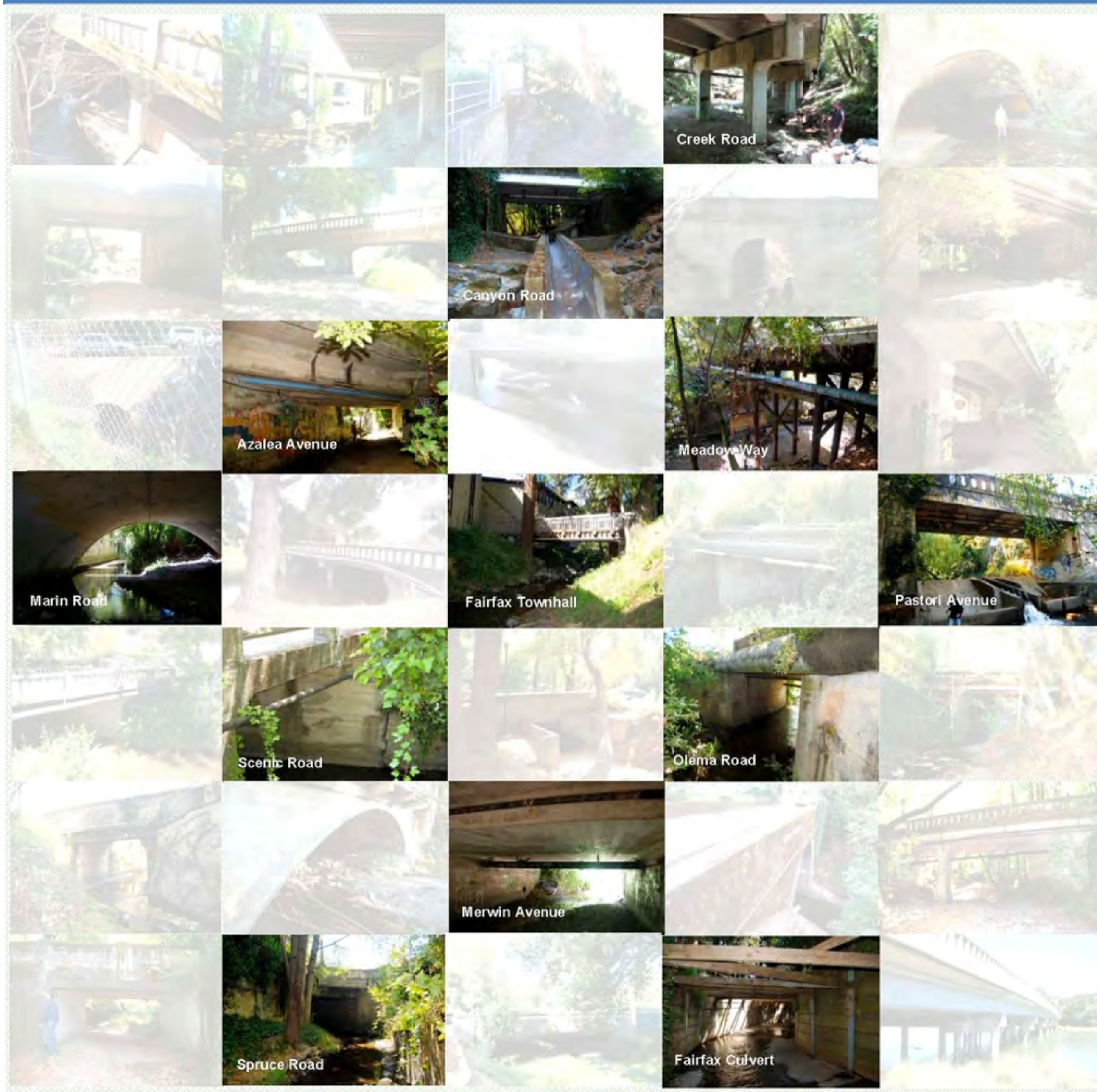
Bridge Type Selection Report for Replacement of Meadow Way Bridge over San Anselmo Creek (Bridge No. 27C-0008)



California Infrastructure Consultancy

Submitted to the Town of Fairfax

Department of Public Works

May 26, 2016

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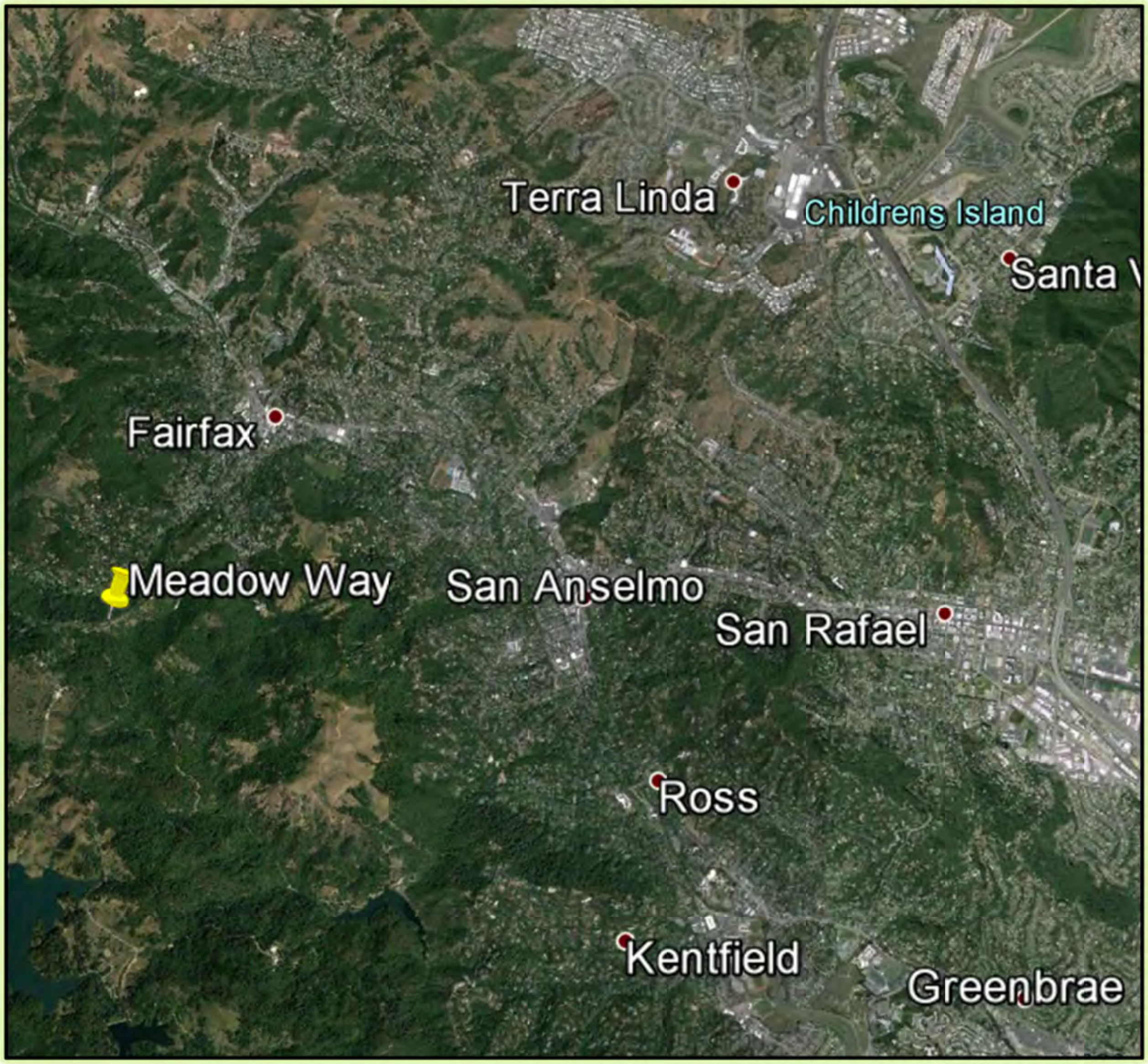


Regional Map

Location Map

EXECUTIVE SUMMARY

The existing Meadow Way Bridge is a wooden trestle-type structure constructed in early 1950s. The 70-foot long, 5-span bridge is made up of timber and few steel beams supporting a wooden deck, with a substructure of five sets of three driven timber pile extensions. The bridge has a Sufficiency Rating (SR) of 47.5, according to the latest Caltrans Bridge Inspection Report (BIR), and is Functionally Obsolete (FO). An earlier assessment report by CIC found the bridge infeasible for repairs. Due to the deficiencies of the bridge, signs of its ever-increasing maintenance needs and safety concerns, it has been determined by Caltrans the bridge needs to be replaced. Funding for bridge replacement has come from the Highway Bridge Program, supporting 88.5% of the design, environmental studies and construction costs. Additionally, for construction, the Town's 11.5% share will be paid by the State Toll Credits Program.

The new bridge deck will be at the current elevation and its length will be 70 feet long. Similar to the existing bridge, the new bridge will have a single lane. The overall bridge width will be 21'-6", allowing for a 12' lane, a 5' sidewalk, a 1' buffer between these two strips and two 1'-9" wide railings at the edges of the bridge. To minimize creek disruptions and construction time, and for better creek flow, the new bridge will be a single-span crossing. The supports will consist of a concrete abutment at each end, connecting with a retaining wall at the upstream west corner and wingwalls at its other three corners to protect the bridge and the adjacent creek banks.

The construction of the new bridge will be staged while the one-way traffic on the existing bridge is maintained. During the initial stages, and after constructing a temporary access road to the creek bed, portions of the east and west abutments and retaining walls on the south side of the existing bridge (upstream) will be built. The superstructure will then be constructed between the two abutments parallel with the existing bridge. Next, the traffic will be detoured to the new bridge, the existing bridge removed and the rest of the abutments and wingwalls on the downstream side constructed. During the next stage, the traffic will be shut down for a few hours to move the bridge a few feet north of its temporary location and to its final location in the middle of the right-of-way. Because of the short, 3.5-month long construction season in the creek, the construction of the bridge will take two seasons.

The bridge's hydraulic opening is adequate for 100-year flooding events. However, the creek crossing is located at a peculiar location where, because of a double bend in the course of the creek, the flows erode the upstream bank next to the west abutment and the opposite bank at the bridge's east abutment. For this reason, a wingwall/retaining wall on the upstream west side, an extended wingwall on the upstream east side and rock slope protection (RSP) at both abutments will be necessary.

A geotechnical program of three borings at the site, lab tests and analyses to assess the bridge abutment foundations has also been implemented. The investigation revealed the site's soils to be liquefiable during the maximum credible earthquake (MCE) to a depth of nearly 50 feet below the road surface. Deep foundations, in form of cast-in-drilled-hole (CIDH) piles, will be used to support the abutments. Because of the soil liquefaction potential, and since the new bridge will be the only access structure across the creek for the residents on the opposite side of the creek, a Structure Approach Slab Type EQ(10) will be constructed at each abutment to keep the road and bridge open after the MCE.

Three structure types, glulam (wood) arch, prefabricated steel Vierendeel deck truss and concrete arch have been evaluated, priced and compared. Additionally, for creek bank erosion control at the southwest corner of the bridge, both a mechanically stabilized embankment (MSE) and a conventional concrete retaining wall have been considered. Attributes of each bridge and wall type in light of initial and lifecycle costs, ease of construction, temporary site impacts, longevity and aesthetics were assigned scores. In this comparative context, steel superstructure with a conventional retaining wall scored the highest, although concrete arch bridge scored similarly high. Prefabricated steel bridge offers faster and less impacting construction and will be easier to relocate in the final stage. Any combination of bridge and wall alternates chosen will be made architecturally of high aesthetic value. The choice of final alternates will be primarily up to the Town.

INTRODUCTION

The existing Meadow Way Bridge is reported to have been constructed in 1950s by the U.S. Army Corps of Engineers over a relatively wide section of San Anselmo Creek at a very sharp left channel bend. The bridge is primarily made of timber, with few shallow steel beams used in two of its superstructure spans. The substructure is composed of a series of timber pile extension supports and cap beams over the piles. The bridge has five spans, is approximately 70 feet long and 14 feet wide, and supports one narrow lane of traffic plus a narrow adjacent pedestrian path, nearly 23 feet above the creek bed. It serves as the only egress and ingress facility for nearly two dozen homes across the creek from Cascade Drive. There are no bridge as-built plans available, but a Bridge General Plan and another drawing with views of its supports have been created and shown in Appendix C of this report.

This bridge is in the National Bridge Inventory (NBI) and part of the national network of bridges and roads supported by the federal government with various programs. Through Caltrans, the federal Highway Bridge Program (HBP) provides resources for inspection and documentation of the condition of such bridges every two years, assessment of their needs and input to address the deficiencies found. Caltrans produces a Bridge Inspection Report (BIR) after each inspection and shares it with the local agencies.

According to the latest Caltrans BIR (attached in Appendix D), the bridge has a Sufficiency Rating (SR) of 47.5 (out of 100) and is Functionally Obsolete (FO) due to its deck geometry. The combination of the two criteria makes the bridge eligible for replacement. In essence, Caltrans has determined the bridge is too narrow for both autos and pedestrians and is not capable of carrying standard vehicular weights and fire trucks. Additionally, it has unsafe railings, is laden with creosote, has significant foundation scour issues at one abutment and several piers, and the bank immediately upstream of the bridge is eroding in the creek. In the summer of 2015 Caltrans notified the Town about interim repairs needed to replace a wooden cap beam and the split ends of several piles, which the Town complied with at its own cost. There are also obvious signs of additional deficiencies, particularly in reference to the bridge's wooden deck.

The structure is not eligible for placement in the National Register of Historic Places (NRHP), simplifying its replacement process.

In a previous public meeting and workshop (November 2013), attended by the bridge site residents, members of the Town Council, the Town Manager and members of the Town's consulting team, several residents requested that, as an alternative to replacement, the feasibility of repairing of the existing bridge to be considered as well. To fulfill this request, CIC qualitatively investigated the condition of the existing bridge's structural elements, seismic performance, foundation scour and adjacent creek bank erosion, creosote toxicity and fire hazard, and feasibility of repairs and the final appearance. The executive summary from the assessment report appears in Appendix F of this report.

CIC's investigation concluded that, because of the condition of the existing bridge and its geometry, a new bridge deck and substructure framing system will need to be built around and through the existing bridge for repairs and, once completed, none of the existing bridge elements will be needed any longer.

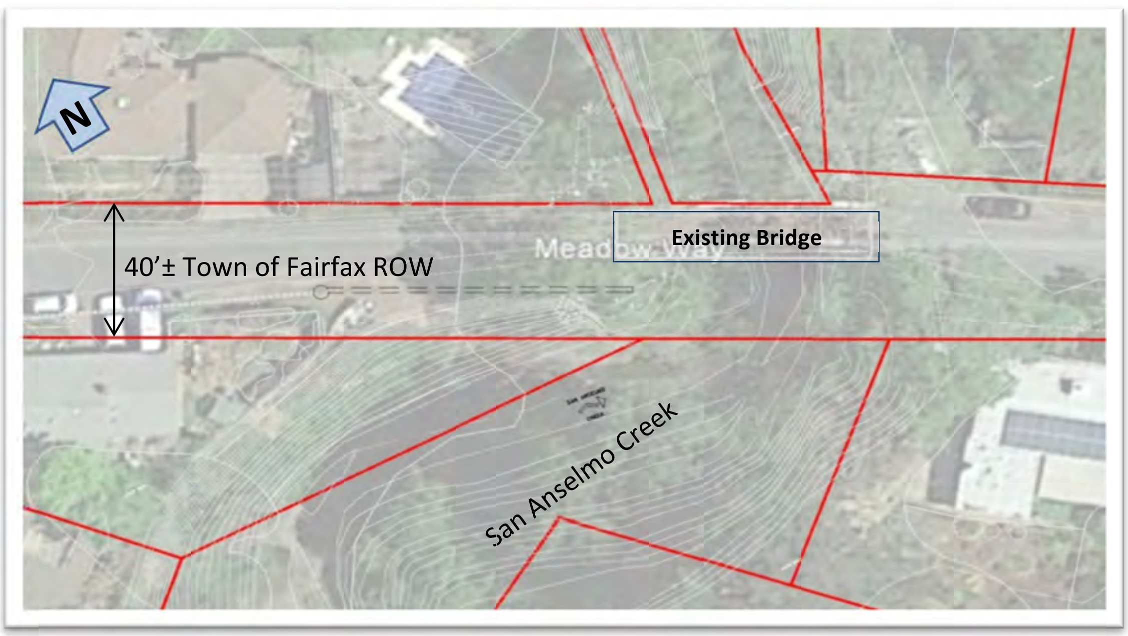
The repairs will in reality become an awkward and expensive bridge replacement exercise and completely alter the character of the existing bridge. Additionally, during the subsequent discussions, Caltrans consistently maintained that the current funding would not support studies for and repairs to the exiting bridge, which the State recognizes eligible for replacement only. However, the State did agree to support a one-lane bridge and glulam timber as one of the bridge replacement options.

The above facts regarding the infeasibility of repairs and the necessity of bridge replacement have been communicated with the Town management directly and the residents through the project's outreach efforts. This report describes three bridges types, made of concrete, steel and glulam timber, as well as conventional and mechanically stabilized embankment (MSE) retaining walls necessary to control the bank erosion immediately adjacent to the bridge. Initial and long-term maintenance costs of the three bridge types and conventional and MSE retaining walls, as well as the pros and cons of each alternate, have been presented to aid with the decision making process for an optimal bridge and wall system.

Federal funding of 88.5% for Preliminary Engineering Phase (including design and environmental process) are provided by the Highway Bridge Program (HBP). For construction, the full cost amounts are funded by HBP and Caltrans Toll Credits Program. Caltrans is the state agency overseeing the project.

SITE CONSTRAINTS AND STRUCTURE TYPES CONSIDERED

Meadow Way Bridge over San Anselmo Creek is in a wooded area within the town of Fairfax and away from the town's urban center. The average daily traffic (ADT) is 55, as reported in the 2014 Bridge Inspection Report (BIR), projected to be 109 in 2034. The existing bridge is a one-lane facility. Homes and private properties share property lines with the road's public right-of-way (ROW). Review of the official, on-file property documents by the team's licensed land surveyors show Meadow Way having a generally 40-foot wide right-of-way through the area, shown in the figure below.



Public and private property lines at the bridge site

The bridge crosses San Anselmo Creek where the flow meanders through two back-to-back bends. The first bend is just upstream of the bridge where the high-stage flows attack the west creek bank and erode the area adjacent to Abutment 1 of the bridge. The high-velocity flows then bounce to the other side and undermine an existing toe wall in the area below the east abutment (Abutment 2) at the other bridge end. The details of these impacts are shown in the next two exhibits.

Creek flow, bank erosion and bridge abutment scour

Scour under fortifications of east abutment, as well as 3.5'± of creek bed drop at Bent 5

Since the bridge is set in its current crossing, the above hydraulic impacts and preventive mitigation for them will need to be built into the new bridge design and its abutments. Early in the preliminary design it was decided that a retaining wall at the upstream west bank, connecting with that bridge abutment, wingwalls at the other three corners of the bridge, and rock riprap armoring the abutments and walls would be necessary to maintain the stability of both the bridge and its adjacent embankments. Accordingly, this Bridge Type Selection report considers options and alternates for a retaining wall adjacent to Abutment 1, and takes into account the riprap protection needed at both bridge abutments.

The current condition of the bridge deck and local signage slows down the low volume of auto crossings to a five-mile per hour crawl at the bridge. The residents prefer this condition and have insisted on the new bridge remaining a one-lane structure. The Town of Fairfax received a design exception from

Caltrans to build the bridge with one lane as long as the clear distance between the barriers will not be less than 18 feet.

Because Meadow Way becomes a dead-ended road after crossing the creek, and there is no other exit route available for some two dozen homes on the east side of the creek, access must remain available for both autos and pedestrians during the entire bridge replacement construction period. Parking the cars on the Cascade side and walking home is not an option if the bridge is not there. This necessitates a staged construction approach, keeping the existing bridge open to traffic while the new bridge is being constructed. An option would be to construct the new bridge next to the existing in the first stage and relocate it to the middle of the road in the subsequent stage, after removing the existing bridge.

The new crossing will be a single-span bridge resting on two concrete abutments. Based on preliminary environmental studies, it is understood bridge construction in the creek can only take place after June 30 here and must end by October 15 because of the spawning and migration time for California Central Cost (CCC) Steelhead fish. This is a substantial reduction of the normal window of April 15 through October 15 for working in the creek. The lost two and a half month of allowable time pushes the bridge construction to two seasons. The goal will be to install the bridge in its temporary location during the first season and complete the project the following year.

