FINAL STRUCTURE TYPE SELECTION REPORT
(DRAFT)

22ND STREET: KINO PKWY TO TUCSON BLVD PROJECT
22ND STREET OVER UNION PACIFIC RAILROAD (UPRR) & BARRAZA-AVIATION PARKWAY BRIDGE

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PREPARED FOR:

RTA Regional Transportation Authority

CITY OF TUCSON FOUNDED 1775

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1.0 INTRODUCTION

In May 2006, the Regional Transportation Authority (RTA) plan and sales tax were approved by the voters of Pima County. One of the 35 roadway improvement projects included in the RTA plan is 22nd Street from Interstate 10 (I-10) to Tucson Blvd. Currently 22nd Street operates above capacity and the condition of the existing bridge that spans the Union Pacific Railroad (UPRR) Gila Sub and Yard and the Barraza-Aviation Parkway is declining with weight restrictions imposed. This Structure Type Selection Report has been prepared for the section of 22nd Street between Kino Pkwy and Tucson Blvd and addresses the design of a new 6-lane overpass structure over the existing UPRR yard and the Barraza-Aviation Parkway located approximately two miles east of I-10 on 22nd Street. The new bridge will replace an existing 4-lane structure and is being coordinated with the design for the roadway widening of 22nd Street between Kino Pkwy and Tucson Blvd. This section of 22nd Street will be widened to 6-lanes with a divided median and is needed to add traffic capacity, improve pedestrian and bicycle safety and improve existing SunTran bus service along the 22nd Street corridor. The alignment chosen for this segment of the project is discussed in the Alternative Alignment Report (AAR), 22nd Street between Kino Pkwy to Tucson Blvd., August 2008.

This Structure Type Selection Report identifies and studies structure type alternatives that will meet City of Tucson standards, minimize disruption to the operations of the Union Pacific Railroad Gila Sub and Yard, adhere to the design criteria established with the project's Citizen's Advisory Council (CAC) as well as applicable American Association of State Highway and Transportation Officials (AASHTO) bridge design standards and the BNSF Railway- Union Pacific Railway Guidelines for Railroad Grade Separation Projects,

2.0 EXECUTIVE SUMMARY

The existing 22nd Street viaduct structure over the UPRR yard and the Barraza-Aviation Pkwy is a 4-lane bridge located on a crest vertical curve. The existing bridge structure has a weight limit of 15 Tons GVW that prevents heavy truck and school bus access. This weight limit was imposed in 2005. A new viaduct structure is necessary to provide the new 6-lanes of traffic as well as to improve traffic safety along 22nd Street and remove the current detour imposed on vehicles over the posted 15 Tons GVW. Additionally inadequate horizontal clearances between the railroad tracks and existing viaduct structure is a major concern as it relates to the safety of the traveling public and railroad personnel. Clearances in the yard are up to 70% below the minimum requirements established by American Association of State and Highway Transportation Officials (AASHTO), American Railway Engineering and Maintenance –of- Way Association (AREMA) and UPRR.

The primary design considerations for the new structure include:

- A horizontal alignment shift to the North to maintain existing traffic during construction and ensure constructability of a new 6-lane structure as discussed in the Alternative Alignment Report, prepared by DMJM Harris, August 2008.
- Revised profile to meet required vertical clearances.
- Pedestrian/Bicycle access across the bridge to maintain multi-use continuity along the proposed 22nd Street improvements.
- Railroad safety requirements for UPRR including the required horizontal and vertical clearances to UPRR tracks and facilities.
- Constructability
- Appearance continuity (similarity) with the Kino / 22nd TI Overpass structure.
- Inclusion of design criteria set forth from the project CAC

2.1 HORIZONTAL ALIGNMENT SHIFT

Construction phasing of the new bridge will allow traffic movements on the existing 4-lane structure while the new structure is being built. To accomplish this, a horizontal alignment shift of the 22nd Street centerline is required. As discussed in the Alternative Alignment Report the roadway alignment will be shifted to the north. This shift will require property acquisition from private residences and business owners on the north side of 22nd Street including the University of Arizona warehouse on the northeast corner of 22nd Street & Warren Ave and the Walsh Brothers business on the northwest corner of 22nd Street & Warren Ave. The new WB lanes will be constructed north of the existing alignment and the new EB lanes will replace the existing bridge. Once the westbound 3-lane half-bridge is constructed, traffic will be diverted onto the new structure and the existing bridge will be demolished. The new eastbound 3-lane half-bridge can then be constructed, providing 6 lanes of vehicular traffic. *See Figure 5.1 – Construction Phasing.*

2.2 REVISED VERTICAL PROFILE

The new bridge structure will have a revised vertical profile to accommodate the proposed structure depths, the required UPRR vertical clearances, and the new 22nd Street roadway alignment.

2.3 PEDESTRIAN / BICYCLE ACCESS

The 22nd Street improvements include a pedestrian walkway and multi-use lane on each side of the road. These pedestrian areas will be maintained along both sides of 22nd Street for the bridge approaches. The new bridge cross-section provides for a 6′ multi-use lane and a 7′-9″ raised sidewalk on each side of the bridge for both directions of travel and will have a center median for continuity to the raised landscape median. This improvement will ultimately provide continuous pedestrian access from Tucson Blvd to I-10 and future connections to regional trail systems.

2.4 RAILROAD SAFETY REQUIREMENTS INCLUDING HORIZONTAL & VERTICAL CLEARANCES

Horizontal clearance between piers and railroad tracks is a critical safety consideration. The AASHTO, AREMA, and BNSF Railway & Union Pacific Railway Guidelines for Railroad Grade Separation Projects require that the clearance from the face of the pier to center of closest track be at least 18′-0″ when pier protection is provided and 25′-0″ when pier protection is not provided. The proposed span arrangement for each alternative meets these criteria. In addition the vertical profile proposed meets the vertical clearances required by BNSF Railway & Union Pacific Railway Guidelines for Railroad Grade Separation Projects. In addition, the new bridge profile provides the16 ft minimum vertical clearances required over the realigned Campbell Ave and the existing Barraza-Aviation Pkwy.

2.5 CONSTRUCTABILITY

Structure types that allow construction techniques and procedures that will minimize disruption to the operations of the UPRR Gila Sub and Yard as well as minimize disruption to Barraza Aviation Pkwy traffic are considered essential in determining the most effective structure type for this bridge.

2.6 CAC DESIGN CRITERIA

The project team has been meeting with the Citizens Advisory Council since October 2005 to solicit their input for key design criteria to use in the overall design of this project. The bridge criteria that has been collaboratively developed for the Kino/22nd St TI and is also applicable to the 22nd Street over UPRR and Barraza-Aviation Bridge includes:

- Maximize the length of the bridge to minimize the fill required and minimize the high walls.
- Design to make this a positive addition for the neighborhoods, not an eyesore.
- Make sure the bridge has some meaning to the citizens.
- Integrate thematic elements with structure of the bridge; do not use "plop art", surface applications that lacks meaning.
- Integrate future project planning with this effort.

3.0 PROJECT LOCATION

The UPRR Bridge Project is part of the three-mile 22nd Street improvement project between Tucson Blvd. and Interstate 10, located within the City of Tucson and Pima County, Arizona. More specifically, within portions of Sections 17 through 20, Township 14 South, Range 14 East, Gila & Salt River Meridian. *See Figures 3.1 and 3.2*.

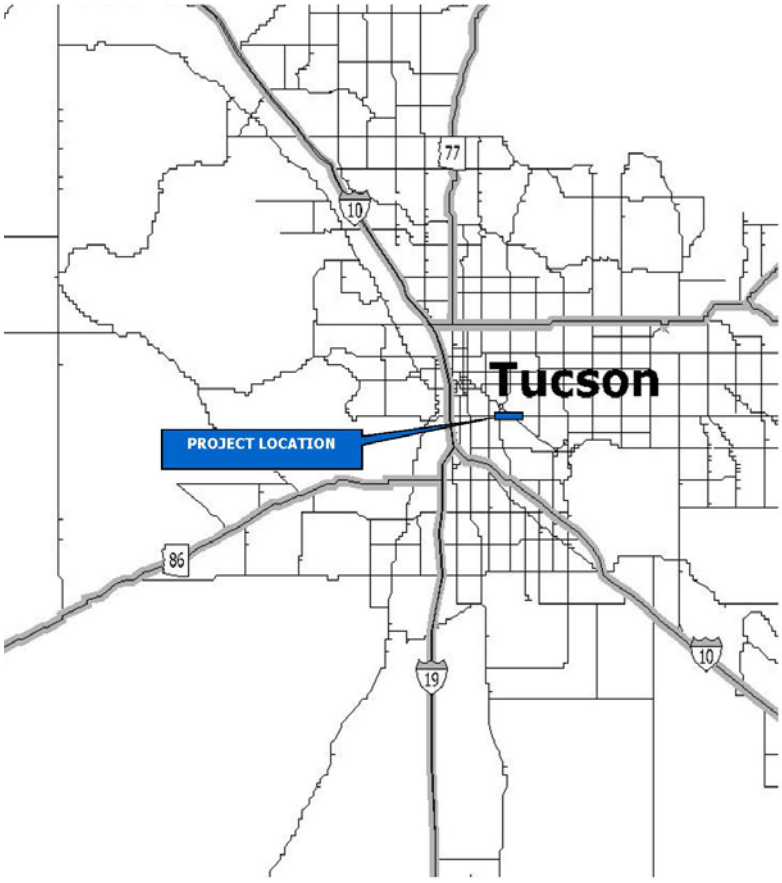


FIGURE 3.1
Location Map

PROJECT MAP

FIGURE 3.2
Vicinity Map

4.0 EXISTING BRIDGE

The existing bridge that carries 22nd Street traffic over the UPRR yard and Barraza-Aviation Pkwy (Structure Number 9011) was constructed in 1966. The bridge is a four-lane structure that consist of two different types of construction: Cast-in-place, short span, concrete structural slabs; and long-span composite construction utilizing variable-depth, continuous, steel plate girders with a cast-in-place concrete deck. The overall bridge length is approximately 1357′-7″. The bridge deck is comprised of two independent structures with a clear roadway width of 26′-7″ in each direction of traffic, raised end units (which act as sidewalks) and metal rails along the fascias; a vehicular barrier with a metal rail is located between the traffic lane and sidewalk, and a raised concrete

median separates the westbound and eastbound lanes. The overall bridge width of the two structures is 75′-10″. The bridge skew varies from approximately 30° to 54° to the left. There are 7 sets of railroad tracks below the bridge.

FIGURE 4.1
Cross Section of Existing Bridge over UPRR and Barraza-Aviation Parkway

The bridge is comprised of 5 structural units identified as Units A through E. Unit A and E are the exterior short span CIP slab bridges that are 152′-9″ and 223′-0″ in length. Units B through D make up the internal long-span composite variable depth steel plate girder bridge with a total length of 981′-10 3/8″. Units B through D span the current UPRR yard. The west approach contains 442′-6″ of retaining walls on the north and south sides, the east approach contains 373′-8 7/8″ of retaining walls on the south side and 330′-4″ on the north side. The minimum vertical clearance below the bridge to the high rail was approximately 23′-0″ at the time of construction. The minimum lateral clearance from the centerline of the track to the outside of the nearest pier is 9′-4 ½″ at Pier #13. Each abutment is a full height wall abutment supported on a spread footing and each pier is comprised of a concrete cap beam supported by three (3) - 40 inch diameter concrete columns on individual spread footings. See Appendix C for the existing bridge drawings. The existing bridge structure has a weight limit of 15 Tons GVW that prevents heavy truck and school bus access. This weight limit was imposed in 2005 and is discussed in the September 18, 2003 Report "Structural Review of the 22nd Street Overpass at Union Pacific Railroad," prepared for the City of Tucson by Holben, Martin & White Consulting Structural Engineers. Current AASHTO LRFD requires HL-93 vehicle load (45 tons) capacity to reflect the heavier traffic common today. Additionally the lateral clearance of approximately 9′-4″ between the existing Pier and the centerline of the rail is insufficient. The combination of inadequate capacity and clearance deficiencies eliminate widening as a feasible option and make the existing structure functionally obsolete.

FIGURE 4.2
Existing Bridge over UPRR and Barraza-Aviation Parkway

5.0 BRIDGE CRITERIA & ALTERNATIVES

The ultimate bridge section carries 3 lanes of vehicular traffic, a multi-use lane and a sidewalk in each direction. The sidewalks are separated from the vehicular lanes by an F-shape vehicle barrier. There is a 20′ wide median between the opposing lanes of traffic. The overall width of the bridge is 120′-0″. Stationing is set from east to west. The roadway profile is set to achieve at least 23′-4″ of vertical clearance above the top of high rail to the low bridge chord in accordance with current UPRR requirements and 16′-0″ of vertical clearance above proposed Campbell Ave and existing Barraza-Aviation Pkwy.

Two span arrangements resulting in three alternatives are considered. The two span arrangements consist of

- Moderate spans – spans that can accommodate Steel Plate Girder type bridges or traditional Cast-In-Place Concrete Post Tensioned Box Girders built on conventional false-work.
- Long spans- non- typical structure types, Cast-In-Place Concrete Box Girders built from above with form travelers (commonly referred to as balanced cantilever segmental construction). This arrangement resulted in an overall longer bridge length than the moderate span alternatives.

A short span arrangement was not feasible due to a minimum required span arrangement of 180 ft needed to clear the eastern most tracks utilizing an 18 ft minimum horizontal clearance from face of pier to centerline of adjacent track.

Each alternative locates the piers at least 25 ft horizontally clear from the centerline of the tracks such that crash protection barriers or walled piers are not required. For the purpose of comparative costs, all pier substructure units are assumed to be founded on drilled shaft foundations. The capacity of the drilled shafts used for this report are based on the preliminary geotechnical report prepared by NCS Consultants, November 2007. The use of spread footings at the pier locations based on the final geotechnical investigations will be evaluated during final design, however due to the large pier substructure reactions and limits of excavation adjacent to the railroad tracks, it is unlikely that spread footings will be feasible at the pier locations.

Alternative 1 (moderate spans) is a five span bridge with a total length of approximately 1147′-9″. The superstructure for this alternative is a CIP Post-Tensioned Box Girder Bridge cast on conventional falsework, with an overall depth of 10′-6″. The piers are skewed approximately 50° Lt with respect to the 22nd Street Construction C.L.

Alternative 2 (long span) is a five span bridge with a total length of 1346′-0″. The superstructure for this alternative is a CIP post tensioned segmental box girder bridge with a varying structure depth (16′-6″ at piers and 9′-0″ at abutments and at mid span.) The piers are located perpendicular to the roadway and the eastbound and westbound piers are staggered approximately 70 ft.

Alternative 3 (moderate span) is a five span bridge with a total length of approximately 1147′-9″. The superstructure for this alternative is comprised of steel plate girders with an overall depth of 10′-8″. The piers are skewed approximately 50° Lt with respect to the 22nd Street Construction C.L.

A fourth alternative – referred to as a Spliced AASHTO Girder design, was evaluated to determine its feasibility. This alternative consisted of 8 spans with a total bridge length of approximately 1035 ft. The longest span of 180 ft spans five sets of tracks. This span could be constructed utilizing spliced Type VI AASHTO Girders. The spliced girder would require temporary supports approximately 30 ft from the centerline of adjacent piers. The track arrangement does not provide the required clearance, as specified by the UPRR standards, to these temporary supports. Therefore this alternative is not feasible and was not investigated further.

For cost comparison estimates Alternative 1 and 3 will include 200′ of retaining walls such that the bridge plus wall length is equivalent to the bridge length of Alternative 2. A separate wall report for the remaining retaining walls along the project is being prepared by DMJM Harris.

5.1 BRIDGE DESIGN CRITERIA

The bridge type selection process evaluates the functional requirements to construct a bridge with respect to the practical and economical constraints imposed by roadway geometrics, site conditions, and physical limitations of

bridge structural systems. The bridge configurations evaluated in this report meet this project's functional requirements. These configurations are considered to be economical, constructible, serviceable, and aesthetically acceptable for the proposed site. Federal funding may be utilized for the final design and construction of this structure.

The design criteria used to develop the alternatives are based on:

- AASHTO LRFD Bridge Design Specifications, 3rd Edition-2004, with current interim updates.
- BNSF Railway- Union Pacific Railway Guidelines for Railroad Grade Separation Projects, January 2007
- AREMA American Railway and Maintenance-of-Way Association, 2000

5.2 FOUNDATION DESIGN

A preliminary geotechnical investigation was prepared to determine preliminary foundation recommendations for this bridge. The report, prepared by NCS, "Preliminary Geotechnical Report, 22nd Street Overpass over Aviation Parkway and the Union Pacific Railroad Tracks", dated November 1, 2007 concludes that the predominantly very dense or hard soils present at shallow depths in the vicinity of the proposed bridge location are considered suitable for both shallow spread-type foundations as well as deep foundations. Based on significant loads at the piers, and the limitation of the footing size due to proximity to the rail road tracks, only deep foundations can be utilized at the pier locations. At the abutments, the loads are significantly smaller and there are no railroad tracks within the vicinity therefore it will be more cost effective to utilize spread footings at these locations.

5.3 DRAINAGE

The bridge structure drainage will drain longitudinally along the road to a point outside the UPRR Right-of-Way and then directed to the bridge deck drains. The UPRR has restrictions on allowing drainage into their ROW therefore closed pipe drain system will be utilized. The existing bridge crosses over two existing concrete lined channels. One of the channels flows into multi barrel box culverts as it passes under the existing bridge. The channel furthest east remains an open channel as it passes under the existing bridge. Alternative 1 and 3 will require this channel to flow into a new box culvert since these alternatives locate the new Abutment 2 further west than the existing abutment and hence the channel will need to flow under the roadway embankment.

