APPENDIX E

Hydraulic Design Report Addendum

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Belcaro – Oak Springs Canyon Creek

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APPROVED
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Introduction

The proposed Belcaro project, located in Santa Clarita, has been in a process of design and agency review since 2024, leading toward project entitlement. Part of the project regional flood protection design described in the engineering documents includes replacing and upgrading the existing culvert at Oak Springs Canyon Road and adding a crossing for future J Street, shown on Figure 1.

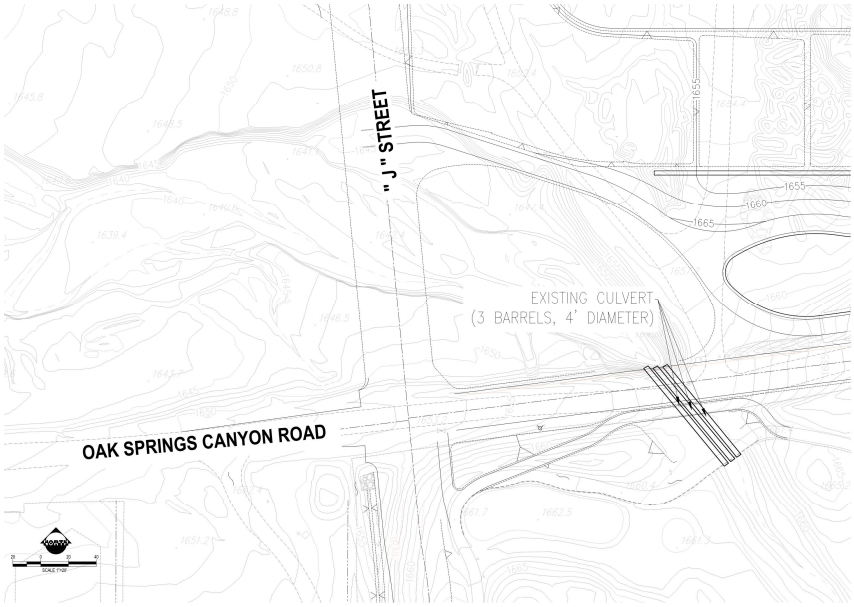

Figure 1: Existing Oak Springs Canyon Road Culvert and Future J Street

Because there has been historic erosion in Oak Springs Canyon Creek, there is an existing vertical drop of approximately ten feet downstream of Oak Springs Canyon Road. The design proposed in the original series of engineering documents utilized rip rap and grouted rip rap to dissipate energy and protect the channel as shown on Figure 2.

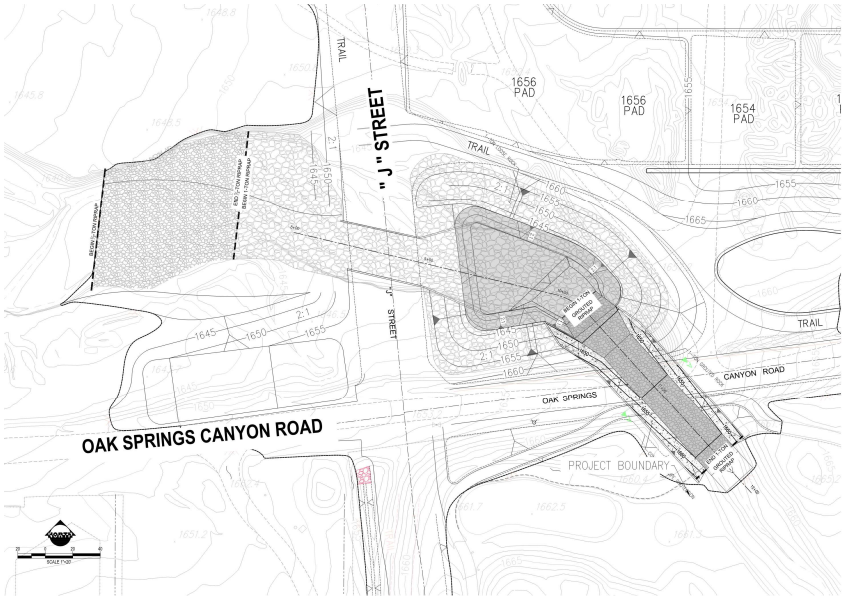

Figure 2: Original Design at Oak Springs Canyon Road Culvert and Future J Street

Although the original design retained an open channel between Oak Springs Canyon Road and future J Street, the client had some concerns about aesthetics, material costs, and public safety. At the request of the client, the proposed creek protection, between Oak Springs Canyon Road and future J Street, was revised to utilize a safer, more economical, and more aesthetically pleasing design. This design addendum describes the design revision, and includes hydraulic analysis, floodplain mapping and results discussion, which demonstrate that the revised design is functionally equivalent to the original proposed design.

