RECLAMATION

Managing Water in the West

TR-2009-01

Travel to Santa Margarita River Conjunctive Project, CA

Dates of travel: January 6-7, 2009

U.S. Department of the Interior
Bureau of Reclamation
Technical Service Center
Hydraulic Investigations and Laboratory Services Group
Denver, Colorado

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BUREAU OF RECLAMATION
Technical Service Center
Denver, Colorado

TRAVEL REPORT

Code : 86-68460 Date: February 26, 2009

To : Manager, Hydraulic Investigations and Laboratory Services Group

From : Kathleen H. Frizell, Hydraulic Engineer, 86-6840
Brent W. Mefford, P.E. Fish Passage Technical Specialist, 86-68460

Subject : Travel to the Santa Margarita River Watershed and O' Neill Diversion Weir in support of the Santa Margarita River Conjunctive Use Project, CA

1. Travel period: January 6-7, 2009.

2. Places or offices visited: Santa Margarita River drainage basin and O' Neill Diversion Weir on Camp Pendleton, CA

3. Purpose of trip: To meet with the Reclamation Southern California Area Office project coordinator, visit the site of the O' Neill Diversion Weir on the Santa Margarita River, and provide initial guidance on fish passage options for the project.

4. Synopsis of trip: We arrived in San Diego, CA on the morning of January 6, 2009, picked up a rental car and drove to Oceanside, CA where we met Mr. Doug McPherson of the Southern California Area Office (SCAO-1500). After lunch we drove with Mr. McPherson onto the Marine Corps Base Camp Pendleton, CA where we met with the civilian professionals; Mike Rouse, Fisheries Biologist, Collen Eckenroad, Environmental Specialist, and a Hydrology Technician from Camp Pendleton that are also working on the project.

The purpose of this travel report is to convey initial impressions from a site visit to the O' Neill Diversion Dam, make comments regarding existing draft designs of concrete fishways, and make recommendations regarding the feasibility of adding a low-head rock fishway to other improvements.

The proposed Conjunctive Use project includes replacing an existing water diversion with inflatable bladder-operated leaf gates upgrading an existing groundwater recharge and recovery system and installing new wells, pump stations and a pipeline between the Base and Fallbrook Public Utilities District facilities. Other potential project elements involve instream water retention structures, reclaimed wastewater, off-stream storage, and recharge of other groundwater basins on the base. The water yield from project implementation could increase from the current 7,000 acre-feet per year to 16,200 acre-feet per year.

The Santa Margarita River watershed lies within the Southern California Distinct Population Segment (DPS) of endangered steelhead, which ranges from the Santa Maria River to the Mexican Border (71 FR 834). T is watershed is included in the Santa Catalina Gulf Coast biogeographic group, which includes nine streams located in Orange and San Diego Counties. The NMFS Steelhead Technical Recovery Team has identified this group of streams as being crucial to the viability and recovery of the southern California DPS of steelhead (Boughton et al. 2006, Boughton et aL 2007). NMFS believes that this watershed was historically inhabited by steelhead, and because steelhead have recently been found in other streams near the Santa Margarita River *e.g.*, San Juan Creek, San Mateo Creek, and the San Luis Rey River) it is possible that steelhead will attempt to enter the Santa Margarita River during the winter and spring when rainstorms and increased wet-season flows occur. Therefore, the project coordinators are also interested in the possibility of adding fish passage to the project.

Figure 1 shows an aerial view of the lower Santa Margarita River with the existing recharge ponds on the left and Lake O' Neill on the right. Many studies have been conducted over the years. Project background work includes studies by West (2000), Stetson (2002), Baysinger (2004), Bountry (2004), Reclamation (2006).