5.4 RIGHT-OF-WAY

In the segment of 22nd Street between Kino Parkway and the UPRR yard, the existing right-of-way is approximately 145 ft wide. Existing right-of-way width on the east side of the bridge is generally 130 ft, but varies from 170 ft at the bridge to 120 ft at the intersection with Tucson Blvd. The existing bridge over the UPRR yard is within a 96 ft right of way corridor. Additional right-of-way will be required.

5.5 UTILITIES

The need for bridge-supported utilities has not been established at this time. As-built roadway plans indicate that several utilities are located on both the east and west sides of the existing bridge; however, the majority of utilities do not cross the railroad property. Sanitary sewer, gas and water are located on both sides of the bridge. Overhead power is limited to the 22nd Street/Cherrybell Stravenue intersection. The only large diameter utilities are located on the east side of the bridge. They include a 27 inch diameter sanitary sewer, a 24 inch diameter waterline and a 30 inch diameter water line. The 30 inch water line runs parallel to the bridge and turns to the south outside the limits of the bridge structure. The line crosses the railroad right of way well to the south of the bridge. The 24 inch water line branches off the 30 inch across the width of the bridge. In Alternatives 1 and 3 (the shorter length bridge alternatives) the 24 inch line is adequately behind the east abutments (Abutment 2). In

Alternative 2, the 24 inch line falls between the east abutment of the eastbound and westbound bridges. Therefore, it should not be necessary to relocate these large waterlines for any of the alternatives. The 18″ sewer line may need to be relocated based on the proximity of this line to the new roadway retaining walls for all alternatives. For Alternative 1 and 3, Abutment 2 of the westbound bridge sits over the 27″ sewer line and Abutment 2 of the eastbound bridge sits over an 8″ water line. The 27″ sewer line is approximately 11 ft below existing grade and the proposed foundation at this location is a spread footing located above the sewer line. Upon discussion with the Pima County Waste Water Department, it seems likely that this 27″ sewer line will need to be relocated for Alternatives 1 and 3. The 8″ water line is only 3 ft below existing grade and may also require relocation for Alternatives 1 and 3. All other abutments locations will be clear of utilities within the bridge footprint. All pier locations for all alternatives are clear of utilities within the bridge footprint.

5.6 AESTHETICS

The project team, in conjunction with the CAC, is in the process of determining an appropriate bridge aesthetic plan via collaborative CAC design meetings and a subsequent design workshop. A project artist has been selected via the Tucson Pima Arts Council (TPAC) to participate in the aesthetic design.

5.7 CONSTRUCTABILITY AND COSTS

The 22nd Street Bridge will be constructed over the UPRR Gila Sub and Yard and the Barraza-Aviation Pkwy, consequently construction considerations are critical in determining the most effective structure type for this bridge. Railroad yard constraints will add significant cost to the project if measures are not taken to minimize railroad impacts during bridge construction. This includes minimizing both substructure and superstructure activities, time and costs through selection of the most appropriate method of construction. Erection of steel girders, false work or precast concrete girders would utilize traditional ground-based techniques requiring movement and placement of large cranes in and on railroad tracks and facilities. Coordination of a ground based erection/construction operation around UPRR operations will have substantial challenges and will reduce construction productivity. Alternatively, cast-in-place concrete box girders built from above using form travelers working from already constructed piers in a balanced cantilever fashion minimize disruption to railroad facilities and reduce unknowns associated with UPRR operations coordination since all work would be performed above the tracks. *See Figure 5.2, Erection Schematics*.

The cost estimated for each bridge does not include railroad impact costs such as improved crossings, temporary crossings, planned track shutdowns, flagger costs, etc. Further detailed construction studies should be done for the recommended structure type to approximate these costs. However the relative railroad impact costs with respect to each alternative will be considered in determining the recommended structure type.

In addition, it is desired to keep traffic flowing on the existing bridge while building the new bridge. This can be accomplished by phasing the construction of the new bridge. A proposed construction phasing plan, as shown in Figure 5.1, includes:

- Phase 1- build the northern half of the new bridge, keep traffic on the existing bridge
- Phase 2- detour EB and WB traffic to northern half of new bridge and demo existing bridge
- Phase 3- build the southern half of the new bridge, detour EB to southern half of bridge

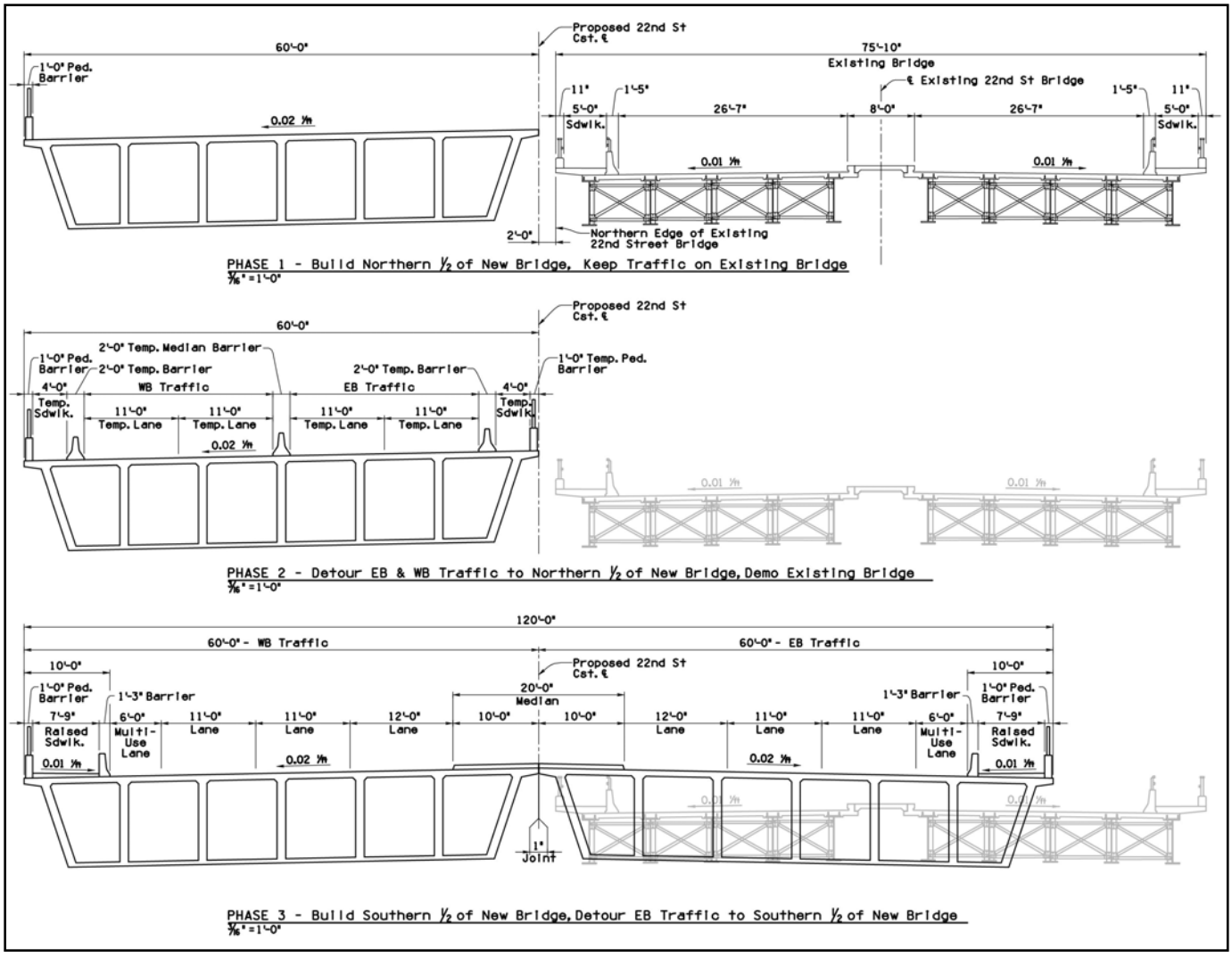
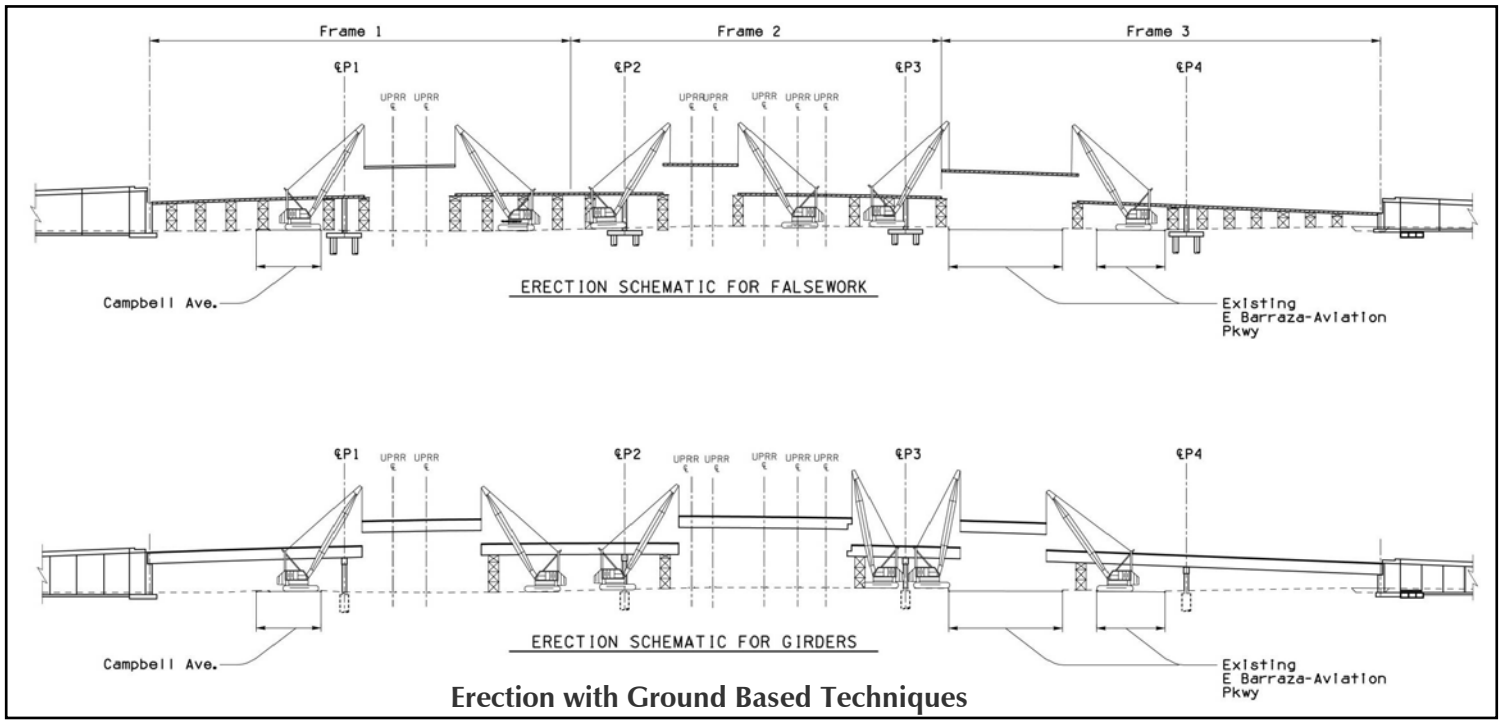
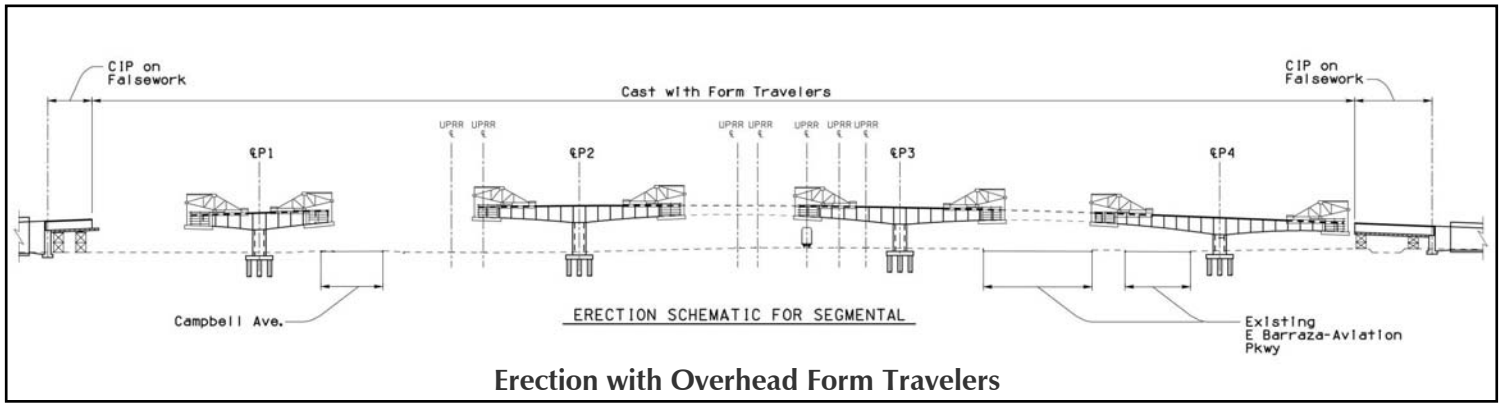


FIGURE 5.1
Construction Phasing



Erection with Ground Based Techniques



Erection with Overhead Form Travelers

FIGURE 5.2
Erection Schematics

5.8 ALTERNATIVE 1

Superstructure

The bridge consists of twin superstructures separated by a 1" joint. The overall width of each structure is 60'-0". Each superstructure consists of a CIP Post Tensioned Box Girder with interior webs spaced at 9'-2" and an 8 ½" thick deck. There are 2'-0" overhangs along each edge. The depth of the superstructure is 10'-6". The minimum vertical clearance for this alternative over the UPRR tracks is 25'-4", the minimum vertical clearance over Barraza-Aviation Pkwy is 23'-10" and the minimum vertical clearance over Campbell Ave is 22'-10". There

are 3 main spans each 260 feet long and two end spans of 180 ft each for an overall bridge length of approximately 1148 feet. Expansion joints are located at each abutment and hinge location.

Substructure

The pier type is an integral pier cap spanning between four - 4 ft diameter concrete columns. Each column is founded on 2 - 6ft diameter drilled shafts with a concrete pile cap between the shafts. The abutments are full-height abutments on spread footings. The spread footings at abutment 2 sits over the 27″ sewer line at the westbound bridge and over the 8″ water line at the eastbound bridge. Therefore these utility lines will need to be relocated for this alternative.

Constructability

This alternative will require falsework over the UPRR tracks and the existing Barraza-Aviation Pkwy. Falsework will be required to support the CIP sections until each frame is post tensioned. The vertical clearances over the Barraza-Aviation Pkwy provide ample room for falsework over existing traffic. The vertical clearance over the UPRR tracks will allow approximately 4 ft of falsework depth over the UPRR tracks to meet the required minimum 21′-0″ vertical construction clearance specified by the UPRR Railway Guidelines. Lane detours on Barraza-Aviation may be necessary during falsework construction and concrete pours.

Pier 1 is located just outside the western boundary, Pier 3 is located just east of the eastern boundary of the UPRR Right of Way, therefore construction of these piers should not cause any impact to rail road operations other than the need for flaggers. Pier 4 and Abutment 1 and 2 are completely outside the UPRR Right of Way and will not effect the rail road operations. Pier 2 is located well within the UPRR yard and will require access over two sets of tracks from the west side of the yard. The existing railroad crossing currently utilized by UPRR will most likely need to be improved to accommodate construction traffic. This crossing is shown in Figure 5.3 below.

FIGURE 5.3
West Crossing into UPRR Yard

This alternative requires ground based erection techniques to erect and then dismantle falsework and will most likely have the greatest railroad impacts as well as the most detours and lane closures over Barraza Aviation Pkwy. It will therefore take the longest of the three alternatives to construct and will have the most railroad impact costs.

Construction Cost

The estimated construction cost for this alternative (including the cost of relocating the drainage channel and the cost of 100 ft of the approaching roadway at each end for comparison to the longer alternative 2) is approximately $38,263,000. The unit bridge cost, excluding the aforementioned additions is approximately $34,437,000 or $250/SF. These costs include a 15% contingency. This alternative will have the greatest amount of railroad impact costs.

5.9 ALTERNATIVE 2

Superstructure

The superstructure consists of two single cell cast-in-place haunched Post-tensioned Segmental Box Girders constructed by the balanced cantilever method. The eastbound and westbound bridges are separated by a 1″ joint. The depth of the Box Girder varies from 16′-6″ at the piers to 9′-0″ at mid span and at the abutments. The minimum vertical clearance over the UPRR tracks is 24′-6″, the minimum vertical clearance over Barraza-Aviation Pkwy is 22′-8″ and the minimum vertical clearance over Campbell Ave is 18′-7″. The overall width of each Box Girder is 60′-0″. The box has two webs and a transversely post-tensioned top slab. The segments are longitudinally post-tensioned as the segments are erected and following the completed span. There are 3 main spans each 310 feet long and two end spans. The end spans for the Eastbound Bridge are 205 feet long for an overall bridge length of 1340 feet. The end spans for the Westbound Bridge are 185 feet and 225 feet respectively, for an overall bridge length of 1340 feet. Expansion joints are located at each abutment. It is possible to build all of span 1 and half of span 2 on traditional falsework if detouring of existing Campbell Ave during falsework erection is possible and a false work tower within 12 ft of the western track will not significantly impact railroad activity such that cost savings could be realized. This will also accelerate the construction time, as the cast-in-place on falsework portions can be constructed independently of the cantilevered segments.

Substructure

The piers consists of 13′ x 26′ rectangular hollow walled columns with 2′ thick walls supported on a 34′ x 34′ pile cap with 9 – 48″ diameter drilled shafts at each pier. The pier walls are fully integral with the superstructure at Pier 1, 2 and 3. Pier 4 acts as an expansion pier and therefore the column is not integral with the superstructure. The abutments are mid-height wall abutments supported on spread footings.