Because of tight ROW, bridge construction sequencing at this site will be challenging. The goal is to have the new bridge be ultimately located in the middle of the existing ROW so that it is the same distance away from the homes on each side. In this light, CIC has developed a four-stage process for bridge and retaining wall construction, described below and shown on the following four pages, which will result in the new bridge being in the middle of the ROW:

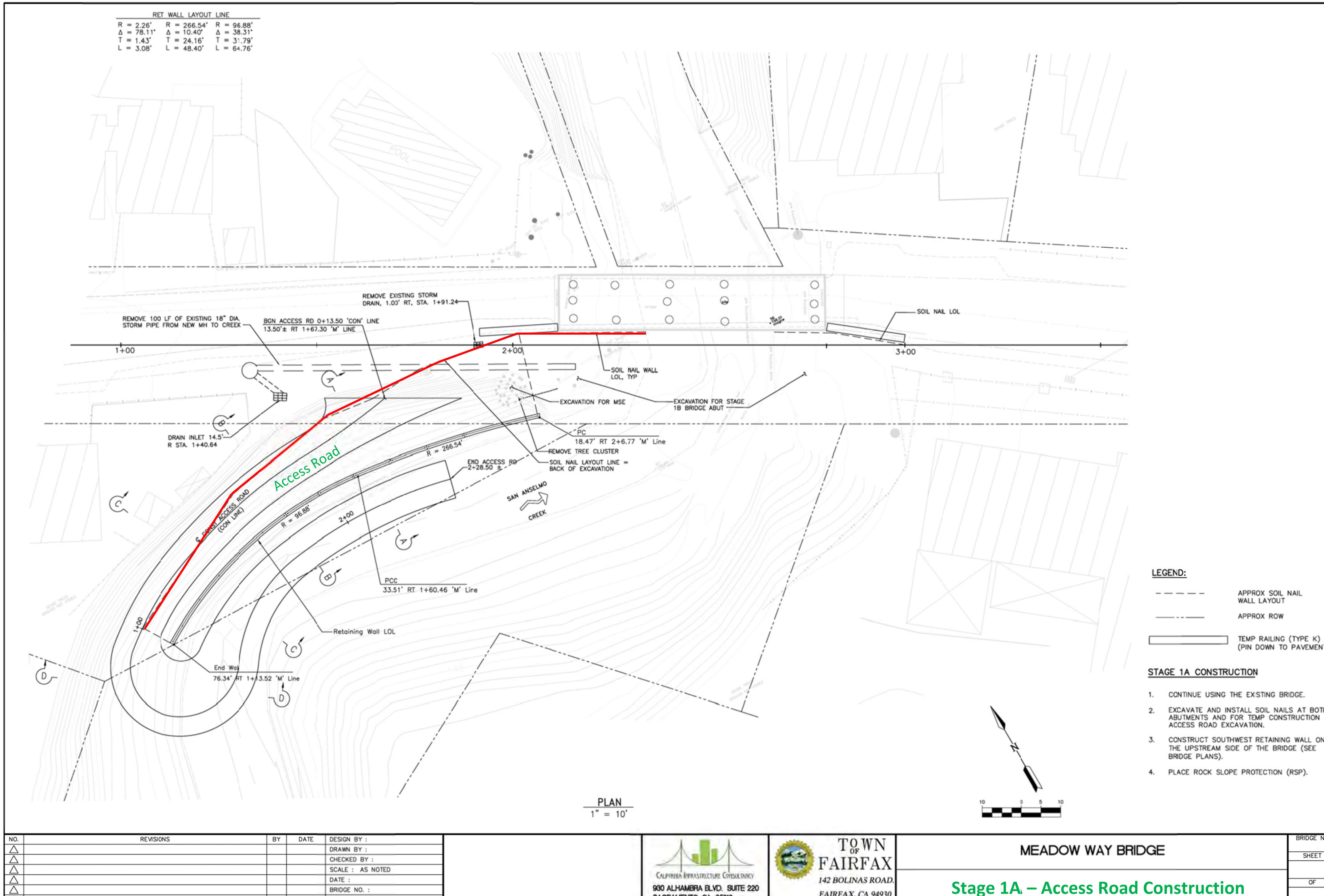
Stage 1A - Maintain traffic on the existing bridge and separate the work area from the traffic with temporary railing. Construct an access road from Meadow Way to the creek bed at the southwest quadrant of the bridge location. This access road will sit above the same long upstream retaining wall that will be protecting Abutment 1 and the creek bank immediately adjacent to the bridge. This road will be used to transport materials and equipment to and from the creek bed area for construction.

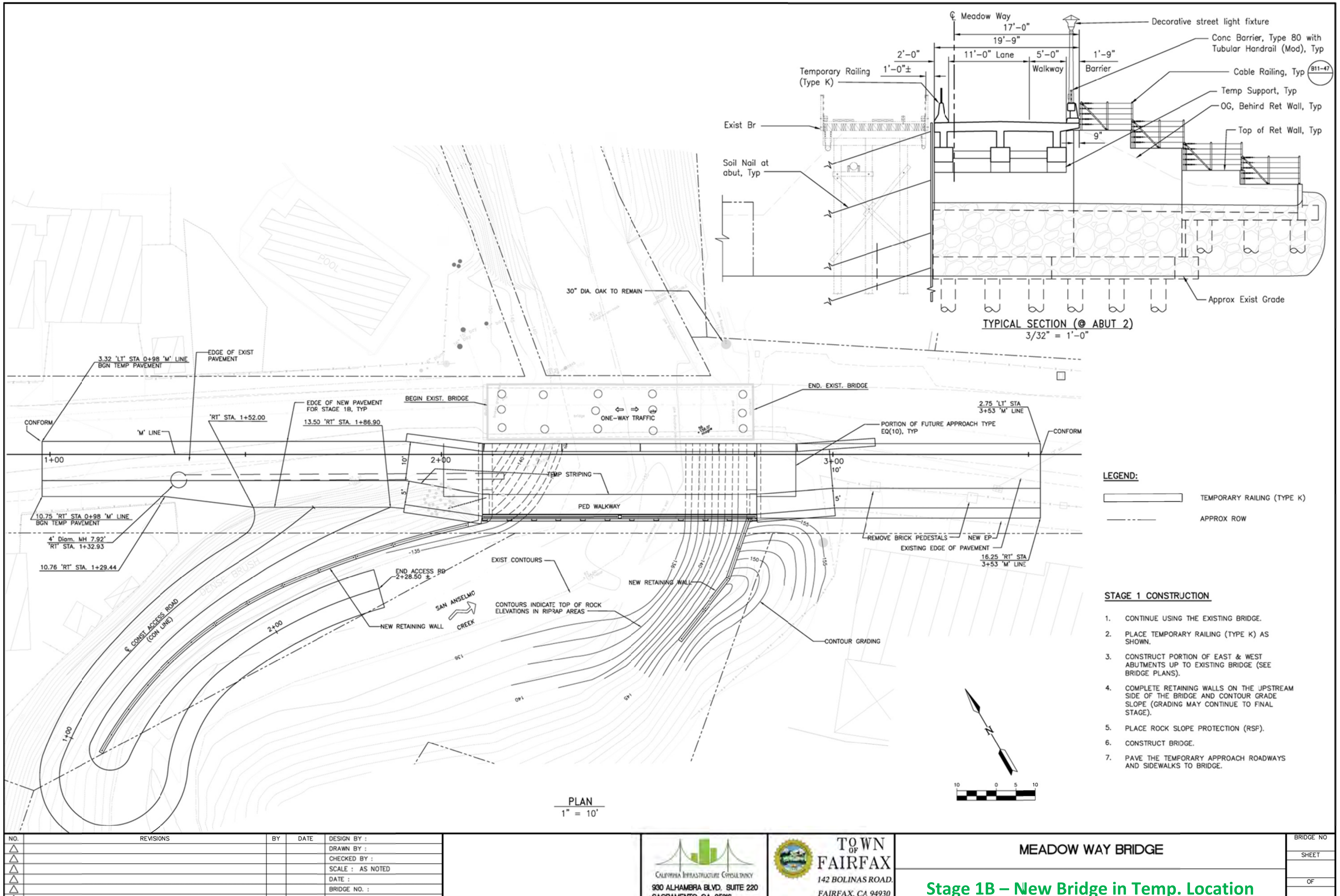
Stage 1B – While maintaining traffic on the exiting bridge, construct the above retaining wall (west side) and large portions of Abutments 1 and 2 up to the existing bridge, construct the upstream east wingwall, place rock riprap in front of the abutments and walls and construct the superstructure approximately one foot away from the existing bridge. Construct a portion of approach slab at each abutment. (This stage could conclude the end of the first season.)

Stage 2 – Maintaining separation with temporary concrete railing, detour the traffic on to the new bridge, remove the existing bridge, construct the remaining portions of Abutments 1 and 2, construct the downstream wingwall at each abutment and finish the protection of the abutments and wingwalls with rock riprap.

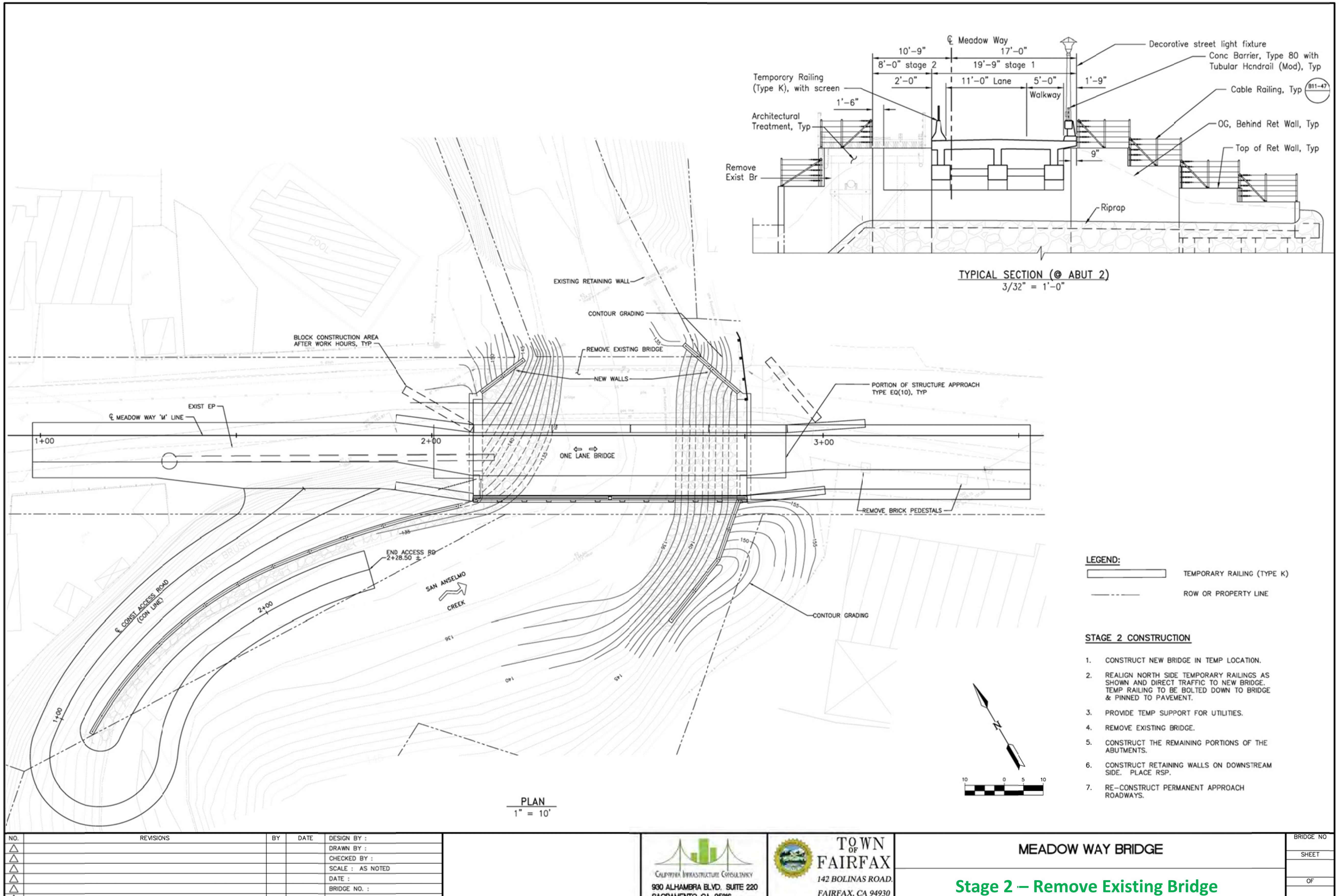
Final Stage – Complete the approach roadway and slab on each side of the bridge while the traffic is still using the detour. Shut down the traffic temporarily and move the bridge over to its permanent location as described later in this report. Place the traffic on the new bridge in its permanent location and complete the rest of the work on the topside and elsewhere. After moving the bridge to its permanent location, the previous space occupied by it on each abutment seat during Stages 1B and 2 can be converted to planters. The construction of the bridge in a temporary location and moving it sideways minimizes the footprint of the abutments.

To accomplish the four stages of work, ROW easement agreements with two residences will be necessary. The Town has begun a process of information exchange with the two residences on the south side of the bridge.

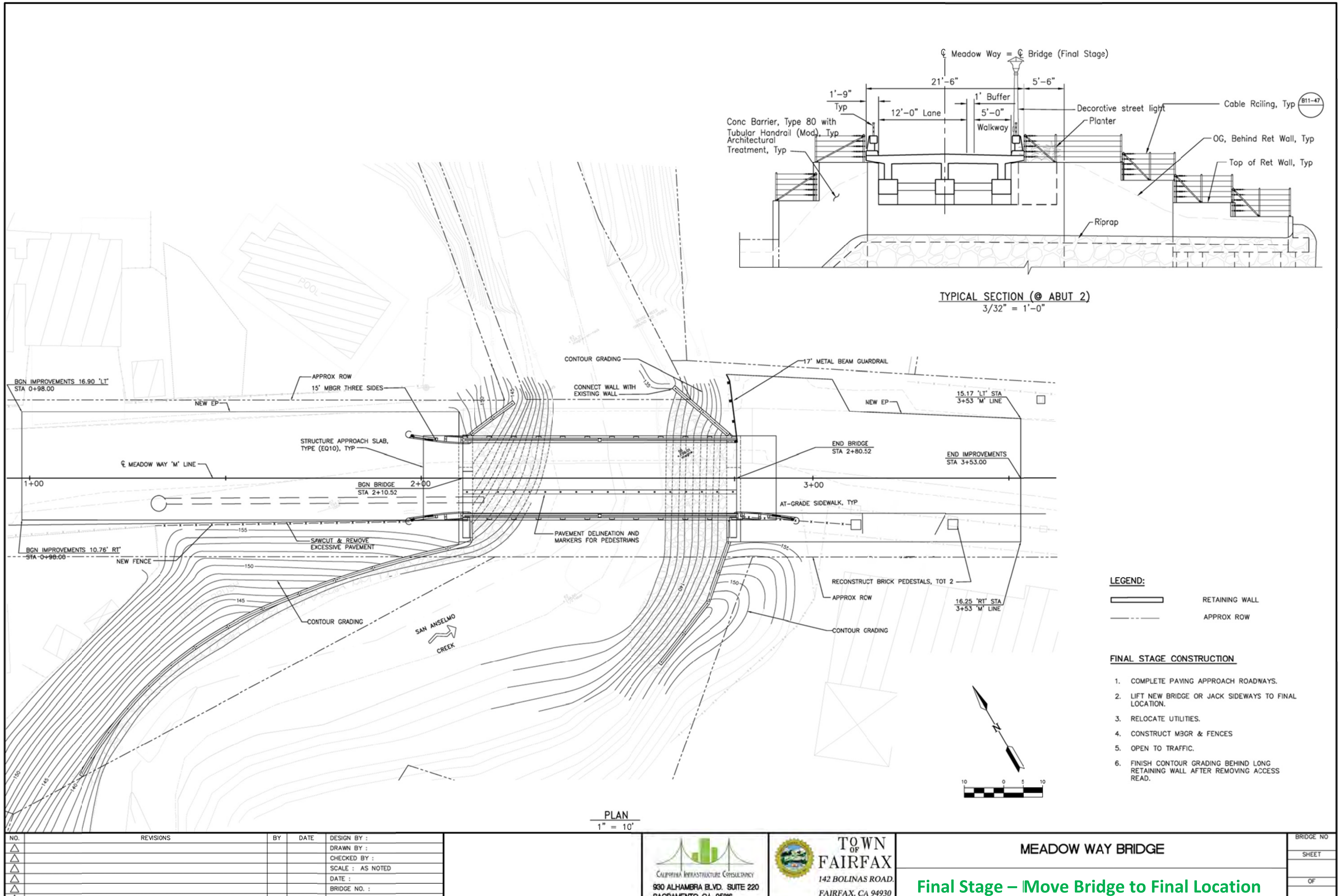

RET WALL LAYOUT LINE
R = 2.26' Δ = 78.11° T = 1.43' L = 3.08'
R = 266.54' Δ = 10.40° T = 24.16' L = 48.40'
R = 96.88' Δ = 38.31° T = 31.79' L = 64.76'
REMOVE EXISTING STORM DRAIN, 1.03' RT, STA. 1+91.24
REMOVE 100 LF OF EXISTING 18" DIA. STORM PIPE FROM NEW MH TO CREEK
BGN ACCESS RD 0+13.50 'CON' LINE 13.50'± RT 1+67.30 'M' LINE
SOIL NAIL LOL
1+00
2+00
3+00
SOIL NAIL WALL LOL, TYP
EXCAVATION FOR MSE
EXCAVATION FOR STAGE 1B BRIDGE ABUT
DRAIN INLET 14.5' R STA. 1+40.64
PC 18.47' RT 2+6.77 'M' Line
REMOVE TREE CLUSTER
SOIL NAIL LAYOUT LINE = BACK OF EXCAVATION
END ACCESS RD 2+28.50 ±
Access Road
R = 266.54'
R = 96.88'
SAN ANSELMO CREEK
PCC 33.51' RT 1+60.46 'M' Line
Retaining Wall LOL
End Wall 76.34' RT 1+13.52 'M' Line
LEGEND:
APPROX SOIL NAIL WALL LAYOUT
APPROX ROW
TEMP RAILING (TYPE K) (PIN DOWN TO PAVEMENT)
STAGE 1A CONSTRUCTION
1. CONTINUE USING THE EXISTING BRIDGE.
2. EXCAVATE AND INSTALL SOIL NAILS AT BOTH ABUTMENTS AND FOR TEMP CONSTRUCTION ACCESS ROAD EXCAVATION.
3. CONSTRUCT SOUTHWEST RETAINING WALL ON THE UPSTREAM SIDE OF THE BRIDGE (SEE BRIDGE PLANS).
4. PLACE ROCK SLOPE PROTECTION (RSP).
N
PLAN
1" = 10'
NO. REVISIONS BY DATE
DESIGN BY :
DRAWN BY :
CHECKED BY :
SCALE : AS NOTED
DATE :
BRIDGE NO. :
PROJ NO. :
California Infrastructure Consultancy
930 ALHAMBRA BLVD. SUITE 220 SACRAMENTO, CA 95816
TOWN OF FAIRFAX
142 BOLINAS ROAD. FAIRFAX, CA 94930
MEADOW WAY BRIDGE
Stage 1A – Access Road Construction
BRIDGE NO
SHEET
OF