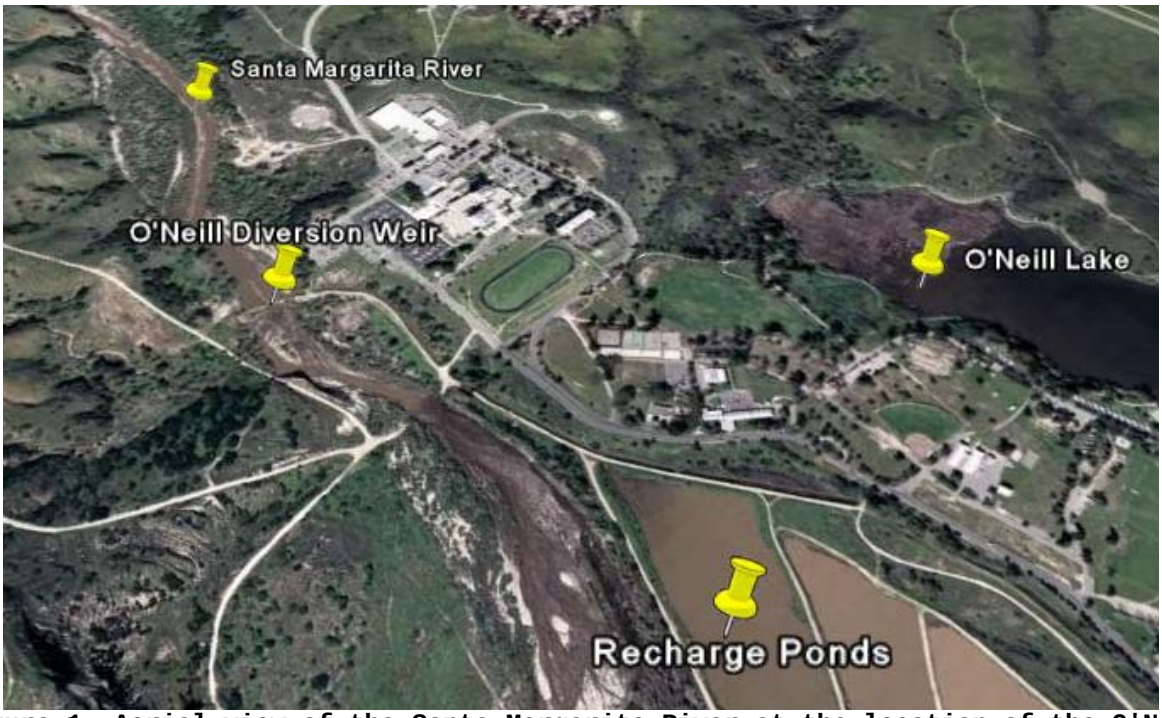

Figure 1. Aerial view of the Santa Margarita River at the location of the O'Neil Diversion Weir on Camp Pendleton Base.

Figures 2 and 3 show views of the existing sheet pile weir in its typical condition with large amounts of sediment deposition and vegetation upstream and downstream from the weir. The top of the sheet pile weir is at about El.116.6 ft. The exposed height of the weir was about 4 to 5 ft on the downstream side. Some large riprap was visible but most seemed to be buried in sediment.

Figure 2. - View looking across the existing sheet pile O'Neill Diversion Dam. (January 2009)

Figure 3 - Downstream channel below the O'Neill Diversion Weir. (January 2009)

Only a small amount of water is passing the weir as surface flow, mostly through holes in the piles under low flow conditions, (figure 4). Some water must be seeping under and/or around the weir to account for the amount of flow downstream at the river crossing. It was reported that the river flow often disappears during the summer months in the reach downstream from the diversion weir.

Figure 4. - Water spurting through sheet pile diversion dam.

Figure 5 shows the approach channel on the left side of the river to the existing gate controlling the flow into the canal leading to Lake O' Neill. Note that there is currently a tremendous amount of sediment traveling down the river and depositing in the canal approach. Therefore, one of the

components of the diversion upgrade is a proposed sediment bypass (sluice) on the left abutment of the improved dam. The draft designs also have the canal headgate with bulkhead moved out closer

Figure 5. - View looking from the existing headgate back to the river and diversion dam on left and into the gate structure on right. (Note the sediment deposition.)

to the flow channel on the left side of the river with a 1-ft-high sill to reduce sediment intake into the diversion canal.

