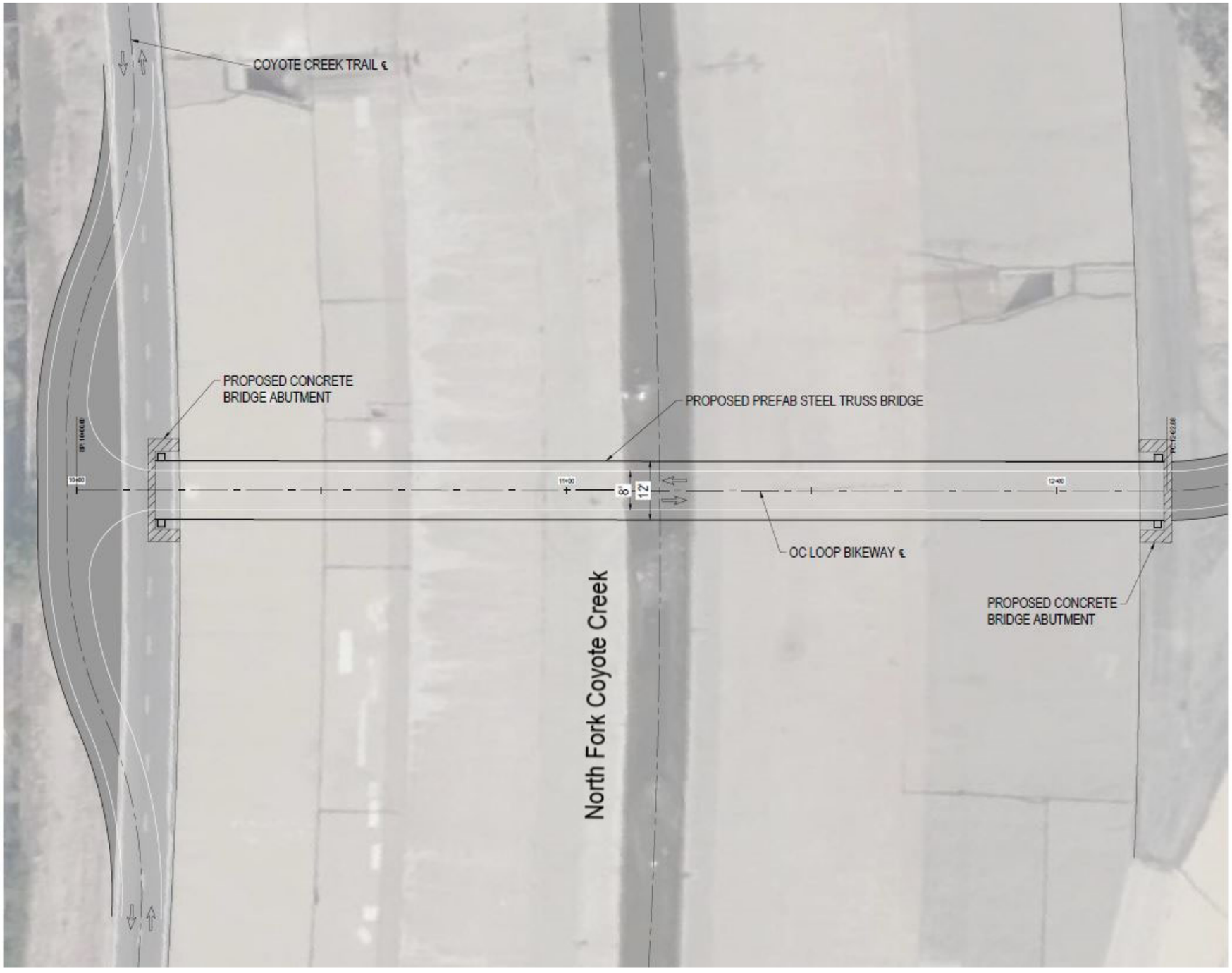


Figure 4: Bridge Location Map – Bridge #1: Coyote Creek 1 Bikeway Bridge

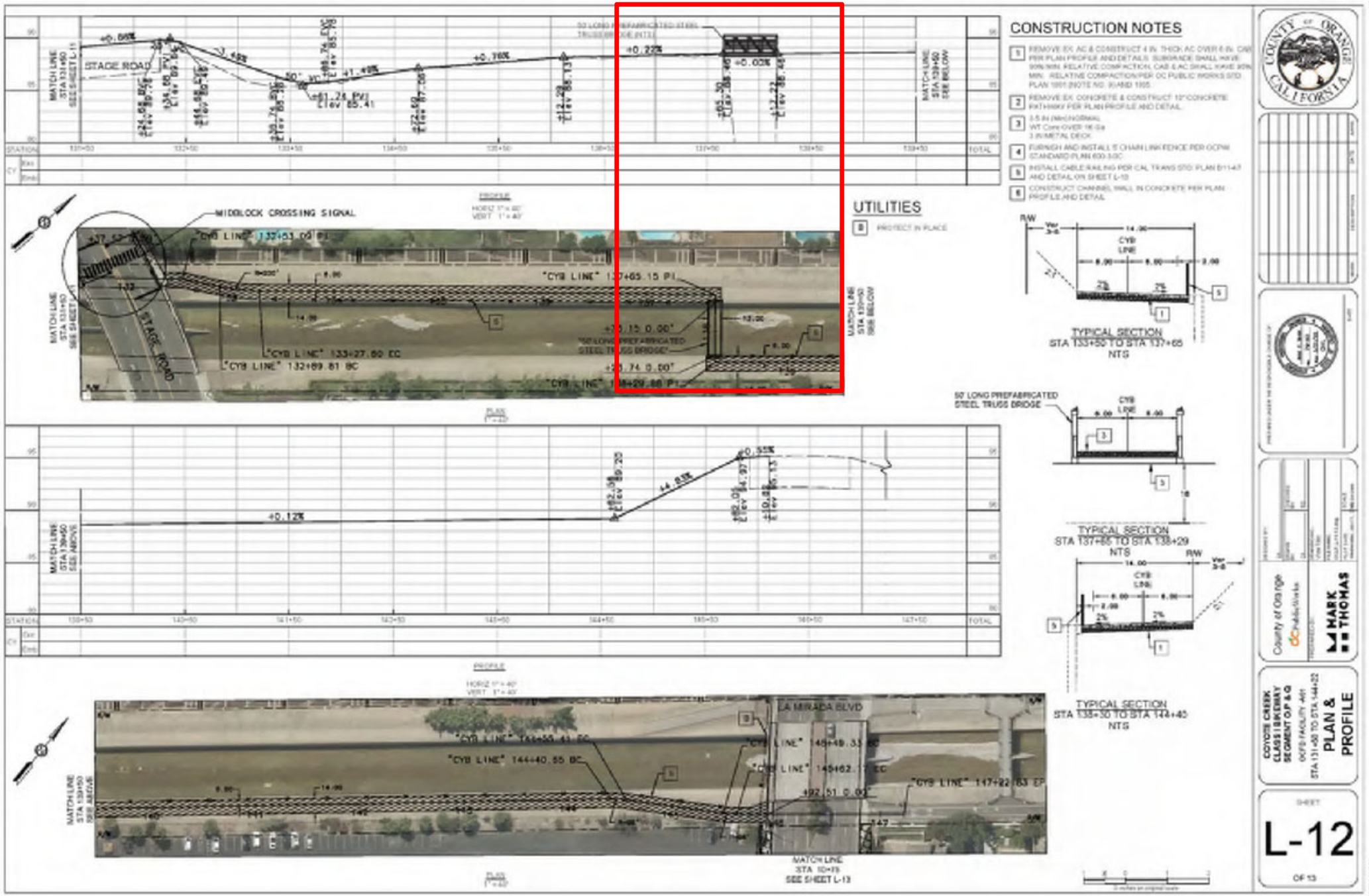


Figure 5: Bridge Location Map – Bridge #6: Coyote Creek 3 Bikeway Bridge

2. Bridge Descriptions

Bridge No. 1 is proposed at the beginning of Segment O, where the Coyote Creek flood channel divides into the north and east fork. It is proposed to be 202-ft long and 12-ft clear width, founded on two abutments with no intermediate supports within the channel. At 207-ft length, this bridge would typically justify an intermediate bent/ pier. However, due to the sensitive hydraulics in the channel at this location, coupled with the aged channel lining/ concrete, it was determined that the best alternative would be to span Coyote Creek flood channel completely and not to include any intermediate supports.

Bridge No. 6 is near the end in Segment Q, approximately 560-ft upstream of the State Road at grade crossing. The structure is proposed to be 65-ft long and 12-ft clear width, founded on two abutments with no intermediate supports within the channel.

See Figures 2, 3, and 4 for Project Location Map and each Bridge Location Map.

Each of the two bridges will carry a Class 1 (off-road, paved) Bikeway and pedestrians and be comprised of a prefabricated steel truss superstructure with wooden deck. GHD Inc. (GHD) will design the abutments for the bridges and work closely with the manufacturers of the prefabricated steel truss bridges to ensure superstructure design and plans are compliant with governing bridge design criteria and align with substructure design and overall OC Loop design as well. See Appendix A for General Plan sheets of both bridges.

3. Bridge Design Criteria