Revised Design and Layout Changes

The revised utilizes a broken back culvert to provide the necessary energy dissipation. The design follows guidance in Hydraulic Engineering Circular 14, Hydraulic Design of Energy Dissipators for Culverts and Channels. The culvert features a steep upstream section to create supercritical flow, and a flat downstream section that creates a hydraulic jump to dissipate hydraulic energy. The upstream section is steep enough to create high flow velocity necessary for a strong hydraulic jump. The downstream section is long enough so that the hydraulic jump is contained within the culvert.

The revised design combines two separate crossing structures and energy dissipation elements in to a single continuous culvert that conveys flow from upstream of Oaks Springs Canyon Road, to downstream of future J Street, as shown on Figure 3.

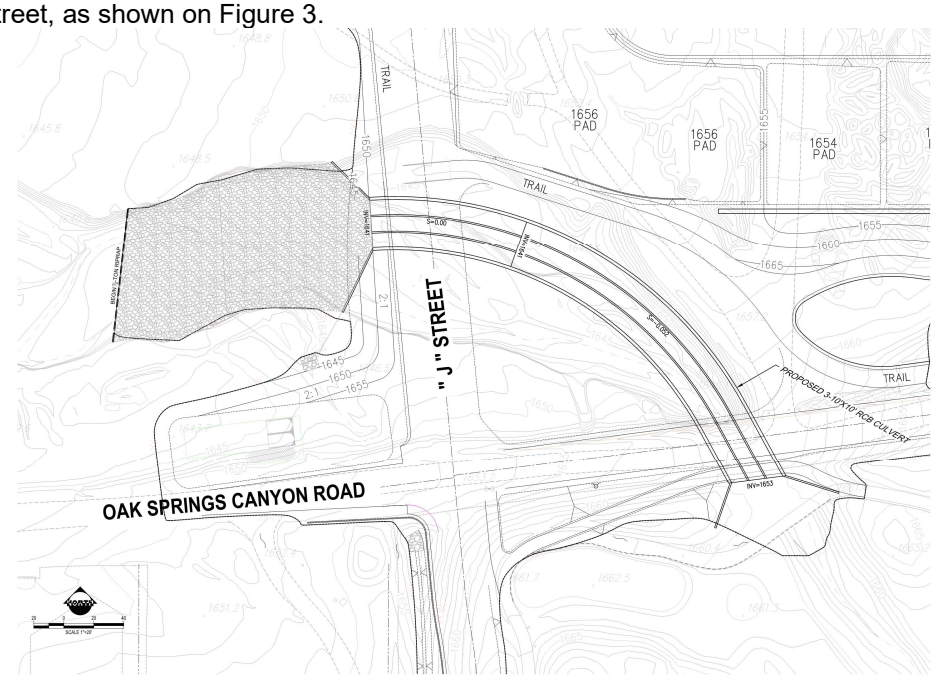

Figure 3: Revised Design at Oak Springs Canyon Road Culvert and Future J Street

The area between Oaks Springs Canyon Road and Future J Street will be filled in and landscaped. This will provide better aesthetics than the grouted rock lined channel section of the original design that would allow no vegetation growth. The revised design will also eliminate the safety hazard of the deep channel with steep walls, present in existing conditions and in the original proposed design.

Hydraulic Analysis

HEC-RAS is not able to analyze broken back culverts, so the culvert for the revised design was analyzed using FHWA HY-8. The creek hydraulic analysis is accomplished with two HEC-RAS models, one downstream of the culvert and one upstream of the culvert. The HY-8 hydraulic results provide the upstream boundary condition for the downstream HEC-RAS model, and the downstream boundary condition for the upstream HEC-RAS model. The HY-8 model and the HEC-RAS models used for the revised design are included with this addendum as an appendix.

Hydraulic Results

The hydraulics of the revised design are similar to those of the original design at the FEMA flowrate, 1,140 cfs, and at the design flowrate, 3,535 cfs. The differences in hydraulics, between the two designs, are confined to the vicinity of the proposed culvert inlet and outlet.

