BUREAU OF RECLAMATION
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DENVER, COLORADO

TRAVEL REPORT

RES-3.50

Code: 86-68560 **Date**: April 7, 2006

To: Clifford A. Pugh
Manager, Water Resources Research Laboratory (WRRL)

From: Robert Einhellig
Hydraulic Engineer

Subject: Travel to Carlsbad, New Mexico, to provide flow measurement assistance to the Carlsbad Irrigation District

1. Travel period: February 13-17, 2006.

2. Places or offices visited: Carlsbad Irrigation District in Carlsbad, New Mexico.

3. Purpose of trip: To assist the Carlsbad Irrigation District with flow measurement improvements, including the construction of a long-throated flume in the main canal.

4. Synopsis of trip: On February 13th I flew from Denver to El Paso, Texas, where I rented a car and then drove approximately 160 miles to Carlsbad, New Mexico. Once in Carlsbad, I proceeded to the Carlsbad Irrigation District (CID) office located at 201 South Canal Street where I met with the District Manager, Tom Davis (phone: 505/885-3203, Email: cid@plateautel.net), and Woodrow Irving of Reclamation's El Paso office (EP-421). We discussed the construction of a long-throated flume in the Southern (main) Canal which was to begin the next day. The flume had been designed for the district by Tony Wahl of Reclamation's Technical Service Center in Denver (86-68560) based on canal geometry and flow information provided by the district. The designed flume featured a 2.75-ft-high crest with a 3:1 approach ramp. We discussed the construction criteria and allowable tolerances. I emphasized that the flume could easily be calibrated for the as-built dimensions, provided that the crest was level. Thus, the critical construction criterion was that the crest be level; all other dimensions could vary slightly during construction without negatively impacting the performance or ratability of the flume. I also suggested that they might want to consider adding a drain line such as a 4 inch PVC pipe through the flume at the canal invert level to allow the upstream side of the flume to drain free when water was not running. They had not planned on this feature, but agreed it was a good idea and would incorporate it into the construction.

Tom, Woodrow, and I then drove out to the construction site, located off Callaway Drive in the northwest corner of town. Water for the CID is released into the system from Avalon Dam (figure

1) on the Pecos River approximately 3 miles north of Carlsbad. The first control point downstream of the dam is located at the northwest corner of Carlsbad. At this location three independent gate structures control flow respectively into the East Canal, a wasteway back to the Pecos River, and the Southern (main) Canal, as shown in figure 2.

Figure 1—Headworks of the Carlsbad Irrigation District system at Avalon Dam.

Figure 2—Gate structures for (from left to right) the East Canal, the wasteway to the Pecos River, and the Southern Canal, viewed from the upstream side.

The proposed flume construction site (figure 3) was in the Southern Canal, approximately 188 ft downstream from the control gates and 72.5 ft downstream from the Callaway Drive road bridge

(figure 4). The bridge features three 10-ft-wide by 8-ft-tall box openings, each box 48-ft-long in the flow direction and separated by 8-inch-thick walls. The canal section at the flume site is concrete lined and trapezoidal in shape, with a bottom width of approximately 30 ft, a depth of 7 ft, and a top width of 51 ft, yielding side slopes of 1.5:1. The estimated maximum discharge to be measured by the flume is 400 ft^3/sec, and the existing high-water mark at the site indicates a flow depth of 4 ft.

Figure 3—Proposed flume site in the Southern Canal as viewed from the Callaway Drive bridge looking downstream prior to construction.

Figure 4—Southern Canal headgates (foreground) and Callaway Drive bridge (background) upstream from the flume construction site (hidden by the bridge).

Tony had previously indicated that the flume design did not allow a lot of protection against submergence. Given the large amount of freeboard available, and the apparent head available

upstream from the control gate structure, the possibility of increasing the height of the flume crest was discussed. Tom indicated that he thought they had more than enough head available upstream of the control gates to tolerate the increase in water level downstream from the gates induced by the flume. Thus, we agreed to increase the designed flume crest height to 3.0 ft to allow a little more submergence protection.

Tuesday morning Woodrow and I met the CID maintenance foreman, Dane Williams (cell phone: 505/361-3152) at the construction site. We discussed the district's flume construction plans, including the change in crest height to 3.0 ft, the allowable construction tolerances (especially the need for a level crest), and installation of a drain line. Woodrow departed for El Paso late in the morning, and I spent the remainder of the day with the construction crew.