Project bridge and foundation designs will follow the latest editions of the following bridge manuals:

- AASHTO LRFD (Load and Resistance Factor Design) Guide Specifications for the Design of Pedestrian Bridges dated December 2015;
- AASHTO Guide Specifications for LRFD Seismic Bridge Design Specifications 2nd Edition with 2015 Interim Revisions.

Scour loading combinations will use the latest Caltrans standard:

- AASHTO LRFD Bridge Design Specifications, 6th Edition with California Amendments.

Following the above specifications, the pedestrian bridges will be designed for 90 lbs per square ft pedestrian and H10 truck loading, a 20,000 lb truck. The wood deck or composite FRP will be checked for the point load of a truck wheel load.

4. Alternatives Considered

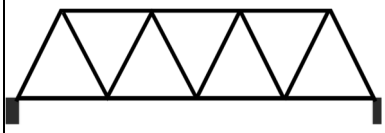
Both alternatives of concrete and steel superstructures are viable at both bridge sites. However, the bid RFP specifies prefabricated steel pedestrian bridges. Therefore, our focus will be on alternatives within steel prefabricated bridges.

Additionally, steel truss bridges are already in use in Orange County, as part of existing trail and bikeway networks, to span creeks and streams. Steel truss bridges also offer a more pleasing aesthetic than the concrete trail and bikeway bridges.

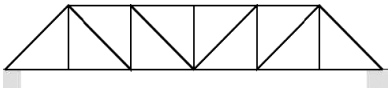
Truss Structure Configurations

Truss bridges are comprised of load-bearing superstructures, comprised of connected elements forming units. The connected elements are typically straight and may be stressed from tension, compression, or sometimes both, in response to dynamic loads. Truss configurations considered for each bridge site are summarized below. Options are evaluated in the Type Selection Matrix.