The site is clearly dominated by a large amount of sediment and vegetation. It was reported that a week before our visit the weir could not be seen because of all the vegetation. The channel vegetation had clearly been recently disturbed by a larger than normal flow. This gave some idea of the flashy nature of the river which will be a consideration in design of any fish passage facility. The existing condition during the trip is typical, with all the flow following the left bank and entering the channel to the headgate to Lake O' Neill. The weir clearly retains large amounts of sediment which easily supports heavy vegetation. The channel to the headgate, figure 5, carries all but about 3 ft^3/s of the flow and a subsequent large amount of sediment into the canal, lake and groundwater recharge ponds. Two stoplog sections were located near the left side of the weir and could be used to sluice sediment, but they did not appear to be used often. There did seem to be a fairly well established channel near the left bank on the downstream side of the weir, but there was no other visible release from the weir other than through the holes in the sheet piles (figure 4). The riprap that had been placed below the weir had been mostly covered by sediment deposits and/or moved downstream during flood flows.

The basic plans for the diversion improvement are to increase diversion to Lake O' Neill from 60 to 200 ft^3/s and leave 3 to 9 ft^3/s in the river year-round. The inflatable bladder-operated leaf gates will replace the existing sheet pile weir and raise the upstream water surface to El. 117.1 ft with no

flow over the top of the gates. The operation of the gates is unclear at this point in terms of the number operated individually or simultaneously, the frequency of operation, joint operation with the sluice, elevation of the sluiceway, headworks gate structure, etc.

Fish Passage

Approximately two weeks prior to our visit, river flows measured near Fallbrook (figure 6) peaked at about 600 ft^3/s (Flow records for the December 20, 2008 flood at the Ysidora gage were not available at the time). As illustrated by the recent flood record shown in figure 6a, floods in the Santa Margarita are typically of short duration with rapid rise and fall of flow. Figure 6b shows the recorded annual peak flow for the last ten years. The flow records indicate peak flows of 1,000 ft^3/s or greater occur in most years. The river channel downstream of the diversion following the December 20, 2008 flow event was choked with sand and contained significant debris piles composed largely of brush that had been dislodged during the flood flow. West (2000) characterizes the bed material in the river reach near the diversion as about 93 percent sands with little material larger than medium gravel. Channel conditions are assumed to change considerably following floods greater than about the 5-year-return (~8,000 ft^3/s). Bountry (2004) cites several observations of significant scouring of the channel during large floods.