Constructability

A CIP Segmental Bridge allows the concrete superstructure to be built by overhead construction techniques, thereby leaving the UPRR tracks and roadway below uninterrupted by superstructure construction activities. A small portion of the end spans (approx 60 ft) will be built by the Cast-in-Place on falsework method, however these falsework sections are not over railroad or vehicle traffic. It is assumed only one set of form travelers will be used for construction of this bridge. The overall construction schedule can be reduced by using an additional set of form travelers but this will increase the overall costs All construction will take place overhead, requiring minimal disturbance to rail road and vehicle traffic below since building from above eliminates the need for movement and placement of heavy cranes and other construction equipment on and over active railroad tracks and vehicle traffic. Additionally superstructure construction can continue above active railroad tracks without interruption to railroad operations.

Pier 1, Pier 4 and Abutment 1 and 2 are completely outside the UPRR Right of Way and construction of these substructure elements will not effect the rail road operations. Pier 3 is located on the eastern boundary and Pier 2 is located well within the UPRR yard and will require access over two sets of tracks from the west side of the yard. Pier 3 of the east bound bridge is the closest pier to the tracks with one corner of the pier 30 ft from the centerline of the tracks. All other piers are well over 40 feet from the centerline of tracks. Therefore foundation and substructure construction will minimally impact railroad operations. Access to Pier 3 through UPRR's east

gate entrance will keep construction vehicles from crossing the tracks for the construction of Pier 3. See Figure 5.3. The existing railroad crossing currently on the west side of the yard utilized by UPRR will most likely need to be improved to accommodate construction traffic. See Figure 5.3

Once foundations and piers are built, a "pier table" is constructed atop each pier to serve as a platform for the balanced cantilever superstructure erection. All subsequent activities occur only above the tracks and construction operations in the yard are completed. While, this alternative may require the most upfront set up time for form traveler erection at the pier locations, it will have the shortest overall construction duration of the three alternatives considered and will have the least railroad impact costs.

FIGURE 5.4
Eastern Access to UPRR Yard

Construction Cost

The estimated construction cost for the bridge structure of this alternative is approximately $40,710,000. The unit bridge cost is approximately $252/SF. This alternative does not require any additional approach cost for comparison since it is the longest of the 3 alternatives. However, this alternative will allow the roadway profile to be lowered by approximately 1'-2", thus, reducing the overall roadway cost by decreasing the adjacent wall heights and the amount of roadway embankment fill. This reduction has not been accounted for in this estimate. These costs include a 15% contingency. This alternative will have the least amount of railroad impact costs.

5.10 ALTERNATIVE 3

Superstructure

The superstructure consists of twin superstructures separated by a 1" joint. The overall width of each structure is 60'-0". Each superstructure is comprised of 6 Steel Plate Girders in each span. The girders are spaced at 10'-10". There are 2'-11" overhangs along each edge. The deck slab is 9" thick. The overall depth of the superstructure is 10'-8". The minimum vertical clearance over the UPRR tracks is 25'-2" the minimum vertical clearance over Barraza-Aviation Pkwy is 23'-4" and the minimum vertical clearance over Campbell Ave is 22'-5". A Stay-in-place form system is necessary to limit the amount of formwork and stripping activity over the active railroad. There are

3 main spans each 260 feet long and two end spans of 180 ft each for an overall bridge length of approximately 1148 feet. Expansion joints are located at each abutment and hinge location.

Substructure
The pier type is a concrete pier cap spanning between four 4 ft diameter concrete columns with an 8 ft diameter drilled shaft below each column. The abutments are full-height abutments on spread footings. The spread footings at abutment 2 sits over the 27″ sewer line at the westbound bridge and over the 8″ water line at the eastbound bridge. Therefore these utility lines will need to be relocated for this alternative.

Constructability
This alternative requires ground based erection techniques including cranes and temporary shoring towers to set the Steel Plate Girder structure. Pier and drop-in girder sections would be shop fabricated and field spliced to accomplish the required span. Stay-in-place forms will be used over the UPRR tracks and Barraza-Aviation roadway to limit the amount of formwork over the railroad and roadway. Lane detours on Barraza-Aviation will be necessary during Steel Plate Girder erection and concrete deck pours.

Pier 1 is located just outside the western boundary, Pier 3 is located just east of the eastern boundary of the UPRR Right of Way, therefore construction of these piers will not cause any impact to rail road operations. Pier 4 and Abutment 1 and 2 are completely outside the UPRR Right of Way and will not effect the rail road operations. Pier 2 is located well within the UPRR yard and will require access over two sets of tracks from the west side of the yard. The existing railroad crossing currently utilized by UPRR will most likely need to be improved to accommodate construction traffic. See Figure 5.3.

This alternative will have the second greatest railroad impact costs as well as the second most detours and lane closures at Barraza Aviation Pkwy of the three alternatives.

Construction Cost
The estimated construction cost for this alternative (including the cost of relocating the drainage channel and the cost of 100 ft of the approaching roadway at each end for comparison to the longer alternative 2) is approximately $48,698,000 with a unit bridge cost, excluding the aforementioned additions, of approximately $328/SF or $45,129,000. In addition this alternative will allow the roadway profile to be lowered by approximately 1′-10″. This will reduce the overall roadway cost by decreasing the adjacent wall heights and the amount of roadway embankment fill. This reduction has not been accounted for in this estimate. These costs include a 15% contingency. This alternative will have the second greatest railroad impact costs.

5.11 RECOMMENDATIONS
The estimated construction cost for Alternative 1 and Alternative 2 is approximately the same, which is approximately 25% less ($9 million) than Alternative 3. Construction of cast-in-place concrete box girders from above using form travelers has a constructability advantage since it would create less impact to the railroad yard and the Barraza-Aviation Pkwy. Concrete is cast-in-place, and other construction materials such as forms, reinforcing steel are lighter and more manageable. The need for delivery, heavy lift mobilization and placement of large, heavy elements intrusive to the space below is eliminated. Truck mounted concrete boom pumps positioned on the existing bridge or other remote areas can deliver material to the pour without disruption to railroad operations. By progressing in balanced cantilever from pier locations, completed portions provide the work platform for subsequent operations. Therefore the construction procedures of Alternative 2 provides the least impact to railroad operations, will therefore have significantly less railroad impact costs and will also provides less impact to Barraza-Aviation Pkwy traffic, requiring less detours and lane closures. In addition, Alternative 2 will not require the 27″ diameter sewer line or the 8″ diameter water line to be relocated, resulting

in substantial savings. Pre-stressed concrete bridges have been documented to have superior durability and require less maintenance than steel bridges, therefore Alternative 1 and 2 will have lower life cycle costs than Alternative 3. This structure type will also be of similar type to the structures being evaluated for the Kino /22nd TI and provides clean lines and long elegant spans that provide superior aesthetics over the multi beam steel girder bridge of Alternative 3 and the traditional cast-in-place box of Alternative 2. The variable depth girder shape in conjunction with the long cantilever wings creates a favorable appearance. Therefore Alternative 2 is the recommended structure type for this bridge.

APPENDIX A
Construction Cost Estimates

PRELIMINARY COST ESTIMATE - ALTERNATIVE #1
(5 Span CIP Post-Tensioned Box Girder Bridge)

LUMP SUM STRUCTURE ITEMS					
ITEM NUMBER	DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST
2020162	REMOVE BRIDGE	SQ.YD.	$225	11,442	$2,574,530
6010003	STRUCTURAL CONCRETE (CLASS S) (F'C = 3,500)	CU.YD.	$500	4,170	$2,085,000
6010004	STRUCTURAL CONCRETE (CLASS S) (F'C = 4,000)	CU.YD.	$550	2,061	$1,133,550
6010005	STRUCTURAL CONCRETE (CLASS S) (F'C = 4,500)	CU.YD.	$850	13,458	$11,439,300
6011102	PEDESTRIAN FENCE AND PARAPET (B-22.60)	L.FT.	$100	2,504	$250,400
6011130	F-SHAPE BRIDGE CONCRETE BARRIER AND TRANSITION (32IN)	L.FT.	$95	2,504	$237,880
6011345	DECK JOINT ASSEMBLY (STRIP SEAL JOINT)	L.FT.	$200	772	$154,400
6011371	APPROACH SLAB (SD 2.01)	SQ.FT.	$25	12,883	$322,075
6015102	RESTRAINERS, VERTICAL EARTHQUAKE (EXPANSION)	EACH	$150	112	$16,800
6020001	PRESTRESSING CAST-IN-PLACE CONCRETE	L.SUM	$2,347,000	1	$2,347,000
6050002	REINFORCING STEEL	LB.	$1.00	4,904,200	$4,904,200
6090072	DRILLED SHAFT FOUNDATION (72")	L.FT.	$700	6,400	$4,480,000
	SUBTOTAL BRIDGE				$29,945,135
	ADDITIONAL ROADWAY COST				$3,327,000
				SUBTOTAL:	$33,272,135
				CONTINGENCY: 15%	$4,990,820
				TOTAL COST:	$38,262,955
				TOTAL BRIDGE COST/SF:	$250
				TOTAL COST/SF:	$237

Structure Name:	**Bridge Over Union Pacific Railroad**		
Superstructure Type:	**CIP Post-Tensioned Box Girder**		
Substructure Type:	**Full Height Abutments/Multi-Column Piers**		
Foundation Type:	**DS at Piers / Spreadfooting at Abut**		
No. of Spans:	**5**	Total Bridge Length (ft):	**1147.75**
Span Lengths (ft):	**180 - 3 x 260 - 180**	Width (Out to Out) (ft):	**120.00**
Skew (deg):	**50**	Area (sq ft):	**137,730**

PRELIMINARY COST ESTIMATE - ALTERNATIVE #2
(5 Span Segmental CIP Post-Tensioned Box Girder Bridge)

LUMP SUM STRUCTURE ITEMS					
ITEM NUMBER	DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST
2020162	REMOVE BRIDGE	SQ.YD.	$225	11,442	$2,574,530
6010003	STRUCTURAL CONCRETE (CLASS S) (F'C = 3,500)	CU.YD.	$500	2,966	$1,483,000
6010004	STRUCTURAL CONCRETE (CLASS S) (F'C = 4,000)	CU.YD.	$550	3,400	$1,870,000
6010060	STRUCTURAL CONCRETE (CLASS S) (F'C = 6,000)	CU.YD.	$1,000	13,600	$13,600,000
6011102	PEDESTRIAN FENCE AND PARAPET (B-22.60)	L.FT.	$100	2,792	$279,200
6011130	F-SHAPE BRIDGE CONCRETE BARRIER AND TRANSITION (32IN)	L.FT.	$95	2,752	$261,440
6011355	DECK JOINT ASSEMBLY (MODULAR, MOVEMENT RATING)	L.FT.	$750	248	$186,000
6011371	APPROACH SLAB (SD 2.01)	SQ.FT.	$25	3,720	$93,000
6015200	HIGH-LOAD MULTI-ROTATIONAL BEARINGS	EACH	$8,100	8	$64,800
6020001	PRESTRESSING CAST-IN-PLACE CONCRETE	L.SUM	$4,350,000	1	$4,350,000
6050002	REINFORCING STEEL	LB.	$1.00	4,281,700	$4,281,700
6090048	DRILLED SHAFT FOUNDATION (48")	L.FT.	$550	7,920	$4,356,000
60XXXXX	ERECTION EQUIPMENT	L.SUM	$2,000,000	1	$2,000,000
			SUBTOTAL:		$35,399,670
			CONTINGENCY:	15%	$5,309,951
			TOTAL COST:		$40,709,621
			TOTAL BRIDGE COST/SF:		$252

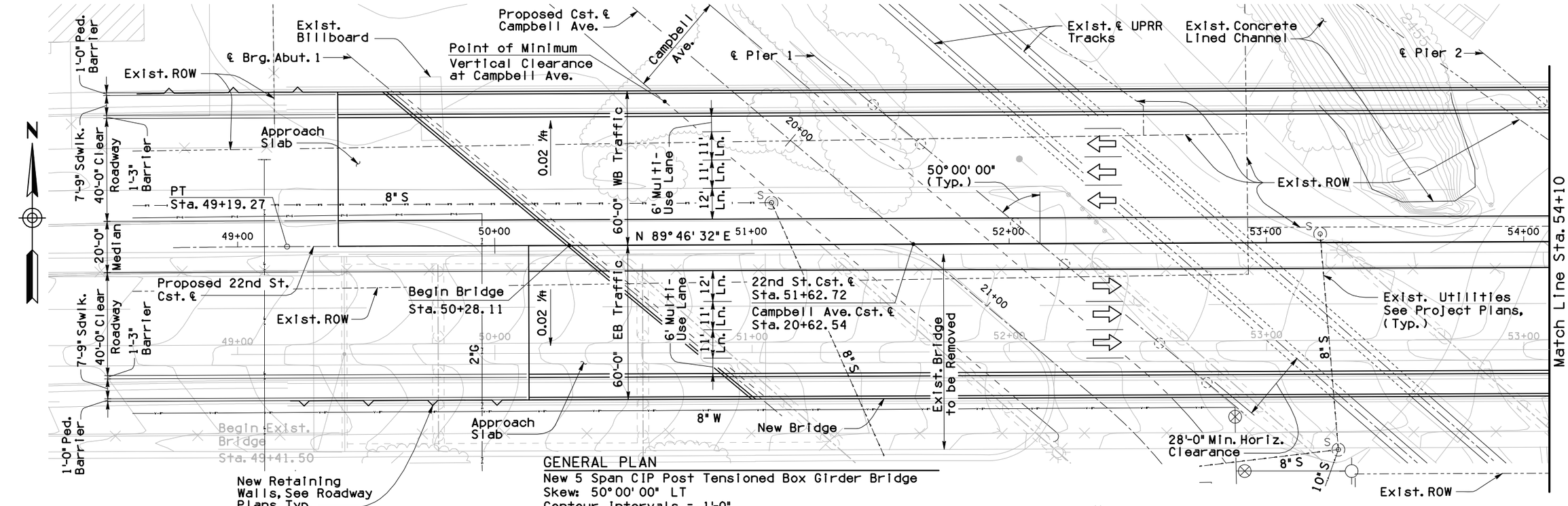
Structure Name:	**Bridge Over Union Pacific Railroad**		
Superstructure Type:	**Segmental CIP with variable depth**		
Substructure Type:	**Mid-Height Abutments/Hollow Rectangular Wall Piers**		
Foundation Type:	**DS a Piers / Spreadfooting at Abut**		
No. of Spans:	**5**	Total Length (ft):	**1346.00**
Span Lengths (ft):	**205 - 3 x 310 - 205**	Width (Out to Out) (ft):	**120.00**
Skew (deg):	**0**	Area (sq ft):	**161,520**

PRELIMINARY COST ESTIMATE - ALTERNATIVE #3
(5 Span Steel Plate Girder Bridge)

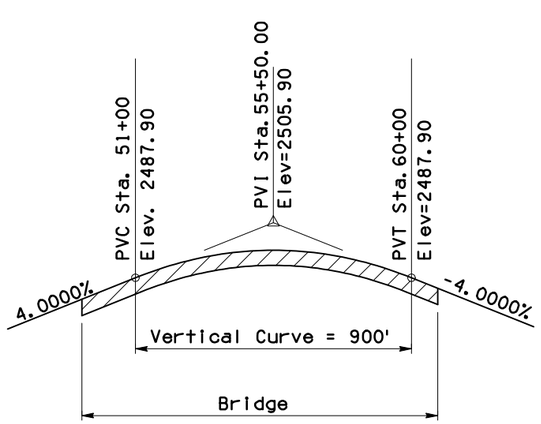
LUMP SUM STRUCTURE ITEMS					
ITEM NUMBER	DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST
2020162	REMOVE BRIDGE	SQ.YD.	$225	11,442	$2,574,530
6010003	STRUCTURAL CONCRETE (CLASS S) (F'C = 3,500)	CU.YD.	$500	4,333	$2,166,500
6010004	STRUCTURAL CONCRETE (CLASS S) (F'C = 4,000)	CU.YD.	$550	1,004	$552,200
6010005	STRUCTURAL CONCRETE (CLASS S) (F'C = 4,500)	CU.YD.	$600	4,265	$2,559,000
6011102	PEDESTRIAN FENCE AND PARAPET (B-22.60)	L.FT.	$100	2,504	$250,400
6011130	F-SHAPE BRIDGE CONCRETE BARRIER AND TRANSITION (32IN)	L.FT.	$95	5,008	$475,760
6011345	DECK JOINT ASSEMBLY (STRIP SEAL JOINT)	L.FT.	$200	386	$77,200
6011371	APPROACH SLAB (SD 2.01)	SQ.FT.	$25	12,880	$322,000
6015102	RESTRAINERS, VERTICAL EARTHQUAKE (EXPANSION)	EACH	$150	20	$3,000
6040002	STRUCTURAL STEEL (A709 Grade 50)	LB.	$2.25	11,226,115	$25,258,759
6050002	REINFORCING STEEL	LB.	$1.00	2,123,500	$2,123,500
6090096	DRILLED SHAFT FOUNDATION (96")	L.FT.	$900	3,200	$2,880,000
	SUBTOTAL BRIDGE				$39,242,849
	ADDITIONAL ROADWAY COST				$3,103,000
			SUBTOTAL:		$42,345,849
			CONTINGENCY:	15%	$6,351,877
			TOTAL COST:		$48,697,726
			TOTAL BRIDGE COST/SF:		$328
			TOTAL COST/SF:		$301

Structure Name:	**Bridge Over Union Pacific Railroad**		
Superstructure Type:	**Steel Plate Girder Bridge**		
Substructure Type:	**Full Height Abutments/Multi-Column Piers**		
Foundation Type:	**DS a Piers / Spreadfooting at Abut**		
No. of Spans:	**5**	Total Length (ft):	**1147.75**
Span Lengths (ft):	**180 - 3 x 260 - 180**	Width (Out to Out) (ft):	**120.00**
Skew (deg):	**50**	Area (sq ft):	**137,730**