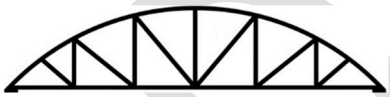
- **Warren Truss**: Connected elements create equilateral triangles to alternate tension and compression members thereby spreading loads out along the length of the bridge



- **Pratt Truss**: Truss includes vertical components between upper and lower members and diagonal members sloping towards the middle. The diagonals act as tension and verticals are compression.



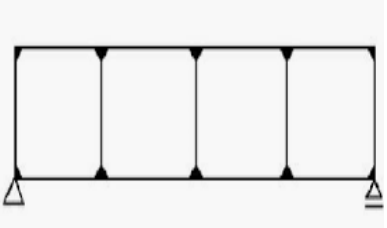
- **Bowstring Truss**: Truss consists of an arched beam (the bow) joined with both vertical and diagonal components. The “bow” meets the bottom member at both ends.



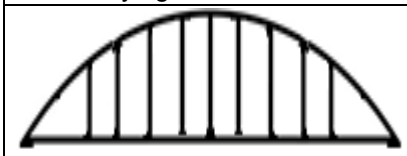
- **Modified Bowstring Truss:** Similar to a standard bowstring truss, the modified truss ends short of the bot meeting the bottom stringer and is instead connected by vertical components



Vierendeel Truss: Structure where members for rectangular openings, framed with fixed joints to resist bending moments.



- **Tied Arch Truss:** Truss in which the outward direction horizontal forces of the arch are borne by a chord tying the arch ends, rather than by the ground or bridge foundations.



Truss Bridge Material and Finish Selection

- **Material Options**: Two main material options for the bridge crossings are steel and aluminum. Steel is efficient, versatile, and ideal for long-lasting structures. Aluminum is more lightweight and good for corrosive environments. Based on project location and needs, the team recommends the use of Steel.
- **Finish Options:** Steel has three standard finish options: Weathered, painted, or galvanized.

Weathered: Forms a rust-like appearance after years of weather exposure.

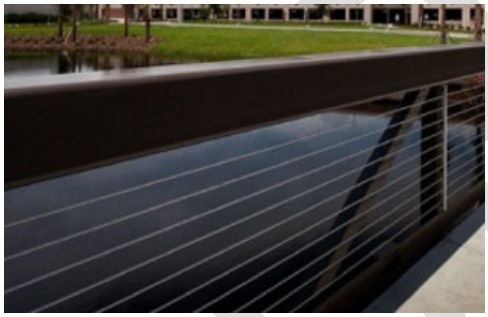
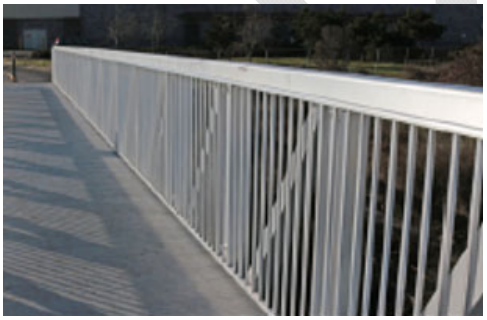
Painted: Adds protective layer of paint and can enhance the appearance of the bridge

Galvanized: Hot-dipped chemical zinc process after fabrication. Protects the metal and extends service life.

Finish options are evaluated in the Type Selection Matrix below.

Bridge Railing Styles

There are four main railing styles available. They are:

	**Horizontal:** Most economical and classical choice for recreational / pedestrian bridges
	**Mesh:** Versatile with an array of opening sizes. Discourages climbing while maintaining the view. Also eliminates debris from passing through to the channel below.
	**Cable:** Ideal for highlighting panoramic vistas as it allows for the best view. Modern and minimal while still meeting code.
	**Vertical Picket:** Economical and discourages climbing, but can impede views.

Each railing type will be evaluated in the Type Selection Matrix below.

Bikeway Deck Options

The riding surface, deck, options for the bikeway structures are split into two categories:

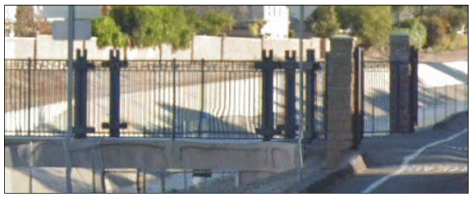
- **Natural Wood** – Typically is categorized into hard or soft wood options. Natural woods must be treated (pressure, stain, paint) to increase longevity and prevent deformation over time and exposure to elements. Wood decks can be shop installed but also may be installed plank by plank after bridge is set to reduce structure lifting weight.
- **Engineered Wood**- Includes materials such as composite and FRP and are typically longer lasting and more durable than natural wood options. Additionally, they are available in a variety of surface textures, able to mimic natural wood or provide additional slip resistance for pedestrian applications.

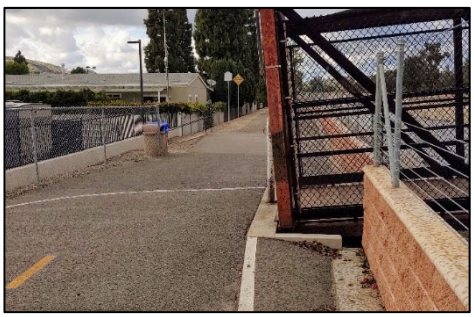
	
Hardwood: A hard, dense, wood providing greater dimensional stability and uniform smooth riding surface.	**Soft wood:** Treated with preservatives to prevent rot in moist or high-humidity environments. Less uniform than Hardwood.
	
Composite: A combination of industrial wood waste and recycled plastic materials. It is highly resistant to rot and decay, is pre-colored, and is virtually maintenance free.	**Fiber reinforced plastic:** (FRP) is water resistant, economic to install, and also virtually maintenance free.

