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Subject: Conceptual Plan and Cost Estimate for Reconstruction of Fish Passage Barrier on San Antonio Creek at Confluence to Ventura River, Casitas Springs, CA.

INTRODUCTION

This letter report presents a review of previous hydraulic, geomorphic and fish passage barrier engineering analysis of the Ojai Valley Trail crossing of San Antonio Creek at the confluence to the Ventura River. Boyle Engineering prepared a draft report of investigations of this site, including preliminary design recommendations, for the Ventura County Parks Department in February 2007. This updated study includes alternative conceptual engineering design drawings and an Engineer's Estimate of Probable Construction Costs. The existing box culvert crossing is a partial and seasonal passage barrier to steelhead.

Three project alternatives were examined by the Boyle team: 1) reconstruction of the existing seasonal crossing, 2) construction of a 120-foot long center-pier bridge below the 100-year flood water surface elevation, and 3) construction of a 40-foot long bridge with large earth fill approaches, also below the 100-year flood water surface elevation. The 120-foot long bridge was recommended as the preliminary preferred alternative. However, the proposed 120-foot long bridge alternative included a center-pier support and presented other design constraints making approval unlikely.

Several additional alternatives were examined by Questa as part of this update, including: 1) removal of the existing box culvert crossing and installation of a long (760') elevated bridge and trail structure, above the 100-year flood water surface elevation, 2) replacement of the existing four-barrel culvert crossing with a larger, soft-bottom double-barrel box culvert, and 3) replacement of the existing culvert with a soft-bottom, single opening, arched culvert.

The recommended Questa alternative, considering only fish passage barrier corrective actions, involves replacement of the existing undersized, hard-bottom box culvert with a larger soft-bottomed culvert to significantly improve, or eliminate, the current velocity and depth fish passage obstruction.

SITE LOCATION

The project site is located at the confluence of San Antonio Creek and the Ventura River, approximately 0.5 miles north of the community of Casitas Springs, in Ventura County.

The site is just west of State Highway 33, (Ventura Avenue) at the intersection of West Old Creek Road and the Ojai Valley Trail (see Location and Vicinity Maps on **Figure 1**).

FISH PASSAGE BARRIER ID

Passage ID # 17548
Barrier ID # 713866

EXISTING CONDITIONS

The existing crossing, where the Ojai Valley Trail crosses San Antonio Creek, consists of a four-barrel reinforced concrete box culvert with removable covers, each barrel having inside dimensions of approximately 24 inches in height and 36 inches in width. The removable reinforced concrete covers of the box culvert, which are currently in poor condition, serve as the travel surface of the Ojai Valley Trail. The existing culvert crossing is roughly 10 feet wide with 50-foot long concrete surfaced approach ramps to the north and south, as shown on **Figure 1**. The trail embankment and the box culvert are protected on both the upstream and downstream sides by grouted rock riprap.

The Ojai Valley Trail follows a former railroad alignment through the crossing area. The north approach to the crossing is cut through an alluvial terrace, which levels out approximately 10 feet higher than the south embankment, just below the 100-year flood water surface elevation. The south approach follows the former railroad alignment, well below the 100-year water surface elevation. It is assumed that a railroad trestle existed at this location at one time, which has since been completely demolished. The lower San Antonio Creek banks and, and the area south of the crossing are located within an active willow-shrub dominated floodplain estimated to be at or just below the 10-year flood water surface elevation, based on the hydraulic analysis completed by Hawks & Associates of Ventura, California, for Boyle Engineering.

As noted in the URS geomorphic analysis completed as part of the Boyle investigation, both San Antonio Creek and the Ventura River are highly energetic streams carrying large debris and streambed materials during flood events. The elevation of the existing box culvert crossing (303.0'[1]) appears to be roughly 6 feet below 2-year water surface elevation (309.4'[2]), and protected with grouted riprap from over-topping during flood events. The existing culvert crossing requires maintenance to remove debris from clogged barrels, and trail surface and approach embankment repairs after large flood events. For example, portions of the existing approach embankments and trail surface were washed away during flood events in 2005, and two of the four culvert barrels were clogged with gravel and cobbles during site visits in early 2007. In a clogged condition, the trail

[1] Elevations in this report are referenced to the NGVD29 vertical datum. Ventura County drawings reprinted in the Boyle Report and FEMA studies are referenced to NGVD29. Boyle and Hawks Reports reference both NGVD29 and NAVD88 datums, requiring further verification.
[2] Hawks & Assoc. HEC-RAS output, January 2007 for existing conditions at Sta. 108.23 (see Footnote 1).

surface is even more susceptible to over-topping and damage, forcing trail closures during and immediately following flood events.

