Up-Stream DO TMDL Project
Task: 5
Description of Flow and Water Quality Monitoring Upgrades and Photo Documentation

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Introduction

The main objective of the flow and continuous monitoring stations is to produce real-time data that can be used to support managerial decisions within the San Joaquin River system. Stations were to report flow, temperature, and electrical conductivity (EC) data on a real-time basis. This data could then be used to calculate loading levels of different water quality parameters to the San Joaquin River. Monitoring station sites were placed at existing stations, utilizing the structures and equipment already present. If a site did not have an existing station, the site was chosen based upon its accessibility and channel morphology. Existing monitoring stations were upgraded, or in locations where no station existed, were built from scratch.

Methods

Existing monitoring stations were used where possible. If no monitoring station existed a new station was constructed. New sites were chosen at locations along the tributary that had landowner permission and were accessible. Sites were chosen that had stable channels, and preferably an existing weir structure. Sites used existing telemetry, such as SCADA systems or phone lines, where possible and GOES satellite telemetry on sites that did not have access to these other systems. Power for the monitoring equipment was either provided by onsite electric service or from a battery and solar array.

At a minimum each site was equipped with a way to measure EC and flow. Data was measured and recorded every fifteen min at the westside stations and hourly at the eastside stations. Dataloggers stored data from the sensors that could be accessed through a telemetry system or manually downloaded using a PCMCIA flash card from the logger. GOES telemetry reported data directly to a DOMSAT station operated by the Department of Water Resources California Data Exchange Center, which could then be downloaded from the California Data Exchange Center website. SCADA systems reported data directly through e-mail to the persons responsible for the site's data collection.

Existing structures and channel morphology determined what equipment was used to measure flow at a given site. Where a weir was present, the stage value along with the weir equation was used to compute discharge. Pressure transducers, float and shaft encoders, Stevens chart recorders, and Design Analysis H355 Smartgas bubbler systems were all used to measure stage (Table 1). Sites with culverts and open channels were installed with Doppler units to measure the discharge, such as a SONTEK, MACE, or STARFLOW (Table 1). Continuous monitoring sites that lacked a structure relied on a stage to discharge relationship from a rating curve to determine flow. These sites could then utilize a Design analysis H355 Smartgas bubbler system or some other stage measuring equipment to determine discharge. Doppler units, which can measure both stage and velocity, were deployed at some open channel sites to measure flow. Electrical conductivity was measured using an YSI 600XL with an attached temperature compensated conductivity probe (Table 1). DO-20 Los Banos Creek used a Campbell Scientific EC sensor in place of the YSI 600XL. The EC and flow could then be used to calculate total dissolved solids (TDS) loading.

Results and Discussion

Monitoring stations were placed on tributaries along the San Joaquin River. The sites were divided into westside and eastside monitoring stations depending on which side of the river they were on. There are thirteen westside stations and fifteen eastside stations. Nine of the westside stations were newly constructed. A list of stations and locations can be found by referring to Table 2. Of the eastside stations, most already measured flow and only eight needed to be upgraded to include a YSI 600XL to measure electrical conductivity. Most of the stations operated by Turlock Irrigation District and Modesto Irrigation District already had SCADA systems installed.

Monitoring Station Operators

DO-13 Stanislaus River at Ripon, DO-15 Tuolumne River at Modesto, DO-18 Mud Slough near Gustine, DO-19 Salt Slough at Lander, and DO-21 Orestimba Creek are all operated by USGS. DO-20 Los Banos Creek is operated by the Grassland Water District. DO-17 Merced River at Stevinson is operated by DWR. DO-31 New Jerusalem Drain, DO-33 Hospital Creek, DO-34 Ingram Creek, DO-35 Westley Wasteway, DO-36 Del Puerto Creek, DO-38 Marshall Road Drain, DO-37 Ramon Lake at Levee, DO-64 Moran Drain, and DO-65 Spanish-Grant Drain are all operated by EERP at University of the Pacific. DO-22 Lateral 4 to SJR, DO-23 Lateral 5 to Tuolumne, DO-24 Lateral 6 to Stanislaus, and DO-25 Miller Lake Outfall are all operated by Modesto Irrigation District. DO-26 Highline Spill, DO-27 Lateral 2 to San Joaquin River, DO-28 Westport Drain, DO-29 Harding Drain, and DO-30 Lateral 6 & 7 at Levee are all operated by Turlock Irrigation District.