Deck options will be evaluated in the Type Selection Matrix below.

Approach Railing

GHD suggests the inclusion of approach railing at each bridge location. This guides users onto the bridge and can match or compliment bridge railing. At Bridge site #1, the channel is sloped and there is no existing fencing/ fall protection into the channel. Approach railing will transition the user onto/ off the bridge. At Bridge site #6, the channel has vertical sides and the current fall protection is chain link fence with barbed wire topping. To create a more aesthetic and user-friendly feel to the bikeway bridge, an approach fence will transition from the existing fence to the bridge type railing selected. Additionally, the use of aesthetic pillars can create a pleasing look while giving the bridge a finite begin and end, similar to what is currently crossing the Coyote Flood Channel, north of La Mirada Blvd, where proposed Segment Q connects to the existing Bikeway.





Bridge Type Selection Evaluation Matrix

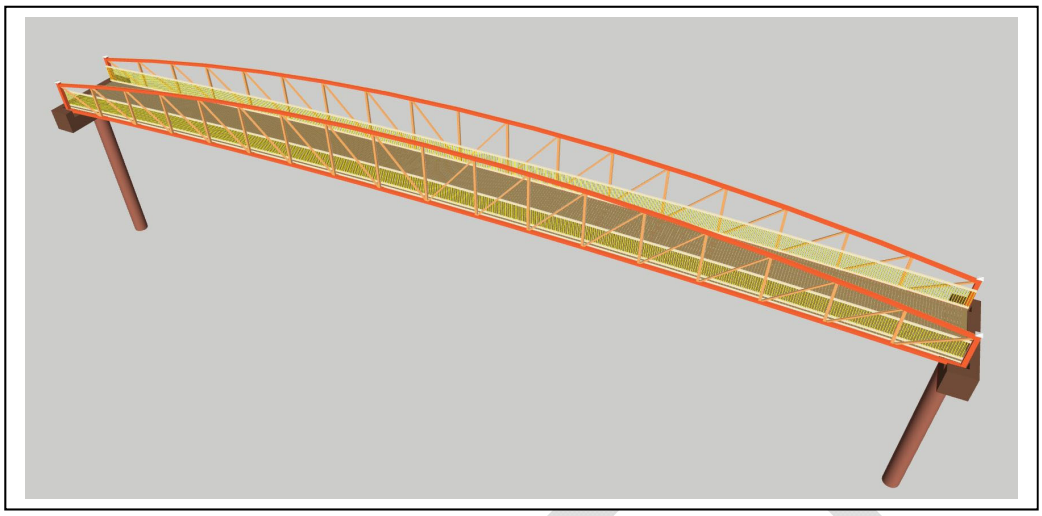
The below bridge type selection matrix evaluated each of the aforementioned bridge components in the categories of Fabrication, Erection, Aesthetics, Cost, and Long-Term Maintenance on a scale of 1 to 5. The overall bridge type selection will be a combined value of each category, the highest score being the preferred alternative.

- Fabrication – Refers to the ease of fabrication of the truss, readiness of materials, available suppliers, etc. Score of 5 will be assigned to alternatives with the easiest fabrication process.
- Erection – Refers to the ease of fabrication, how many pieces the truss will need to be split into for transportation, difficulty of assembly at the bridge site, size of equipment required to hoist into final place, etc. Score of 5 will be assigned to the alternatives with the easiest erection process
- Aesthetics – As this is a bikeway and an extension of the OC Loop, the pathway should reflect the area, existing trail aesthetics, and be visually pleasing. Therefore, a score of 5 will be assigned to alternatives with the best aesthetic value.
- Cost – Refers to the overall cost of the alternative, including material availability, readiness, shipping, installation, etc. Score of 5 will be assigned to the alternatives with the lowest cost.
- Long-Term maintenance – Refers to the maintenance effort required over the life-span of the bridge. This may include inspections, material coatings, replacement of components as they wear, etc. Score of 5 will be assigned to the alternatives requiring the least amount of maintenance over the anticipated service life of the bridges.