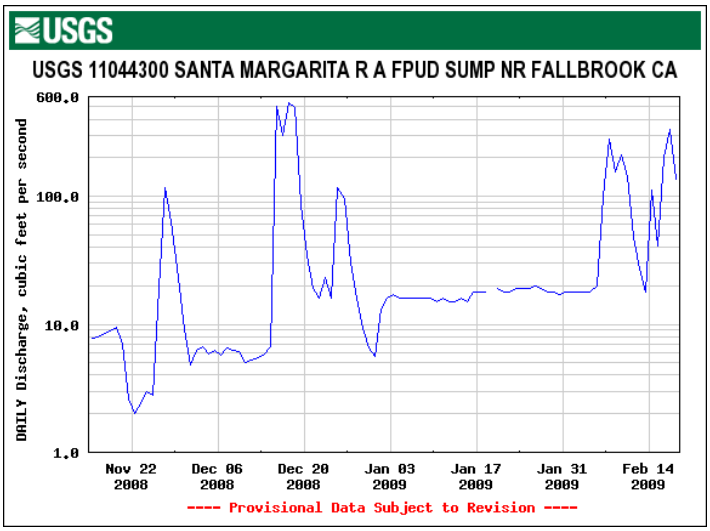

Fig. 6a

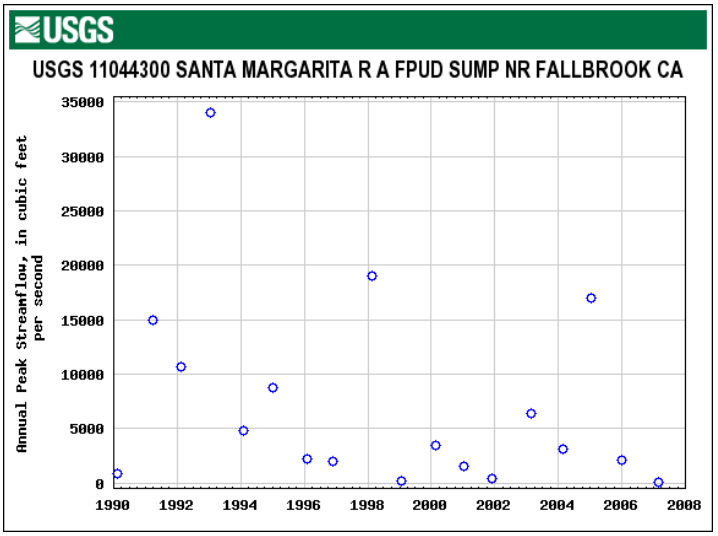

Fig. 6b

Figures 6a & 6b – Daily average river flow and annual peak flow for the Santa Margarita River near Fallbrook Ca.

For the purposes of fish passage, the river conditions we viewed at the O' Neill Diversion Weir following a small flood are assumed to be generally typical of channel conditions. The channel conditions observed present several challenges to fish passage:

- Braided channel conditions downstream of the diversion dam may frequently prevent upstream migration to the diversion dam during base flow.
- A sediment delta will likely form downstream of the entrance to the fishway.

- Channel and flow conditions near the entrance to the fishway are likely to vary significantly during each flood recession and following each flood due to sediment and debris deposits.
- The fishway will be subjected to high volumes of woody debris and high concentrations of sand size bed load sediment.

Fishway Type – Steelhead are strong swimmers capable of sustained swimming speeds in the range of 10 ft/s and burst speeds of 20 ft/s. As strong swimmers they are capable of ascending many different types of fishways under varying flow conditions. The challenge is to design a fishway that will provide flow conditions supporting upstream fish passage during flows that convey significant debris and sediment. The high levels of debris and sediment carried by the river would impede operation and result in frequent maintenance of all technical fishways that rely on extensive baffling to control flow. In the view of the authors, the best option would be to construct a roughened channel skimming-flow style fishway. This style fishway more closely simulates a natural channel and uses bed roughness, channel shape, slope, and limited large scale roughness to control flow velocity. During high river flow, a skimming flow fishway conveys a substantial volume of unobstructed flow through the fishway while supporting passage conditions adjacent to the main flow. Floating debris is generally passed through the fishway carried by the unobstructed flow. An example of a rock fishway that operates in skimming mode during high river flows is shown in figure 7. The fishway shown uses rock boulders located on the channel floor to control fishway flow during normal river conditions. Under high river conditions the boulders become submerged creating unobstructed surface flow along the centerline of the fishway while providing good passage conditions along both banks. Skimming flow fishways using rock boulders can be used up to slopes of about 5 percent. For fishway slopes of 5 to 10 percent slope, cylindrical concrete baffles are used in place of boulders (figure 8).

Figure 7 - Skimming flow rock weir fishway.

Rock weir fishway operating during high water with surface flow skimming over

Rock weir fishway operating during normal or low water with boulders controlling flow.

Fishway Location- The best location for the fishway would likely be adjacent to the proposed sediment sluice, figure 8. This allows good access to the fishway and utilizes sluiceway flow to augment fishway attraction flow. A concern with this location is the potential for increased sediment deposition downstream of the sluice impacting fish access to the fishway entrance. This issue would need to be further investigated during the fishway design phase.