Monitoring Station Status

While all sites are currently operational, some sites have had problems that have had to be repaired. DO-20 Los Banos Creek was recently rehabilitated after being washed out during the storms of 2005/2006. A new bridge was constructed replacing the old wooden bridge. The SONTEK SL acoustic sensor was re-sited and new cable drawn. The EC sensor was replaced and a new pipe laid into the water for the bubbler sensor. At DO-38 Marshall Road Drain a leak in the T valve on bubbler line was found on 5/9/06. All flow data from the bubbler unit was low quality prior to this date. DO-65 Spanish-Grant Drain had sediment built up behind the weir resulting in low quality QA stage readings from 05/22/07 to 01/17/08. The sediment was cleared out on 01/17/08. DO-64 Moran Drain is currently operational with no significant problems. Sediment can build up behind the weir structure at these three sites and it occasionally needs to be cleared. The STARFLOW acoustic Doppler stage transducer is prone to clogging from the sediment and sometimes the unit becomes buried in the mud, especially at DO-38 Marshall Road Drain and DO-65 Spanish-Grant Drain. The monitoring systems for all three sites are powered by the same battery and solar panel which could cause a potential power issue. The steep bed slope at DO-36 Del Puerto Creek can result in low stage that is barely above bubbler at low flow events causing low quality flow values. The solar panel at this site has been stolen once. Frequent flow ratings are required due to a shifting channel bed. The bubbler line was found clogged with debris on 10/09/07 and cleared on 11/01/07. The clog resulted in low quality stage data from June 2006 until 11/01/07. DO-57 Ramona Lake at Levee was washed out during the 2005/2006 San Joaquin River flooding. Water flowed backwards through the culvert. The landowner dropped sandbags down the culvert to avert flooding his land and decommissioned the monitoring station. The EC sensor was redeployed and a new pipe laid for the bubbler sensor. The site is currently operational. The original culvert at DO-35 Westley Wasteway was undersized. The district replaced it with a lager diameter structure to accommodate more flow. A weir structure was installed at the same time. New pipe was laid for the EC probe and bubbler line just upstream of weir. Flow data was originally calculated with a STARFLOW acoustic Doppler which was prone to error from the small culvert and constant debris dumped upstream. The new weir provided high quality data from a bubbler system. DO-34 Ingram Creek has no significant problems. Heavy sediment load during summer months necessitated occasional removal of sediment behind weir structure. Sediment was last cleared out on 11/01/07. DO-31 New Jerusalem Drain was upgraded with a STARFLOW Doppler sensor which failed after six months of placement. Unit was replaced in mid-2006 with a MACE integrated stage/velocity acoustic Doppler sensor which has proved more reliable. The station is currently operational with no significant problems. DO-25 Miller Lake Outfall had a Design Analysis H355 Smartgas bubbler system installed in late 2007 and is currently operational with few significant problems. DO-22 Lateral 4 to SJR, DO-23 Lateral 5 to Tuolumne, DO-24 Lateral 6 to Stanislaus, DO-26 Highline Spill, DO-27 Lateral 2 to San Joaquin River, DO-28 Westport Drain, DO-29 Harding Drain, and DO-30 Lateral 6 & 7 at Levee are all operational with few significant problems. DO-33 Hospital Creek is operational with few significant problems.

Conclusions

Most sites that were upgraded are currently operational with no significant problems. Occasionally problems arise that are beyond the station operator's control, such as flooding and equipment failure. However, when these issues came up they were identified and corrected. Reliability of flow data depended on the site in question. Any station that had consistency in structure, such as a weir system that is routinely cleared of debris, provided reliable flow and water quality data. Sites that had a bubbler line installed and a developed flow stage relationship supplied high quality flow data. However, if the weir was not kept clear of debris then the flow data was not reliable. The goals of this report were met with the continuous monitoring of flow at the relevant EERP sample sites.