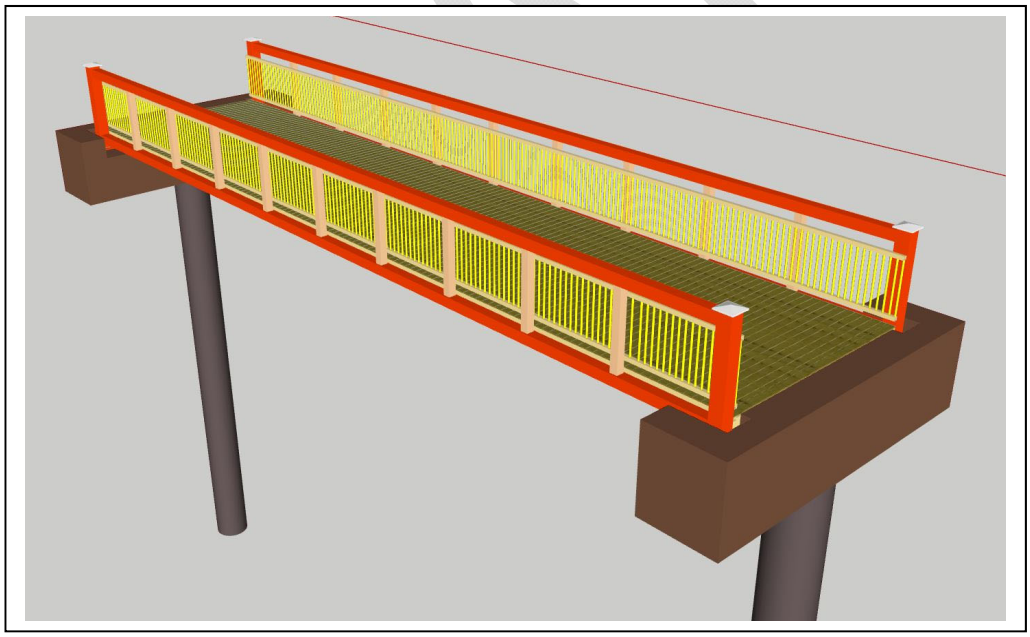
Bridge Type Selection Evaluation Matrix						
Category:	Fabrication	Erection	Aesthetics	Cost	Long-Term Maintenance	Total
Bridge #1: Coyote Creek Bikeway 1 Bridge						
Truss Configurations						
Warren	5	5	3	5	4	22
Pratt	4	5	4	4	4	21
Bowstring	4	5	5	3	3	20
Modified Bowstring	4	5	5	4	4	22
Vierendeel	5	5	3	5	4	22
Tied Arch	2	3	4	2	2	13
Truss Material and Finish						
Weathered Steel	5	5	3	5	5	23
Painted Steel	4	5	4	4	3	20
Galvanized Steel	3	5	5	3	4	20
Railing Style						
Horizontal	5	4	3	5	4	21
Mesh	5	5	4	4	3	21
Cable	5	3	5	3	2	18
Vertical Picket	5	5	3	5	5	23
Bikeway Deck Material						
Natural: Hardwood	5	4	5	4	3	21
Natural: Soft Wood	4	4	4	5	4	21
Engineered: Composite	3	5	3	3	5	19
Engineered: FRP	2	5	2	3	5	17
Bridge #6: Coyote Creek Bikeway 3 Bridge						
Truss Configurations						
Warren	5	5	3	5	4	22
Pratt	4	5	4	4	4	21
Bowstring	4	5	5	3	3	20
Modified Bowstring	4	5	5	4	4	22
Vierendeel	5	5	4	5	4	23
Tied Arch	2	3	4	2	2	13
Truss Material and Finish						
Weathered Steel	5	5	3	5	5	23
Painted Steel	4	5	4	4	3	20
Galvanized Steel	3	5	5	3	4	20
Railing Style						
Horizontal	5	4	3	5	4	21
Mesh	5	5	4	4	3	21
Cable	5	3	5	3	2	18
Vertical	5	5	3	5	5	23
Bikeway Deck Material						
Natural: Hardwood	5	4	5	4	3	21
Natural: Soft Wood	4	4	4	5	4	21
Engineered: Composite	3	5	3	3	5	19
Engineered: FRP	2	5	2	3	5	17

Based on the above truss component alternatives evaluation matrix, GHD recommends the following bridge alternative type at each site:

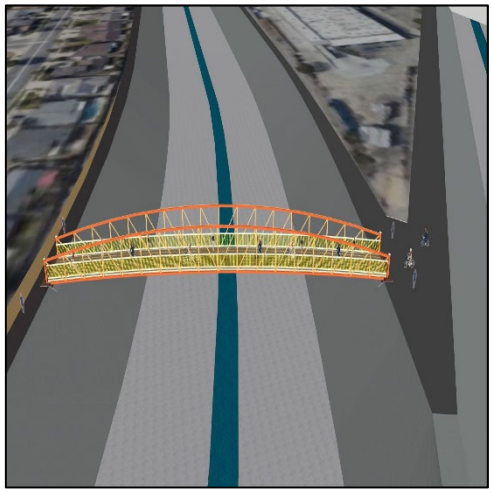
BRIDGE #1 Recommendation: Coyote Creek Bikeway 1 Bridge – Modified Bowstring Truss, Painted Steel, Vertical Picket Railing, Softwood/Composite Deck.

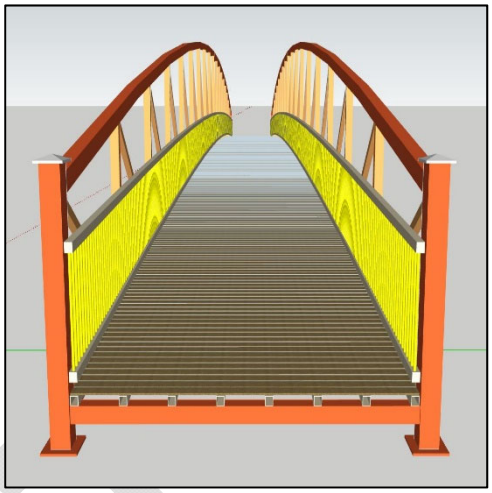


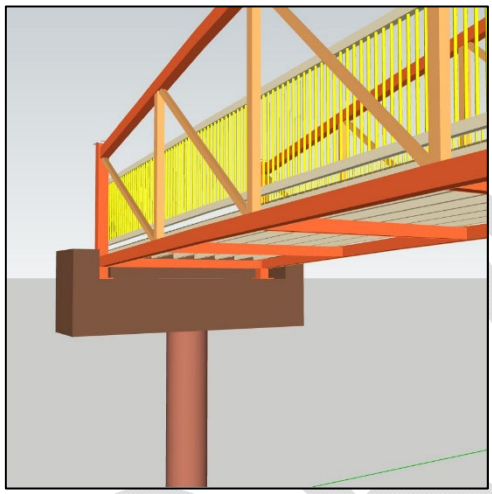
BRIDGE #6 Recommendation: Coyote Creek Bikeway 3 Bridge – Vierendeel Truss, Painted Steel, Vertical Picket Railing, Softwood/Composite Deck

