Water-Energy Grant Application
Cross Valley Canal Extension Lining - Pool No. 8

Appendix 3.3 - Pool No. 8 Channel Analysis Memorandum

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MEMORANDUM

To: David Beard, KCWA ID4

From: Benjamin Fenters, Calvin Monreal

Subject: ID4 CVC Pool 8 Channel Analysis

Date: November 25, 2014

The following is support information regarding the hydraulic analysis of the Central Valley Canal Extension Lining Project – Phase 2 (Pool 8) located near the intersection of the Westside Parkway and Mohawk Street in Bakersfield, California for the categories as listed below.

The existing extension of the Central Valley Canal (CVC) was designed and built as an earth canal in 1975 to lift water to the Improvement District No. 4 water treatment plant. The CVC Extension is composed of two pools, Pool 7 and Pool 8, both of which were constructed with fill areas and cut sections. The length of Pool 8, earthen canal section is approximately 6,477 feet, where the total pool (including siphons) is 6,855 feet long. This analysis is only for Phase 2 of the CVC Extension Lining Project, which is composed of Pool 8.

Existing Conditions of Channel and Surrounding Area

The trapezoidal channel existing dimensions of the Pool 8 canal are as follows:

Side slope	3:1± horizontal: vertical
Bottom width	14± feet
Design water level	5.5± feet
Total depth	8.5± feet
Freeboard	3.0± feet
Top width	65± feet
Channel slope	0.0016±
Design flow	306 cfs

The existing channel's side slopes have eroded such that the cross sectional profile is more characteristic of a parabolic bowl shape than the original trapezoidal shape; the top width and the water surface width have remained approximately the same.

The existing right of way varies along the alignment. The existing channel has some plant growth on the banks and saturated material that is considered unsuitable for use as embankment/compacted fill to support the proposed canal lining and will have to be removed and replaced with suitable material. Downstream of the Calloway Canal Siphon several large trees are growing along the canal bank.

At least 5 existing turnouts are present along the project alignment; the Kern River Turnout #4 and Overpour Spill Structure is located approximately 550 feet upstream of the Calloway Canal Siphon and 4 other turnouts are located between the Calloway Canal Siphon and the Highway 99 Siphon. A utility pipeline crossing is located approximately 315 feet downstream of the Calloway Canal Siphon.

Proposed Design

The design criteria that were considered included initial capital cost, constructability, maintenance and life of the project.

A hydraulic analysis of different cross-sections was performed to determine the optimal canal configuration. After evaluating various configuration options, it was determined that the optimal configuration was to not down-size the canal significantly, but only import enough fill material to replace the unsuitable material to be removed, slightly widen the existing operating roads, and essentially line the existing canal section. The original design inverts, channel slope and canal depth will not be changed. The side slopes will be changed from 3:1 (horizontal: vertical) to 2:1 (horizontal: vertical), the bottom width will increase by 9 feet giving an oversized canal. The oversized (bigger) canal cross-section will benefit the project in cost reduction (less import material) and in water storage capacity of the pool, reducing fluctuations in water levels, which will prevent over topping. Concrete lining and geomembrane lining were both evaluated.

The extra concrete lining required in the bottom of the canal was determined to be less expensive than importing and compacting the large volume of fill material required to down-size the canal; additionally, the oversized canal provides more flexibility in operations by providing additional storage. The proposed design channel dimensions are as follows:

Side slope	2:1 horizontal: vertical
Bottom width	23± feet
Design water level	5.5 feet
Total depth	8.5 feet
Freeboard	3.0 feet
Top width	57± feet
Channel slope	0.00016 ft/ft
Design flow	400 cfs

The proposed canal configuration will allow for a smooth transition connection to the existing siphon and culvert inlet and outlet concrete transition sections. When the Kern River experiences high flows, shallow groundwater seepage can enter the canal. To mitigate potential seepage impacts the proposed liner will include weep valves to alleviate the back pressure against the liner when the canal is dry and the pond adjacent to the canal is full.

It was determined that the proposed concrete lining for the canal would possess a 50-year life span. This alternative was chosen because of the low maintenance activities once installed. The Agency is more familiar with concrete lined channels and it matches current operations.

The figure below, **Figure 1**, shows the hydraulic analysis performed on the channel and its design characteristics. Pool 8 will operate at a velocity of approximately 2.1 feet per second within the typical proposed open channel portions and 7.96 feet per second for the siphons at a water depth of 5.5 feet, with a free board of 3 feet. The reduced velocity will act as a safety factor in the event that pumps at Pump Plant 8 shut down suddenly, reducing the wave speed and the probability of over topping the canal.

HYDRAULIC CHARECTERISTICS OF THE CHANNEL FLOW FOR POOL 8													
Beg Station	End Station	Length (ft)	Beg HGL EL (ft)	End HGL EL (ft)	D (ft)	b (ft)	n	HGL Slope s	z	Q (cfs)	V (ft/s)	Vel Head (ft)	Note
1054+35	1105+95	5160	5.6	5.5	5.5	23	0.015	0.000075	2	400	2.14	0.07	
1105+95	1109+73	378	7.8	5.6									Calloway Canal Siphon
1109+73	1122+90	1317	5.6	5.5	5.5	23	0.015	0.000075	2	400	2.14	0.07	

Calculations are based on the Manning Equation as applied to Trapezoidal Channels
per Page 7-16 of "HANDBOOK OF HYDRAULICS" Sixth Edition by Brater & King.
Calloway Siphon Headloss estimated to be 2.2 ft @ 400 CFS

Figure 1-Hydraulic Characteristics of the Channel Flow

The following pictures show the Cross Valley Canal