Table 1: Equipment Descriptions

Device	Description
Campbell Logger (Campbell Scientific Inc., Logan, UT)	Logger put into continuous monitoring stations. Records and stores data from EC probe, flow device, and bubbler.
H-350XL Design Analysis Logger (Design Analysis Associates Inc., Logan, UT)	Logger put into continuous monitoring stations. Records and stores data from EC probe, flow device, and bubbler.
MACE Agriflo (MACE, Sydney, Australia)	Doppler device put near bottom of channel to measure flow. This device is better for defined structures such as pipes and weir structures. Often used at monitoring stations.
Starflow (Unidata, O'Connor, Australia)	Doppler device put near bottom of channel to measure flow. This device is better for defined structures such as pipes and weir structures. Often used at monitoring stations.
Sontek (Sontek/YSI Inc., San Diego, CA)	Doppler device put in channel to measure flow. MACE units measure flow by looking out into the channel and are better for open, or natural, channel situations. Often used at monitoring stations.
H-350XL/355 Combo Bubbler (Design Analysis Associates Inc., Logan, UT)	A bubbler measures water level by detecting the pressure required to force air through a tube below the water level in the channel. In areas with a weir system a bubbler can be used to measure flow, as the height of water above the weir is proportional to the flow.
Staff Gauge (Wildlife Supply Company, Buffalo, NY)	A gauge put in a fixed location to observe water level. Often used to verify bubbler reading during QA visits.
Cal Poly ITRC Weir Stick (Cal Poly ITRC, San Luis Obispo, CA)	Scale mounted on a stick used to measure the height of the water above a weir structure. This value is then multiplied times the weir width to get flow.
EC Probe (YSI Inc., Yellow Springs, OH) (Campbell Scientific Inc., Logan, UT)	Sensor used to measure the Electrical Conductivity or Specific Conductivity of the water. Often deployed at monitoring stations in the field
YSI Sonde (YSI Inc., Yellow Springs, OH)	Multi-parameter instrument used to measure water quality. Most often used during sampling events and continuous monitoring.

Table 2: List of Flow Stations Upgraded or Constructed between 2005-2007 in the San Joaquin River Valley.

DO Site	*Station Name*	*Latitude*	*Longitude*	*Station Operator*	*Location*
20	Los Banos Creek Flow Station	37.275	-120.955	Grassland WD	Westside
22	Modesto ID Lateral 4 to SJR	37.630	-121.158	Modesto ID	Eastside
23	Modesto ID Lateral 5 to Tuolumne	37.6145	-121.143	Modesto ID	Eastside
24	Modesto ID Lateral 6 to Stanislaus River	37.703	-121.141	Modesto ID	Eastside
25	Miller Lake Outfall	37.670	-121.219	Modesto ID	Eastside
26	Turlock ID Highline Spill	37.386	-120.813	Turlock ID	Eastside
27	Turlock ID Lateral 2 to SJR	37.565	-121.138	Turlock ID	Eastside
28	Turlock ID Westport Drain Flow station	37.541	-121.094	Turlock ID	Eastside
29	Turlock ID Harding Drain	37.464	-121.030	Turlock ID	Eastside
30	Turlock ID Lateral 6 & 7 at Levee	37.397	-120.972	Turlock ID	Eastside
31	BCID - New Jerusalem Drain	37.726	-121.299	UOP EERP	Westside
33	Hospital Creek	37.610	-121.230	UOP EERP	Westside
34	Ingram Creek	37.600	-121.225	UOP EERP	Westside
35	Westley Wasteway Flow Station	37.558	-121.163	UOP EERP	Westside
36	Del Puerto Creek Flow Station	37.539	-121.122	UOP EERP	Westside
38	Marshall Road Drain	37.436	-121.036	UOP EERP	Westside
57	Ramona Drain at Levee	37.478	-121.068	UOP EERP	Westside
64	Moran Drain	37.435	-121.035	UOP EERP	Westside
65	Spanish-Grant Drain	37.435	-121.035	UOP EERP	Westside

EERP Site No. DO-20

Site Description	**20. Los Banos Creek** Located within the Kesterson National Wildlife Refuge approximately ¼ mile south of Hwy 140.
Power	Solar Panel with 12-volt battery
Datalogger	Campbell Scientific datalogger
EC Sensor	Campbell Scientific temperature-compensated EC sensor
Flow Measurement	SONTEK SL acoustic Doppler sensor with built-in stage sensor
Depth	Design Analysis H350XL with H355 Smartgas system
Velocity	SONTEK SL
Telecommunications	GOES Telemetry installed but not operational.

Figure 1: Bridge at Los Banos Creek before being damaged during storms of 2005/2006.

Figure 2: New bridge and equipment installed at LBC after old bridge was washed out.