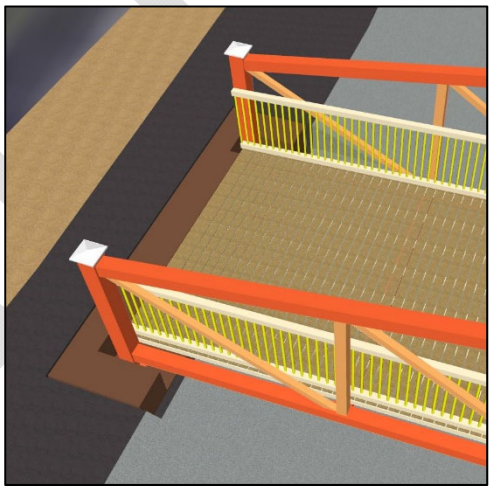


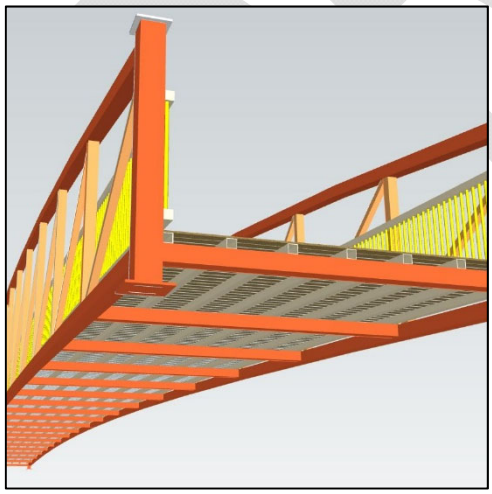
5. Bridge No. 1 Renderings

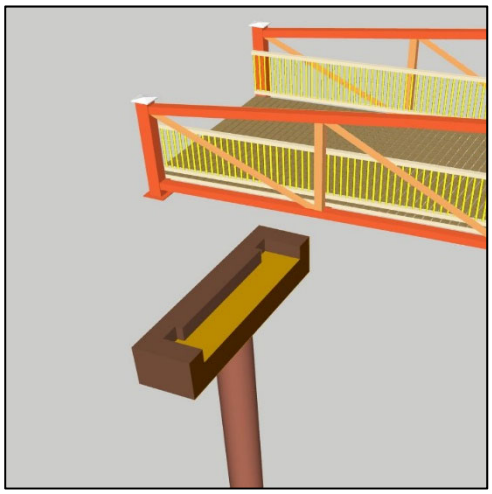




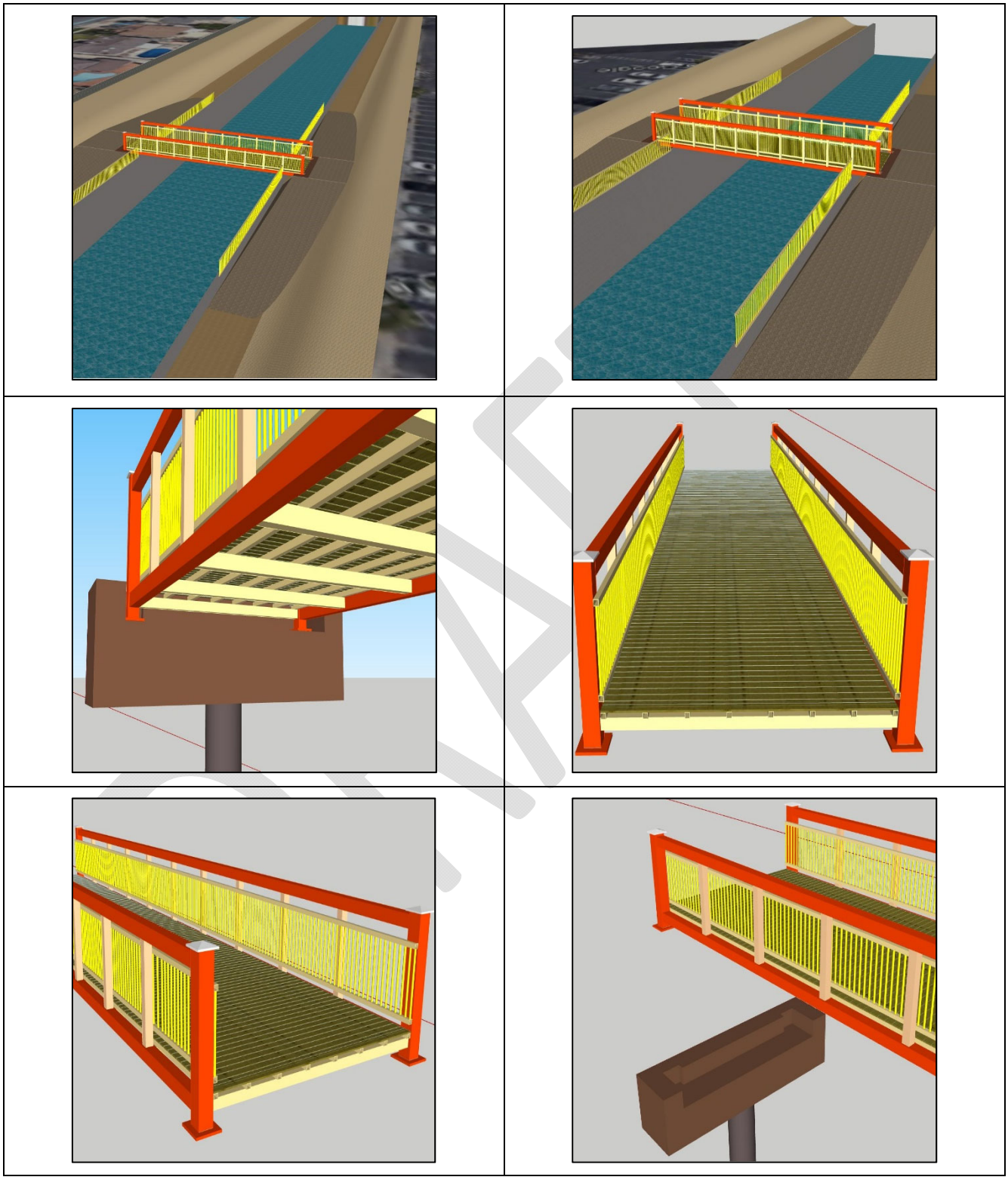








6. Bridge No. 6 Renderings



The following sections in the report will document reasoning for the recommendations here as well as support for assigned scores of components at each bridge site.