APPENDIX B
Alternative Drawings



GENERAL PLAN
New 5 Span CIP Post Tensioned Box Girder Bridge
Skew: 50°00'00" LT
Contour Intervals = 1'-0"
Scale: 1"=20'



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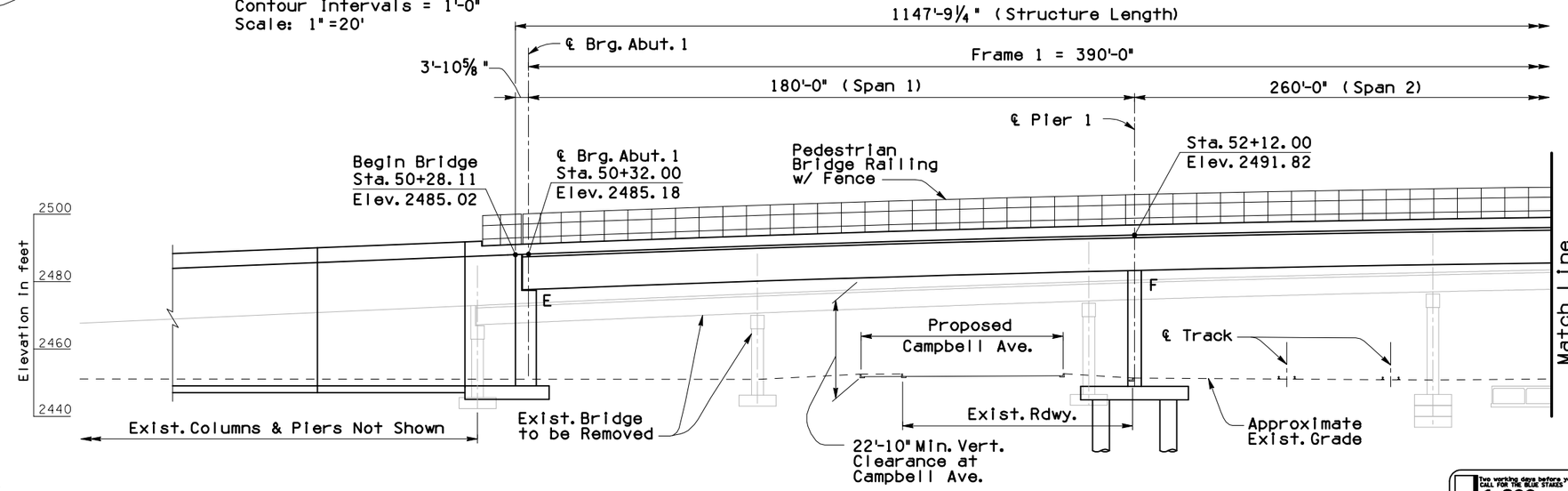

ELEVATION
Scale: 1"=20'

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BRIDGE OVER UPRR & E BARRAZA-AVIATION PKWY
PLAN & ELEV - ALTERNATIVE 1 (CIP PT BOX)

S1.1 OF S1.4

CITY OF TUCSON

DRWN. BY LMR	9/08	REF.	SCALE:
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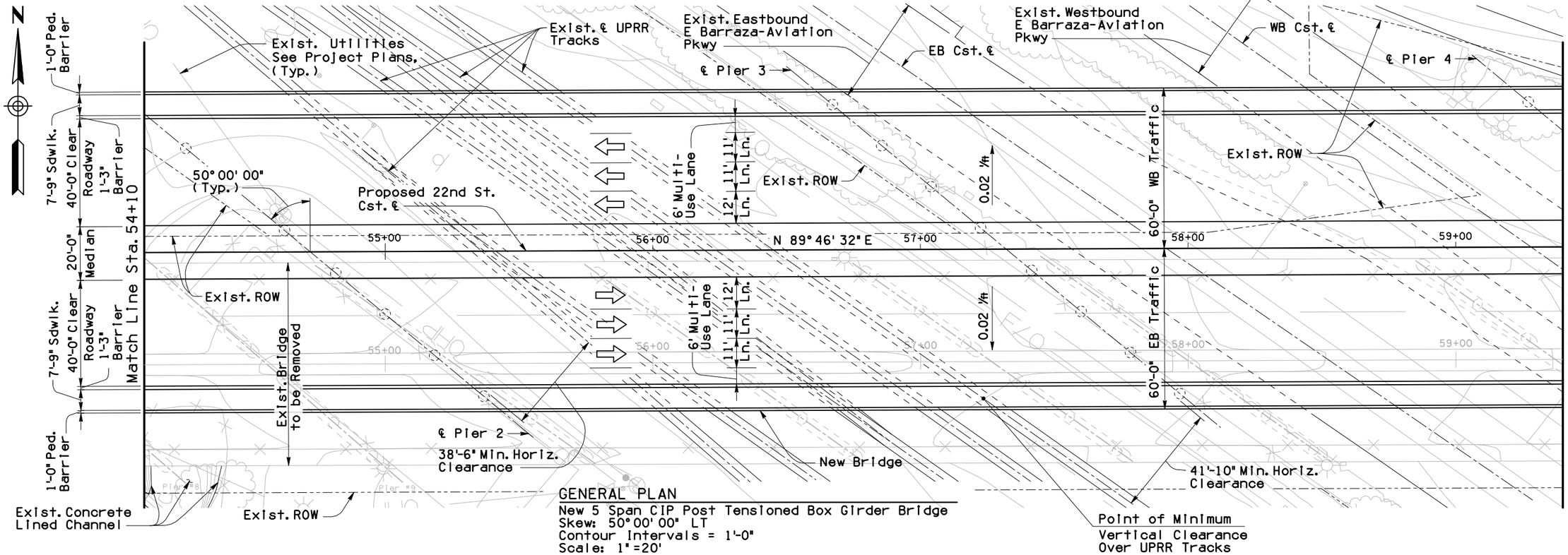
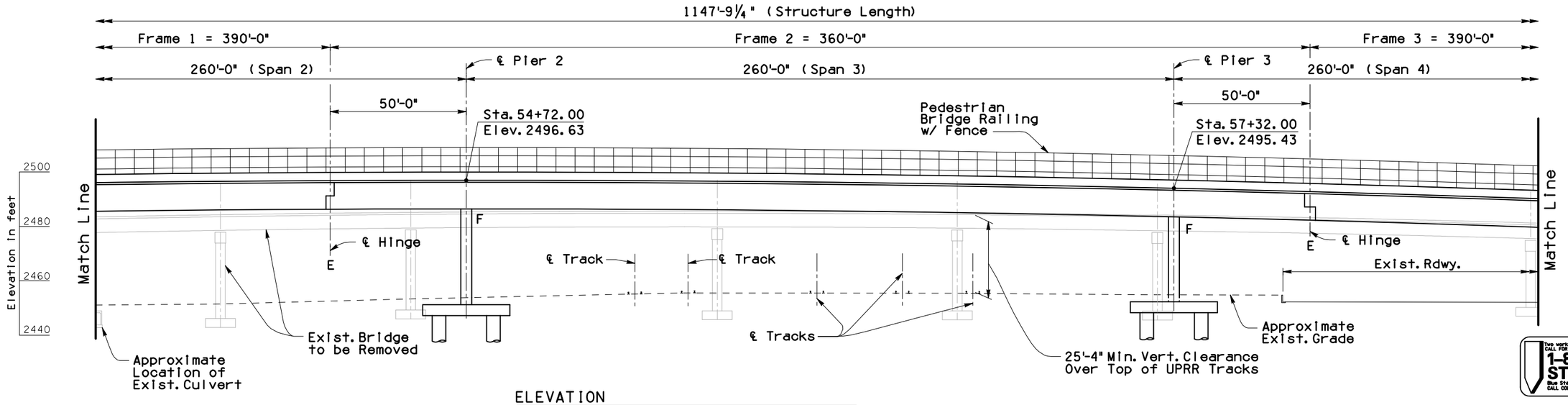


GENERAL PLAN
New 5 Span CIP Post Tensioned Box Girder Bridge
Skew: 50° 00' 00" LT
Contour Intervals = 1'-0"
Scale: 1" = 20'



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S1.2 OF S1.4

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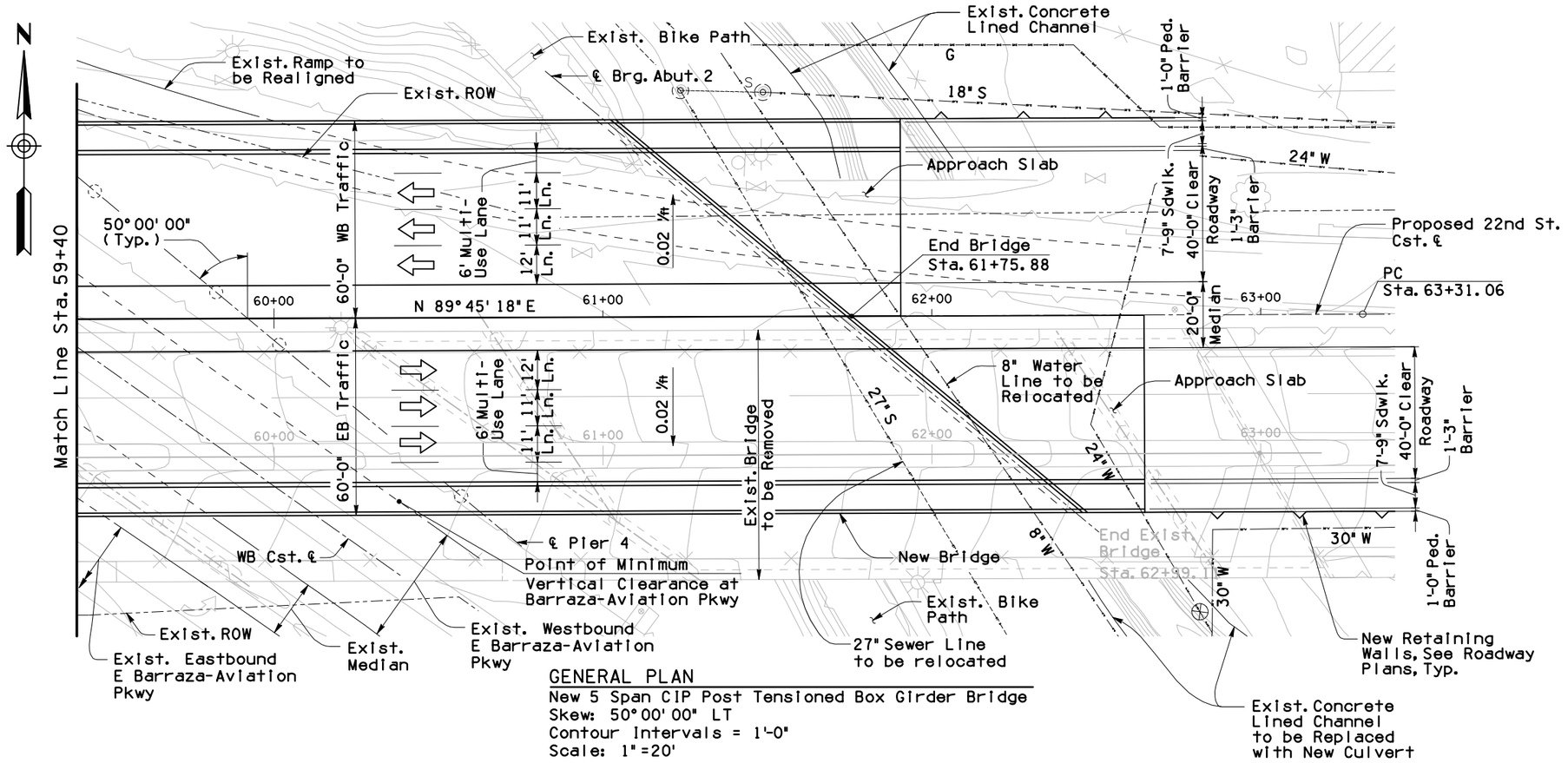
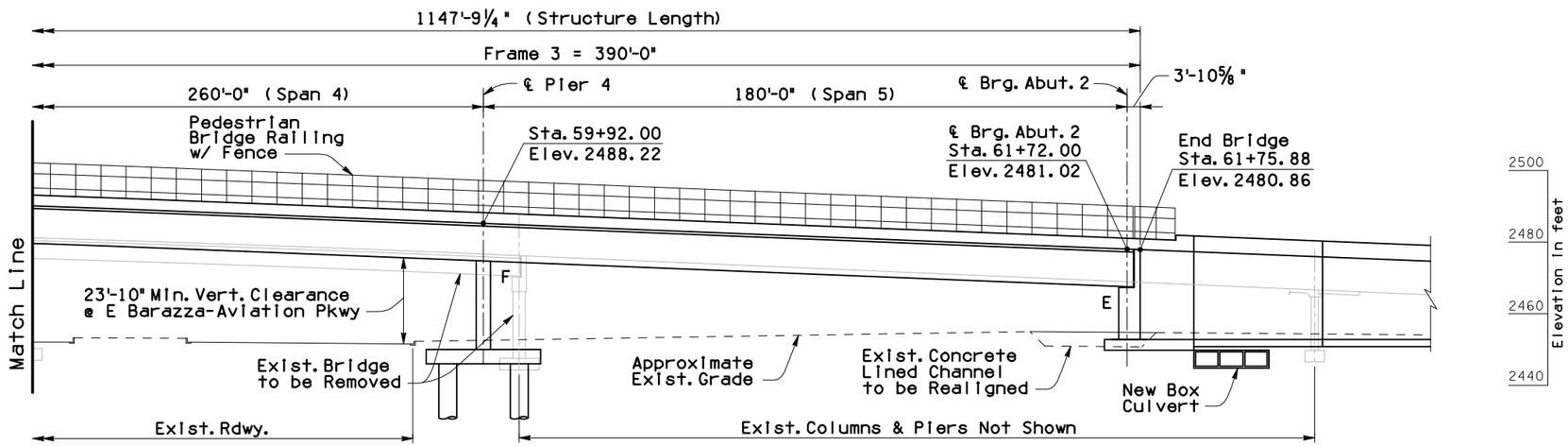


GENERAL PLAN

New 5 Span CIP Post Tensioned Box Girder Bridge
Skew: 50° 00' 00" LT
Contour Intervals = 1'-0"
Scale: 1"=20'



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Scale: 1"=20'

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BRIDGE OVER UPRR & E BARRAZA-AVIATION PKWY
PLAN & ELEV - ALTERNATIVE 1 (CIP PT Box)

S1.3 OF S1.4

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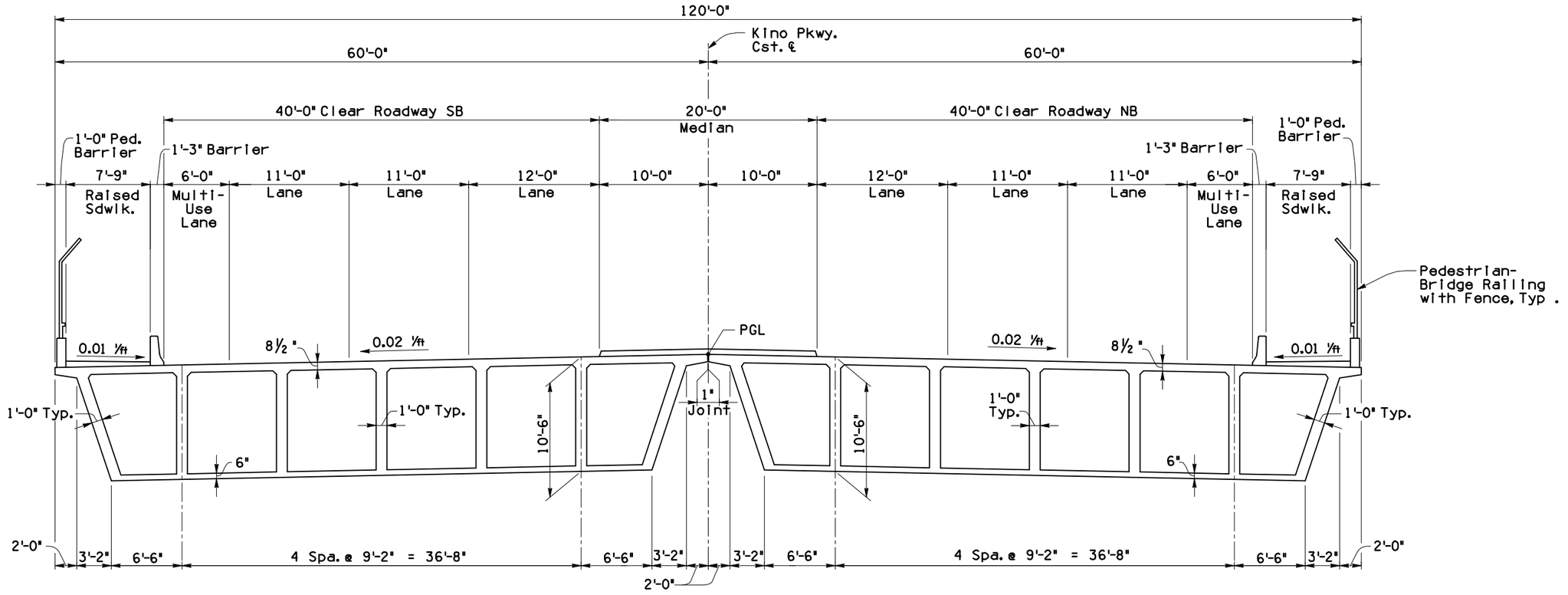

TYPICAL SECTION

3/16" = 1'-0"

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TYPICAL SECTION - ALTERNATIVE 1 (CIP PT BOX)