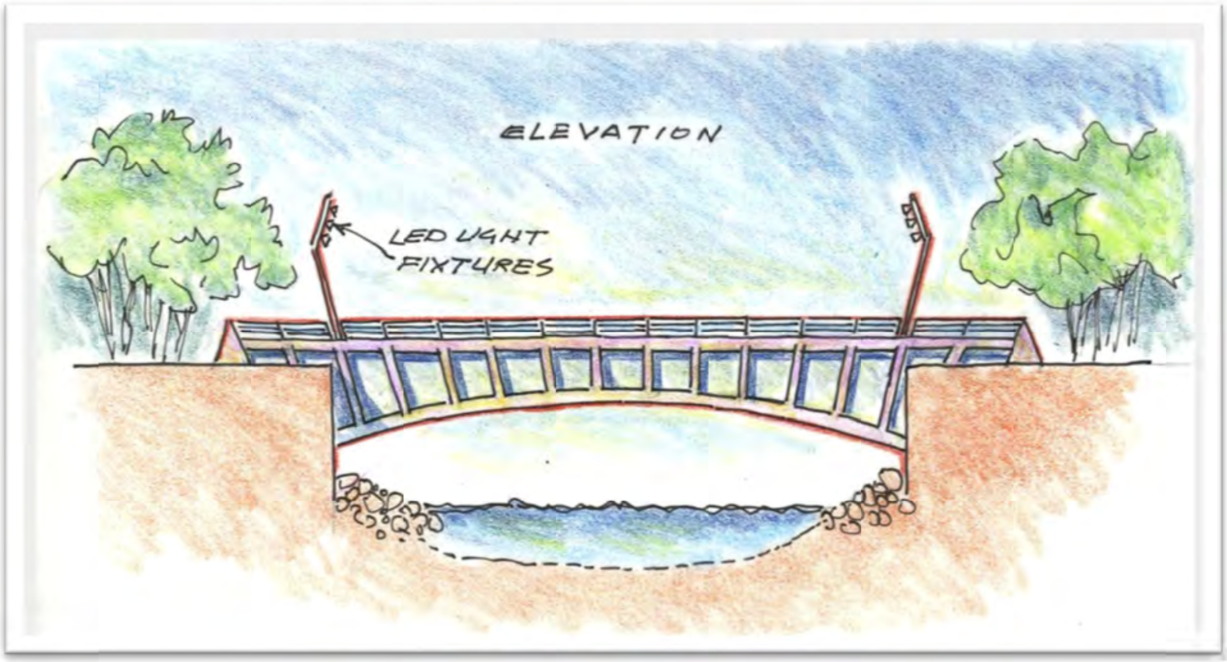
Meadow Way
17'–0"
19'–9"
2'–0"
11'–0" Lane
5'–0"
1'–9"
1'–0"±
Walkway
Barrier
Temporary Railing (Type K)
Decorative street light fixture
Conc Barrier, Type 80 with Tubular Handrail (Mod), Typ
Cable Railing, Typ
Temp Support, Typ
OG, Behind Ret Wall, Typ
Top of Ret Wall, Typ
Exist Br
9"
Soil Nail at abut, Typ
Approx Exist Grade
TYPICAL SECTION (@ ABUT 2)
3/32" = 1'–0"
30" DIA. OAK TO REMAIN
3.32 'LT' STA 0+98 'M' LINE BGN TEMP PAVEMENT
EDGE OF EXIST PAVEMENT
EDGE OF NEW PAVEMENT FOR STAGE 1B, TYP
BEGIN EXIST. BRIDGE
END. EXIST. BRIDGE
ONE–WAY TRAFFIC
'RT' STA. 1+52.00
13.50 'RT' STA. 1+86.90
CONFORM
'M' LINE
1+00
2+00
3+00
2.75 'LT' STA 3+53 'M' LINE
PORTION OF FUTURE APPROACH TYPE EQ(10), TYP
TEMP STRIPING
PED WALKWAY
10.75 'RT' STA 0+98 'M' LINE BGN TEMP PAVEMENT
4' Diam. MH 7.92' 'RT' STA. 1+32.93
10.76 'RT' STA. 1+29.44
REMOVE BRICK PEDESTALS
NEW EP
EXISTING EDGE OF PAVEMENT
16.25 'RT' STA 3+53 'M' LINE
EXIST CONTOURS
END ACCESS RD 2+28.50 ±
NEW RETAINING WALL
CONST ACCESS ROAD (CON LINE)
SAN ANSELMO CREEK
CONTOURS INDICATE TOP OF ROCK ELEVATIONS IN RIPRAP AREAS
CONTOUR GRADING
PLAN
1" = 10'
LEGEND:
TEMPORARY RAILING (TYPE K)
APPROX ROW
STAGE 1 CONSTRUCTION
1. CONTINUE USING THE EXISTING BRIDGE.
2. PLACE TEMPORARY RAILING (TYPE K) AS SHOWN.
3. CONSTRUCT PORTION OF EAST & WEST ABUTMENTS UP TO EXISTING BRIDGE (SEE BRIDGE PLANS).
4. COMPLETE RETAINING WALLS ON THE UPSTREAM SIDE OF THE BRIDGE AND CONTOUR GRADE SLOPE (GRADING MAY CONTINUE TO FINAL STAGE).
5. PLACE ROCK SLOPE PROTECTION (RSF).
6. CONSTRUCT BRIDGE.
7. PAVE THE TEMPORARY APPROACH ROADWAYS AND SIDEWALKS TO BRIDGE.
N
NO.
REVISIONS
BY
DATE
DESIGN BY :
DRAWN BY :
CHECKED BY :
SCALE : AS NOTED
DATE :
BRIDGE NO. :
PROJ NO. :
California Infrastructure Consultancy
930 ALHAMBRA BLVD. SUITE 220 SACRAMENTO, CA 95816
TOWN OF FAIRFAX
142 BOLINAS ROAD, FAIRFAX, CA 94930
MEADOW WAY BRIDGE
Stage 1B – New Bridge in Temp. Location
BRIDGE NO
SHEET
OF



℄ Meadow Way
10'-9"
17'-0"
8'-0" stage 2
19'-9" stage 1
2'-0"
11'-0" Lane
5'-0"
1'-9"
Walkway
1'-6"
9"
Temporary Railing (Type K), with screen
Architectural Treatment, Typ
Remove Exist Br
Decorative street light fixture
Conc Barrier, Type 80 with Tubular Handrail (Mod), Typ
Cable Railing, Typ
OG, Behind Ret Wall, Typ
Top of Ret Wall, Typ
Riprap
TYPICAL SECTION (@ ABUT 2)
3/32" = 1'-0"
EXISTING RETAINING WALL
CONTOUR GRADING
BLOCK CONSTRUCTION AREA AFTER WORK HOURS, TYP.
REMOVE EXISTING BRIDGE
NEW WALLS
PORTION OF STRUCTURE APPROACH TYPE EQ(10), TYP
EXIST EP
℄ MEADOW WAY 'M' LINE
1+00
2+00
3+00
ONE LANE BRIDGE
REMOVE BRICK PEDESTALS
END ACCESS RD 2+28.50 ±
SAN ANSELMO CREEK
℄ CONST ACCESS ROAD (CON LINE)
CONTOUR GRADING
PLAN
1" = 10'
LEGEND:
TEMPORARY RAILING (TYPE K)
ROW OR PROPERTY LINE
STAGE 2 CONSTRUCTION
1. CONSTRUCT NEW BRIDGE IN TEMP LOCATION.
2. REALIGN NORTH SIDE TEMPORARY RAILINGS AS SHOWN AND DIRECT TRAFFIC TO NEW BRIDGE. TEMP RAILING TO BE BOLTED DOWN TO BRIDGE & PINNED TO PAVEMENT.
3. PROVIDE TEMP SUPPORT FOR UTILITIES.
4. REMOVE EXISTING BRIDGE.
5. CONSTRUCT THE REMAINING PORTIONS OF THE ABUTMENTS.
6. CONSTRUCT RETAINING WALLS ON DOWNSTREAM SIDE. PLACE RSP.
7. RE-CONSTRUCT PERMANENT APPROACH ROADWAYS.
N
10 0 5 10
NO.
REVISIONS
BY
DATE
DESIGN BY :
DRAWN BY :
CHECKED BY :
SCALE : AS NOTED
DATE :
BRIDGE NO. :
PROJ NO. :
California Infrastructure Consultancy
930 ALHAMBRA BLVD. SUITE 220
SACRAMENTO, CA 95816
TOWN OF FAIRFAX
142 BOLINAS ROAD,
FAIRFAX, CA 94930
MEADOW WAY BRIDGE
Stage 2 – Remove Existing Bridge
BRIDGE NO
SHEET
OF


TYPICAL SECTION (@ ABUT 2)
3/32" = 1'-0"
PLAN
1" = 10'
LEGEND:
RETAINING WALL
APPROX ROW
FINAL STAGE CONSTRUCTION
1. COMPLETE PAVING APPROACH ROADWAYS.
2. LIFT NEW BRIDGE OR JACK SIDEWAYS TO FINAL LOCATION.
3. RELOCATE UTILITIES.
4. CONSTRUCT MBGR & FENCES
5. OPEN TO TRAFFIC.
6. FINISH CONTOUR GRADING BEHIND LONG RETAINING WALL AFTER REMOVING ACCESS READ.
MEADOW WAY BRIDGE
Final Stage – Move Bridge to Final Location
TOWN OF FAIRFAX
142 BOLINAS ROAD.
FAIRFAX, CA 94930
930 ALHAMBRA BLVD. SUITE 220
SACRAMENTO, CA 95816

For the superstructure, bridges with three types of materials, concrete, steel and glulam timber have been considered. Each superstructure type offers its own set of advantages and disadvantages, which will be discussed later. The supports, or the two concrete abutments, would be the same for all three alternates and only the superstructure type would be different. The three conceptual bridge types, as portrayed by the bridge architect, are described and shown below. (These concepts are also shown in 3-D renderings in Appendix A.)



Concrete Arch Bridge Concept

Concrete Arch Alternate - The concrete arch has been historically a common bridge type in Ross Valley and this bridge type will harken back to those of a bygone era, some of which have been in the National Register of Historic Places (NRHP). The concept shown above would be made of three main concrete arch ribs with short, slanted spandrel columns conveying the loads from the bridge deck to the arch ribs. The ribs will be connected to each other transversely at the abutments and at two or three other locations along their lengths. The concrete bridge deck would be 21'-6" wide, allowing for a single 12' wide lane, a 5' wide sidewalk, a 1' wide buffer between the lane and sidewalk and two 1-9" wide Barriers Type 80 with modified Tubular Handrails. The barrier is open type, crash-tested and approved by Caltrans, better revealing the creek view as seen by motorists and pedestrians alike. The overall height of the barrier and handrail would be 4-6", as required for bicycle riders' safety.

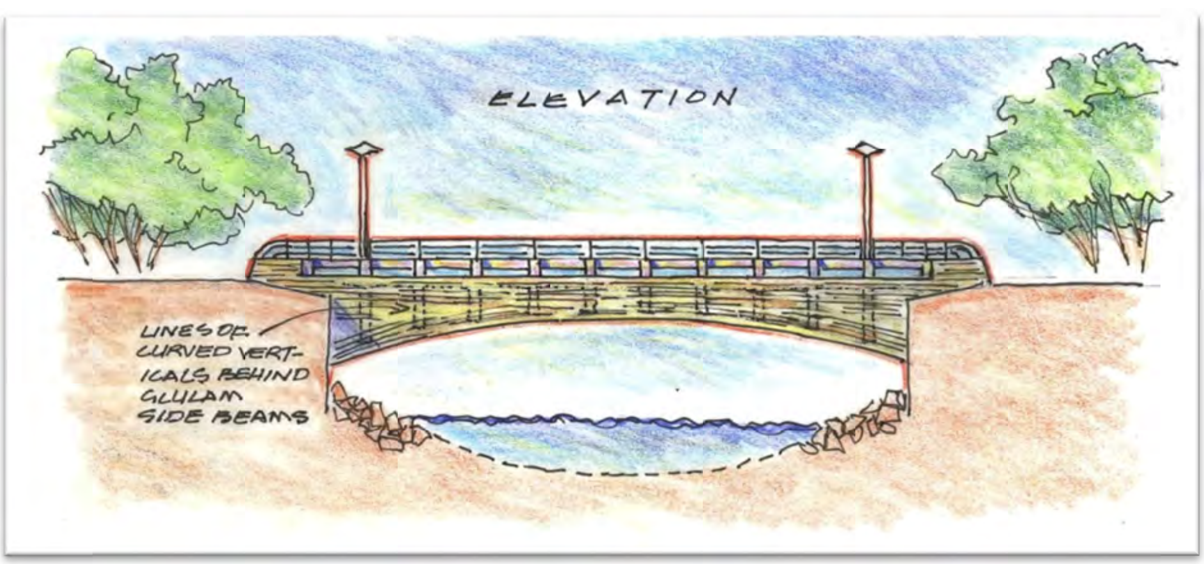
This bridge superstructure will be cast-in-place. Falsework, or temporary timber frames that support the concrete formwork, would be erected on the creek bed at certain intervals and removed once the wet concrete has cured and attained certain strength.

This bridge configuration, like the other types presented below, will have an intrinsic aesthetic value. Additional beautification will be achieved through architectural treatment of its concrete abutment and wall surfaces, as well as amenities such as special lighting, open barriers and native vegetation planted on and around the bridge. The pedestrian path on the bridge would be clearly delineated with striping along the one-foot buffer strip, which will also have raised reflective pavement markers at proper intervals to alert the drivers and pedestrians of the two separate travel zones.

Steel Vierendeel Deck Truss Bridge Concept

Steel Bridge Alternate – The concept shown above is a Vierendeel deck truss span where the structural steel framing will be below the travel way. The deck will be concrete and the bridge span, deck width, pedestrian and vehicular separation, barriers and handrails, and the other architectural and aesthetic amenities will be the same as the concrete arch option described above.

The truss system will be prefabricated, possibly in two equal halves for the ease of transportation to the site, and bolted together at the site before its full bearing on the abutment seats. The deck concrete would be formed and poured after the erection of the truss. The structural steel may be the Corten steel used for aesthetic reasons, where a superficial layer of rust is allowed to develop and protect the rest of the bridge. The steel approach guardrail can match this look. Alternatively, the truss can be painted.



Glulam Timber Bridge Concept

Glulam Arch Bridge Alternate – The appearance of this alternate, the concept for which is shown on the previous page, will be similar to concrete alternate, except that the spandrels will be vertical. Three curved glulam beams will be the main load bearing elements of the superstructure. The bridge span, width and its other deck characteristics will be the same as the other two alternates.

The curved beams for this alternate will be premanufactured and each delivered to the project in one piece. Since each beam will be 70 feet long, negotiating the last truck turn onto Meadow Way could be difficult, if not impossible. However, this can be accomplished with the help of two cranes. The beams can be lifted after the first truck parks on Cascade Drive, swung about and reloaded onto a second truck parked on Meadow Way and delivered to the site a hundred feet or so away and unloaded on the bridge abutments. The wood elements will be treated with modern nontoxic preservatives and connected to each other with high-strength galvanized steel hardware.

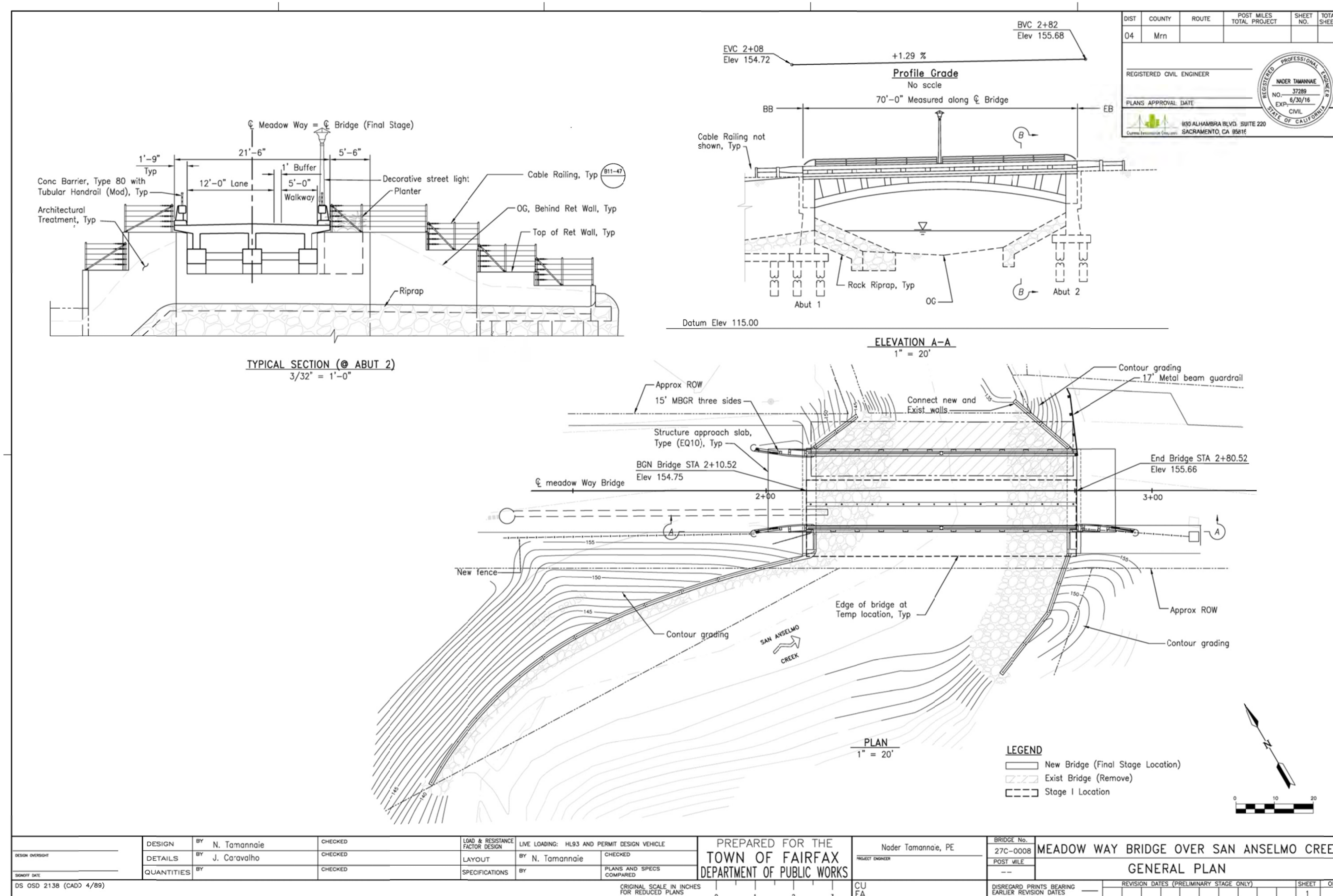
Moving the Bridge to Final Position (in Final Stage) – A couple of procedures are available to relocate the bridge constructed in Stage 2 to its location in Final Stage. The first technique will be to lift the bridge with a crane at each end simultaneously and place it on the bearings positioned for its permanent location. To do this, the existing bridge has to be crossed by one of the two cranes in advance. The Contractor will be required to show analysis that the existing bridge can handle the weight of the crane. Otherwise, the Contractor will be required to fortify and strengthen the existing bridge for the crane loading. To help minimize the load lifted by the cranes, both barriers on the bridge for Stages 1 and 2 can be temporary ones (Type K) that are bolted down initially and unbolted during the lifting process.

The second way of relocating the bridge may be by hydraulically pushing it sideways. Hydraulic jacks will be placed on the abutments transversely to work simultaneously and move the bridge into final position. This may prove to be the better of the two solutions, particularly if the selected alternate is the heavier concrete superstructure. Special details and bearing elements will be built into the abutments to make this option workable. Feasibility of each of the two methods will be further studied during design.

To move the bridge, traffic will need to be halted for a few hours, especially if the lifting method is involved. Emergency vehicles will be located across the creek should the need for emergency treatment arise. This is similar to a situation envisioned for the one-lane bridge at Canyon Road a mile or so away from this site. However, at Canyon Road, even though the bridge would be closed for a few hours, it can be opened up for an emergency crossing any time, if needed. Once the Meadow Way Bridge is lifted, no crossing would be possible until the bridge is put back down. Two solutions to address this are available:

1. Specify the sideways jacking option only. In this case, the bridge would not be lifted off the abutment and emergency vehicles can cross as the creek over the bridge, if need be, while the sideways jacking operations are underway.
2. Use the lifting option, but be prepared to set the bridge back down immediately for an emergency crossing. The bridge will be lifted just a couple of inches off its temporary bearing pads to move it a few feet sideways to its permanent location. The lifting will be done from all four corners of the bridge, with the two corners at each end lifted with the same crane. Lifting cables attached to the two corners at each end will rise up vertically and be attached to a 25'-long horizontal steel beam parallel with, and well above, the roadway. The crane will then lift the beam, creating a “gate” at each end for the emergency vehicle to drive through after quickly setting the bridge back down.

Bridge General Plan - A tentative Bridge General Plan is exhibited on the following page, showing a concrete arch bridge for illustration purposes only. The choice of the bridge type will be up to the Town of Fairfax first and the residents in the neighborhood of the bridge. This Bridge Type Selection report will later present initial costs, lifecycle costs and a pros and cons matrix, with numbers (1 to 10) assigned to reflect the value of each factor and an overall score to aid with the decision making process.