7. Bridge Construction Considerations

Suggested means & methods to be provided including information regarding site access, equipment sizing, transportation, crane locations and capacity, and erection methodology.

8. Preliminary Foundation Report

There are no preliminary foundation reports available at this time. Based on adjacent completed project, GHD anticipates that the two bridge sites will be founded on driven deep foundations or CIDH foundations, topped with concrete cast-in-place abutments which rest at their respective channel edge in order to not impede channel hydraulics during extreme events. More information will be provided, including anticipated pile depth, soil data, etc. when the report becomes available.

9. Seismic Design

GHD anticipates seismic design parameters to be provided with the preliminary geotechnical and foundation report(s).

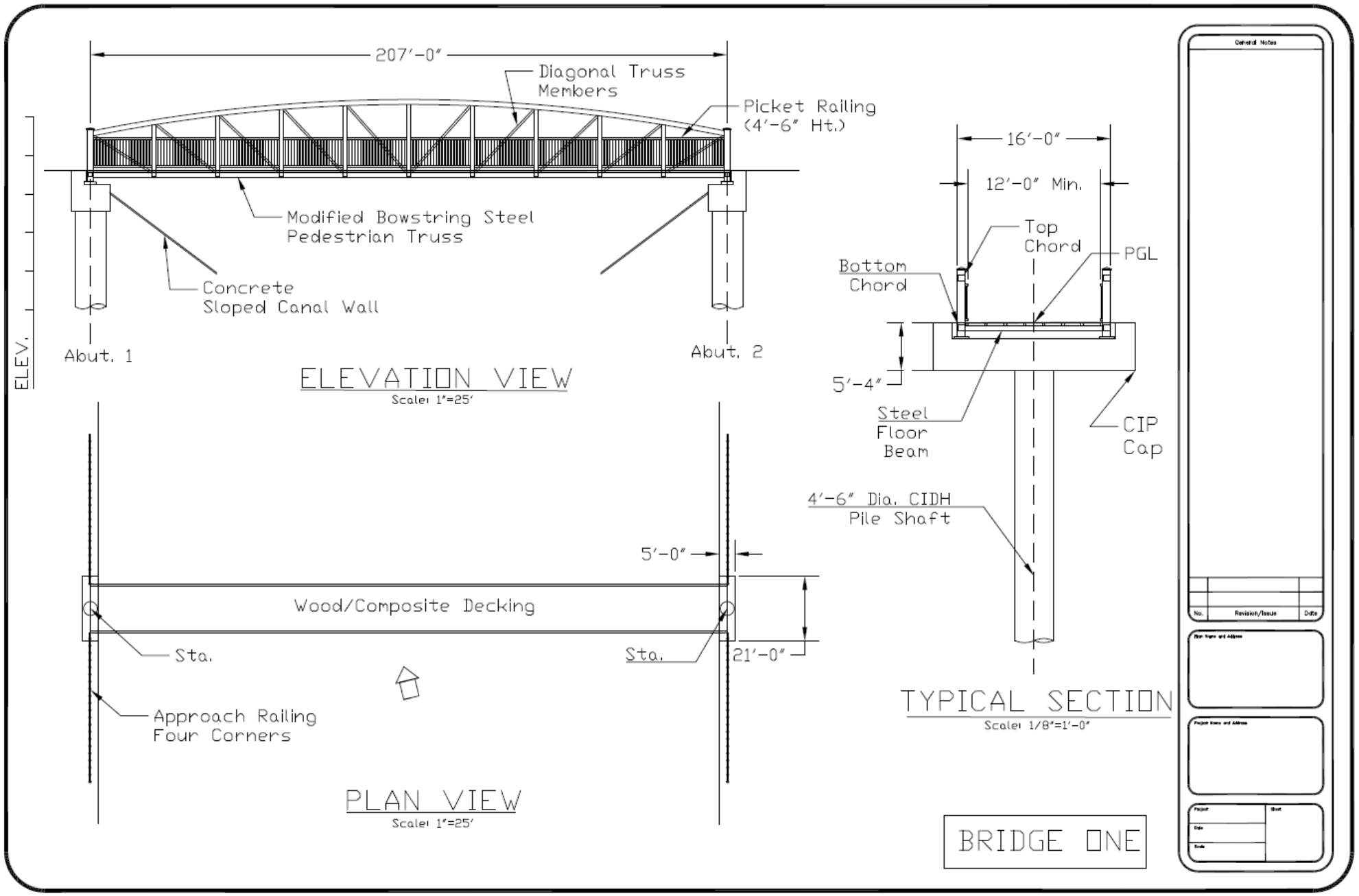
10. Right-of-way

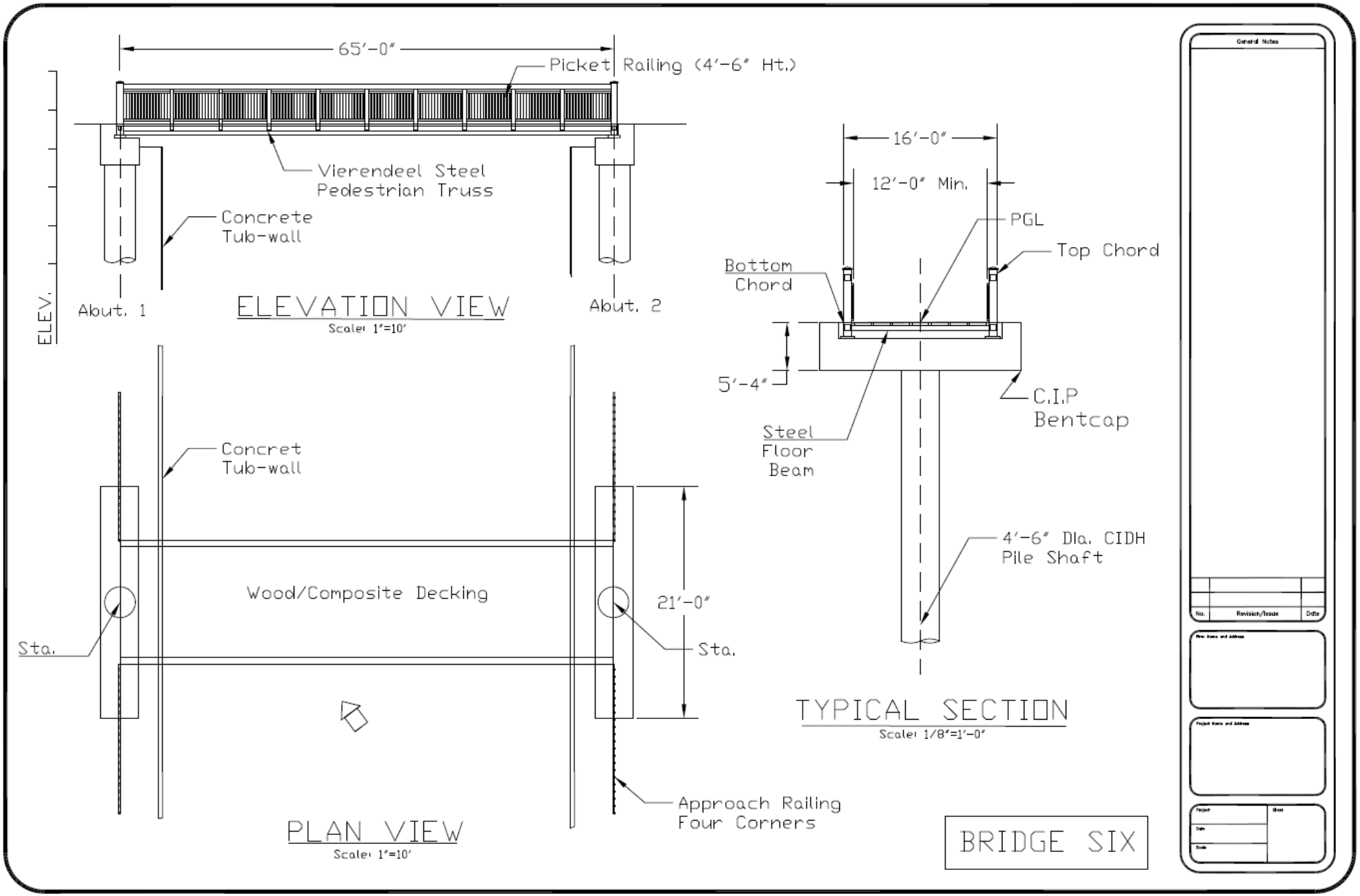
Project construction would take place in both Los Angeles and Orange counties along the 2.7 mile stretch of Coyote Creek Channel. Majority of the property required for the project is owned by the Los Angeles County Flood Control District.