EXISTING FISH PASSAGE CONSTRAINTS

Based on an analysis of conditions presented in the Boyle Engineering Draft Report, dated February 2007, the existing crossing presents a temporal fish passage barrier due to flow depth and velocity in the culvert barrels. Velocities above 6 fps were determined at the 1.25 to 2 year peak flows[2].

PREVIOUS BOYLE ANALYSIS AND RECOMMENDATIONS

As noted earlier, a team led by Boyle Engineering, with assistance by URS (geomorphologic assessment) and Hawks and Associates (hydrologic/hydraulic analysis) completed a preliminary analysis of this partial barrier in February 2007. The previous study evaluated 3 design alternatives that would either rebuild the culvert with a larger box structure, or remove and replace the existing culvert with various bridge structures. These were ***Alternative A*** (replace existing culvert with single-barrel culvert with a removable deck for maintenance, and soft or natural bottom), ***Alternative B*** (replace existing culvert with a 120-foot long bridge with a center pier, two concrete retaining wall abutments and earth fill approaches), and ***Alternative C*** (replace existing culvert with a 40-foot long clear span pre-engineered bridge with large earth fill approaches). ***Alternative D***, the "detour" alternative, consisted of removing the existing culvert crossing and trail approaches, and relocating the paved trail through the wooded areas along the top of the creek banks to a new crossing on or adjacent to the existing Highway 33 bridge. This detour alternative was ruled out due to environmental concerns.

Both bridge alternatives, ***Alternative B*** (120-foot bridge) and ***Alternative C*** (40-foot bridge) were proposed below the 100-year flood water surface elevation, and did not span the active floodplain. As a result, both bridge alternatives included "temporary fill" approach ramps, which were assumed to wash away during large flood events, requiring repairs and/or replacement. Both bridge alternatives also included collapsible handrails to minimize damage to the remaining bridge structures during flood events. The Boyle team preliminarily recommended ***Alternative B***, the 120-foot bridge, consisting of two 60-foot spans with a center-pier structure.

Both of the bridge structures, ***Alternatives B*** and ***C*** (hydraulically modeled with the assumption that the approach ramps would wash away), would raise the upstream flood water surface elevations by 1.6 and 2.0 feet, respectively. Federal Emergency Management Administration (FEMA) and Ventura County hydraulic design procedures typically will not allow the assumption of earthen fill washing away. The upstream impacts of both ***Alternatives B*** and ***C*** would be much more significant if the earth fill approach ramps did not wash away in major flood event, as predicted. In addition to maintenance and reconstruction requirements of the "temporary fill" designs, the conceptual bridge designs would require a major design variance approval from the Ventura County Flood Control District.

Alternative A, replacement of the existing box culvert with a single 12' wide, 3' deep soft-bottom box structure, was not recommended by the Boyle team, although it would improve fish passage by eliminating the depth of flow obstruction of the existing culvert. The apparent reason for elimination of ***Alternative A*** was the possibility of a velocity barrier remaining through the single culvert opening during as low as a 2-year recurrence flow. In addition to the fish passage concerns, ***Alternative A*** was eliminated due to the increased potential for sediment and debris clogged barrels, and frequent flood-related trail closures.

ALTERNATIVE BARRIER REMOVAL OPTIONS INVESTIGATED BY QUESTA

Additional Culvert Repair/Replacement Options

Two alternate culvert repair or replacement options were considered to mitigate the limitations of the single 12' wide x 3' deep soft-bottom culvert considered by Boyle. (Note: a "repair" approach may assist in obtaining a design variance from the County for replacement of the damaged and maintenance-intensive existing culvert structure in the floodplain).