TYPICAL SECTION (@ ABUT 2)
3/32" = 1'-0"
ELEVATION A-A
1" = 20'
Profile Grade
No scale
70'-0" Measured along ℄ Bridge
Datum Elev 115.00
PLAN
1" = 20'
LEGEND
New Bridge (Final Stage Location)
Exist Bridge (Remove)
Stage I Location
BGN Bridge STA 2+10.52
Elev 154.75
End Bridge STA 2+80.52
Elev 155.66
MEADOW WAY BRIDGE OVER SAN ANSELMO CREEK
GENERAL PLAN
PREPARED FOR THE
TOWN OF FAIRFAX
DEPARTMENT OF PUBLIC WORKS
Nader Tamannaie, PE
BRIDGE No. 27C-0008
DESIGN N. Tamannaie
DETAILS J. Carvalho
LIVE LOADING: HL93 AND PERMIT DESIGN VEHICLE

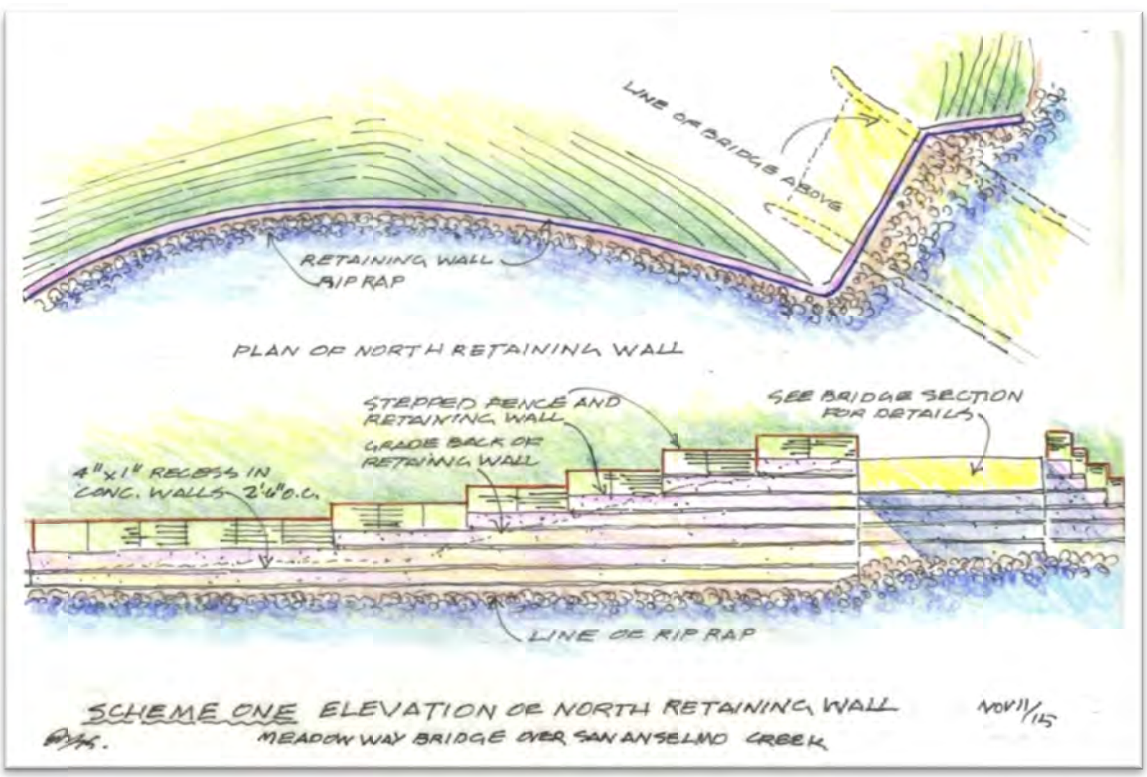
THE RETAINING WALL AT SOUTHWEST QUADRANT AND OTHER WALLS ATTACHED TO THE BRIDGE

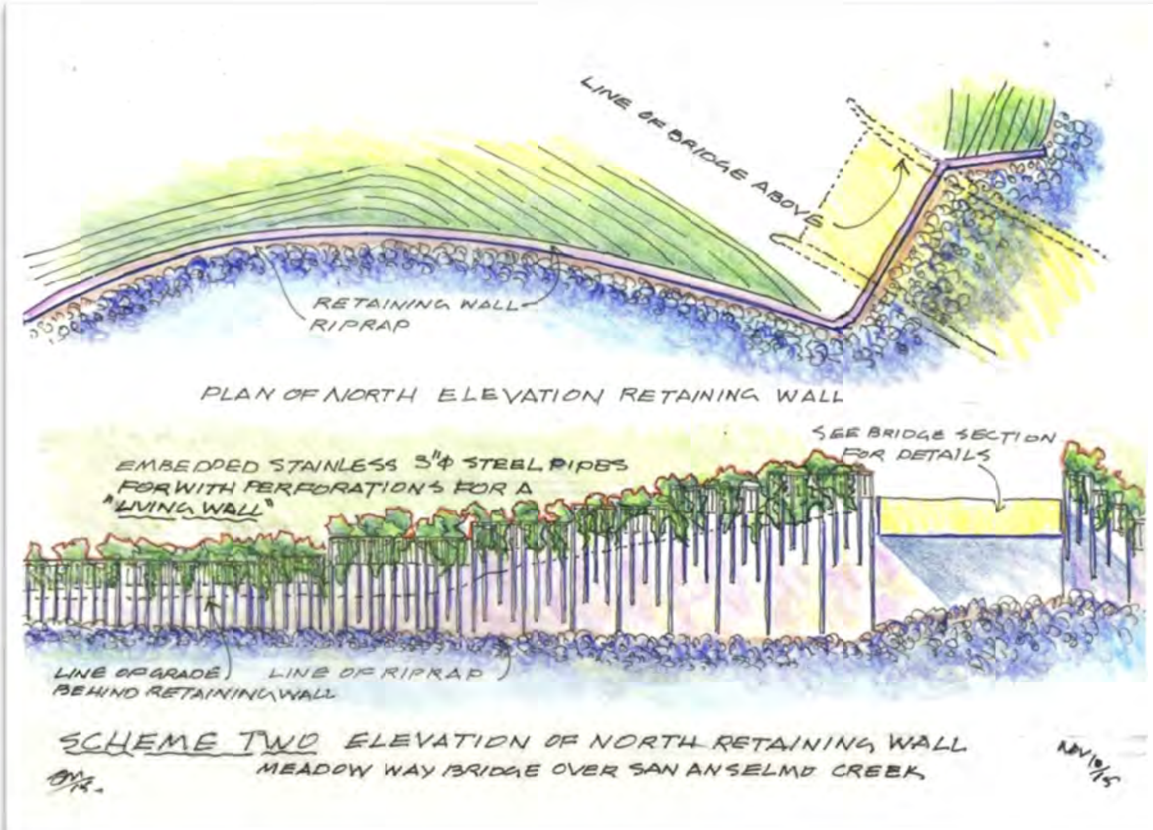
For this retaining structure, required by the project to prevent the erosion of the bank into the creek, two types of walls have been considered: conventional and mechanically stabilized embankment (MSE) retaining walls. The former wall will be the cantilevered concrete retaining wall that sits on top of a continuous footing and piles. The MSE wall consists of a relatively thin facing element connected to layers of reinforcement buried in the soil behind the facing. The reinforcement can be strips of galvanized steel, steel bar mats or carbon fiber mats. When the soil pressure behind the facing pushes into it, the friction and grip between the reinforcement and soil prevents the facing from toppling over, hence a retaining system is created. Since the length of the reinforcement can be as long as the wall is high, the initial excavation footprint of an MSE wall is larger than that of a conventional wall.

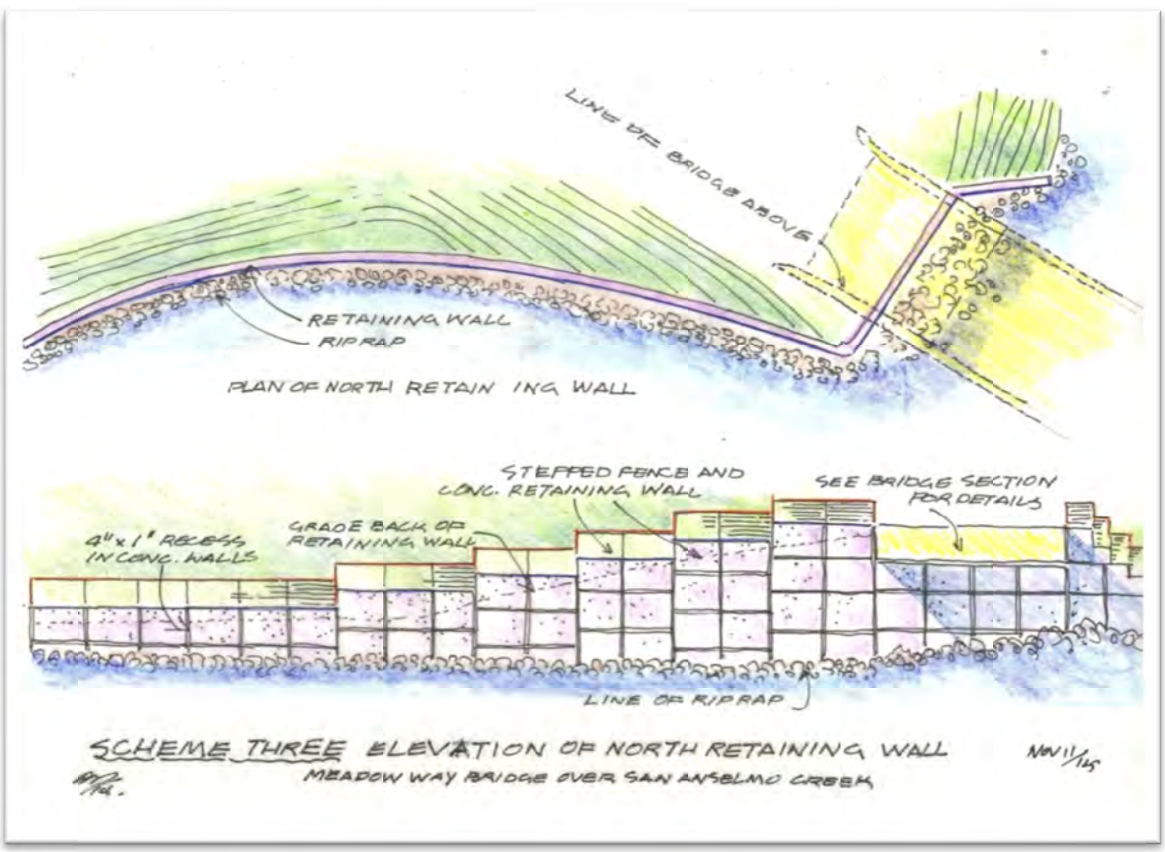
The MSE wall is constructed after excavating the ground all the way down to bottom of the wall, in this case the creek bed level, and constructing it back up in 2-foot lifts, having placed mats of reinforcement in each layer, bolted to stacks of vertical facing elements. Depending on the wall height and length, MSE walls are more economically feasible and better conducive to greening. Note the MSE wall will only be feasible for the long retaining wall at the southwest quadrant of the project and the other three bridge wingwalls are neither feasible as MSEs, nor can the excavations be accommodated due to tight ROW.

MSE walls are good in seismic regions, such as the Bay Area, as the wall moves and gives with seismic movements and dissipates energy. Both the conventional and MSE wall types can have green (planted) or architecturally attractive facades. The wall surfaces will either be architecturally treated using formliners that will show architectural relief or texture after the forms are stripped, or set up to support planting that will cover the wall surface. The tops of the four walls, each connecting to a corner of the bridge, will be stepped and have special cable railings for fall protection. Three architectural wall treatment concepts have been presented below, and in 3-D perspective in Appendix A.

The choice of wall type, and whether it will be a green wall, will be up to the Town Council and the residents. A pros and cons matrix for both wall types is presented for the walls later in this report.




LINE OF BRIDGE ABOVE
RETAINING WALL
RIPRAP
PLAN OF NORTH ELEVATION RETAINING WALL
SEE BRIDGE SECTION FOR DETAILS
EMBEDDED STAINLESS 3"Φ STEEL PIPES FOR WITH PERFORATIONS FOR A "LIVING WALL"
LINE OF GRADE BEHIND RETAINING WALL
LINE OF RIPRAP
SCHEME TWO ELEVATION OF NORTH RETAINING WALL
MEADOW WAY BRIDGE OVER SAN ANSELMO CREEK

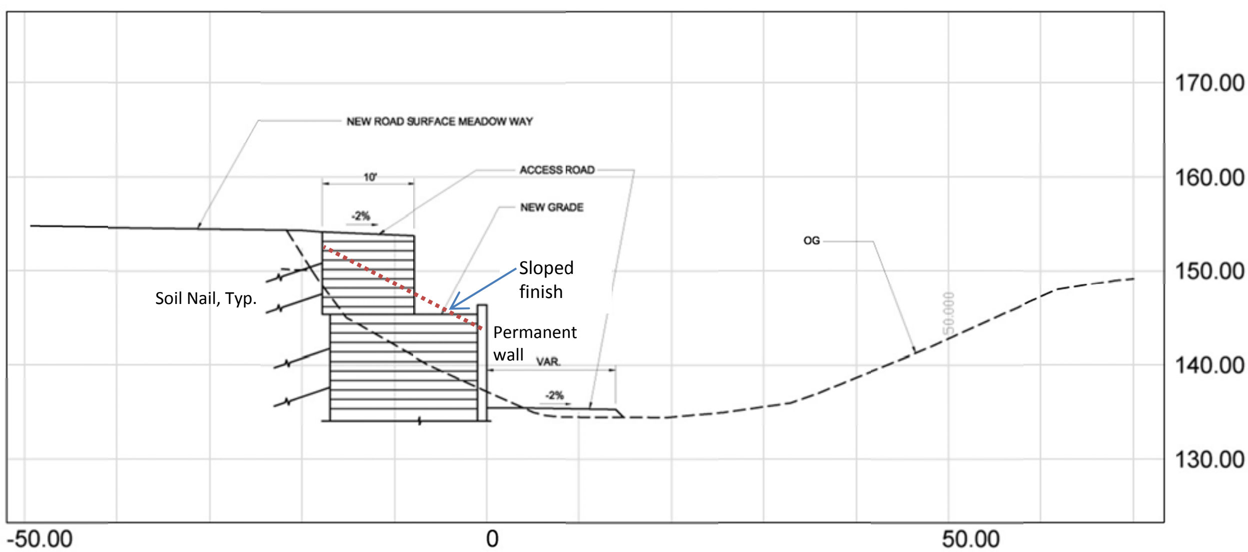

LINE OF BRIDGE ABOVE
RETAINING WALL
RIPRAP
PLAN OF NORTH RETAIN ING WALL
STEPPED FENCE AND CONC. RETAINING WALL
SEE BRIDGE SECTION FOR DETAILS
4"x1" RECESS IN CONC. WALLS
GRADE BACK OF RETAINING WALL
LINE OF RIPRAP
SCHEME THREE ELEVATION OF NORTH RETAINING WALL
MEADOW WAY BRIDGE OVER SAN ANSELMO CREEK

TEMPORARY ACCESS ROAD CONSTRUCTION

Building the access road and the long retaining wall at the southwest bridge quadrant will be the first order of construction, after which the Stage 1 abutments (west and east), one wingwall (upstream, east), riprap and other features can be constructed. In this project, construction of the access road in combination with an MSE versus a conventional wall will take form differently, described below.

To build the road with an MSE, excavations will be made, from the existing roadway level at the southwest corner of the existing bridge to the creek bed, progressing south to the end of the wall. The width of the excavation will be the same as its depth, decreasing as the wall gets shorter. The red line on Stage 1A plan view (page 9) represents the vertical surface in the back of the excavated space, being nearly 25 feet deep at the existing bridge and a few feet deep at the south end of the wall. This vertical surface will need to be held in place temporarily with soil nails, some of which will protrude under the adjacent private property. (This is one of the temporary easement items negotiated with the neighbor.) To build this high vertical surface, shallow excavations, about 4-feet deep, are made from the top and held back with a set of soil nails. Similarly, the full depth is excavated in 4’ deep subsequent increments and stabilized with soil nails, ultimately resulting in a stable, continuous and deep vertical face.

Subsequently, a two-tier MSE wall will be constructed with two-foot deep lifts of backfill, interlaid with steel mats of reinforcement stretching from the face of the wall to the back of the excavation. A cross section of the two-tier wall near the beginning of the access road is shown below. The lower tier represents the final retaining wall at this location and the upper tier will be a temporary MSE wall to carry the Contractor’s equipment and vehicles down to the creek level.

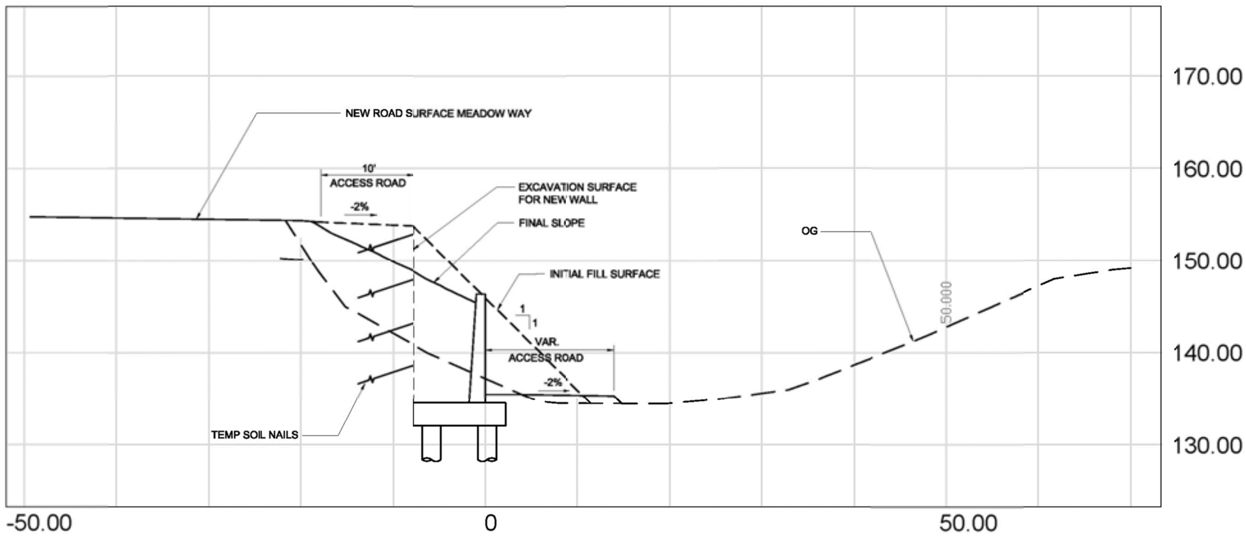


Permanent and temporary MSE walls at the bridge southwest quadrant

Once construction is completed, the top tier can be either left in place for the private property owner’s use, or removed and the ground contour-graded (shown with a red-dotted line in the above exhibit). This choice will be negotiated with the property owner.

Alternatively, the long retaining wall in this quadrant may be a chosen as a conventional cantilever concrete wall on a continuous footing and a series of piles. To build the conventional wall, sloped earth fill reaching the creek bed will first be added to the side of the existing embankment to put the inclined access road on. Once access to creek bed is achieved, a vertical surface in the back of the future wall footing will be excavated, using soil nails to support the access road above. Next, cast-in-drilled-hole (CIDH) piles, the concrete footing and the wall are constructed and the space behind the wall backfilled.

This wall will have the same height and alignment as the MSE. The final treatment of the area above the wall will be similar to that described for the MSE; either the access road is removed and the ground contour-graded, or the road is left in place, as agreed upon during negotiations with the owner.



Temporary embankment and final conventional retaining wall at the southwest quadrant

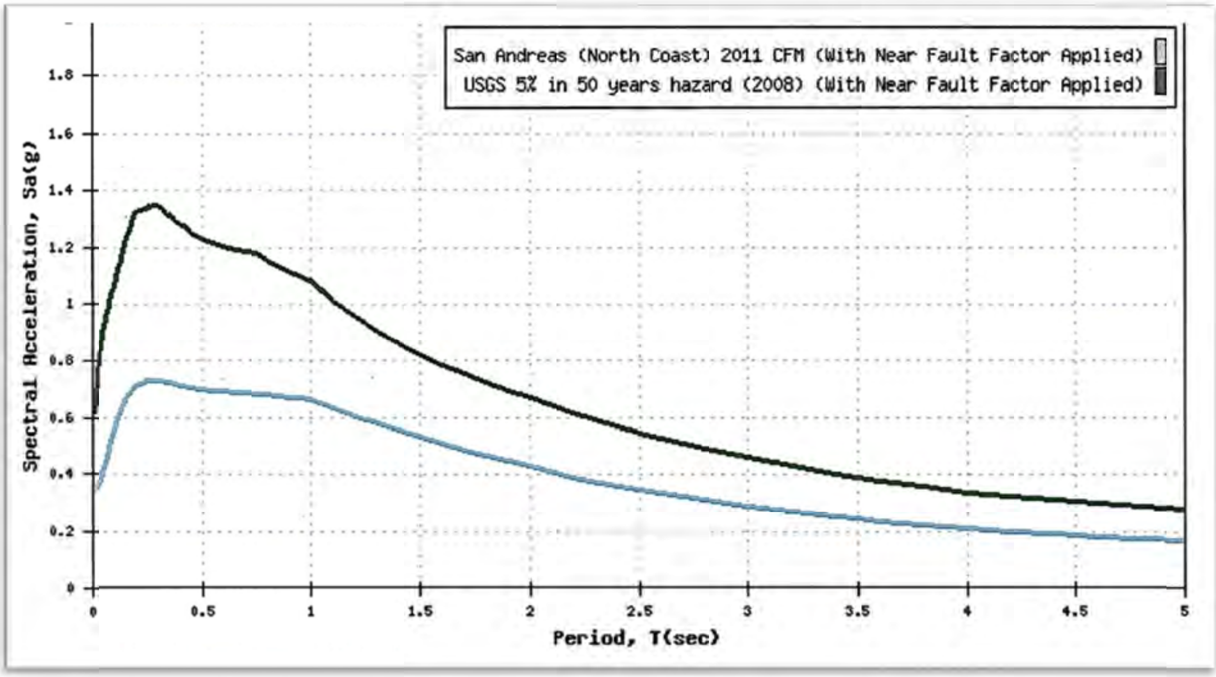
GEOTECHNICAL FACTORS ASSOCIATED WITH THE BRIDGE SITE

The team's geotechnical engineer drilled a total three borings at the site to study the soil layers and assess their feasibility for bridge foundations. Initially, two borings, 50 feet deep near each future abutment, were drilled. Structurally speaking, the geotechnical engineer's job consists of two interrelated responsibilities: make recommendations for the foundations of the bridge and provide specific parameters for seismic design of the bridge.