S1.4 OF S1.4

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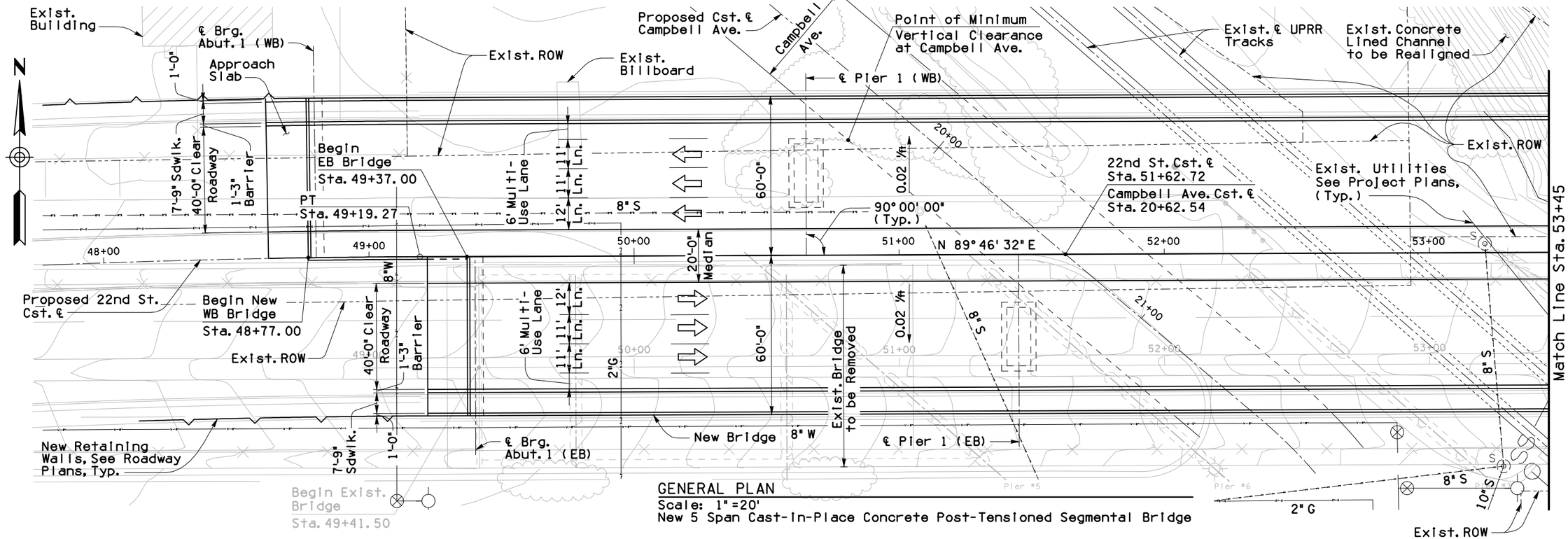
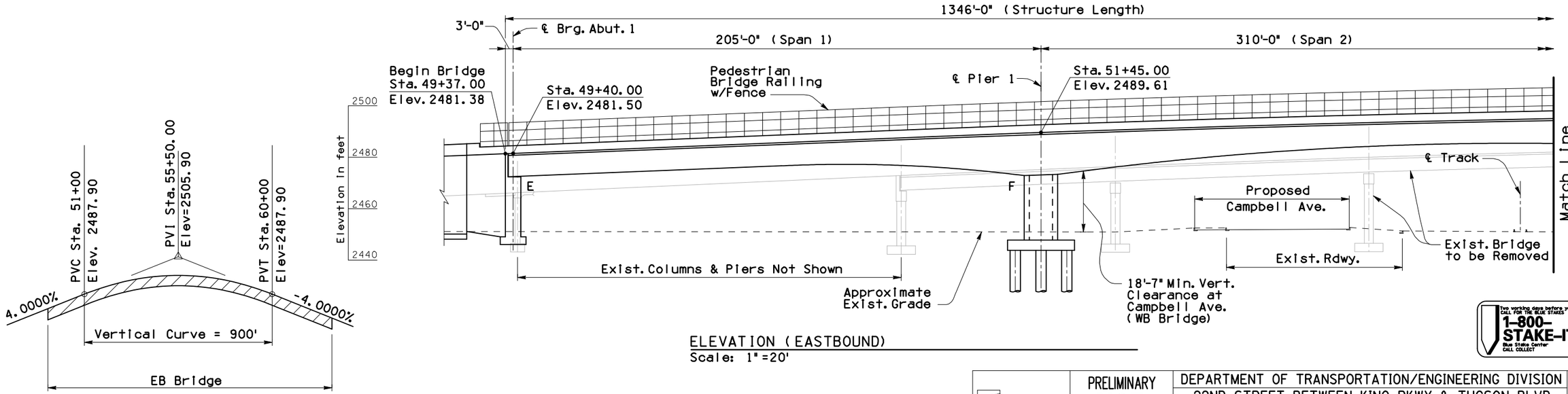


GENERAL PLAN
Scale: 1"=20'
New 5 Span Cast-In-Place Concrete Post-Tensioned Segmental Bridge



ELEVATION (EASTBOUND)
Scale: 1"=20'

PROFILE GRADE
No Scale

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BRIDGE OVER UPRR & E BARRAZA-AVIATION PKWY
PLAN & ELEV - ALTERNATIVE 2 (CIP Segmental)

S2.1 OF S2.4

CITY OF TUCSON

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CHKD. BY CGP	9/08	PLAN NO.

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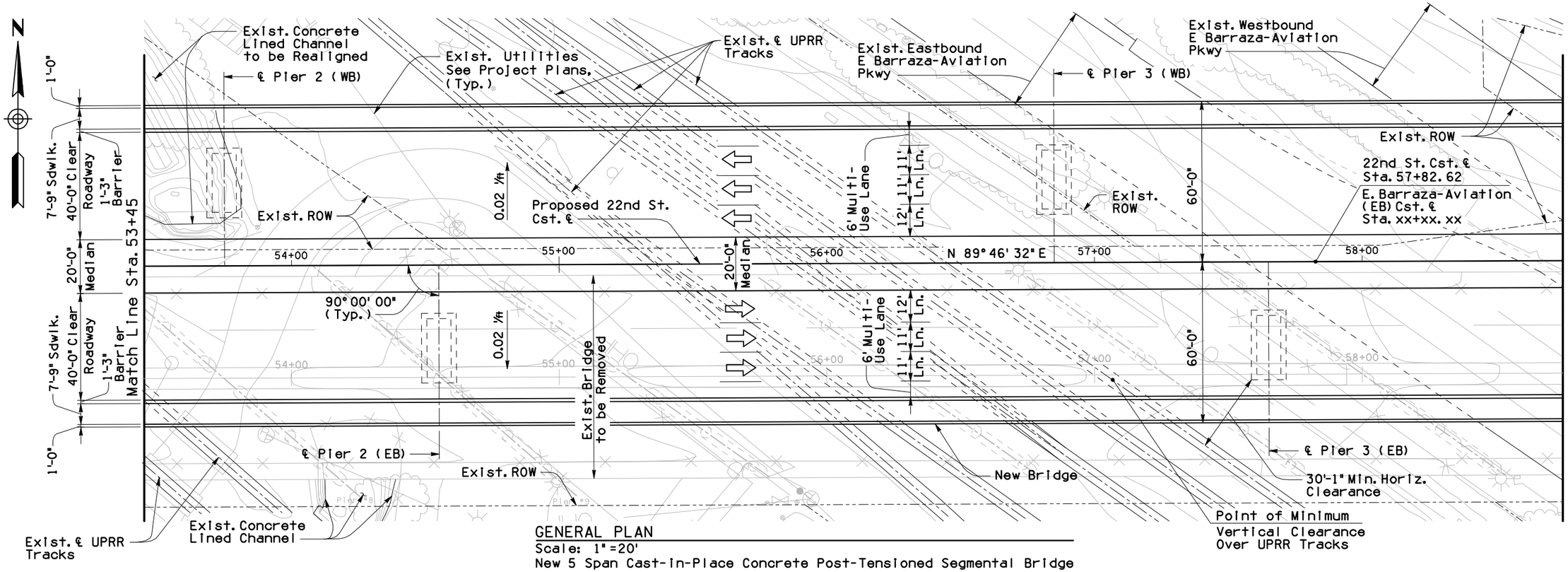
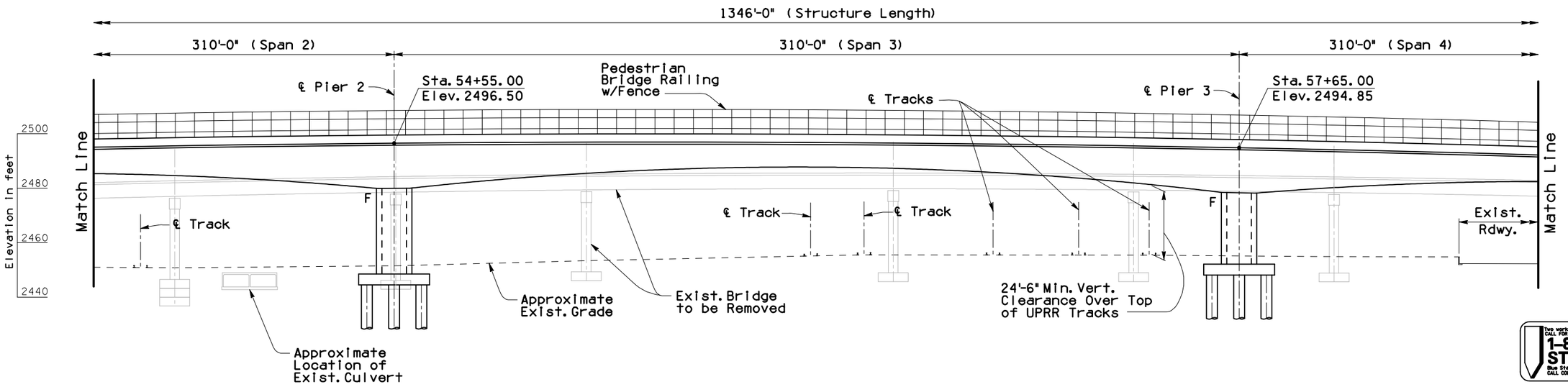


GENERAL PLAN
Scale: 1"=20'
New 5 Span Cast-In-Place Concrete Post-Tensioned Segmental Bridge



ELEVATION (EASTBOUND)
Scale: 1"=20'

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BRIDGE OVER UPRR & E BARRAZA-AVIATION PKWY
PLAN & ELEV - ALTERNATIVE 2 (CIP Segmental)

S2.2 OF S2.4

CITY OF TUCSON

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DSGN. BY AO	9/08	SCALE:
CHKD. BY CGP	9/08	PLAN NO.

NO.	DATE	REVISION	BY	CHKD.	APPR.

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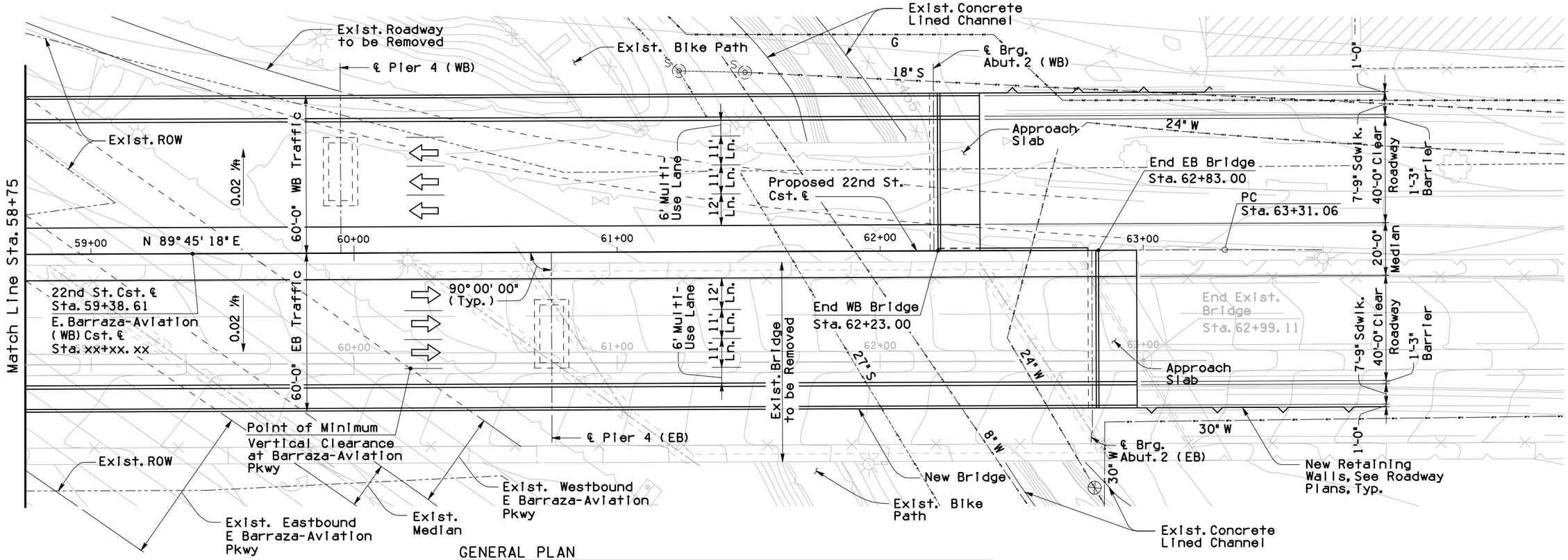
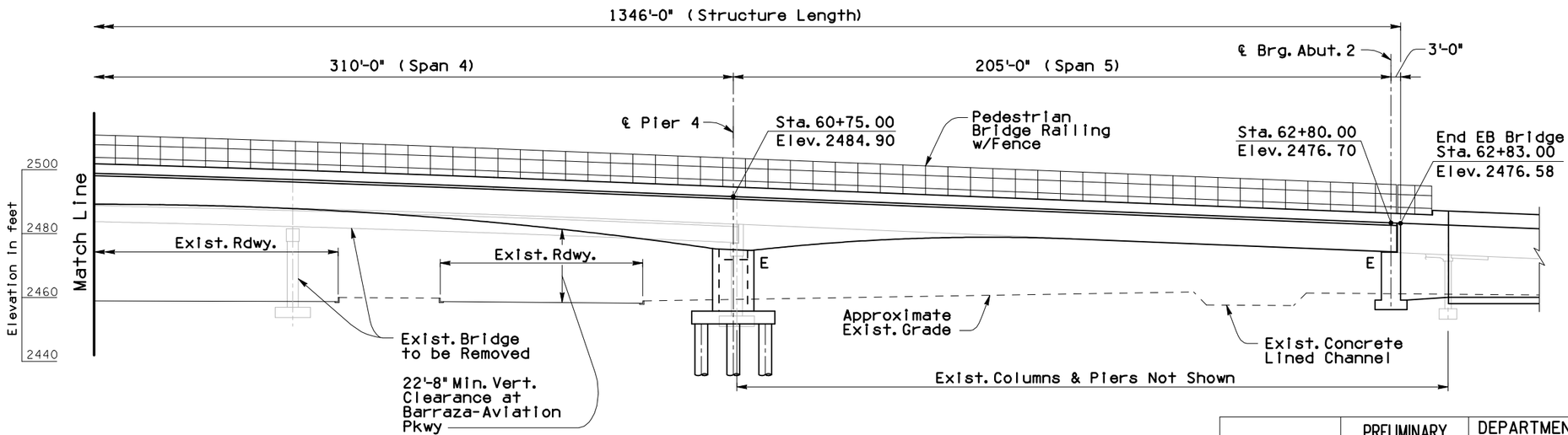


GENERAL PLAN

Scale: 1" = 20'
New 5 Span Cast-In-Place Concrete Post-Tensioned Segmental Bridge



ELEVATION (EASTBOUND)

Scale: 1" = 20'

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22ND STREET BETWEEN KINO PKWY & TUCSON BLVD
BRIDGE OVER UPRR & E BARRAZA-AVIATION PKWY
PLAN & ELEV - ALTERNATIVE 2 (CIP Segmental)

S2.3 OF S2.4

CITY OF TUCSON

DRWN. BY LMR	9/08	REF. _____ SCALE: _____
DSGN. BY AO	9/08	
CHKD. BY CGP	9/08	PLAN NO. _____

NO.	DATE	REVISION	BY	CHKD.	APPR.