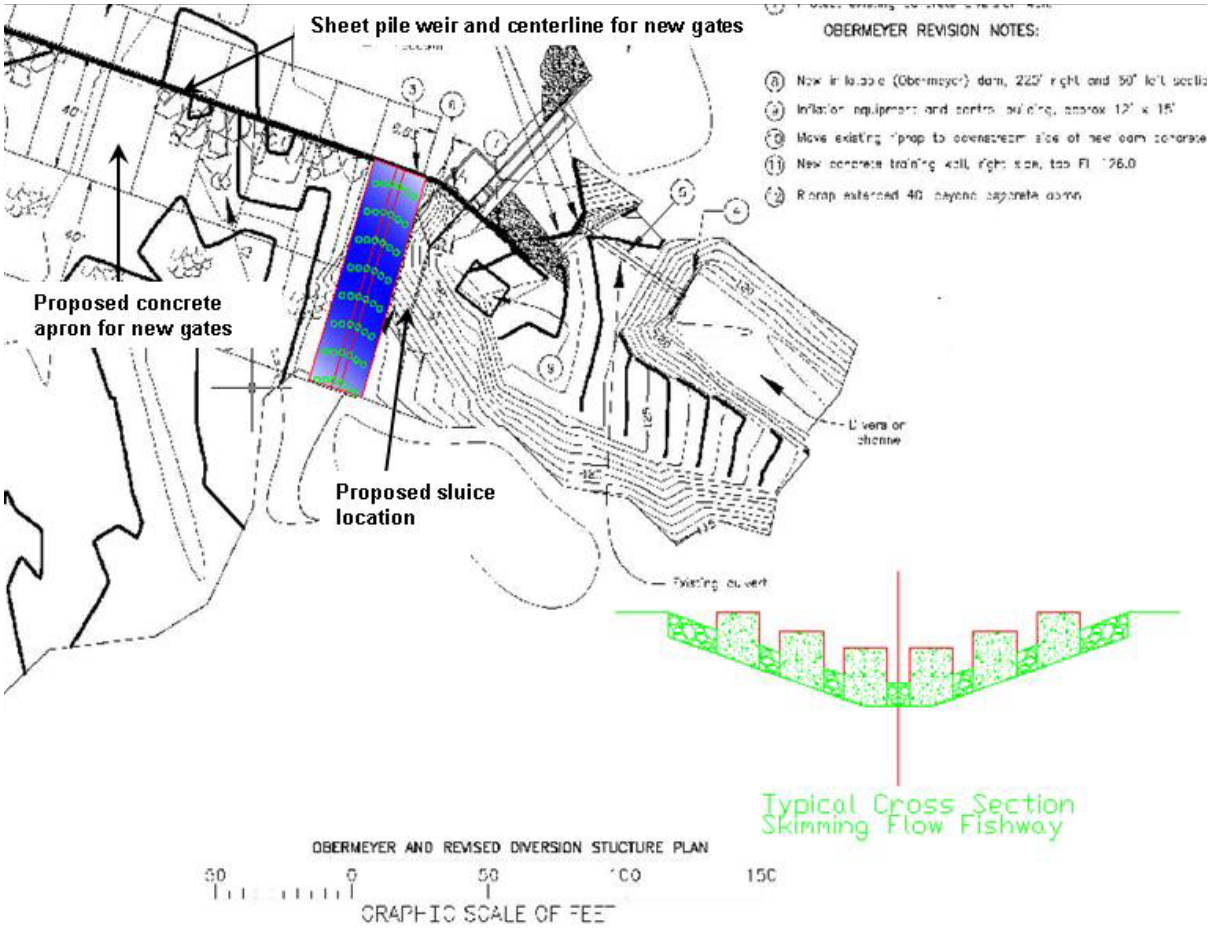

Figure 8 – Illustrative plan and section of skimming flow fishway using cylindrical baffles at the most likely fishway location.

Diversion Facility Operation – Prior to designing a fishway for the O' Neill Diversion, a general operating plan for the diversion should be established. The fishway can then be optimized for the head and flow conditions during which passage is most important. An example of a possible facility operation matrix is presented in Table 1. For the final facility design, the table would be adjusted to reflect water diversion requirements, sediment management goals, and fish passage goals.