The hydraulic results for the revised design are compared with the hydraulic results for the original design in Table 1 for the FEMA flowrate, 1,140 cfs.

Table 1: FEMA 100-yr WSE and Velocity Comparison (Q_{100} = 1,140 cfs)

Upstream Comparison						
HEC-RAS Cross Section	**WSE Origional Design (ft)**	**WSE Revised Design (ft)**	**Difference in WSE (ft)**	**Velocity Origional Design (ft/s)**	**Velocity Revised Design (ft/s)**	**Difference in Velocity (ft/s)**
6120	1675.4	1675.4	0.00	11.1	11.1	0.0
5780	1669.5	1669.6	0.07	7.0	6.8	-0.2
5441	1665.1	1664.8	-0.29	9.1	10.3	1.2
5353	1663.5	1663.5	-0.06	9.9	10.1	0.2
5238	1662.0	1661.9	-0.12	6.5	7.2	0.7
5167	1660.7	1660.6	-0.10	8.9	9.6	0.7
5140.5 / 5141	1659.7	1659.3	-0.40	10.3	11.6	1.3
5114 / 5115	1656.7	1657.0	0.26	13.8	14.8	1.0
Downstream Comparison						
HEC-RAS Cross Section	**WSE Origional Design (ft)**	**WSE Revised Design (ft)**	**Difference in WSE (ft)**	**Velocity Origional Design (ft/s)**	**Velocity Revised Design (ft/s)**	**Difference in Velocity (ft/s)**
4744	1643.6	1643.1	-0.55	8.1	17.8	9.6
4593	1641.3	1641.3	0.03	7.5	7.4	-0.1
4418	1638.0	1638.0	0.00	7.0	7.0	0.0
4248	1635.4	1635.4	-0.01	6.1	6.1	0.0
4143	1633.5	1633.5	-0.01	7.5	7.6	0.0

The hydraulic results for the revised design are compared with the hydraulic results for the original design in Table 2 for the design flowrate, 1,140 cfs.

Table 2: Design WSE and Velocity Comparison (Q_{Design} = 3,535 cfs)

Upstream Comparison						
HEC-RAS Cross Section	**WSE Origional Design (ft)**	**WSE Revised Design (ft)**	**Difference in WSE (ft)**	**Velocity Origional Design (ft/s)**	**Velocity Revised Design (ft/s)**	**Difference in Velocity (ft/s)**
6120	1679.9	1679.9	0.00	14.6	14.6	0.0
5780	1670.0	1670.0	-0.02	18.6	18.7	0.2
5441	1668.5	1668.8	0.25	9.9	10.5	0.6
5353	1665.3	1666.4	1.04	9.2	6.6	-2.6
5238	1664.8	1666.3	1.44	7.2	5.1	-2.1
5167	1663.5	1666.0	2.51	10.9	6.2	-4.7
5140.5 / 5141	1663.7	1666.0	2.35	9.1	5.3	-3.8
5114 / 5115	1663.7	1666.1	2.33	7.4	4.5	-2.8
Downstream Comparison						
HEC-RAS Cross Section	**WSE Origional Design (ft)**	**WSE Revised Design (ft)**	**Difference in WSE (ft)**	**Velocity Origional Design (ft/s)**	**Velocity Revised Design (ft/s)**	**Difference in Velocity (ft/s)**
4744	1645.6	1648.4	2.77	14.5	15.4	1.0
4593	1643.3	1643.3	0.03	11.1	11.1	0.0
4418	1639.1	1639.1	0.02	12.2	12.3	0.1
4248	1637.6	1637.5	-0.02	8.3	8.4	0.1
4143	1635.6	1635.6	0.00	10.9	10.9	0.0

Conclusion

The revised design proposed in the vicinity of Oak Springs Canyon Creek and future J Street provides several benefits. The area will be safer because the revised design will not have the steep channel segment and steep embankments present in existing conditions and in the original design. The area will look better because the expanse of grouted rip rap will be visually replaced with a landscaped area.

The creek hydraulics, near the culvert in the revised design, are similar to those with the original design. Everywhere else, the creek hydraulics match the original design hydraulics and existing conditions.

Changes to the hydraulics, revised design compared to original design, only occur near the culvert inlet and outlet. Away from the culvert, there are no changes to the Oak Springs Canyon Creek hydraulics, upstream or downstream.