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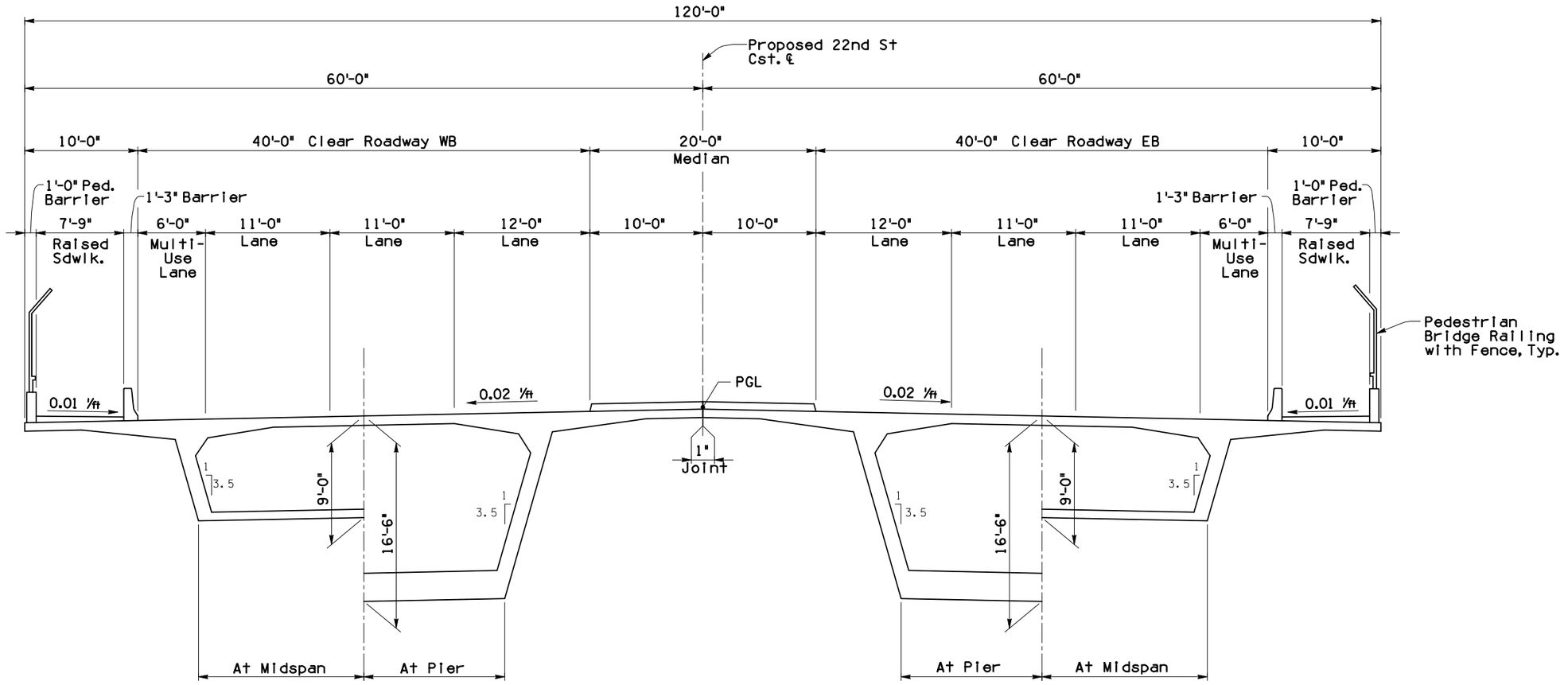

TYPICAL SECTION

3/16" = 1'-0"

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PRELIMINARY
NOT
FOR
CONSTRUCTION
OR RECORDING

DEPARTMENT OF TRANSPORTATION/ENGINEERING DIVISION

22ND STREET BETWEEN KINO PKWY & TUCSON BLVD
BRIDGE OVER UPRR & E BARRAZA-AVIATION PKWY
TYPICAL SECTION - ALTERNATIVE 2 (CIP Segmental)

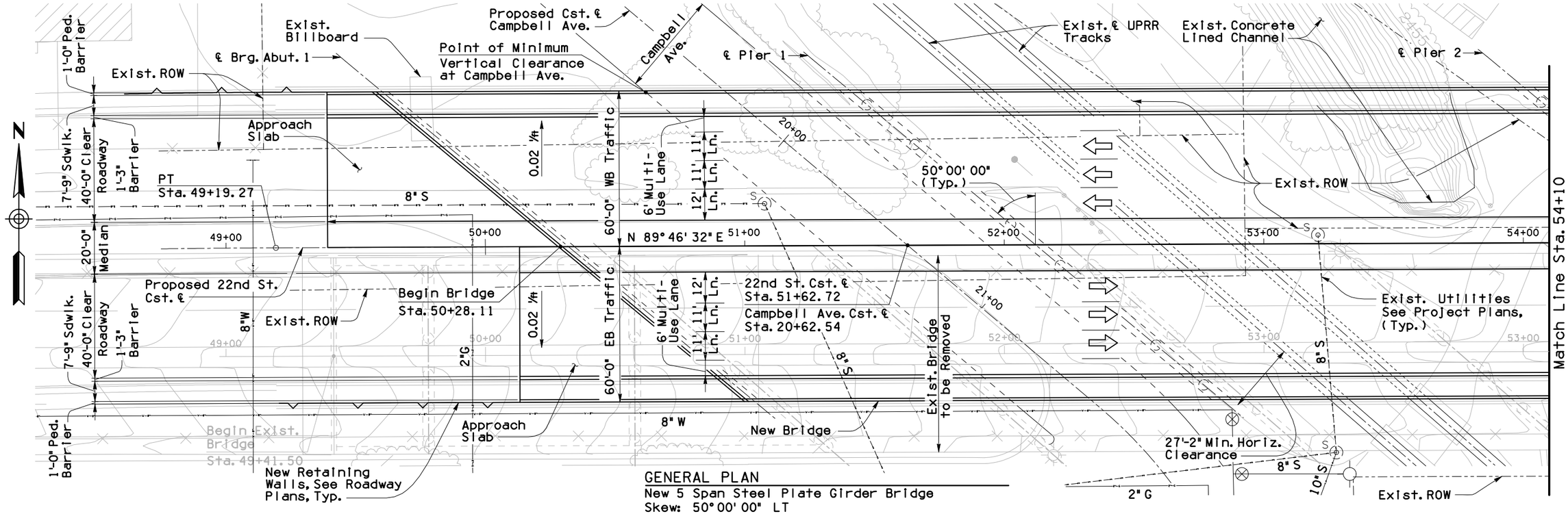
S2.4 OF S2.4

CITY OF TUCSON

DRWN. BY LMR	9/08	REF. SCALE:
DSGN. BY AO	9/08	
CHKD. BY CGP	9/08	PLAN NO.

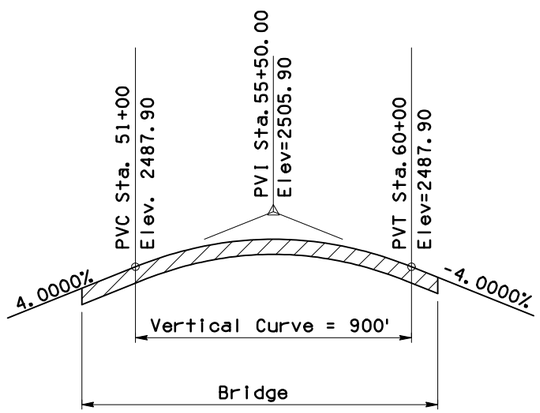
NO.	DATE	REVISION	BY	CHKD.	APPR.

W:\Jobs\2005\0540_Kino-22nd\0540_22nd-over-UPRR_SSR\0540_22nd-over-UPRR_Wrkng\Alt-2\0540_22nd_XS01-Alt-2.dgn 1/22/2009 5:45:06 PM



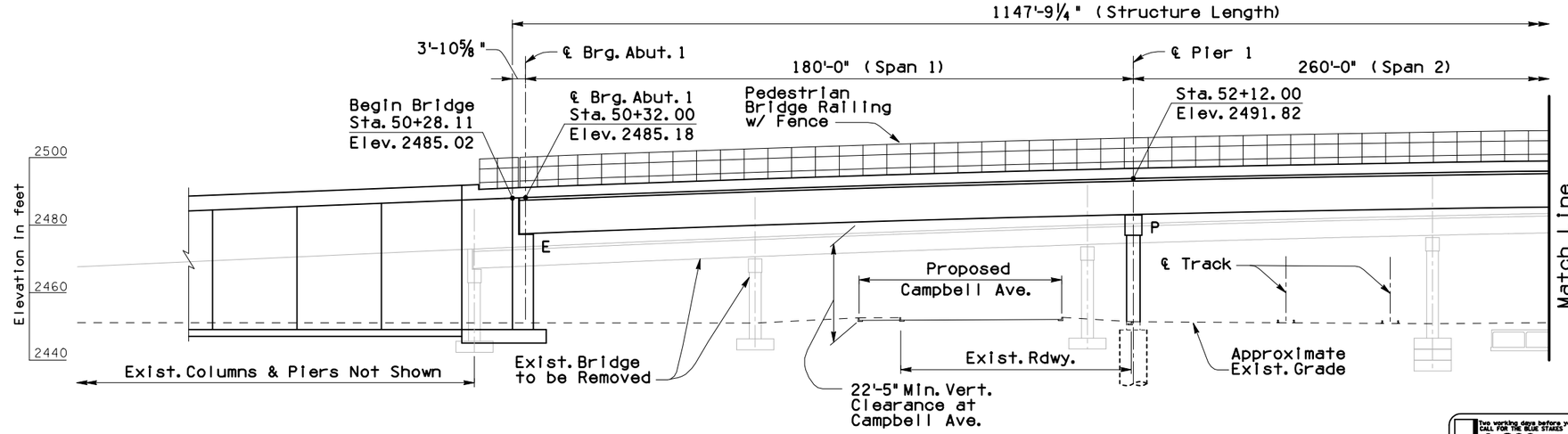
GENERAL PLAN

New 5 Span Steel Plate Girder Bridge
Skew: 50° 00' 00" LT
Contour Intervals = 1'-0"
Scale: 1" = 20'



PROFILE GRADE

No Scale



ELEVATION

Scale: 1" = 20'

Two working days before you dig. CALL FOR THE BLUE STAKES 1-800-STAKE-IT Blue Stake Center CALL COLLECT

NO.	DATE	REVISION	BY	CHKD.	APPR.

Structural Grace, Inc
1430 E. Ft. Lowell
Suite-200
Tucson, Arizona 85719
(520) 320-0156

PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

DEPARTMENT OF TRANSPORTATION/ENGINEERING DIVISION

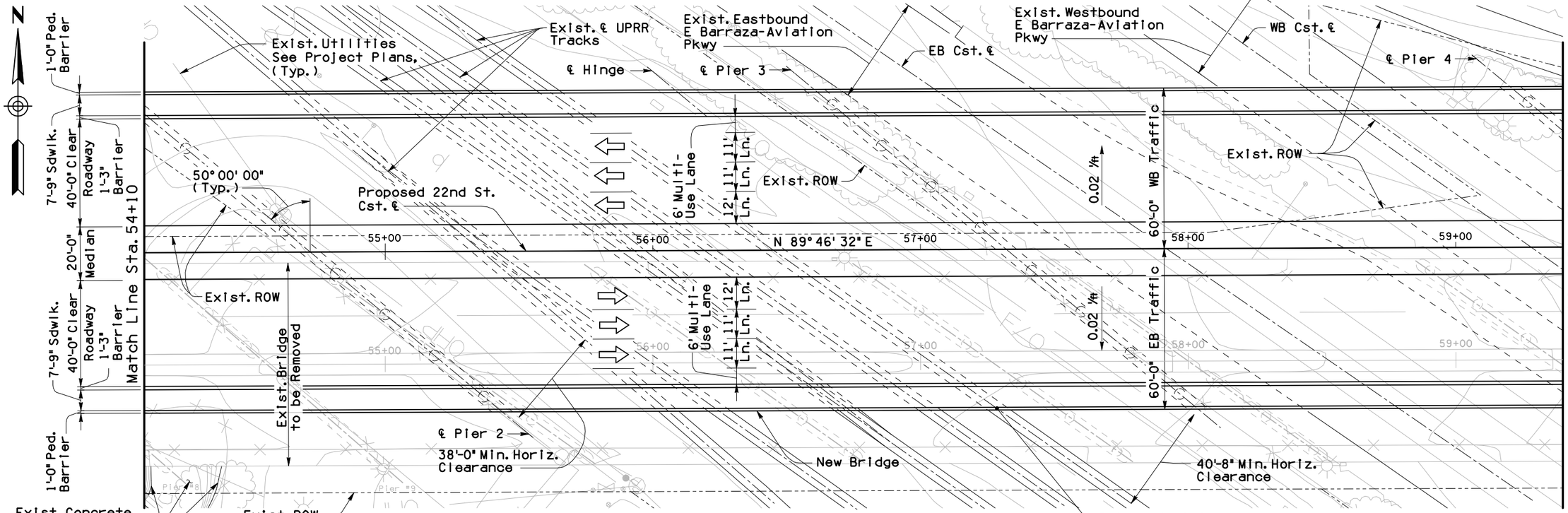
22ND STREET BETWEEN KINO PKWY & TUCSON BLVD
BRIDGE OVER UPRR & E BARRAZA-AVIATION PKWY
PLAN & ELEV - ALTERNATIVE 3 (STEEL ℄ GIRDER)

S3.1 OF S3.4

CITY OF TUCSON

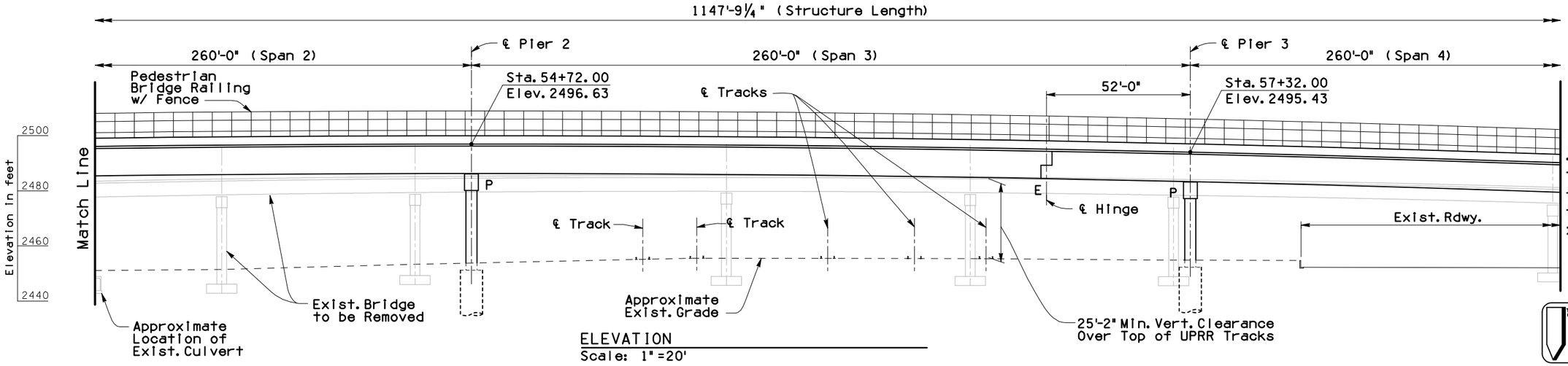
DRWN. BY LMR	9/08	REF.	SCALE:
DSGN. BY JAM	9/08		
CHKD. BY CGP	9/08	PLAN NO.	

W:\Jobs\2005\0540_Kino-22nd\0540_22nd-over-UPRR_SSR\0540_22nd-over-UPRR_Wrkng\Alt-3\0540_22nd_PE01-Alt-3.dgn 7/22/2009 5:46:02 PM



GENERAL PLAN

New 5 Span Steel Plate Girder Bridge
Skew: 50° 00' 00" LT
Contour Intervals = 1'-0"
Scale: 1" =20'



ELEVATION

Scale: 1" =20'

Two working days before you dig CALL FOR THE BLUE STAKES 1-800-STAKE-IT Blue Stake Center CALL COLLECT

NO.	DATE	REVISION	BY	CHKD.	APPR.

Structural Grace, Inc
1430 E. Ft.Lowell
Suite-200
Tucson, Arizona 85719
(520) 320-0156

PRELIMINARY
NOT
FOR
CONSTRUCTION
OR RECORDING

DEPARTMENT OF TRANSPORTATION/ENGINEERING DIVISION

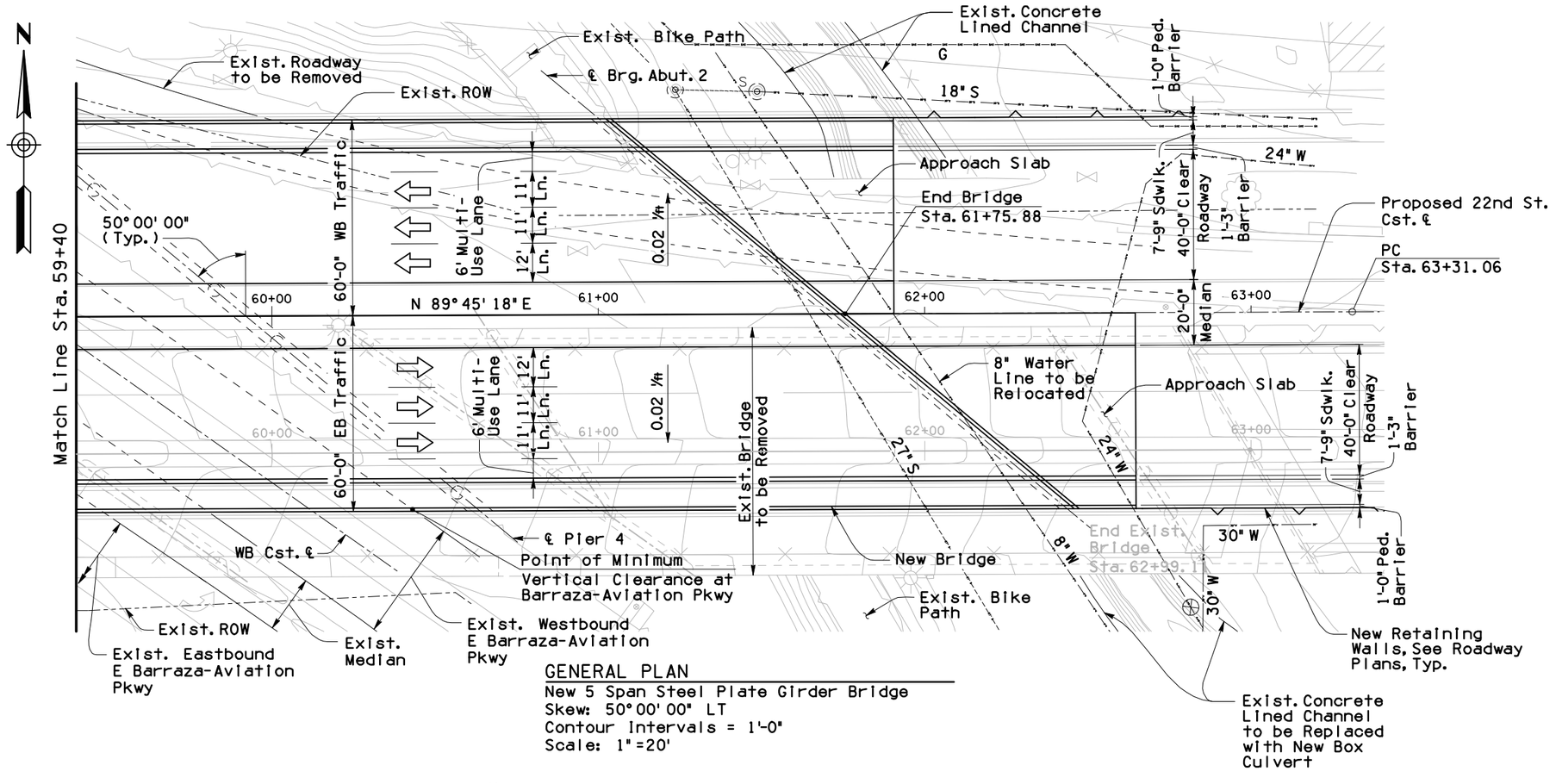
22ND STREET BETWEEN KINO PKWY & TUCSON BLVD
BRIDGE OVER UPRR & E BARRAZA-AVIATION PKWY
PLAN & ELEV - ALTERNATIVE 3 (STEEL ℞ GIRDER)