The project site is located within the seismically active San Francisco Bay Region where numerous small to large earthquakes have occurred in historical times. The most notable seismic event is the earthquake of April 18, 1906 on the San Andreas Fault (Richter Magnitude 8.2). The San Andreas Fault is the nearest known active fault to the project site at a distance of approximately 5.6 miles. Significant seismic events have also occurred on other nearby faults including the Hayward and Rogers Creek faults.

The analysis showed the soil layers were liquefiable under the Maximum Credible Event (MCE) seismic event. Based on the creek bed elevation being 20 feet or so below the roadway surface, the top 30' of the soil below the creek bed are deemed liquefiable. Liquefaction occurs when the foundation materials are made up of loose sandy or gravelly soils coexisting with an active ground water. During the MCE, the ground shakings push the water table through these loose soils and create a "quicksand" condition underground. Miller Pacific returned to the site for a deeper third boring to see the depth at what the liquefiable soil layer stops for proper bridge and wall foundation assessments and recommendations. The foundations of the bridge abutments and the long conventional retaining wall will need to be placed on pilings that penetrate well beyond the 30-foot deep liquefiable layer into stiff soils or rock.

Conclusions from the most recent Uniform California Earthquake Rupture Forecast (UCERF) indicate the highest probability of an earthquake of magnitude 6.7 or higher in the region by 2045 is assigned to the San Andreas Fault. The predicted peak ground acceleration (PGA) at the project site ranges from 0.35g to 0.55g. By the time the rock acceleration reaches the surface where the bridge is located, the forces ae attenuated by the layers of soil to much higher levels, almost 1.35g, as shown in the following exhibit where accelerations are plotted in relationship to the period of bridge vibrations.



The single span bridge considered in this report has certain seismic advantages. The abutments are semi-buried and the soil behind them dampens the bridge movements and resists the seismic pushing of the span into the soil. Absence of exposed columns reduces structural seismic vulnerability. The seismic design challenge for this bridge is to predict the longitudinal seismic movement of the superstructure and provide enough horizontal abutment seat surface upon which the span ends will rest. Since the soils under the approach roadways will remain liquefiable, a ten-foot long seismic approach slab at each end of the bridge will be needed to maintain the drive to and from the bridge after a major event.

BRIDGE HYDRAULICS, FLOW CAPACITY AND FISH PASSAGE

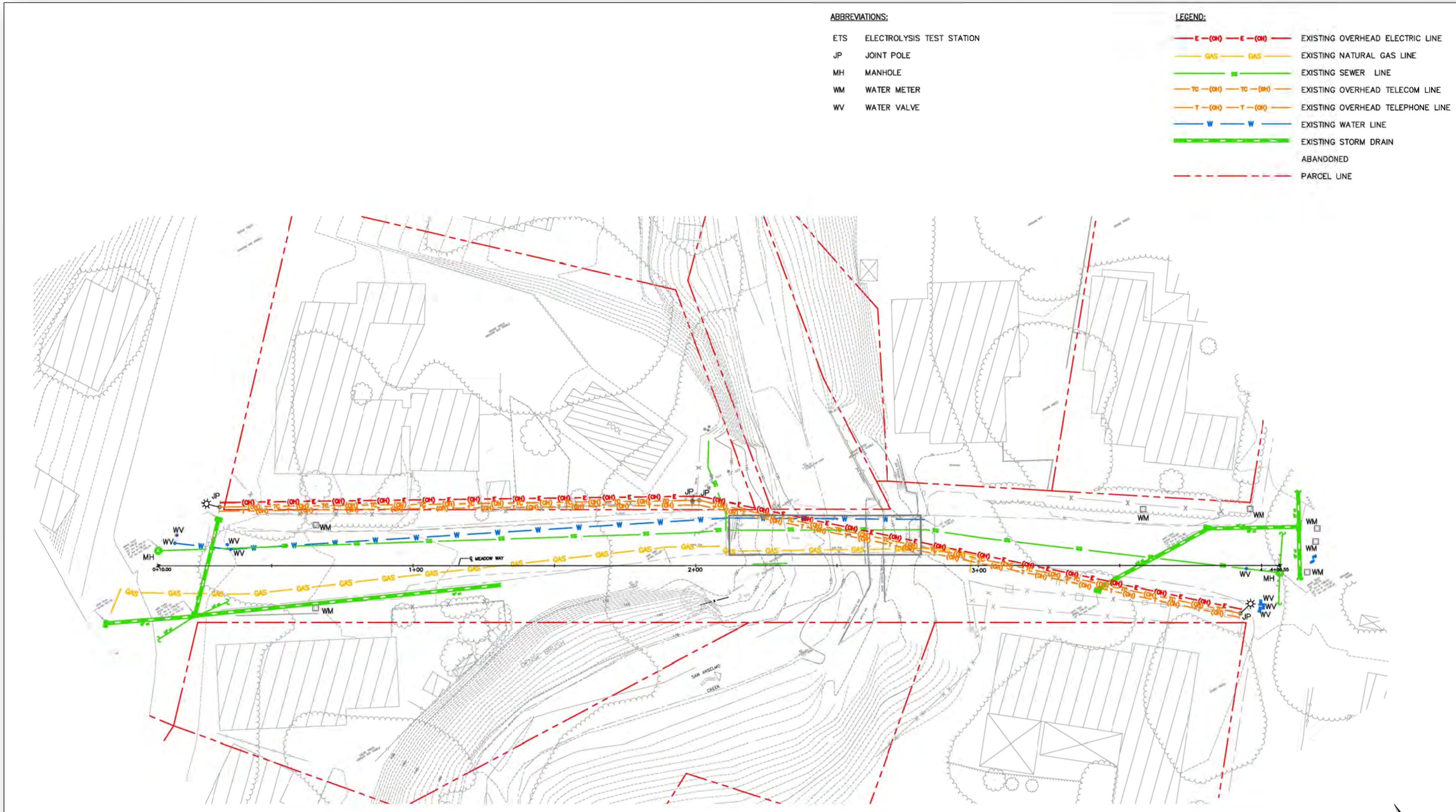
Hydraulically, the bridge waterway opening is relatively large and adequate. The 1977 Flood Insurance Study indicates that the Meadow Way Bridge deck would not be overtopped by the then estimated 500-year flood and it was not overtopped during the December 31, 2005 flood. High-water marks collected in the vicinity of the bridge after this event were between 6.5 and 8.0 feet above the channel bed.

The team's hydrologists and hydraulic engineers have predicted the high flow elevations to be 141.4 and 141.8 feet for 50- and 100-year storms, respectively. The bridge will be designed so that its soffit (underside) clears the 100-year flow and passes the 50-year flood with two feet of freeboard, which in this case will be the controlling design elevation (143.4 '). Considering the bridge deck is at the elevation 155', this leaves over 11 feet for structure depth, which is plenty adequate for any bridge type selected.

The creek bottom at the site is natural and not covered by concrete or a fish ladder structure. Several studies have been conducted by the firms of Ross Taylor and Associates as well as Michael Love and Associates on the fish barriers in the watershed's creeks. The Meadow Way Bridge site is not in these reports because of the width of the creek and its natural creek bed here pose no fish passage issues.

UTILITIES

Utilities present are overhead electric, telephone and telecom lines, as well as underground gas, water, sewer and storm drain systems, shown on the following page. CIC has previously begun the coordination process with all existing utility owners and, after Bridge Type Selection, will identify the specifics of relocation during construction while maintaining service, as well as housing few utilities in the bridge.


ABBREVIATIONS:
ETS ELECTROLYSIS TEST STATION
JP JOINT POLE
MH MANHOLE
WM WATER METER
WV WATER VALVE
LEGEND:
EXISTING OVERHEAD ELECTRIC LINE
EXISTING NATURAL GAS LINE
EXISTING SEWER LINE
EXISTING OVERHEAD TELECOM LINE
EXISTING OVERHEAD TELEPHONE LINE
EXISTING WATER LINE
EXISTING STORM DRAIN
ABANDONED
PARCEL LINE
POOL
MEADOW WAY
0+10.00
1+00
2+00
3+00
SAN ANSELMO CREEK

REPORT CONCLUSIONS

The condition of the existing Meadow Way Bridge makes repairs to it infeasible. Another approach, such as placing a railroad car over, on in place of, the exiting bridge, has also been ruled out. Such structural element will need reliable supports in the form of deep foundations because of ground liquefaction problem and a temporary bridge will be needed, requiring its own abutments and deep foundations, all adding to the cost. Replacing the bridge and addressing the bank erosion problems are the only sensible and feasible long-term solutions.

Bridge Replacement Type Evaluation - The bridge types described earlier, concrete, steel and wood, have been priced for both initial cost and lifecycle (long-term maintenance) cost. The costs of different wall type for the southwest quadrant wall are also presented. The detailed breakdown of the costs are presented in Appendix B and include roadway improvement costs, as well as the standard 15% for construction engineering (CE) and 25% for contingency (Cont) amounts.

Bridge Type	**Concrete Arch**		**Steel Truss**		**Glulam Wood Arch**	
Retaining Wall Type	**Conventional**	**MSE**	**Conventional**	**MSE**	**Conventional**	**MSE**
Initial Cost, CON+Cont+CE	$2,747,000	$2,334,000	$2,860,000	$2,447,000	$2,961,000	$2,547,000
*PW 50-Year Lifecycle Cost	$56,000	$71,000	$372,000	$387,000	$362,000	$377,000
Total Present Worth Cost (rounded)	$2,803,000	$2,405,000	$3,232,000	$2,834,000	$3,323,000	$2,924,000
Unitized Relative to Least Costly Alternate	117%	100%	134%	118%	138%	122%

*PW = Present Worth

Initial construction costs have a 38% maximum swing between the concrete arch bridge with an MSE wall (lowest) and the glulam bridge alternate with a conventional wall (highest). This is because concrete is the staple bridge construction material in California, fetching lowest bids, and arch glulam is a highly specialized material for a bridge of this span length, requiring special order and manufacturing.

Initial and lifecycle costs, as well as four other factors listed below, should be the minimum criteria considered in the type selection process. The table below assigns values of 1 to 10 (10 being the most desirable) to the various factors affecting the bridge. The maximum possible overall score is 60.

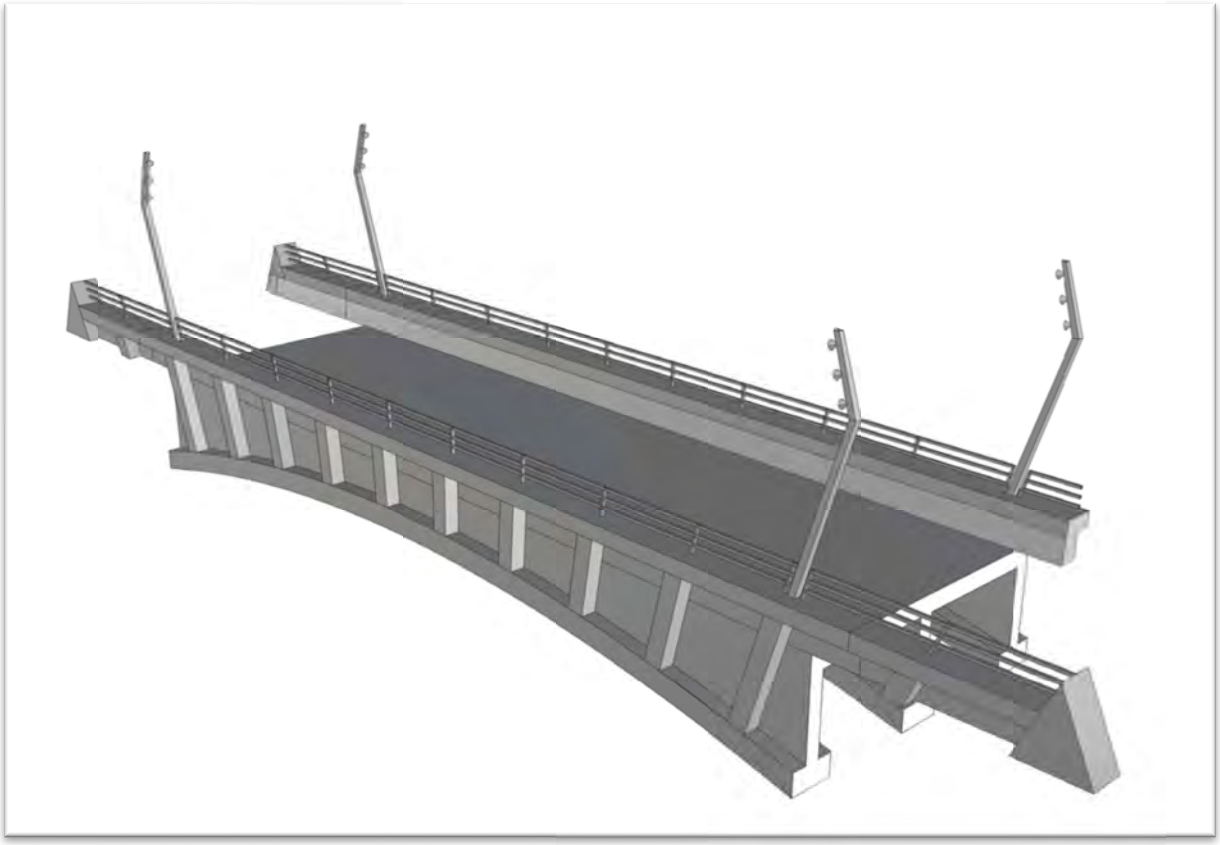
Bridge Type	Initial Cost	Lifecycle Cost	Ease of Construction	Temporary Site Impacts	Longevity	Aesthetics	Total Score
Concrete Arch	10	10	8	8	10	10	56
Steel Truss	9	8	10	10	9	10	56
Glulam Arch	8	8	9	9	8	10	52

Retaining Wall Type Evaluation - A similar matrix has been created for the wall at the southwest project quadrant. The four candidates are MSE wall, green MSE wall, conventional wall and green conventional wall. Green walls have been considered because of the project's context and the potential desire to blend this relatively large wall in the natural setting. Such greening should be done using native, noninvasive plants. While both the MSE and conventional walls can be designed to be green, maintenance and takeover by invasive plants can influence the future of the wall. To be sure, the non-green walls will be architecturally treated for high aesthetic value. The same six factors used for the bridge alternates are reflected in the scoring of the wall alternates in the following table.

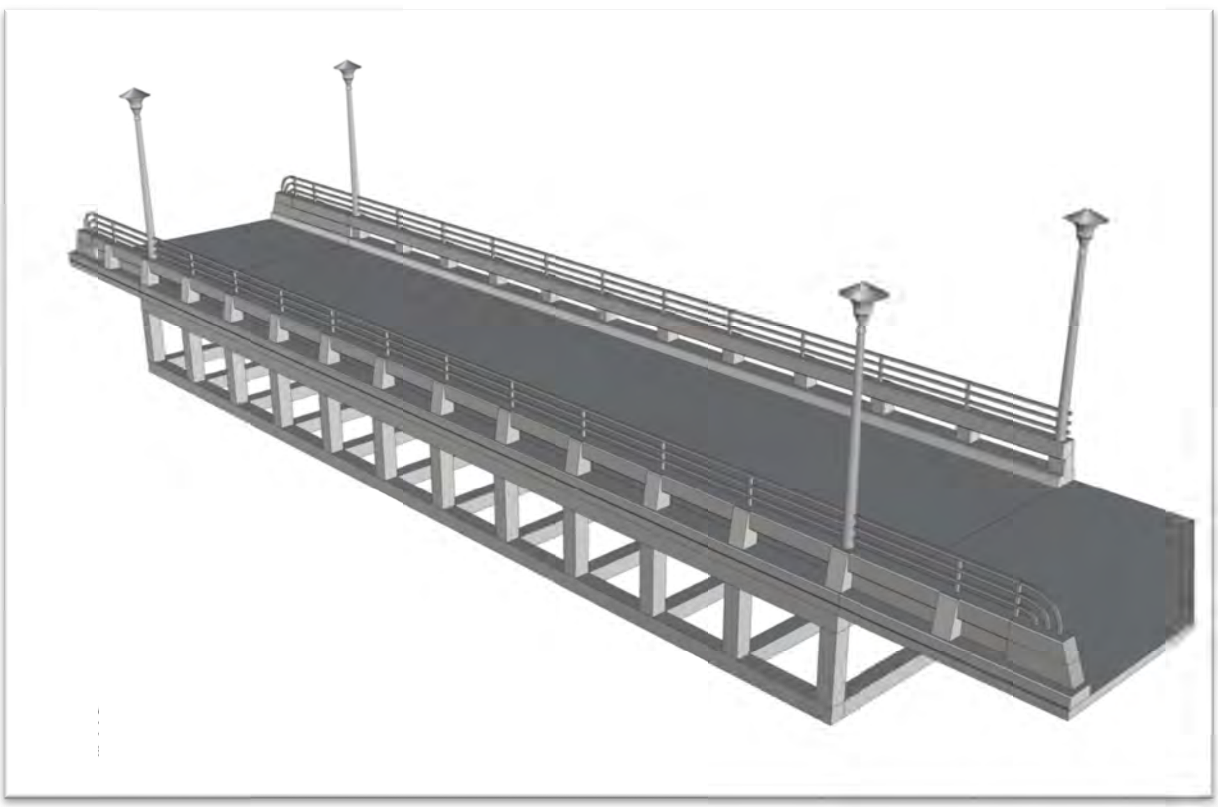
Wall Type	Initial Cost	Lifecycle Cost	Ease of Construction	Temporary Site Impacts	Longevity	Aesthetics	Total Score
MSE Wall with Architectural Treatment	10	9	9	8	9	9	56
Green MSE Wall	9	8	9	8	9	10	53
Conventional Wall with Architectural Treatment	9	10	10	10	10	9	58
Green Conventional Wall	8	9	9	10	10	10	56

In conclusion, all three bridge alternates considered are feasible, reasonable and fundable, although the steel or concrete superstructure with a conventional retaining wall appear to garner the highest overall scores. Because of the impacts of cast-in-place concrete construction on the site, the speed of prefabricated steel construction and the relative ease of moving it to its ultimate location (in Final Stage), steel superstructure may be the best alternate. This fact is especially validated since initial costs and lifecycle costs are currently covered by federal HBP programs for bridge replacement and BPMP.