Limitations of Boyle's ***Alternative A*** culvert include: a) frequent maintenance to remove sediment accumulation, b) restoration of earthen approach ramps due to frequent over-topping flows, and c) remaining fish passage velocity obstructions at approximately 2-year recurrence intervals.

Questa Alternative A2; Double-Barrel Soft-Bottom Box Culvert

To minimize the fish passage velocity issues identified by Hawks at higher flows, i.e., the 2-year recurrence interval, ***Alternative A2*** proposes two (2) side by side 12' wide by 4' deep soft or natural bottom concrete box culverts, as shown on **Figure 2**. The feature of removable concrete decks capable of supporting light vehicle traffic loads was retained to allow for ease of maintenance. Periodic sediment removal could be performed from the 10-foot wide trail surface without the need to enter the stream channel.

The larger opening and natural bottom of this alternative allows for the formation of an improved low flow channel, reducing gravel clogging and high stream velocity problems inherent to the existing and Boyle proposed ***Alternative A*** culvert. Further, because this alternative includes two openings, residual flows during maintenance can be directed into one of the two barrels, minimizing wildlife disturbances.

Alternative A2 still presents trail access limitations during and immediately following flood events along the Ventura River and San Antonio Creek. The trail surface could be raised to an elevation above the annual flood event, up to approximately a 2-year event (based on Hawks & Associates analysis). However, raising the trail height at the crossing by just one foot, as shown on **Figure 2**, is still likely to reduce the frequency of trail closures because of the enlarged culvert opening. Additional hydraulic and sediment

transport analysis should be completed on ***Alternative A2*** to better estimate maintenance and closure frequencies and fish passage obstructions, including analysis of a variety of assumed flows below the annual peak flow. Probable construction costs for ***Alternative A2*** are shown on **Table 1**.

Questa Alternative A3; Single Opening Pre-Constructed Arch Culvert

Another option to minimize the fish passage velocity issues, ***Alternative A3,*** consists of a single 20' wide by 5' deep, soft-bottom, pre-cast concrete arched-culvert (Bebo Arch Systems™, or similar), also shown on **Figure 2.** The pre-cast arched-culvert would include pre-cast wing-walls to improve inlet efficiency and sediment passage through the opening, and thereby reduce the frequency of over-topping, and the risk of flanking by the creek channel. As with ***Alternative A2***, a larger opening would allow for the formation of an improved low flow channel within the arched-culvert opening, reducing the clogging and stream velocity limitations of a single 12' wide culvert opening. The proposed trail surface would be one foot higher than the existing crossing for both ***Alternatives A2 and A3***, however, the larger openings of the proposed culverts would compensate for any increased floodplain obstructions. Willow planted rock riprap would be included in both ***Alternatives A2 and A3*** to protect adjacent stream banks.

The ***Alternative A3*** pre-cast arched-culvert would simplify construction, and minimize stream disturbances, possibly reducing the trail closure period during construction. Probable Construction Costs for both ***Alternatives A2*** and ***A3*** are comparable, as shown **Tables 1 and 2**.

Questa Alternative B2, Clear Span Bridge and Raised Trail Above the 100-Year WSE

Assuming a project design requirement for County permit approval is to cross San Antonio Creek and portions of the Ventura River floodplain with a new trail bridge, the lowest surface of the bridge (the low chord) must be a minimum of one foot above the estimated 100-year flood water surface elevation. At the location of the crossing, the 100-year floodplain is estimated to be approximately 760 feet wide, thus requiring an elevated structure consisting of several bridge segments and approach ramps, shown on **Figure 3** as ***Alternative B2***. ***Alternative B2*** would utilize a 120-foot clear span bridge centered over the current San Antonio Creek channel with 420 feet of elevated trail to the south and 120 feet of elevated trail to the north consisting of 60-foot span segments with earth fill approach ramps at either end. The proposed ***Alternative B2*** structure may still require some form of design variance from Ventura County Flood Control District, in consideration of the risks and impacts.