11. Lighting and Aesthetics

No lighting is proposed. Only required aesthetics is a weathered steel “rust patina” look for the bridge.

Appendix A: Proposed Bridge No. 1 and No. 6 General Plan, Elevation, and Typical Section


207'-0"
Diagonal Truss Members
Picket Railing (4'-6" Ht.)
Modified Bowstring Steel Pedestrian Truss
Concrete Sloped Canal Wall
ELEV.
Abut. 1
Abut. 2
ELEVATION VIEW
Scale: 1"=25'
16'-0"
12'-0" Min.
Top Chord
PGL
Bottom Chord
5'-4"
Steel Floor Beam
CIP Cap
4'-6" Dia. CIDH Pile Shaft
TYPICAL SECTION
Scale: 1/8"=1'-0"
5'-0"
Wood/Composite Decking
Sta.
Sta.
21'-0"
Approach Railing Four Corners
PLAN VIEW
Scale: 1"=25'
BRIDGE ONE


65'-0"
Picket Railing (4'-6" Ht.)
Vierendeel Steel
Pedestrian Truss
Concrete
Tub-wall
ELEV.
Abut. 1
Abut. 2
ELEVATION VIEW
Scale: 1"=10'
16'-0"
12'-0" Min.
PGL
Top Chord
Bottom
Chord
5'-4"
C.I.P
Bentcap
Steel
Floor
Beam
4'-6" Dia. CIDH
Pile Shaft
TYPICAL SECTION
Scale: 1/8"=1'-0"
Concret
Tub-wall
Wood/Composite Decking
21'-0"
Sta.
Sta.
Approach Railing
Four Corners
PLAN VIEW
Scale: 1"=10'
BRIDGE SIX