S3.2 OF S3.4

CITY OF TUCSON

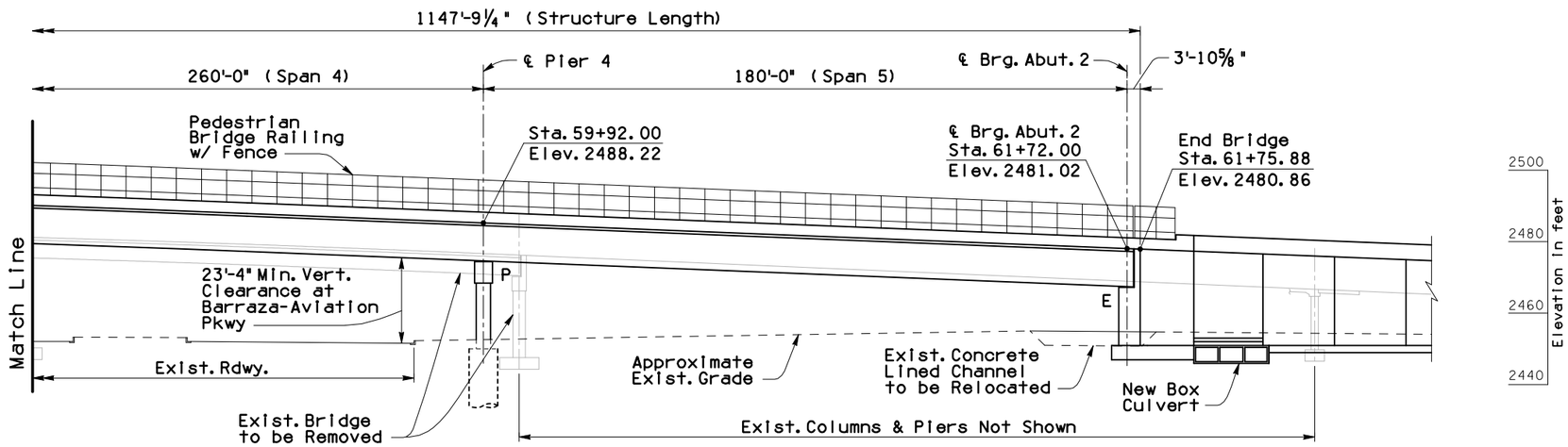
DRWN. BY LMR	9/08	REF. SCALE:
DSGN. BY JAM	9/08	
CHKD. BY CGP	9/08	PLAN NO.

W:\Jobs\2005\0540_Kino-22nd\0540_22nd-over-UPRR_SSR\0540_22nd-over-UPRR_Wrkng\Alt-3\0540_22nd_PE02-Alt-3.dgn 9/23/2009 9:32:44 AM



GENERAL PLAN

New 5 Span Steel Plate Girder Bridge
Skew: 50° 00' 00" LT
Contour Intervals = 1'-0"
Scale: 1" = 20'



ELEVATION

Scale: 1" = 20'

Two working days before you dig, CALL FOR THE BLUE STAKES
1-800-STAKE-IT
Blue Stake Center
CALL COLLECT

NO.	DATE	REVISION	BY	CHKD.	APPR.

Structural Grace, Inc
1430 E. Ft. Lowell
Suite-200
Tucson, Arizona 85719
(520) 320-0156

PRELIMINARY
NOT
FOR
CONSTRUCTION
OR RECORDING

DEPARTMENT OF TRANSPORTATION/ENGINEERING DIVISION

22ND STREET BETWEEN KINO PKWY & TUCSON BLVD
BRIDGE OVER UPRR & E BARRAZA-AVIATION PKWY
PLAN & ELEV - ALTERNATIVE 3 (STEEL PL GIRDER)

S3.3 OF S3.4

CITY OF TUCSON

DRWN. BY LMR	9/08	REF.	SCALE:
DSGN. BY JAM	9/08		
CHKD. BY CGP	9/08	PLAN NO.	

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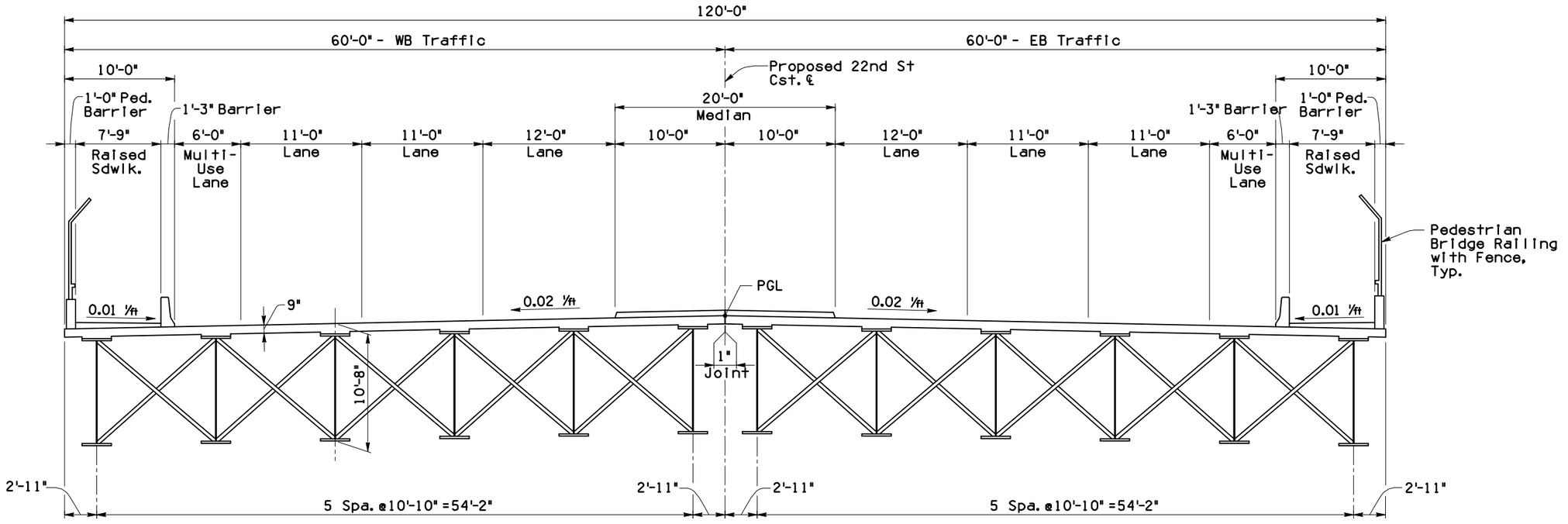


TYPICAL SECTION

3/16" = 1'-0"

Two working days before you dig, CALL FOR THE BLUE STAKES
1-800-STAKE-IT
Blue Stake Center
CALL COLLECT

Structural Grace, Inc
1430 E. Ft.Lowell
Suite-200
Tucson, Arizona 85719
(520) 320-0156

PRELIMINARY
NOT
FOR
CONSTRUCTION
OR RECORDING

DEPARTMENT OF TRANSPORTATION/ENGINEERING DIVISION

22ND STREET BETWEEN KINO PKWY & TUCSON BLVD
BRIDGE OVER UPRR & E BARRAZA-AVIATION PKWY
TYPICAL SECTION - ALTERNATIVE 3 (STEEL ℄ GIRDER)

S3.4 OF S3.4

CITY OF TUCSON

DRWN. BY LMR	9/08	REF. SCALE:
DSGN. BY JAM	9/08	
CHKD. BY CGP	9/08	PLAN NO.

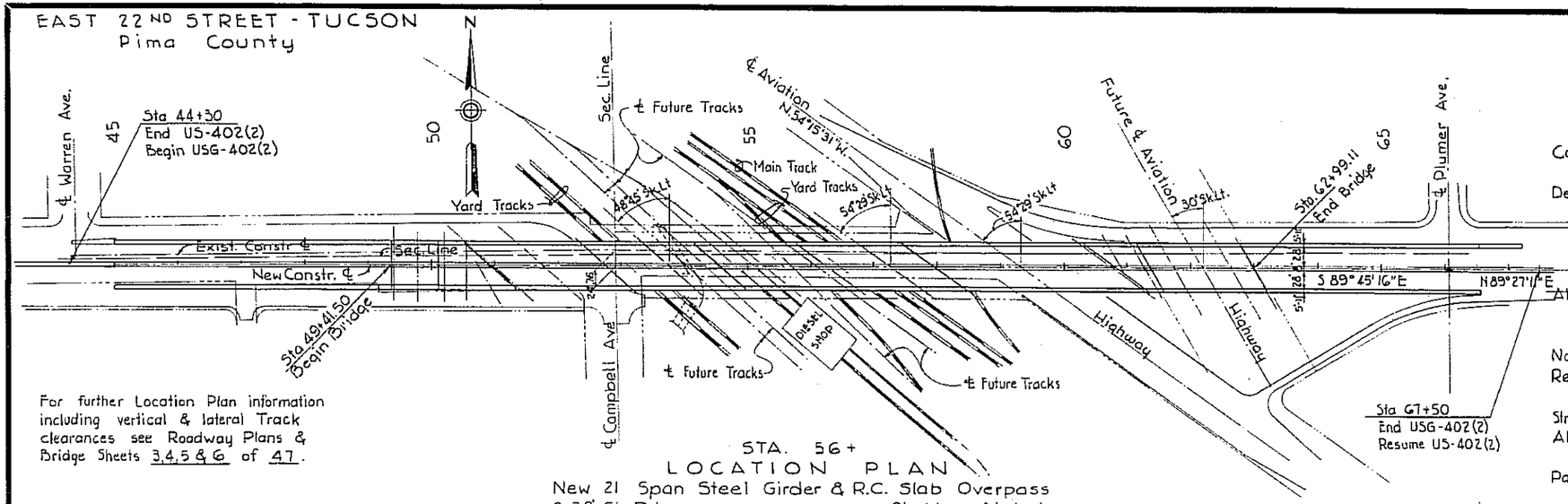
NO.	DATE	REVISION	BY	CHKD.	APPR.

W:\Jobs\2005\0540_Kino-22nd\0540_22nd-over-UPRR_SSR\0540_22nd-over-UPRR_Wrkng\Alt-3\0540_22nd_XS01-Alt-3.dgn 22/2009 5:51:50 PM

APPENDIX C
Existing Bridge Drawings

EAST 22ND STREET - TUCSON
Pima County

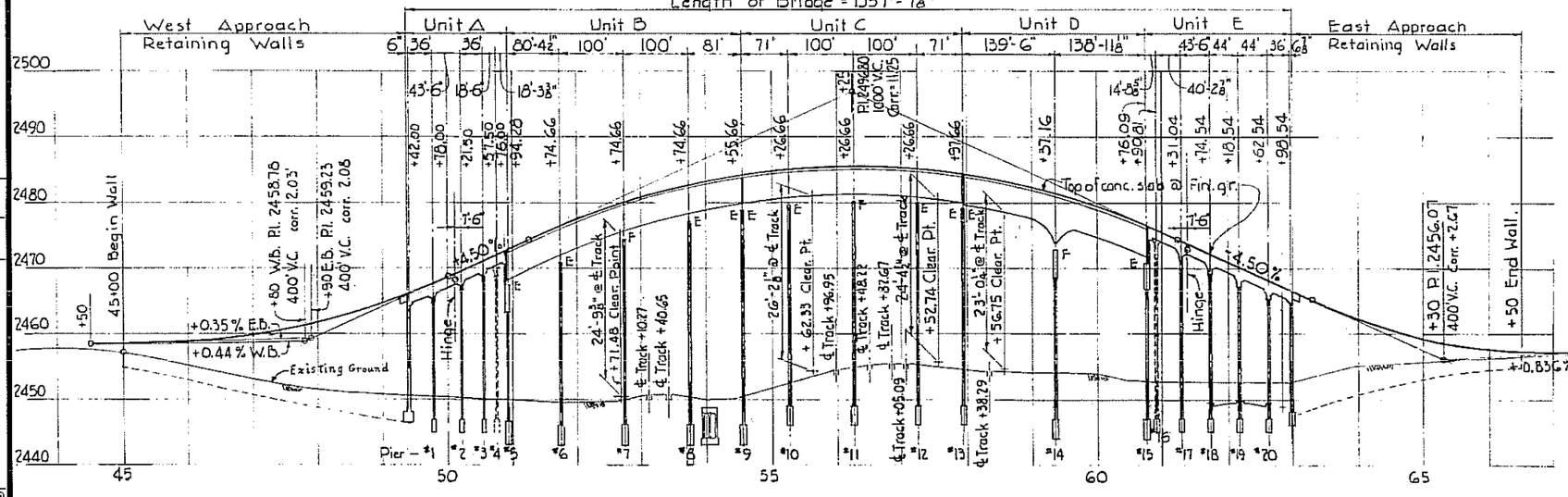
FED. ROAD DIV. NO.	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
7	ARIZONA	US-USG-402(2)	23	73	



For further Location Plan information including vertical & lateral Track clearances see Roadway Plans & Bridge Sheets 3,4,5 & 6 of 47.

STA. 56+
LOCATION PLAN
New 21 Span Steel Girder & R.C. Slab Overpass
2-28' Cl. Rdwys. Sk. Lt. as Noted

Scale: 1"=100'
Length of Bridge = 1357'-7⅜"



SECTION ON CONSTRUCTION ℄
Scale: Horiz: 1"=100' Vertical : 1"= 10'

GENERAL NOTES

Construction - Standard Specifications Arizona Highway Department Edition of 1960.
Design: A.A.S.H.O. Specifications 1961 revised to date.
Loading Class: H20 S16 1944
Composite Design: Dead load carried by steel stringers.
Negative liveload bending moment carried by steel stringers.
Positive liveload bending moment carried by composite section.
Allowable Stresses: Structural steel - f_s = 18,000 p.s.i.
Class D Concrete: f_s= 20,000 p.s.i.; fc = 1200 p.s.i ; n=10
Class A Concrete: f_s = 20,000 psi. ; fc = 1000 psi ; n=12
No wearing surface allowance in deck slab design.
Reinforcing steel shall be intermediate grade conforming to ASTM A-15 and ASTM A-305 (high bond).
Structural steel shall conform to ASTM A-7 or A-373 as shown on Plans.
All welding shall conform to American Welding Society Specifications for Welded Highway and Railway Bridges.
Paint and painting shall conform to Standard Specifications
Contact surfaces shall not be painted.
Shop paint - one coat paint #1A or #1B
Field paint - first coat paint #3 ; second coat paint #10.
Payment for the structural steel item will be made on the basis of computed net weights in accordance with Standard Specifications.
All dimensions for reinforcing steel shall be from the surface of the concrete to the center of the bar unless otherwise noted on the Plans.
All "Pneumatically Placed Mortar" on Abutment and Retaining Wall surfaces shall be of ½" thickness with no reinforcement.
Deck slab forms shall be struck before curbs & sidewalks are placed.