Appendix A
3-D Renderings of the New Bridge and Retaining Wall Concepts

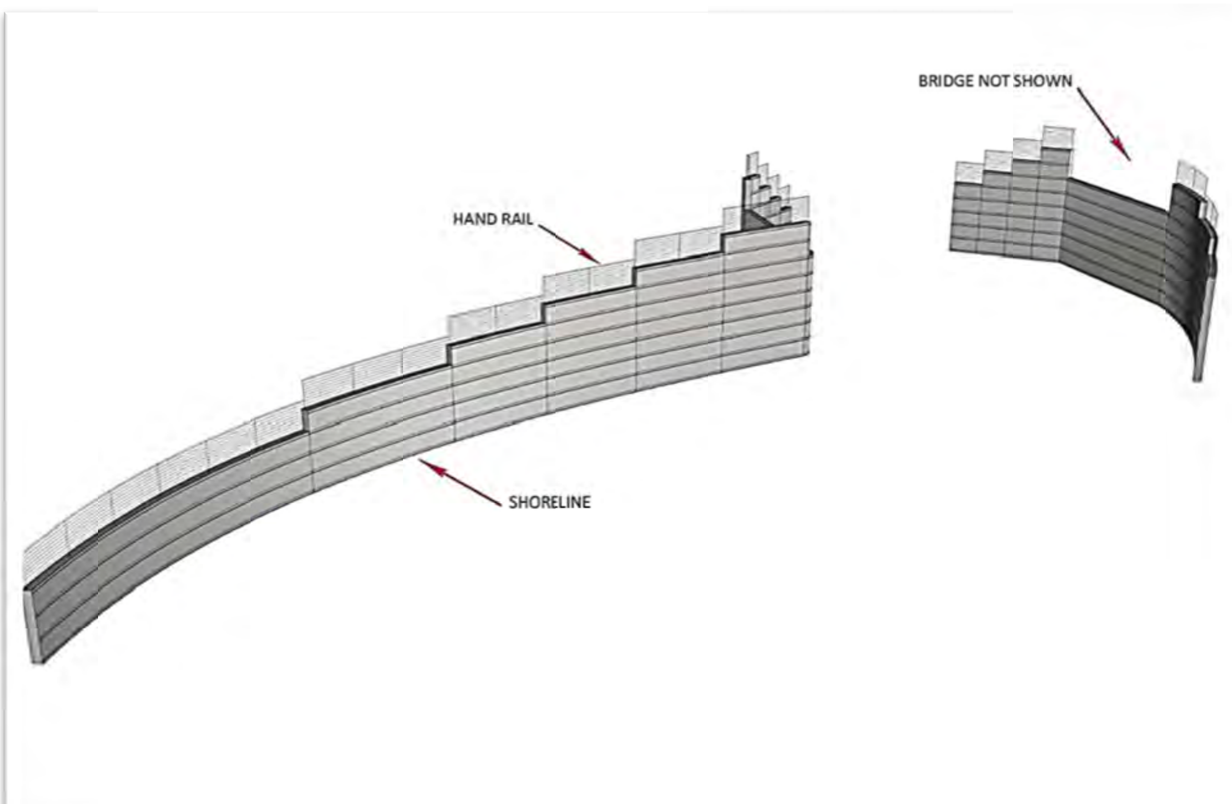


Concrete Arch Superstructure Perspective

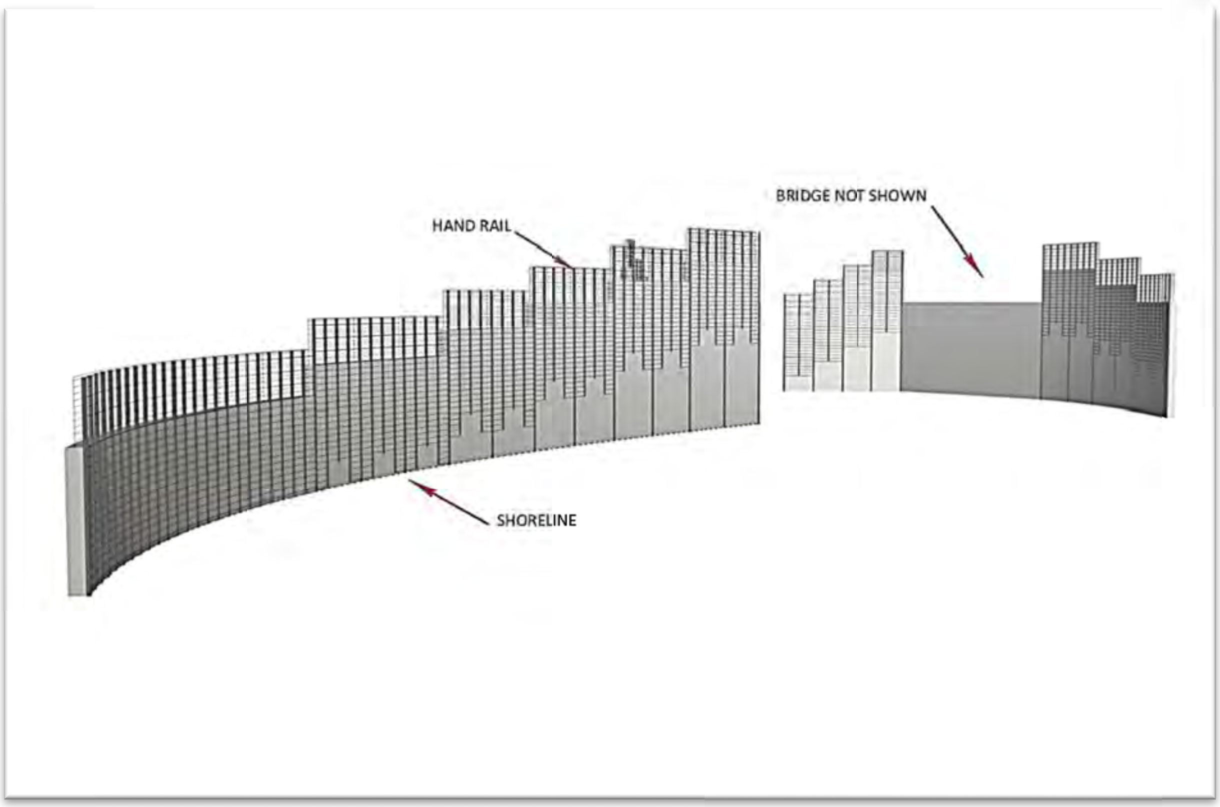


Steel Superstructure Perspective

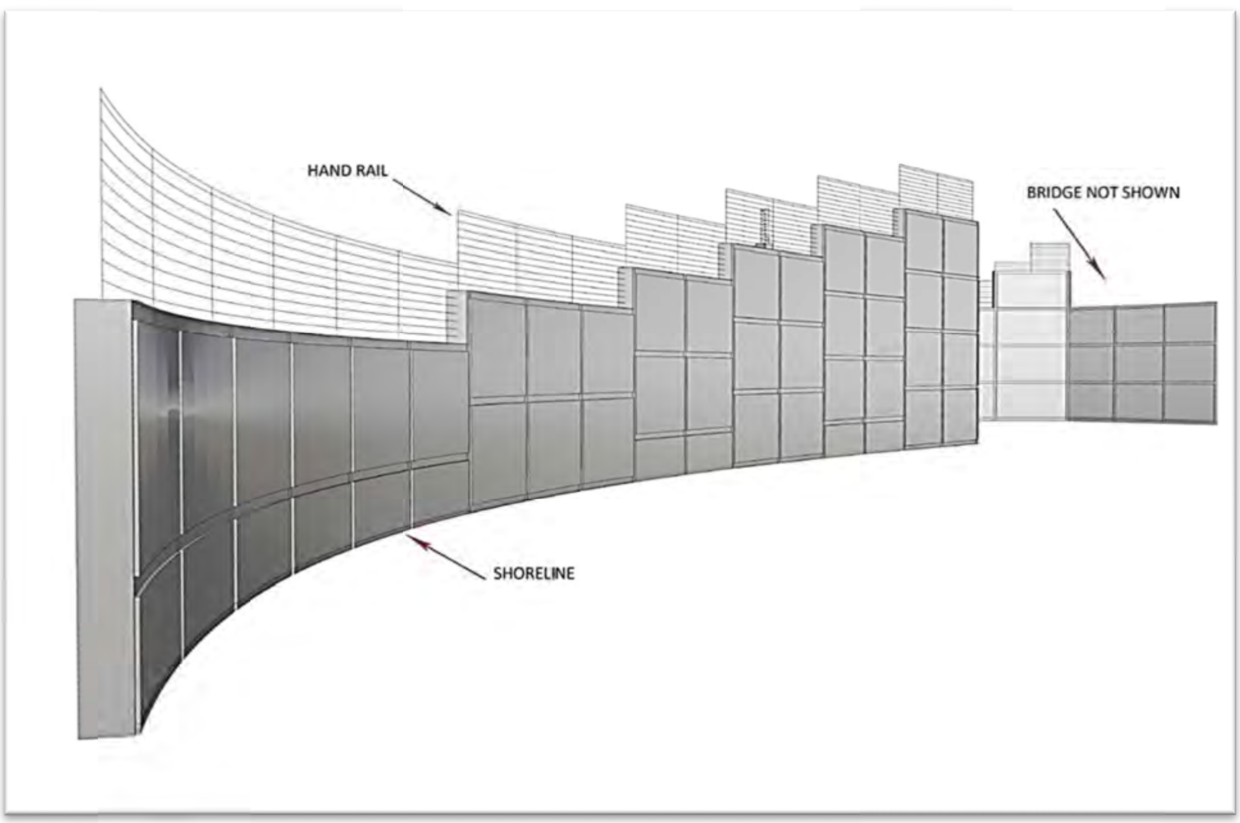
Glulam Superstructure Perspective



Scheme 1 Wall Treatment Perspective



Scheme 2 Wall Treatment Perspective



Scheme 3 Wall Treatment Perspective

Appendix B
Project Cost Details for Various Alternates

Meadow Way Bridge – 21’-6” x 70' Single-Span Concrete Arch Bridge with MSE Retaining Wall Construction Cost Estimate

Item Description	Quantity	Unit	Unit Price	Item Cost
Structure Conc, Bridge superstructure	81	CY	$1,000	$81,000
Structure Conc, Bridge substructure	91	CY	$800	$72,800
Structure Conc, Bridge Footing	56	CY	$450	$25,200
Bar Reinforcing Steel	45,500	LB	$3	$136,500
24" CIDH Piling	900	LF	$150	$135,000
Structure Excavation (Bridge)	221	CY	$100	$22,100
Structure Backfill (Bridge)	83	CY	$150	$12,450
Joint Seal (MR=1")	43	LF	$50	$2,150
Structural Conc Approach Slab Type EQ (10)	17	CY	$1,500	$25,500
Concrete Barrier Type 80	140	LF	$125	$17,500
Miscellaneous Metal	350	LB	$10	$3,500
Metal Beam Guard Rail	110	LF	$25	$2,750
Tubular hand railing	140	LF	$80	$11,200
Rock Slope Protection (1/4 Ton, Method B)	500	CY	$300	$150,000
Move Bridge to Final Alignment	1	LS	$30,000	$30,000
Existing Bridge Removal	1	LS	$50,000	$50,000
Water Diversion	1	LS	$30,000	$30,000
Furnish & Install street Lights	4	EA	$50,000	$200,000
Access Road (Earthwork)	250	CY	$100	$25,000
Furnish & Install MSE Wall	3600	SF	$65	$234,000
Cable Railing	146	LF	$20	$2,920
Temporary Railing (Type K)	300	LF	$50	$15,000
Utility Relocation	1	LS	$60,000	$60,000
Storm Drain System	1	LS	$15,000	$15,000
Traffic Control	1	LS	$25,000	$25,000
Approach Roadway	1	LS	$100,000	$100,000
Vegetation Restoration	1	LS	$15,000	$15,000
Subtotal 1				$1,499,570
Mobilization				$166,619
Subtotal 2 (CON)				$1,666,189
Use for CON				$1,667,000
Contingency (25%)				$416,750
Construction Engineering (15%)				$250,050
Grand Total				$2,333,800

Bridge CON	$1,119,611
MSE Wall	$291,022
Road CON	$255,556
Total CON	$1,666,189

Meadow Way Bridge – 21’-6” x 70' Single-Span Concrete Arch with Conventional Retaining Wall Construction Cost Estimate

Item Description	Quantity	Unit	Unit Price	Item Cost
Structure Conc, Bridge superstructure	81	CY	$1,000.00	$81,000
Structure Conc, Bridge substructure	91	CY	$800.00	$72,800
Structure Conc, Bridge Footing	56	CY	$450.00	$25,200
Bar Reinforcing Steel	45,500	LB	$3.00	$136,500
24" CIDH Piling	900	LF	$150.00	$135,000
Structure Excavation (Bridge)	221	CY	$100.00	$22,100
Structure Backfill (Bridge)	83	CY	$150.00	$12,450
Joint Seal (MR=1")	43	LF	$50.00	$2,150
Structural Conc Approach Slab Type EQ (10)	17	CY	$1,500.00	$25,500
Concrete Barrier Type 80	140	LF	$125.00	$17,500
Miscellaneous Metal	350	LB	$10.00	$3,500
Metal Beam Guard Rail	110	LF	$25.00	$2,750
Tubular hand railing	140	LF	$80.00	$11,200
Rock Slope Protection (1/4 Ton, Method B)	500	CY	$300.00	$150,000
Move Bridge to Final Alignment	1	LS	$30,000.00	$30,000
Existing Bridge Removal	1	LS	$50,000.00	$50,000
Water Diversion	1	LS	$30,000.00	$30,000
Furnish & Install street Lights	4	EA	$50,000.00	$200,000
Access Road (Earthwork)	150	CY	$75.00	$11,250
Temporary Shoring	4040	SF	$17.00	$68,680
Structure Conc, Retaining Wall	175	CY	$450.00	$78,750
Bar Reinf steel (Retaining Wall)	17,500	LB	$3.00	$52,500
Structure Excavation (Retaining Wall)	75	CY	$80.00	$6,000
Structure Backfill (Retaining Wall)	65	CY	$120.00	$7,800
24" CIDH Piling (Retaining Wall)	2,000	LF	$150.00	$300,000
Cable Railing	146	LF	$20.00	$2,920
Temporary Railing (Type K)	300	LF	$50.00	$15,000
Utility Relocation	1	LS	$60,000.00	$60,000
Storm Drain System	1	LS	$15,000.00	$15,000
Traffic Control	1	LS	$25,000.00	$25,000
Approach Roadway	1	LS	$100,000.00	$100,000
Vegetation Restoration	1	LS	$15,000.00	$15,000
Subtotal 1				$1,765,550
Mobilization				$196,172
Subtotal 2 (CON)				$1,961,722
Use for CON				$1,962,000
Contingency (25%)				$490,500
Construction Engineering (15%)				$294,300
Grand Total				$2,746,800

Bridge CON	$1,119,611
Retaining Wall CON	$586,556
Road CON	$255,556
Total CON	$1,961,722

Meadow Way Bridge - 21'-6" x 70' Single-Span Steel Bridge with Conventional Retaining Wall
Construction Cost Estimate

	Quantity	Unit	Unit Price	Item Cost
Structure Conc, Bridge superstructure	43	CY	$600	$25,800
Structure Conc, Bridge substructure	91	CY	$800	$72,800
Structure Conc, Bridge Footing	56	CY	$450	$25,200
Bar Reinforcing Steel Bridge	23,750	LB	$3	$71,250
24" CIDH Piling	900	LF	$150	$135,000
Structure Excavation (Bridge)	193	CY	$100	$19,300
Structure Backfill (Bridge)	115	CY	$100	$11,500
Joint Seal (MR=1")	43	LF	$30	$1,290
Structural Conc Approach Slab Type EQ (10)	17	CY	$600	$10,200
Prefabricated Steel Vierendeel Truss Bridge	1	LS	$180,000	$180,000
Lift & Erect Bridge	1	LS	$50,000	$50,000
Concrete Barrier Type 80	80	LF	$125	$10,000
Metal Beam Guard Rail	110	LF	$25	$2,750
Tubular hand railing	160	LF	$60	$9,600
Furnish & Install street Lights	4	EA	$50,000	$200,000
Move Bridge to Final Alignment	1	LS	$50,000	$50,000
Water Diversion	1	LS	$30,000	$30,000
Bridge Removal	1	LS	$50,000	$50,000
Rock Slope Protection (1/4 Ton, Method B)	1000	CY	$120	$120,000
Access Road (Earthwork)	150	CY	$75	$11,250
Temporary Shoring	4040	SF	$17	$68,680
Structure Conc, Retaining Wall	175	CY	$450	$78,750
Bar Reinf steel (Retaining Wall)	17,500	LB	$3	$52,500
Structure Excavation (Retaining Wall)	75	CY	$80	$6,000
Structure Backfill (Retaining Wall)	65	CY	$120	$7,800
24" CIDH Piling (Retaining Wall)	2,000	LF	$150	$300,000
Cable Railing	146	LF	$20	$2,920
Temporary Railing (Type K)	300	LF	$50	$15,000
Utility Relocation	1	LS	$60,000	$60,000
Storm Drian System	1	LS	$15,000	$15,000
Traffic Control	1	LS	$25,000	$25,000
Approach Roadway	1	LS	$100,000	$100,000
Vegetation Restoration	1	LS	$15,000	$15,000
Subtotal 1				$1,832,590
Mobilization				$203,621
subtotal 2 (CON)				$2,036,211
Use for CON				$2,043,000
Contingency 25%				$510,750
Const Engineering				$306,450
Grand Total				$2,860,200

Bridge CON	$1,194,099
Retaining Wall CON	$586,555
Road CON	$255,556
Total CON	$2,036,210

Meadow Way Bridge - 21'-6" x 70' Single-Span Steel Bridge with MSE Retaining wall
Construction Cost Estimate

	Quantity	Unit	Unit Price	Item Cost
Structure Conc, Bridge superstructure	43	CY	$600.00	$25,800
Structure Conc, Bridge substructure	91	CY	$800.00	$72,800
Structure Conc, Bridge Footing	56	CY	$450.00	$25,200
Bar Reinf steel (super)	23,750	LB	$3.00	$71,250
24" CIDH Piling	900	LF	$150.00	$135,000
Structure Excavation (Bridge)	193	CY	$100.00	$19,300
Structure Backfill (Bridge)	115	CY	$100.00	$11,500
Joint Seal (MR=1")	43	LF	$30.00	$1,290
Structural Conc Approach Slab Type EQ (10)	17	CY	$600.00	$10,200
Prefabricated Steel Vierendeel Truss Bridge, erect at site	1	LS	$180,000.00	$180,000
Lift & Erect Bridge	1	LS	$50,000.00	$50,000
Concrete Barrier Type 80	140	LF	$125.00	$17,500
Metal Beam Guard Rail	110	LF	$25.00	$2,750
Tubular hand railing	160	LF	$60.00	$9,600
Furnish & Install street Lights	4	EA	$50,000.00	$200,000
Move Bridge to Final Alignment	1	LS	$50,000.00	$50,000
Water Diversion	1	LS	$30,000.00	$30,000
Bridge Removal	1	LS	$50,000.00	$50,000
Rock Slope Protection (1/4 Ton, Method B)	1000	CY	$120.00	$120,000
Access Road (Earthwork)	250	CY	$100.00	$25,000
Furnish & Install MSE	3600	SF	$65.00	$234,000
Cable Railing	146	LF	$20.00	$2,920
Temporary Railing (Type K)	300	LF	$50.00	$15,000
Utility Relocation	1	LS	$60,000.00	$60,000
Storm Drian System	1	LS	$15,000.00	$15,000
Traffic Control	1	LS	$25,000.00	$25,000
Approach Roadway	1	LS	$100,000.00	$100,000
Vegetation Restoration	1	LS	$15,000.00	$15,000
Subtotal 1				$1,574,110
Mobilization				$174,901
subtotal 2 (CON)				$1,749,011
Use for CON				$1,748,000
Contingency 25%				$437,000
Const Engineering				$262,200
Grand Total				$2,447,200

Bridge CON	$1,202,433
MSE Wall CON	$291,022
Road CON	$255,556
Total CON	$1,749,011

Meadow Way Bridge - 21'-6" x 70' Single-Span Arch Glulam Wood with Conventional retaining Wall Construction Cost Estimate

Item Description	Quantity	Unit	Unit Price	Item Cost
Structural Concrete, Bridge	43	CY	$600.00	$25,800
Structure Conc, Bridge substructure	91	CY	$800.00	$72,800
Structure Conc, Bridge Footing	56	CY	$450.00	$25,200
Bar Reinf steel Bridge	23,750	LB	$3.00	$71,250
24" CIDH Piling	900	LF	$150.00	$135,000
Structure Excavation (Bridge)	193	CY	$100.00	$19,300
Structure Backfill (Bridge)	115	CY	$150.00	$17,250
Joint Seal (MR=1")	43	LF	$50.00	$2,150
Structural Conc Approach Slab Type EQ (10)	17	CY	$1,500.00	$25,500
Concrete Barrier Type 80	140	LF	$125.00	$17,500
Furnish Glulam Girders 12 x 42 (70' span)	10	EA	$21,500.00	$215,000
Furnish Glulam Stringer (70')	5	EA	$3,715.00	$18,575
Install 6 3/4 x 18 spandrels	1	LS	$8,000.00	$8,000
Erect Glulam Girders	10	EA	$1,000.00	$10,000
Erect Glulam Stringer	5	EA	$500.00	$2,500
Miscellaneous Metal	350	LB	$10.00	$3,500
Metal Beam Guard Rail	110	LF	$25.00	$2,750
Bridge Removal	1	LS	$50,000.00	$50,000
Tubular hand railing	140	LF	$80.00	$11,200
Move Bridge to Final Alignment	1	LS	$30,000.00	$30,000
Rock Slope Protection (1/4 Ton, Method B)	500	CY	$300.00	$150,000
Water Diversion	1	LS	$30,000.00	$30,000
Furnish & Install Street Lights	4	EA	$50,000	$ 200,000
Access Road (Earthwork)	150	CY	$75.00	$11,250
Temporary Shoring	4040	SF	$17.00	$68,680
Structure Conc, Retaining Wall	175	CY	$450.00	$78,750
Bar Reinf steel (Retaining Wall)	17,500	LB	$3.00	$52,500
Structure Excavation (Retaining Wall)	75	CY	$80.00	$6,000
Structure Backfill (Retaining Wall)	65	CY	$120.00	$7,800
24" CIDH Piling (Retaining Wall)	2,000	LF	$150.00	$300,000
Cable Railing	146	LF	$20.00	$2,920
Tomporary Railing (Type K)	300	LF	$50.00	$15,000
Storm Drain System	1	LS	$60,000.00	$60,000
Utility Relocation	1	LS	$15,000.00	$15,000
Traffic Control	1	LS	$25,000.00	$25,000
Approach Roadway	1	LS	$100,000.00	$100,000
Vegetation Restoration	1	LS	$15,000.00	$15,000
Subtotal 1				$1,901,175
Mobilization				$211,242
Subtotal 2 (CON)				$2,112,417
Use for CON				$2,115,000
Contingency 25%				$528,750
Construction Engineering (CE) 15%				$317,250
Grand Total				$2,961,000