Table 1 – Example Facility Operation Matrix

River Flow, ft^3/s	Diversion Flow, ft^3/s	Sluice Flow, ft^3/s	Fishway Flow, ft^3/s	Weir Gate Up/Down	Pool Elevation, ft	Tailwater Elevation, ft
< 200	River minus Fishway	0	3	Up	~117.1	109.1
200 - 500	200	~30-50% of River flow minus Diversion	~50-70% of River flow minus Diversion	Up with Little or no Overflow	~117.1	?
500 – 1,000	200	~50-80% of River flow minus Diversion	~20-50% of River flow minus Diversion	Up with Weir Overflow	~117.1+	?
> 1,000	Closed?	Open	Passage Over Weir	Down	Run-of - River	No passage barrier

5. Conclusions and recommendations:

- It is questionable if upstream passage is feasible through the lower river during periods of base flow (3 to 9 ft^3/s). We recommend an assessment of low flow conditions in the lower channel be conducted prior to fishway design.

- To aid fishway design and diversion/sluice operation, additional HEC-RAS runs at flows from 250 to 1000 ft^3/s are recommended for several scenarios of weir gate and sluice gate operation.

- Steelhead likely need to pass the diversion weir relatively quickly during a flood event to allow the fish sufficient time to access the upper watershed before flows recede.

- For all overflow conditions with water surface differentials across the weir are less than about three feet, steelhead could likely pass over the weir. Smaller water surface differentials would facilitate more rapid passage.

- Assuming operation of the diversion similar to that given in table 1, the fishway should be designed to provide passage when downstream flows allow for passage through the lower river, weir gates are up, and the water surface differential across the weir is between 2 and 8 ft.

- The design should consider incorporating fish screens as part of the diversion headgate reconstruction. If steelhead are found in the system in the future, screening will likely be required to prevent downstream migrants from entering the canal. Screening high sediment laden flows has been shown to be doable using vertical traveling screens that have no moving parts located within the water. An example is the Hydrolox fish screens used at Reclamation' s Yakima Project. These screens have a good performance and operating history in streams with significant sand bedload.

- During discussions at the site, mention was made of water diverted to the basin from the Lower Colorado River System. Quagga mussel infestation of the Lower Colorado is well underway so, we recommend investigating the potential for the river to support a significant quagga mussel infestation and the risks to the proposed project infrastructure. Further information on the mussel issue can be obtained by contacting members of Reclamation' s study team, Joseph Kubitschek, 303-445-2148 or Fred Nibling, 303-445-2202.

References

West Consultants San Diego Office. July 2000. *Santa Margarita River hydrology, hydraulics and sedimentation study,* prepared for Los Angeles District U.S. Army Corps of Engineers.

Stetson Engineers Inc. "Recycle and reuse Fallbrook PUD supplemental feasibility study", prepared for Fallbrook Public Utility District, February 2002.

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Bountry, Jennifer A., "Hydraulic and Sediment Considerations for Proposed Modifications to O' Neill Diversion Weir on Santa Margarita River, California", US Department of Interior, Bureau of Reclamation, TSC, Denver CO, September, 2004.

Reclamation, "Decision regarding alternatives for further study Santa Margarita River Conjunctive use project, "US Department of Interior, Bureau of Reclamation, Southern California Area Office, December 11, 2006.

6. Action correspondence initiated or required: We will await further direction from the SCAO regarding future work requests.

7. Client feedback received: None

cc: McPherson, SCAO-1500; Khfrizell, 86-68460; Mefford, 86-68460; Edwards, 86-68140; Baysinger, 86-68410

SIGNATURES AND SURNAMES FOR:

Travel to: Santa Margarita River drainage basin and O'Neill Diversion Weir on Camp Pendleton, CA near San Diego, CA

Date or Dates of Travel: January 6-7, 2009

Names and Codes of Travelers: Kathleen H. Frizell and Brent W. Mefford

Traveler	**Date**
Kathleen H Frizell	2/24/08
Brent W Mefford	2/24/09

Noted and Dated by:

Tony L. Wahl 2/26/09