To maintain a minimum of one foot above the 100-year flood water surface elevation, the proposed bridge and elevated trail structure would have a deck elevation of 322.5', or roughly 12 feet higher than the average trail surface elevation of 310.0' through the floodplain. To meet Americans with Disabilities Act (ADA) requirements, the elevated structure would require approach ramps at 5% grades, or less, down to the existing trail at both ends, as shown on **Figure 3**.

The bridge and elevated trail segments would span between vertical concrete piers on deep concrete foundations. Each of the bridge and elevated trail segments would consist of pre-fabricated steel trusses, with a 10-foot wide deck, and ±54" high railings. The bridge and elevated trail structure would be designed to support pedestrians, bicycles, horses and light maintenance vehicles.

Assuming typical pre-fabricated steel bridge costs of about $1,100 per linear foot, plus an additional 35% for footings, piers, abutments, and installation costs, this represents a relatively expensive alternative. Total probable construction costs would exceed $1.2 million, depending upon the final length, foundations and bridge sections. Final design, environmental review, permitting, mitigation, and construction management would increase these costs by another 30%. Adding a 25% overall contingency results in a total probable cost estimate of approximately $2.0 million, as shown on **Table 3**.

Considering that the existing crossing structure represents only a partial and seasonal barrier to fish passage, it is highly unlikely that a Fisheries Restoration (or similar) grant would fund the majority of a bridge project of this magnitude. Alternative sources of funding will need to be obtained to supplement any fisheries restoration grant money, such as from the State Parks Bond, or a larger riparian enhancement project.

PERMITTING AND ENVIRONMENTAL REVIEW

Culvert reconstruction projects such as our recommended ***Alternative A2*** would involve work directly within navigable waters of the United States, including placement of additional fill material in the form of earth fill approaches, concrete footings, cobble and gravel backfill, and rock riprap bank protection. Accordingly, the project will likely need an Individual Corps of Engineers Section 404 permit, and a 401 Water Quality certification issued by the Regional Water Quality Control Board. Because the Ventura River and San Antonio Creek support protected species, including Southern Steelhead and California Red Legged Frogs, a Section 7 consultation with the US fish and Wildlife Service and National Oceanic and Atmospheric Administration Fisheries will also be required, as well as a California Department of Fish and Game Streambed Alteration Agreement. California Environmental Quality Act clearance will be needed before any of the regulatory agencies can issue permits for construction.

It would be highly desirable to include long term maintenance in the various permits, with a requested permit period of at least 5 years. Permitted maintenance should include removal of debris and sediment (sand, gravel and cobble) build up within the culvert structure. As indicated earlier, the removable culvert decks of ***Alternative A2*** will facilitate equipment access from the trail, and with two culvert barrels, maintenance work in live stream flow can be avoided. Scheduled maintenance work should be performed in the late fall, when San Antonio Creek is typically dry, or has a minimal residual flow.

It is expected that the conditions of the permits will require pre-construction survey by a qualified biologist for California Red Legged Frogs in work areas, and any adjacent pools

that could be impacted during maintenance. In addition, a biological monitor will likely be required to be present during construction and maintenance work, adding to project costs.

CONCLUSION

Replacement of the existing box culvert crossing over San Antonio Creek with either ***Alternative A2***, a soft-bottom, double barrel cast-in-place culvert, or ***Alternative A3,*** a soft-bottom pre-cast arched culvert are both feasible and cost effective methods of improving fish passage and trail access, and in our opinion are likely to be permitted as repairs. ***Alternatives A2*** and ***A3*** are also likely to meet the requirements for many fisheries restoration grants, and should be largely fundable under several of the available fish passage barrier removal grant programs.

The Ojai Valley Trail is a regional recreational trail of major importance. A project similar to ***Alternative B2***, at a cost approximately $2.0 million, would be required to provide year-round safe access, and be fully compliant with Ventura County, FEMA, and ADA regulations. A project of this scope would only be partly funded as a fish passage barrier removal project, and would require substantial additional funding. We recommend a detailed feasibility study, including additional ground surveys, hydraulic analyses, structures design, and cost estimation, including discussions with Ventura County be completed, which can typically be grant funded.

Should you have any questions, please do not hesitate to contact me at 510/236-6114, Ext. 206.

Sincerely,

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Principal

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