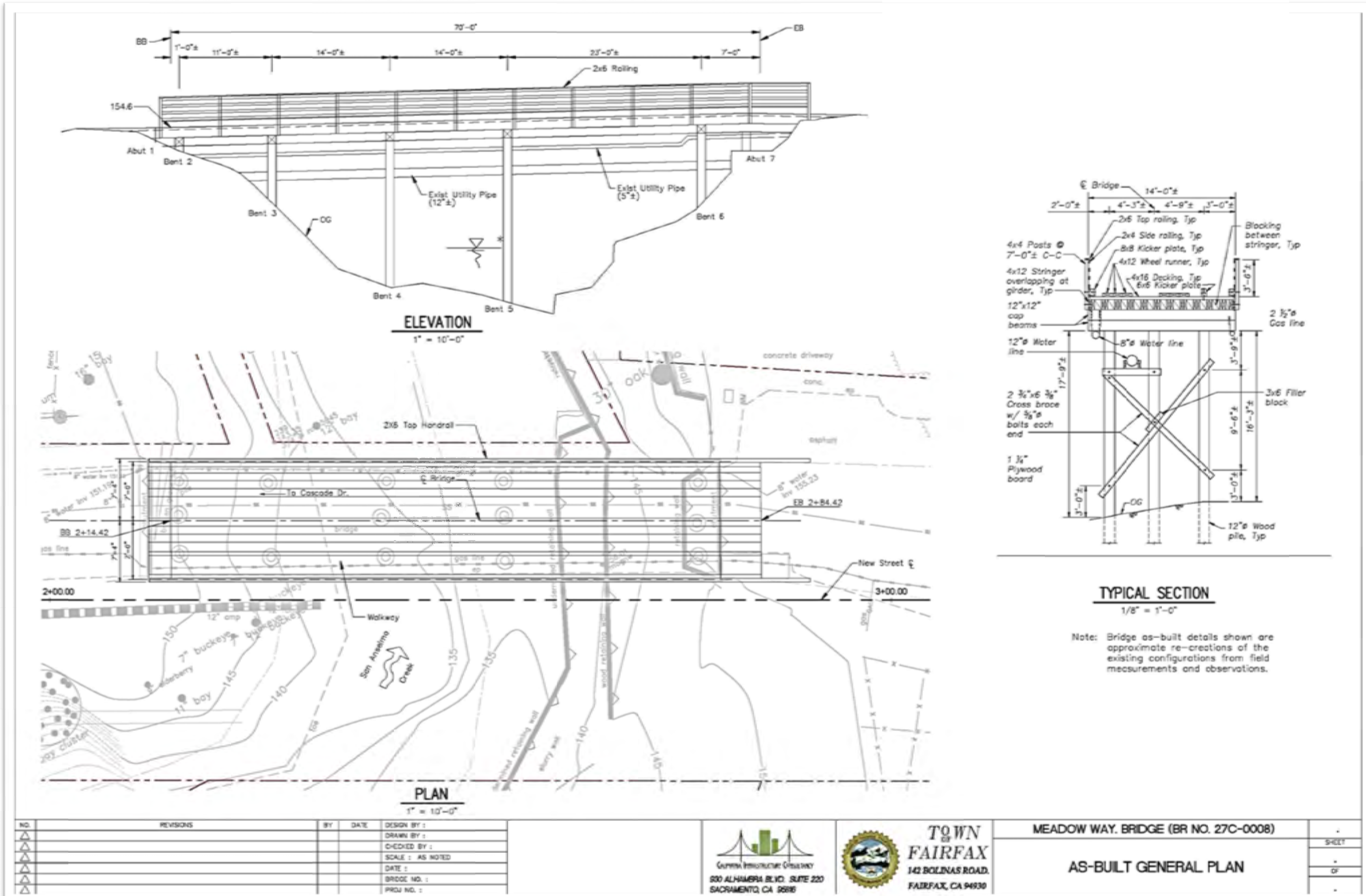
Br CON	$1,270,306
Ret Wall CON	$586,555
Road CON	$255,556
Tot CON	$2,112,416

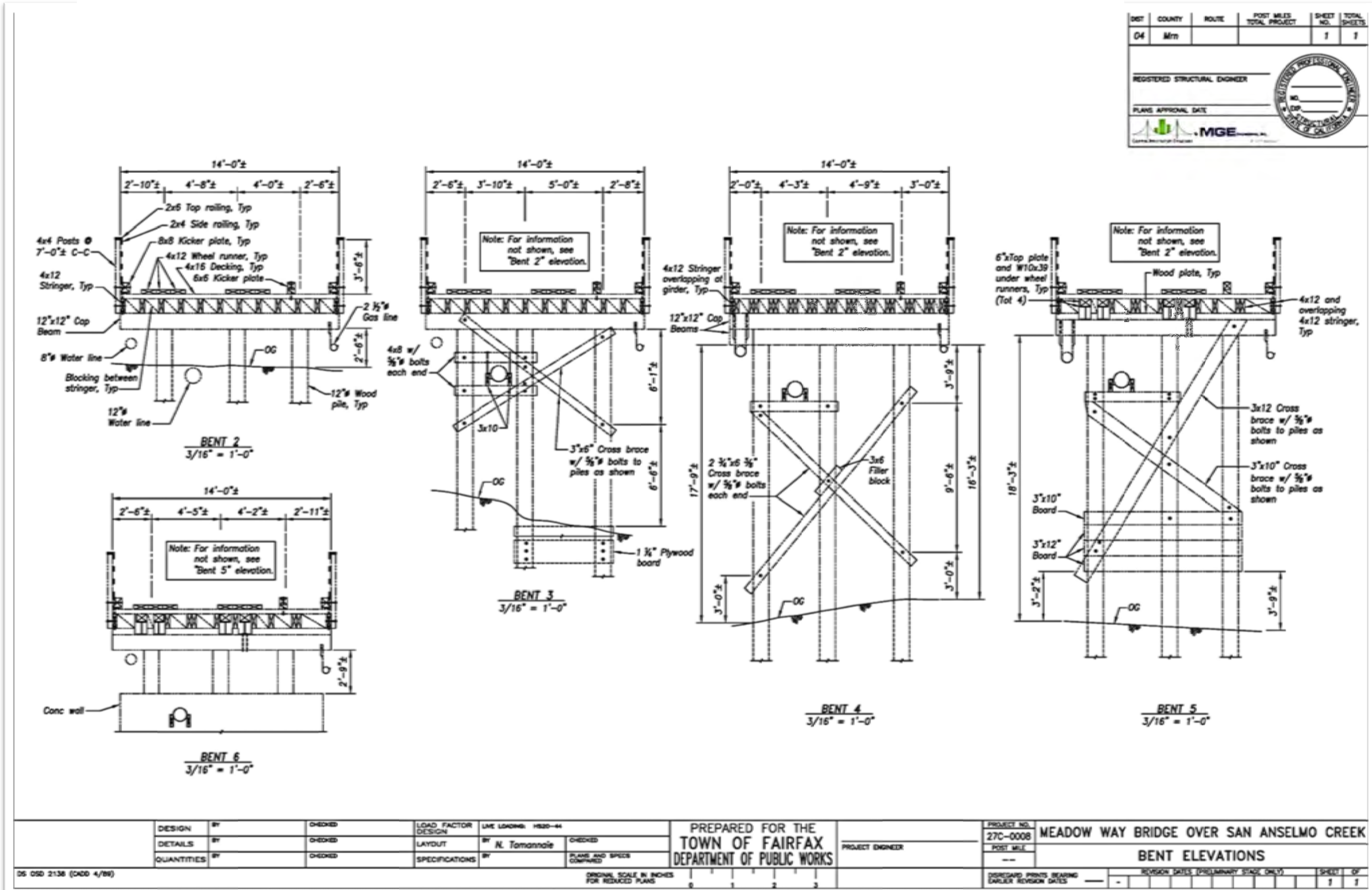
Meadow Way Bridge - 21'-6" x 70' Single-Span Arch Wood Bridge with MSE Retaining wall
Construction Cost Estimate

Item Description	Quantity	Unit	Unit Price	Item Cost
Structural Concrete, Bridge	43	CY	$600.00	$ 25,800
Structure Conc, Bridge Footing	91	CY	$800.00	$ 72,800
Bar Reinf steel Bridge	56	CY	$450.00	$ 25,200
24" CIDH Piling	23,750	LB	$3.00	$ 71,250
Structure Excavation (Bridge)	900	LF	$150.00	$ 135,000
Structure Backfill (Bridge)	193	CY	$100.00	$ 19,300
Joint Seal (MR=1")	115	CY	$150.00	$ 17,250
Structural Conc Approach Slab Type EQ (10)	43	LF	$50.00	$ 2,150
Concrete Barrier Type 80	140	CY	$125.00	$ 17,500
Furnish Glulam Girders 12 x 42 (70' span)	70	LF	$150.00	$ 10,500
Furnish Glulam Stringer (70')	10	EA	$21,500.00	$ 215,000
Install 6 3/4 x 18 spandrels	5	EA	$3,715.00	$ 18,575
Erect Glulam Girders	1	LS	$8,000.00	$ 8,000
Erect Glulam Stringer	10	EA	$1,000.00	$ 10,000
Miscellaneous Metal	5	EA	$500.00	$ 2,500
Metal Beam Guard Rail	350	LB	$10.00	$ 3,500
Bridge Removal	110	LF	$25.00	$ 2,750
Tubular hand railing	1	LS	$50,000.00	$ 50,000
Drive sheetpiling	140	LF	$80.00	$ 11,200
Rock Slope Protection (1/4 Ton, Method B)	1	LS	$30,000.00	$ 30,000
Move Bridge to Final Alignment	500	CY	$300.00	$ 150,000
Water Diversion	1	LS	$30,000.00	$ 30,000
Furnish & Install Street Lights	4	EA	$50,000	$ 200,000
Access Road (Earthwork)	250	CY	$100	$25,000.00
Furnish & Install MSE	3600	SF	$65	$ 234,000
Cable railing	146	LF	$20	$ 2,920
Tomporary Railing (Type K)	300	LF	$50	$ 15,000
Storm Drain System	1	LS	$60,000	$ 60,000
Utility Relocation	1	LS	$15,000	$ 15,000
Traffic Control	1	LS	$25,000	$ 25,000
Approach Roadway	1	LS	$100,000	$ 100,000
Vegetation Restoration	1	LS	$15,000	$ 15,000
Subtotal 1				$1,620,195
Mobilization				$ 180,022
Subtotal 2 (CON)				$1,800,217
Use for CON				$1,819,000
Contingency 25%				$ 454,750
Construction Engineering (CE) 15%				$ 272,850
Grand Total				$2,546,600

Br CON	$1,253,639
Ret Wall CON	$291,022
Road CON	$255,556
Tot CON	$1,800,217

Appendix C
Post-Construction Bridge As-Built Drawings for the Existing Bridge


ELEVATION
1" = 10'-0"
PLAN
1" = 10'-0"
TYPICAL SECTION
1/8" = 1'-0"
Note: Bridge as-built details shown are approximate re-creations of the existing configurations from field measurements and observations.
Abut 1
Bent 2
Bent 3
Bent 4
Bent 5
Bent 6
Abut 7
2x6 Railing
Exist. Utility Pipe (12"±)
Exist. Utility Pipe (5"±)
2X6 Top Handrail
To Cascade Dr.
BB 2+14.42
EB 2+84.42
New Street ℄
Walkway
San Anselmo Creek
2+00.00
3+00.00
℄ Bridge
2x6 Top railing, Typ
2x4 Side railing, Typ
8x8 Kicker plate, Typ
4x12 Wheel runner, Typ
4x16 Decking, Typ
6x6 Kicker plate
4x4 Posts @ 7'-0"± C-C
4x12 Stringer overlapping at girder, Typ
12"x12" cap beams
12"ø Water line
8"ø Water line
2 ½"ø Gas line
Blocking between stringer, Typ
3x6 Filler block
1 ⅛" Plywood board
12"ø Wood pile, Typ
MEADOW WAY. BRIDGE (BR NO. 27C-0008)
AS-BUILT GENERAL PLAN
TOWN OF FAIRFAX
142 BOLINAS ROAD.
FAIRFAX, CA 94930
930 ALHAMBRA BLVD. SUITE 220
SACRAMENTO, CA 95816
REVISIONS
DESIGN BY :
DRAWN BY :
CHECKED BY :
SCALE : AS NOTED
DATE :
BRIDGE NO. :
PROJ NO. :


BENT 2
3/16" = 1'-0"
BENT 3
3/16" = 1'-0"
BENT 4
3/16" = 1'-0"
BENT 5
3/16" = 1'-0"
BENT 6
3/16" = 1'-0"
Note: For information not shown, see "Bent 2" elevation.
Note: For information not shown, see "Bent 5" elevation.
2x6 Top railing, Typ
2x4 Side railing, Typ
8x8 Kicker plate, Typ
4x12 Wheel runner, Typ
4x16 Decking, Typ
6x6 Kicker plate
4x4 Posts @ 7'-0"± C-C
4x12 Stringer, Typ
12"x12" Cap Beam
8"ø Water line
Blocking between stringer, Typ
12"ø Water line
12"ø Wood pile, Typ
2 ½"ø Gas line
OG
Conc wall
1 ¾" Plywood board
3"x6" Cross brace w/ ⅝"ø bolts to piles as shown
3x10
4x8 w/ ⅝"ø bolts each end
3x6 Filler block
2 ¾"x6 ⅝" Cross brace w/ ⅝"ø bolts each end
12"x12" Cap Beams
4x12 Stringer overlapping at girder, Typ
6"xTop plate and W10x39 under wheel runners, Typ (Tot 4)
Wood plate, Typ
4x12 and overlapping 4x12 stringer, Typ
3x12 Cross brace w/ ⅝"ø bolts to piles as shown
3"x10" Cross brace w/ ⅝"ø bolts to piles as shown
3"x10" Board
3"x12" Board
REGISTERED STRUCTURAL ENGINEER
PLANS APPROVAL DATE
MGE
PREPARED FOR THE TOWN OF FAIRFAX DEPARTMENT OF PUBLIC WORKS
MEADOW WAY BRIDGE OVER SAN ANSELMO CREEK
BENT ELEVATIONS
27C-0008
N. Tomannaie
LIVE LOADING: HS20-44

Appendix D
Existing Bridge’s 2014 and 2015 Bridge Inspection Reports (BIRs)

DEPARTMENT OF TRANSPORTATION
Structure Maintenance & Investigations

Bridge Inspection Report

Bridge Number : 27C0008
Facility Carried: MEADOW WAY
Location : IN FAIRFAX
City : FAIRFAX
Inspection Date : 07/16/2015

Inspection Type
Routine FC Underwater Special Other
[x] Other

STRUCTURE NAME: SAN ANSELMO CREEK

CONSTRUCTION INFORMATION

Year Built : 1950
Year Widened: N/A
Length (m) : 21.3

Skew (degrees): 0
No. of Joints : 0
No. of Hinges : 0

Structure Description: A 5 span simply supported timber girder (12 in Spans 1, 2, 3 and 4; 5 timber and 4 steel girder in Span 4) supported by timber bents(3) with timber bent caps and concrete abutments without monolithic wingwalls. Founded on timber piles.

Span Configuration : 0.30 m, 3.35 m, 2 @ 4.27, 7.01 m.

SAFE LOAD CAPACITY AND RATINGS

Design Live Load: M-13.5 OR H-15
Inventory Rating: RF=0.41 =>13.3 metric tons   Calculation Method: ALLOWABLE STRESS
Operating Rating: RF=0.57 =>18.5 metric tons   Calculation Method: ALLOWABLE STRESS
Permit Rating : XXXXX
Posting Load : Type 3: 18 U.S. Tons   Type 3S2: 28 U.S. Tons   Type 3-3: 35 U.S. Tons

DESCRIPTION ON STRUCTURE

Deck X-Section: 0.21 m br, 3.08 m, 0.15 m wg, 0.76 m sw, 0.19 m br
Total Width: 4.3 m   Net Width: 3.0 m   No. of Lanes: 1   Speed: 5 mph
Min. Vertical Clearance: Unimpaired   Overlay Thickness: 0.0 Inches

Rail Code: 0000

Rail Type	Location	Length (ft)	Rail Modifications
Timber Rail	Right/Left	151	

DESCRIPTION UNDER STRUCTURE

Channel Description: Natural creek channel - soil, sand and rock.

NOTICE

The bridge inspection condition assessment used for this inspection is based on the American Association of State Highway and Transportation Officials (AASHTO) Bridge Element Inspection Manual 2013 as defined in Moving Ahead for Progress in the 21st Century (MAP-21) federal law. The new element inspection methodology may result in changes to related condition and appraisal ratings on the bridge without significant physical changes at the bridge.

The element condition information contained in this report represents the current condition of the bridge based on the most recent routine and special inspections. Some of the notes presented below may be from an inspection that occurred prior to the date noted in this report. Refer to the Scope and Access section of this inspection report for a description of which portions of the bridge were inspected on this date.

INSPECTION COMMENTARY

SCOPE AND ACCESS

A field investigation was performed on 7/16/2015 to investigate the timber columns at Pier 3 and timber Bent cap 5 at Abutment 5. A Quality Assurance Review prompted this investigation. The channel was dry. The timber bent caps and timber columns were drilled to determine the extent of the dry rot condition. The findings are recorded in the

INSPECTION COMMENTARY

Element Condition of this report.

MISCELLANEOUS

Nader Tamannaze, the consulting engineer for the Town of Fairfax, was contacted on 7/20/2015, and informed about the condition of the defects at the timber column at Pier 3 and timber bent cap at Abutment 5.

SAFE LOAD CAPACITY

A Load Rating Summary Sheet dated 7/02/2013 is on file for this structure. While this inspection does not include a check of that analysis, it does verify that the structure conditions observed during this inspection are consistent with those assumed in that analysis. The current rating is based on VIRTIS calculations dated 6/21/2012.

OPERATIONAL SIGNS

At both ends:

"5 MPH"
"SLOW"
WEIGHT LIMIT
16 TONS PER VEHICLE
26 TONS PER SEMI-TRAILER COMBINATION
32 TONS PER TRUCK AND FULL-TRAILER

EXISTING POSTING

The following posting has been placed as per the Order of Director of Transportation dated 2/4/1986:

16 TONS PER VEHICLE
26 TONS PER SEMI-TRAILER COMBINATION
32 TONS PER TRUCK AND FULL-TRAILER

RECOMMENDED POSTING

Retain existing posting.

ELEMENT INSPECTION RATINGS AND COMMENTARY

Elem No.	Defect /Prot	Defect	Element Description	Env	Total Qty	Units	Qty in each Condition State St. 1	St. 2	St. 3	St. 4
31			Deck-Timber	2	92	sq.m	62	30	0	0
	1170		Split/Delamination (Timber)	2	30		0	30	0	0

(31-1170)
Thirty percent (30%) of the deck runner planks have split. Based on a field comparison of the photo from the 9/2010 report, this condition has not changed.

Elem No.	Defect /Prot	Defect	Element Description	Env	Total Qty	Units	St. 1	St. 2	St. 3	St. 4
107			Girder/Beam-Steel	2	29	m	0	29	0	0
	1000		Corrosion	2	29		0	29	0	0

(107-1000)
All steel girders are covered with blanket rust. No section loss is observed. Based on a field comparison of the photo from the 9/2010 report, this condition has not changed.

Elem No.	Defect /Prot	Defect	Element Description	Env	Total Qty	Units	St. 1	St. 2	St. 3	St. 4
111			Girder/Beam-Timber	2	190	m	190	0	0	0

(111)
There were no significant defects noted.