See Sheet #2 of 47 for table of Approximate Quantities

1-65-53

MARUM AND MARUM
HOFFMAN-MILLER ENGINEERS

LAYOUT	RAH-LWM	6-60
DRAWN	HEG	7-1-60
CHECKED	WLM	A-62

23 OF 69

	DATE
LAYOUT	
DESIGN	
ARCHITECTURE	
DRAWN	
TRACED	
CHECKED	

ARIZONA HIGHWAY DEPARTMENT
BRIDGE DIVISION

STA. 56+
EAST 22ND STREET OVERPASS
LOCATION PLAN

SHEET NO. 1 OF 47
9011 BRIDGE NUMBER
Tucson DRAWING NUMBER
BRIDGE ENGINEER

US-USG-402(2)

EAST 22ND STREET – TUCSON
Pima County

FED. ROAD DIV. NO.	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
7	ARIZONA	US-USG-402(2)	24	73	

APPROXIMATE QUANTITIES

ITEM	Std. Nº	Sheet Nº	Struc. Excav. C.Y.			CONCRETE Class A C.Y.	CONCRETE Class D C.Y.		STEEL Reinf. Lbs.	STEEL Struct. Lbs.		Spec. Hdrl. L.F.	
Abutment #1	Spec.		~~[illegible]~~	100.5		105.99		[illegible]	8,805				
Abutment #2	"		230	164.7		113.42		1[illegible]936	10,370				
Approach Slabs	"					32.00		5,354	~~5,105~~	864	P-C		
Substruct-Unit "A" W.B.	"		180	86.5		47.90		8,999	7,465				
" " E.B.	"		180	135.[illegible]		72.59		12,077	11,525				
" -Unit "E" W.B.	"		360	151.9		94.25		16,062	15,525				
" " E.B.	"		370	152.6		79.22		13,397	~~12,765~~				
Slabs - Unit "A" W.B.	Spec. R-12					24.53	251.03	[illegible]1,[illegible]32	~~63,515~~	~~6,215~~	[illegible]1,[illegible]07	~~109.74~~	1[illegible]0.7
" " E.B.	" "					41.10	341.34	69,927	~~87,480~~	~~6,339~~	6,325	194.22	134.2
" Unit "E" W.B.	" "					54.15	465.96	131,246	~~129,390~~	7,154	7,130	~~252.70~~	252.9
" E.B.	" "					41.70	404.83	116,224	~~110,760~~	7,092	7,030	~~191.68~~	131.7
Pier 5 W.B.	Spec.		110	114.4		76.95		11,338	~~10,795~~				
" 5 E.B.	"		110	114.4		78.99		11,775	~~11,170~~				
Pier 6 W.B.	"		100	[illegible]		70.99		10,587	~~9,985~~				
" 6 E.B.	"		100	[illegible].3		72.87		10,353	~~10,570~~				
Pier 7 W.B.	"		130	149.7		80.64		14,862	~~14,590~~				
" 7 E.B.	"		130	148.3		81.99		15,462	15,015				
Pier 8 W.B.	"		90	150.1		78.18		11,203	~~11,390~~				
" 8 E.B.	"		90	153.1		83.45		13,667	~~12,200~~				
Pier 9 W.B.	"		120	125.7		79.92		12,133	~~11,750~~				
" 9 E.B.	"		120	125.7		80.67		12,342	~~11,900~~				
Pier 10 W.B.	"		120	166.2		81.68		12,367	~~11,910~~				
" 10 E.B.	"		120	166.2		82.23		12,454	~~12,010~~				
Pier 11 W.B.	"		160	180.3		88.56		13,277	~~13,855~~				
" 11 E.B.	"		160	180.3		88.61		13,304	~~13,835~~				
Pier 12 W.B.	"		120	174.3		82.21		12,448	~~12,010~~				
" 12 E.B.	"		120	174.3		81.65		12,366	~~11,900~~				
Pier 13 W.B.	"		110	131.7		81.50		12,758	~~12,925~~				
" 13 E.B.	"		110	131.7		80.14		12,572	~~12,745~~				
Pier 14 W.B.	"		170	242.6		95.29		21,239	~~21,490~~				
" 14 E.B.	"		170	272.9		93.59		21,287	~~20,345~~				
Pier 15 W.B.	"		110	136.3		87.20		13,103	~~12,740~~				
" 15 E.B.	"		110	136.3		85.34		12,832	~~12,260~~				
Unit "B" W.B.	Spec. R-12					78.08	244.20	71,215	~~69,405~~	~~338,377~~	[illegible]7,[illegible]00	~~369.18~~	3[illegible].1
" E.B.	" "					78.08	244.20	71,315	~~69,405~~	~~338,377~~	337,[illegible]00	~~363.05~~	363.1
Unit "C" W.B.	" "					71.70	227.21	65,717	~~64,470~~	~~320,387~~	[illegible]3,[illegible]00	~~332.36~~	332.+
" E.B.	" "					75.47	233.57	68,[illegible]32	~~66,608~~	~~328,801~~	32[illegible]00	~~351.66~~	351.+
Unit "D" W.B.	" "					60.26	190.15	55,[illegible]3[illegible]	~~53,070~~	~~334,006~~	388,5[illegible]	~~280.74~~	296.2
" E.B.	" "					60.26	190.15	53,[illegible]97	~~53,070~~	~~331,006~~	333,5[illegible]	~~280.57~~	[illegible]30.[illegible]
Test Piers								1,372	1,372				
Precast Slabs	Spec.					190.09		32,733	~~31,455~~				
West Retaining Wall	Spec.		1,250	72[illegible].2		698.84		52,273	~~52,790~~			878.[illegible]	873.1
East Retaining Wall	Spec.		1,390	1,[illegible]0[illegible]		555.62		42,[illegible]41	~~41,295~~			~~693.36~~	691.0
TOTALS			6,780	4,216.1		4387.90	2792.64	[illegible],[illegible]3[illegible],[illegible]09	~~1,260,875~~	~~2735,618~~	[illegible]2,[illegible]1[illegible]0	~~6285.16~~	4,[illegible]8[illegible].1

DECK DRAINAGE SYSTEM – Lump Sum Item – See Sh. # 46 of 47 for Payment Note

PNEUMATICALLY PLACED MORTAR (½" thickness) 890 Sq. Yds.

See C.O. #2
See C.O. #15 (Revised)

1-65-53

MARUM & MARUM
HOFFMAN-MILLER ENGRS.

DRAWN	WLM	10/26/62
CHK'D	[illegible]	10/30/62

Registered Professional Engineer (Civil) CERTIFICATE EXPIRES DEC. 31, 1963 ARIZONA, U.S.A.

24 OF 69

	DATE
LAYOUT	
DESIGN	
ARCHITECTURE	
DRAWN	
TRACED	
CHECKED	

ARIZONA HIGHWAY DEPARTMENT
BRIDGE DIVISION

STA 56+
EAST 22ND STREET OVERPASS
APPROXIMATE QUANTITIES

SHEET NO. 2 OF 47
BRIDGE NUMBER 7011
DRAWING NUMBER TUCSON
BRIDGE ENGINEER

US-USG 402(2)

EAST 22ND STREET - TUCSON
Pima County

FED. ROAD DIV. NO.	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
7	ARIZONA	US-USG 402(2)	25	73	3-19-65 JKP

Exist. R/W
Exist 14" Std. Curb (Remove)
W.B. Service Rd.
Sta 44+40.57
45+00
Exist. ℄ N 89°35'19" E
Sec. Line N 89°39'20" E
Exist Sewer Clean Out
Catch Basin
Exist 8" Sewer (Abandon)
Exist Water Pipe (Abandon)
50+00
New Construction ℄
N 89°45'16" W
Sta. 45+00
Begin Retaining Walls
℄ Warren Ave
+96
+05.81
Exist. R/W
Catch Basin
Sta. 49+41.50
Begin Bridge
Exist 14" Std. Curb (Remove)
℄ Neff Ave
S 0°24'41" E
New R/W
E.B. Service Rd.
24'-0"
5'-11"
28'-0"
80'
75'-10"
40'-0"
5'-11"
24'-0"
6'-0"

NOTE: For Relocated Utilities & Service Road details see Rdwy. Plans.

N

Stations & Grades shown in ELEVATION are on Constr. ℄

W.B. Gutter Control Grade
Fin. Profile Grade
E.B. Gutter Control Grade
-0.01%
-0.01%
Varies
Level Line

SECTION NORMAL TO ℄ STRUCTURE
TYPICAL
from STA 49+41.50 to 62+99.11

LOCATION PLAN - SECTION 1
New 21 Span Steel Girder & R.C. Slab Overpass
2-28' Cl. Rdwys.
Sta. 56+
5k. Lt. as Noted
Scale: 1"=20'

Sta. 45+00 to Sta. 49+41.50
WEST APPROACH RETAINING WALLS

Approach Slab 12'-0" | Unit "A"
6" | 36'-0" | 43'-6" | 36'-0" | 36'-9 3/8" To Pier #5

Catch Basin Note
See Sheet #12 of 47 for Details
See Rdwy Plans for Quantities

400' V.C.
400' V.C.

+41.50 +42.00 +78.00 +21.50 +57.50
For Hinge orientation see sh. 16 of 47
7'-6"
Hinge
+90
El. 2466.97 E.B. Fin. Pr. Gr.
El. 2466.12 W.B. Fin. Pr. Gr.
El. 2469.71 E.B. Fin. Pr. Gr.
El. 2469.10 W.B. Fin. Pr. Gr.
El. 2469.65 Fin. Profile Gr.
El. 2471.27 Fin. Profile Gr.

2480
2470
2460
2450
2440

45+00
+90
+80
+0.350%
South Median Control Gr.
North Median Control Gr.
+0.440%
South Gutter Control Gr.
North Gutter Control Gr.
+4.50%
Catch Basin +64.50 Rt. & Lt.
+80 W.B. corr. 2.03' Pl. Elev. 2456.78
+90 E.B. corr. 2.075' Pl. Elev. 2455.23
corr. 0.93 Pl. Elev. 2458.26 S. Gut.
corr. 0.66 Pl. Elev. 2456.81 N. Gut.
200' V.C.
℄ 8" sewer (Abandon)
Abut. #1
Pier #1
#2

SECTION ON CONSTRUCTION ℄
Horiz. Scale: 1" = 20' Vert. Scale: 1" = 10'

MARUM & MARUM
HOFFMAN-MILLER ENGRS.

DESIGN		
DRAWN	WLM	7-8-60
CHK'D	HEG	10-25-62

REGISTERED CIVIL ENGINEER
CERTIFICATE EXPIRES
R.L.
HOFFMAN-MILLER
TUCSON
ARIZONA, U.S.A.

1-65-53 25 OF 69

	DATE
LAYOUT	
DESIGN	
ARCHITECTURE	
DRAWN	
TRACED	
CHECKED	

ARIZONA HIGHWAY DEPARTMENT
BRIDGE DIVISION

STA. 56+
EAST 22ND STREET OVERPASS
LOCATION PLAN - SECTION 1

SHEET NO. 3 OF 47
BRIDGE NUMBER 9011
DRAWING NUMBER TUCSON
BRIDGE ENGINEER

US-USG 402(2)

EAST 22ND STREET - TUCSON
Pima County

FED. ROAD DIV. NO.	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
7	ARIZONA	US-USG 402(2)	26	73	9-1-3-69 IKP

NOTE "A" (Pier #9)
Grade ground to carry drainage from downspout pipe to channel as indicated.

Note "B" (Pier #5)
Continue downspout pipe to Catch Basin as indicated. For Details see sheet #45 of 47.

For Relocated Utilities and Service Rd. details see Rdwy. Plans.

LOCATION PLAN
New 21 Span Steel Girder & R.C. Slab Overpass
2-28' Cl. Rdways.
Scale: 1"=20'

SECTION 2
Sk. Lt. as Noted

SECTION ON CONSTRUCTION ℄
Scale: Horiz: 1"=20' Vertical: 1"=10'

Shoring required where excavation falls within 1:1 slope from edge of tie. - Typical all Piers

MARUM & MARUM
HOFFMAN-MILLER, ENGRS.

Design		
Drawn	W.G.S.	7-60
Checked	W.L.M.	10-62

1-65-53 26 OF 69

	DATE
LAYOUT	
DESIGN	
ARCHITECTURE	
DRAWN	
TRACED	
CHECKED	
SHEET NO. 4 OF 47	

ARIZONA HIGHWAY DEPARTMENT
BRIDGE DIVISION

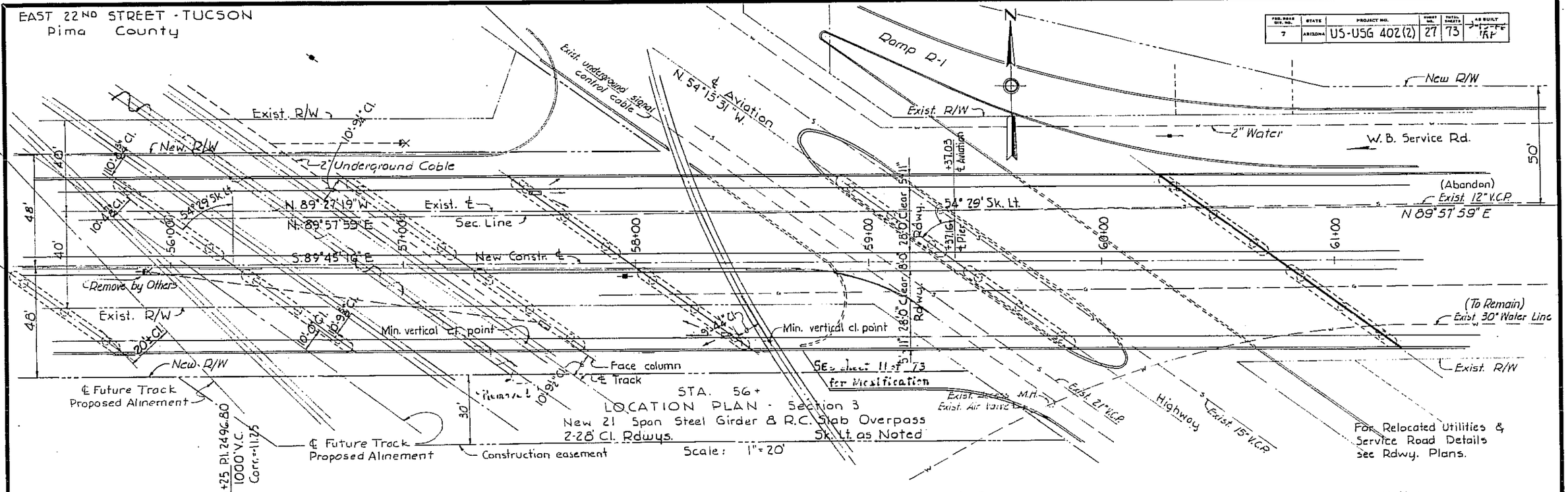
STA 36+
EAST 22nd STREET OVERPASS
LOCATION PLAN - SECTION 2

9011 BRIDGE NUMBER | TUCSON DRAWING NUMBER | BRIDGE ENGINEER

US-USG 402(2)

EAST 22ND STREET - TUCSON
Pima County

FED. ROAD DIV. NO.	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
7	ARIZONA	US-USG 402(2)	27	73	



SECTION ON CONSTRUCTION ℄
Scale: Horiz. - 1" = 20' Vertical - 1" = 10'

1-65-53

MARUM AND MARUM
HOFFMAN-MILLER ENGINEERS

LAYOUT	RAH-LWM	6-60
DRAWN	HEG	7-8-60
CHECKED	WLM	5-1-62

REGISTERED CIVIL ENGINEER — CERTIFICATE EXPIRES — R. A. Hoffman — ARIZONA, U.S.A.

27 OF 69

	DATE
LAYOUT	
DESIGN	
ARCHITECTURE	
DRAWN	
TRACED	
CHECKED	

ARIZONA HIGHWAY DEPARTMENT
BRIDGE DIVISION

STA. 56+
EAST 22ND STREET OVERPASS
LOCATION PLAN - SECTION 3

SHEET NO. 5 OF 47

9011 — BRIDGE NUMBER
TUCSON — DRAWING NUMBER
BRIDGE ENGINEER

US-USG 402(2)

EAST 22ND STREET - TUCSON
Pima County

NOTE "A" (Pier 15)
Grade ground to carry drainage from downspout pipe to channel as indicated.

FED. ROAD DIV. NO.	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
7	ARIZONA	US-USG-402(2)	28	73	

64' Lt. Constr. ℄ Sta 61+15
New 2-8'x3'x45° C.B.C. Skew 30° Lt.
See Rdwy Plans

New R/W

Exist. R/W Line

W.B. Service Rd.

Exist. 8" V.C.P.

Exist. 12" V.C.P. (Abandon)

Exist. M.H.

Sec. Line

Sta. 66+50
End Retaining Walls

Fernald N.89°38' E.

N.89°27'11"E.

35°16' Sk. Lt.

54°29' Sk. Lt.

30° Sk. Lt.

Note "A"

61+00

62+00

63+00

Sta. 62+99.11
End Bridge

64+00

65+00

50'

5'-11"

28'-0" Cl. Rdwy.

8'-0"

75'-10"

S.89° 45' 16" E.

Exist. 4" Gas Line

Exist. 30" Water Line (To Remain)

Exist. 8" V.C.P.

Exist. 8" Sewer (Abandon)

Exist. 36" C.M.P. - Remove

Exist. Conc. Encasement

Found o/s C.E.C.

Exist. R/W Line

New Channel - See Rdwy Plan sheet #10

℄ Aviation Highway

Ramp R-2

℄ F.H.

New R/W

16'

8'

For Relocated Utilities, Service Road details & Misc. Structures see Rdwy Plans.

STA. 56+
LOCATION PLAN Section 4
New 21 Span Steel Girder & R.C. Slab Overpass
2-28' Cl. Rdwys. 5k. Lt. as Noted
Scale: 1" = 20'

Unit D 138'-11⅛" to ℄ Pier #14 | Unit E 54'-11⅛" | 43'-6" | 44'-0" | 44'-0" | 36'-0" | 6⅞" | 12'-0" Approach Slab

Sta. 62+99.11 to Sta. 66+50
EAST APPROACH RETAINING WALLS

5⅛"
+76.09
1'-8⅝"
+90.81
61+25 End V.C.
+31.04
7'-6"
+38.54
El. 2474.03 Fin. Profile Gr.
+74.54
El. 2472.07 Fin. Profile Gr.
+18.54
El. 2470.09 Fin. Profile Gr.
+62.54
El. 2468.11 Fin. Profile Gr.
+98.54
+99.11
El. 2466.47 Fin. Profile Gr.
Beg. V.C. 63+30

400' VC

Sta 65+30 Corr. 2.67
PI Elev 2456.07

-4.50%

+0.836%

2480
2470
2460
2450
2440

Hinge

8'-1¼" 2@12' 5'-6" 5'-6" 2@12' 7'-1½" Cl.
Normal to ℄ Piers

30" Water Main

For Hinge orientation see sheet 16 of 47

Ft. 8" Sewer

Ft. 12" Sewer

Pier #15 | #16 | #17 | #18 | #19 | #20 | Abut. #2

Center Grinnell W.E.

SECTION ON CONSTRUCTION ℄
Scale: Horiz: 1" = 20' Vertical: 1" = 10'

1-65-53

MARUM AND MARUM
HOFFMAN-MILLER ENGINEERS

LAYOUT	RAH-LWM	6-60
DRAWN	HEG.	7-12-60
CHECKED	WLM	10-25-62

Registered Professional Engineer (Civil) Certificate No. 0 Lloyd Wilmer Marum Dec. 31, 1963 Arizona, U.S.A.

28 OF 69

	DATE
LAYOUT	
DESIGN	
ARCHITECTURE	
DRAWN	
TRACED	
CHECKED	

ARIZONA HIGHWAY DEPARTMENT
BRIDGE DIVISION

STA 56+
EAST 22ND STREET OVERPASS
LOCATION PLAN-SECTION 4

SHEET NO. 6 OF 47

9011 BRIDGE NUMBER

TUCSON DRAWING NUMBER

BRIDGE ENGINEER

US-USG 402(2)