Wednesday morning Dane and I traveled to the system headworks at Avalon Dam. We looked at the reservoir outlet control structure and at the district's effort to measure inflow into the canal by installing a stilling well at a control section used by the U.S. Geological Survey (USGS) to measure discharge. I reiterated Tony's previous observation that the inlet to the stilling well was in a non-functional position (in the rapid-flow section of the control), and that for consistency and comparison to the USGS data it would be best to move the inlet closer to the USGS stilling well located upstream from the rapid-flow control section.

Following the visit to the canal headworks, we looked at the gate control structure and initial reach of the East Canal (located in close proximity to the flume construction site on the Southern Canal). The district would like to measure discharge at the head end of the East Canal, similar to what the ramp flume is intended to achieve for the Southern Canal. The East Canal is significantly smaller than the Southern Canal. The initial reach features a concrete-lined trapezoidal channel with 1:1 side slopes, a bottom width of 4 ft, and a channel depth of 3.5 ft which decreases to 2.85 ft approximately 150 ft downstream from the headgate structure. The remnants of a USGS rated section are evident approximately 120 ft downstream from the headgate structure (figure 5). The rated section includes a 7-ft-wide rectangular section of channel 13.5 ft in length, with a staff gage, stilling well, gage house, and USGS Reference Mark on the right side of the channel. A concrete foot bridge across the rectangular channel section includes hash marks at 0.5 ft increments to facilitate propeller-meter velocity measurements and discharge computations through the section. High water marks in the channel indicate a maximum flow depth in the range of 2.0 to 2.1 ft for a reported maximum discharge of 30-35 ft^3/sec. The discharges which the district would like to measure vary from a low of 8 ft^3/sec up to the estimated maximum of 35 ft^3/sec. Using a Kueffel & Esser Ni2 automatic level and a Philadelphia rod borrowed from the district, I collected elevation data in and around the initial reach of the East Canal to facilitate the design of a flow-measurement structure. I was assisted in this effort by Lupe, a member of the district maintenance staff.

Figure 5—Initial reach of the East Canal viewed looking upstream from the abandoned USGS rated section and gage toward the headgate control structure.

Thursday morning I returned to the flume construction site. Tom Davis had suggested I might check the elevation of the compacted fill and grade stakes prior to placing the concrete overlay that would complete the weir construction. Dane Williams met me at the site and informed me that due to limited availability of a concrete pump truck, the concrete placement would not occur until the following Monday. Thus, he indicated there would be no value in checking grade elevations that morning as the elevation marks would likely be disturbed and would have to be rechecked/set on the day of the placement. I returned to the district office where I held a final meeting with Tom and Dane. As there appeared to be no further activities with which I could assist the district at that time, I departed Carlsbad for El Paso early Thursday afternoon, hoping to catch a flight back to Denver that evening. Due to aircraft maintenance problems, however, the flight was delayed until Friday morning and I arrived back at the office late in the morning on Friday.

5. Conclusions: Construction of the new flume in the Southern Canal was not completed during my visit. Based on discussions with the district, however, it appeared that they had a good understanding of what remained to be done to complete the construction. Subsequent communication from the district indicated that the concrete placement and final construction of the flume was completed the following week without incident. The district reported that the as-built dimensions of the completed flume included a level crest with a height of 3.05 ft above the canal

invert, a length (upstream to downstream) of 3.33 ft, a width (side to side) of 39.17 ft, and an approach ramp length of 9.00 ft (3:1 slope). The toe of the flume ramp is located 58.67 ft downstream from an existing stilling well, and 72.58 ft downstream from the Callaway Drive bridge.

Geometric information for the initial 200 ft of the East Canal was gathered during the visit to facilitate the design of a flow-measurement structure for that reach of channel, should one be desired.

6. Action correspondence initiated: As-built dimensions for the completed flume in the Southern Canal were received from the district on the afternoon of March 2. Instructions for installing a staff gage on the sloping canal wall immediately upstream from the flume, as well as an auxiliary staff gage on the existing stilling well located 58.67 ft upstream from the flume, were transmitted to the district on the morning of March 3. The final location of the wall-mounted staff gage (13.67 ft upstream from the toe of the flume ramp) was received from the district on the morning of March 6. Rating tables for each of the two staff gages were then developed and transmitted back to the district by noon of the same day. All information was transmitted and received via electronic mail.

Water was reported to begin running in the district canal system on Monday, March 6, 2006.

cc: Woodrow Irving (EP-421)

SIGNATURES AND SURNAMES FOR:

Travel to: Carlsbad, New Mexico

Date or Dates of Travel: February 13-17, 2006

Names and Codes of Travelers: Robert Einhellig, 86-68560

Traveler: _____ _____
Robert Einhellig, 86-68560 Date

Noted and Dated by:

_____ _____
Clifford A. Pugh, Manager Date
Water Resources Research Laboratory