Elem No.	Defect /Prot	Defect	Element Description	Env	Total Qty	Units	St. 1	St. 2	St. 3	St. 4
206			Column-Timber	2	12	each	11	0	0	1
	1170		Split/Delamination (Timber)	2	1		0	0	0	1

ELEMENT INSPECTION RATINGS AND COMMENTARY

Elem No.	Defect /Prot	Defect	Element Description	Env	Total Qty	Units	Qty in each Condition State St. 1	St. 2	St. 3	St. 4

(206-1170)
There are splits in the timber column at Column 3 of Pier 3. The splits are about 2 feet long by 2 inches deep around the perimeter. Currently, this condition does not affect the load capacity, but it is recommended to be repaired; install steel banding at the top of the column.

215		Abutment-RC	2	9	m	9	0	0	0

(215)
There were no significant defects noted.

228		Pile-Timber	2	1	ea.	1	0	0	0

(228)
The pile element is included to indicate the presence of piles on this structure. The piles were not exposed for visual inspection. No indication of pile distress was noted in any substructure element.

235		Pier Cap-Timber	2	27	m	5	18	0	4
	1140	Decay/Section Loss (Timber)	2	4		0	0	0	4
	1150	Check/Shake (Timber)	2	18		0	18	0	0

(235-1140)
There is a vertical split in Bent cap 5, which extends from the left end to half length of the bent cap. Dry rot has occurred inside the bent cap along the vertical split. Approximately 50 percent of the timber cap has rotted. The bent cap portion at Column 1 has crushed about 1 inch. See attached photos.

(235-1150)
Bent cap 4 has a horizontal check full length. This condition was first noted in the 8/10/1999 report and has not significantly changed at this time. Based on a field comparison of the photo from the 9/2010 report, this condition has not changed.

There is a vertical split in Bent cap 2, which extends from the left end to half length of the bent cap. Based on a field comparison of the photo from the 9/2010 report, this condition has not changed.

332		Railing-Timber	2	42	m	42	0	0	0

(332)
There were no significant defects noted.

WORK RECOMMENDATIONS

RecDate: 07/16/2015	EstCost:	Replace timber bent cap at Pier 5.
Action : Sub-Misc.	StrTarget: 6 MONTHS	Provided steel banding for Column 3 of
Work By: LOCAL AGENCY	DistTarget:	Pier 3.
Status : PROPOSED	EA:	

SAN ANSELMO CREEK

IN FAIRFAX **07/16/2015 [AAAM]** **27C0008**

113 - PHOTO-Sub-Damage/Deterioration

Photo No. 1

Timber cap crushing at Pier 5 Column 1.

113 - PHOTO-Sub-Damage/Deterioration

Photo No. 2

Timber cap split at Pier 5.

SAN ANSELMO CREEK

IN FAIRFAX 07/16/2015 [AAAM] 27C0008

113 - PHOTO-Sub-Damage/Deterioration

Photo No. 3

Timber splits at Column 3 of Pier 3.

113 - PHOTO-Sub-Damage/Deterioration

Photo No. 4

Timber splits at Column 3 of Pier 3.

DEPARTMENT OF TRANSPORTATION
Structure Maintenance & Investigations

Caltrans

Bridge Number : 27C0008
Facility Carried: MEADOW WAY
Location : IN FAIRFAX
City : FAIRFAX
Inspection Date : 10/22/2014

Bridge Inspection Report

Inspection Type

Routine	FC	Underwater	Special	Other
X				

STRUCTURE NAME: SAN ANSELMO CREEK

CONSTRUCTION INFORMATION

Year Built : 1950 Skew (degrees): 0
Year Widened: N/A No. of Joints : 0
Length (m) : 21.3 No. of Hinges : 0

Structure Description: A 5 span simply supported timber girder (12 in Spans 1, 2, 3 and 4; 5 timber and 4 steel girder in Span 4) supported by timber bents(3) with timber bent caps and concrete abutments without monolithic wingwalls. Founded on timber piles.

Span Configuration : 0.30 m, 3.35 m, 2 @ 4.27, 7.01 m.

SAFE LOAD CAPACITY AND RATINGS

Design Live Load: M-13.5 OR H-15
Inventory Rating: RF=0.41 =>13.3 metric tons Calculation Method: ALLOWABLE STRESS
Operating Rating: RF=0.57 =>18.5 metric tons Calculation Method: ALLOWABLE STRESS
Permit Rating : XXXXX
Posting Load : Type 3: 18 U.S. Tons Type 3S2: 28 U.S. Tons Type 3-3: 35 U.S. Tons

DESCRIPTION ON STRUCTURE

Deck X-Section: 0.21 m br, 3.08 m, 0.15 m wg, 0.76 m sw, 0.19 m br
Total Width: 4.3 m Net Width: 3.0 m No. of Lanes: 1 Speed: 5 mph
Min. Vertical Clearance: Unimpaired AC Thickness: 0.0 Inches

Rail Code: 0000

Rail Type	Location	Length (ft)	Rail Modifications
Timber Rail	Right/Left	151	

DESCRIPTION UNDER STRUCTURE

Channel Description: Natural creek channel - soil, sand and rock.

NOTICE

The bridge inspection condition assessment used for this inspection is based on the American Association of State Highway and Transportation Officials (AASHTO) Bridge Element Inspection Manual 2013 as defined in Moving Ahead for Progress in the 21st Century (MAP-21) federal law. The new element inspection methodology may result in changes to related condition and appraisal ratings on the bridge without significant physical changes at the bridge.

The element condition information contained in this report represents the current condition of the bridge based on the most recent routine and special inspections. Some of the notes presented below may be from an inspection that occurred prior to the date noted in this report. Refer to the Scope and Access section of this inspection report for a description of which portions of the bridge were inspected on this date.

INSPECTION COMMENTARY

SCOPE AND ACCESS

The channel was dry. All portions of the substructure were observed on the date of this investigation.

INSPECTION COMMENTARY

SAFE LOAD CAPACITY

A Load Rating Summary Sheet dated 7/02/2013 is on file for this structure. While this inspection does not include a check of that analysis, it does verify that the structure conditions observed during this inspection are consistent with those assumed in that analysis. The current rating is based on VIRTIS calculations dated 6/21/2012. While this inspection does not include a check of that analysis, it does verify that the structural conditions assumed in that rating have not changed significantly.

OPERATIONAL SIGNS

At the both ends:

"5 MPH"
"SLOW"
WEIGHT LIMIT
16 TONS PER VEHICLE
26 TONS PER SEMI-TRAILER COMBINATION
32 TONS PER TRUCK AND FULL-TRAILER

EXISTING POSTING

The following posting has been placed as per the Order of Director of Transportation dated 2/4/1986:

16 TONS PER VEHICLE
26 TONS PER SEMI-TRAILER COMBINATION
32 TONS PER TRUCK AND FULL-TRAILER

RECOMMENDED POSTING

Retain existing posting.

ELEMENT INSPECTION RATINGS AND COMMENTARY

Elem No.	Defect /Prot	Defect	Element Description	Env	Total Qty	Units	Qty in each Condition State St. 1	St. 2	St. 3	St. 4
31			Deck-Timber	2	92	sq.m	62	30	0	0
	1170		Split/Delamination (Timber)	2	30		0	30	0	0
107			Girder/Beam-Steel	2	29	m	0	29	0	0
	1000		Corrosion	2	29		0	29	0	0
111			Girder/Beam-Timber	2	190	m	190	0	0	0
206			Column-Timber	2	12	each	12	0	0	0
215			Abutment-RC	2	9	m	9	0	0	0

(31-1170)
Thirty percent (30%) of the deck runner planks have split. Based on a field comparison of the photo from the 9/2010 report, this condition has not changed.

(107-1000)
All steel girders are covered with blanket rust. No section loss is observed. Based on a field comparison of the photo from the 9/2010 report, this condition has not changed.

(111)
There were no significant defects noted.

(206)
There were no significant defects noted.

(215)
There were no significant defects noted.

ELEMENT INSPECTION RATINGS AND COMMENTARY

Elem No.	Defect	Defect /Prot	Element Description	Env	Total Qty	Units	Qty in each Condition State St. 1	St. 2	St. 3	St. 4
228			Pile-Timber	2	1	ea.	1	0	0	0

(228)
The pile element is included to indicate the presence of piles on this structure. The piles were not exposed for visual inspection. No indication of pile distress was noted in any substructure element.

Elem No.	Defect	Defect /Prot	Element Description	Env	Total Qty	Units	St. 1	St. 2	St. 3	St. 4
235			Pier Cap-Timber	2	27	m	9	18	0	0
	1150		Check/Shake (Timber)	2	18		0	18	0	0

(235-1150)
Bent cap 4 has a horizontal check full length. This condition was first noted in the 8/10/1999 report and has not significantly changed at this time. Based on a field comparison of the photo from the 9/2010 report, this condition has not changed.

There is a vertical split in Bent cap 2, which extends from the left end to half length of the bent cap. Based on a field comparison of the photo from the 9/2010 report, this condition has not changed.

Elem No.	Defect	Defect /Prot	Element Description	Env	Total Qty	Units	St. 1	St. 2	St. 3	St. 4
332			Railing-Timber	2	42	m	42	0	0	0

(332)
There were no significant defects noted.

WORK RECOMMENDATIONS - NONE

Team Leader : Andy N. Dang

Report Author : Andy N. Dang

Inspected By : AN.Dang/RH.Le

A. L. Dang 3/17/15

Andy N. Dang (Registered Civil Engineer) (Date)

REGISTERED PROFESSIONAL ENGINEER
Andy N. Dang
No. 63640
09/30/2016
CIVIL
STATE OF CALIFORNIA

STRUCTURE INVENTORY AND APPRAISAL REPORT

************** IDENTIFICATION **************
(1) STATE NAME- CALIFORNIA 069
(8) STRUCTURE NUMBER 27C0008
(5) INVENTORY ROUTE(ON/UNDER)- ON 150000000
(2) HIGHWAY AGENCY DISTRICT 04
(3) COUNTY CODE 041 (4) PLACE CODE 23168
(6) FEATURE INTERSECTED- SAN ANSELMO CREEK
(7) FACILITY CARRIED- MEADOW WAY
(9) LOCATION- IN FAIRFAX
(11) MILEPOINT/KILOMETERPOINT 0
(12) BASE HIGHWAY NETWORK- NOT ON NET 0
(13) LRS INVENTORY ROUTE & SUBROUTE
(16) LATITUDE 37 DEG 58 MIN 33.58 SEC
(17) LONGITUDE 122 DEG 36 MIN 00.49 SEC
(98) BORDER BRIDGE STATE CODE % SHARE %
(99) BORDER BRIDGE STRUCTURE NUMBER

******** STRUCTURE TYPE AND MATERIAL ********
(43) STRUCTURE TYPE MAIN:MATERIAL- STEEL
TYPE- STRINGER/MULTI-BEAM OR GDR CODE 302
(44) STRUCTURE TYPE APPR:MATERIAL- WOOD OR TIMBER
TYPE- STRINGER/MULTI-BEAM OR GDR CODE 702
(45) NUMBER OF SPANS IN MAIN UNIT 1
(46) NUMBER OF APPROACH SPANS 4
(107) DECK STRUCTURE TYPE- TIMBER CODE 8
(108) WEARING SURFACE / PROTECTIVE SYSTEM:
A) TYPE OF WEARING SURFACE- TIMBER CODE 7
B) TYPE OF MEMBRANE- NONE CODE 0
C) TYPE OF DECK PROTECTION- NONE CODE 0

************** AGE AND SERVICE **************
(27) YEAR BUILT 1950
(106) YEAR RECONSTRUCTED 0000
(42) TYPE OF SERVICE: ON- HIGHWAY 1
UNDER- WATERWAY 5
(28) LANES:ON STRUCTURE 01 UNDER STRUCTURE 00
(29) AVERAGE DAILY TRAFFIC 55
(30) YEAR OF ADT 1981 (109) TRUCK ADT 0 %
(19) BYPASS, DETOUR LENGTH 199 KM

************** GEOMETRIC DATA **************
(48) LENGTH OF MAXIMUM SPAN 7.0 M
(49) STRUCTURE LENGTH 21.3 M
(50) CURB OR SIDEWALK: LEFT 0.8 M RIGHT 0.0 M
(51) BRIDGE ROADWAY WIDTH CURB TO CURB 3.0 M
(52) DECK WIDTH OUT TO OUT 4.3 M
(32) APPROACH ROADWAY WIDTH (W/SHOULDERS) 5.5 M
(33) BRIDGE MEDIAN- NO MEDIAN 0
(34) SKEW 0 DEG (35) STRUCTURE FLARED NO
(10) INVENTORY ROUTE MIN VERT CLEAR 99.99 M
(47) INVENTORY ROUTE TOTAL HORIZ CLEAR 3.0 M
(53) MIN VERT CLEAR OVER BRIDGE RDWY 99.99 M
(54) MIN VERT UNDERCLEAR REF- NOT H/RR 0.00 M
(55) MIN LAT UNDERCLEAR RT REF- NOT H/RR 0.0 M
(56) MIN LAT UNDERCLEAR LT 0.0 M

************** NAVIGATION DATA **************
(38) NAVIGATION CONTROL- NO CONTROL CODE 0
(111) PIER PROTECTION- CODE
(39) NAVIGATION VERTICAL CLEARANCE 0.0 M
(116) VERT-LIFT BRIDGE NAV MIN VERT CLEAR M
(40) NAVIGATION HORIZONTAL CLEARANCE 0.0 M

****
SUFFICIENCY RATING = 47.5
STATUS FUNCTIONALLY OBSOLETE
HEALTH INDEX 93.4
PAINT CONDITION INDEX = N/A

************* CLASSIFICATION ************* CODE
(112) NBIS BRIDGE LENGTH- YES Y
(104) HIGHWAY SYSTEM- NOT ON NHS 0
(26) FUNCTIONAL CLASS- LOCAL URBAN 19
(100) DEFENSE HIGHWAY- NOT STRAHNET 0
(101) PARALLEL STRUCTURE- NONE EXISTS N
(102) DIRECTION OF TRAFFIC- 1 LANE, 2 WAY 3
(103) TEMPORARY STRUCTURE-
(105) FED.LANDS HWY- NOT APPLICABLE 0
(110) DESIGNATED NATIONAL NETWORK - NOT ON NET 0
(20) TOLL- ON FREE ROAD 3
(21) MAINTAIN- CITY OR MUNICIPAL HIGHWAY AGENCY 04
(22) OWNER- CITY OR MUNICIPAL HIGHWAY AGENCY 04
(37) HISTORICAL SIGNIFICANCE- NOT ELIGIBLE 5

*************** CONDITION *************** CODE
(58) DECK 7
(59) SUPERSTRUCTURE 7
(60) SUBSTRUCTURE 7
(61) CHANNEL & CHANNEL PROTECTION 6
(62) CULVERTS N

********* LOAD RATING AND POSTING ********* CODE
(31) DESIGN LOAD- M-13.5 OR H-15 2
(63) OPERATING RATING METHOD- ALLOWABLE STRESS 2
(64) OPERATING RATING- 18.5
(65) INVENTORY RATING METHOD- ALLOWABLE STRESS 2
(66) INVENTORY RATING- 13.3
(70) BRIDGE POSTING- 30.0 - 39.9% BELOW 1
(41) STRUCTURE OPEN, POSTED OR CLOSED- P
DESCRIPTION- POSTED FOR LOAD

*************** APPRAISAL *************** CODE
(67) STRUCTURAL EVALUATION 4
(68) DECK GEOMETRY 2
(69) UNDERCLEARANCES, VERTICAL & HORIZONTAL N
(71) WATER ADEQUACY 5
(72) APPROACH ROADWAY ALIGNMENT 4
(36) TRAFFIC SAFETY FEATURES 0000
(113) SCOUR CRITICAL BRIDGES U

********** PROPOSED IMPROVEMENTS **********
(75) TYPE OF WORK- REPLACE FOR DEFICIENC CODE 31
(76) LENGTH OF STRUCTURE IMPROVEMENT 21.3 M
(94) BRIDGE IMPROVEMENT COST $209,300
(95) ROADWAY IMPROVEMENT COST $41,860
(96) TOTAL PROJECT COST $351,624
(97) YEAR OF IMPROVEMENT COST ESTIMATE 2010
(114) FUTURE ADT 107
(115) YEAR OF FUTURE ADT 2034

*************** INSPECTIONS ***************
(90) INSPECTION DATE 10/14 (91) FREQUENCY 24 MO
(92) CRITICAL FEATURE INSPECTION: (93) CFI DATE
A) FRACTURE CRIT DETAIL- NO MO A)
B) UNDERWATER INSP- NO MO B)
C) OTHER SPECIAL INSP- NO MO C)

Appendix E
Existing Bridge Photos

Photo 1. Bridge Deck - Looking east on bridge showing 2xdeck runner planks and wood railing

Photo 2. Bridge Deck – Closer view of 2xdeck runner planks (note the horizontal checks on the planks)

Photo 3. Bridge Superstructure – Showing 2x6 deck planks, 4x12 stringer and 12x12 bent cap adjacent abutment.

Photo 4. Bridge Superstructure and Substructure – View under bridge looking up at stringers, bent cap and wood piling.

Photo 5. Bridge Superstructure and Substructure – View under bridge looking up at stringers/steel beams, bent cap and wood piling.

Photo 6. Bridge Superstructure – Closer view under bridge looking up at stringers/steel beams, bent cap and wood piling.

Photo 7. Bridge Substructure – View looking southeast towards bridge showing wood piling and bracing.

Photo 8. Bridge Substructure – View looking at wooden pile bracing using thru-bolts.

Photo 9. Bridge Substructure – View below bridge looking southeast towards bridge pier and abutment.

Appendix F
Executive Summary from Existing Meadow Way Bridge Assessment Report

Executive Summary – Existing Meadow Way Bridge Assessment Report

Meadow Way Bridge is a wooden trestle-type bridge constructed in early 1950s. The primarily 5-span bridge is made up of timber and steel beams supporting a wooden deck resting on five sets of three driven timber pile extension bents. There are no bridge record drawings, geotechnical report or hydraulic report from the original design available on file. However, a visual inventory of the bridge's super- and substructure elements has been performed, measurements taken and an "as-built" Bridge General Plan and a second sheet of support details have been prepared and included.

The bridge has a Sufficiency Rating (SR) of 47.5 and is Functionally Obsolete (FO). Visual observations of the bridge, three new geotechnical borings, Caltrans Bridge Inspection Reports (BIRs) and previous bridge investigations, such as the 2010 Scour Plan of Action Report (POA), have been utilized to compile this assessment. The purpose of this study was to qualitatively assess the condition of the bridge and determine whether the current HBP funds can be redirected to make repairs to address the deficiencies cost-effectively. The current structural conditions and the repairs and services are summarized below:

1. In order to repair the existing bridge a temporary bridge will need to be erected parallel to it.
2. The bridge deck is approximately 14 feet wide with a net travelway of 10 feet, which result in the FO condition. To address this deficiency, the bridge deck has to be removed and replaced with a concrete or steel grid deck accommodating a 12' lane, a sidewalk and crash-tested railings.
3. The new deck will need to be supported by the substructure system. There are several significant problems with the existing substructure supporting the bridge, namely:
    a. The absent record drawings make determination of the existing pile depths impossible. Additionally, the original embedded depths have been reduced due to creek erosion and scour by as much as four feet. Excavation in the creek to determine the pile depths to assess their adequacy is impractical and would be damaging to the bridge. At any rate, the question of pile lengths in the ground becomes moot in light of the following two issues.
    b. The structural integrity of the 60-year old timer piles is highly questionable. Recent pullout of similar piles in the area has shown them being hollowed out by termites and rot, and a similar condition is expected here. Field tests to determine the integrity of each embedded pile segment would be both impractical and damaging to the existing bridge.
    c. The project's geotechnical engineer has reported that the ground will be subject to liquefaction during a major earthquake for at least 50 feet below the roadway surface. Given this, the substructure system, regardless of the depth of the piles, will provide no superstructure support and will lead to its collapse during the maximum Credible Event (MCE), the design seismic case.
    d. The piles (as well as other timber bridge elements) are treated with creosote, a toxic compound.
4. The bridge abutments will need to be reconstructed. The creek banks immediately upstream of the bridge on two sides will need to be stabilized with retaining walls and rock riprap.
5. These repairs will require detailed design and full environmental studies and permits.

In essence, a completely new bridge deck, framing and substructure system will need to be built around and through the existing bridge for repairs after environmental permits have been obtained and a temporary bridge is erected alongside of the existing bridge. Once completed, none of the existing bridge elements will be needed any longer. The repairs will indeed become a difficult and costly bridge replacement exercise, result in an incongruous structure and completely alter the character of the existing bridge. In comparison with a low-maintenance, long-lasting, simply staged bridge replacement, the repair option will be not cost effective. Furthermore, Caltrans has informed the town that the HBP dollars would not be allowed for use of repairs in place replacement.