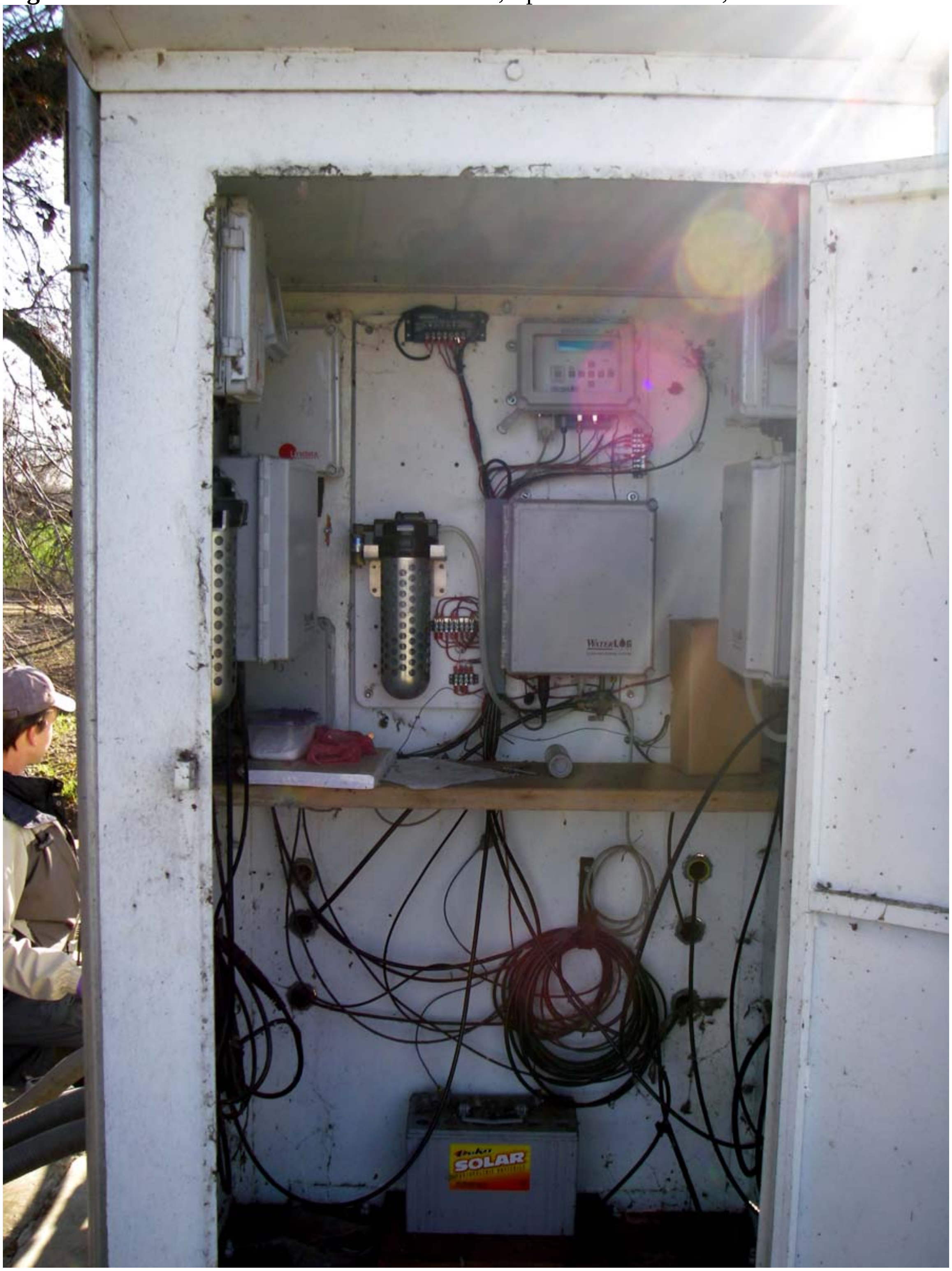
Figure 3: Jeremy Hanlon and Nigel Quinn installing new equipment at Los Banos Creek.

EERP Site No. DO-38

Site Description	**38. Marshall Road Drain** Located within Patterson Irrigation District at the east end of Marshall Road. Carries agricultural return flows from Marshall Road Reservoir.
Power	Solar Panel with 12-volt battery
Datalogger	Design Analysis datalogger
EC Sensor	YSI 600XL temperature compensated EC probe
Flow Measurement	Flow over a sharp crested weir using weir equation and stage to compute discharge (primary) Unidata STARFLOW integrated stage/velocity acoustic Doppler transducer (secondary)
Depth	Design Analysis H350XL with H355 Smartgas system (primary) Unidata STARFLOW stage (secondary)
Velocity	Unidata STARFLOW velocity
Telecommunications	GOES Telemetry installed but not operational.

Figure 4: Manhole at Marshall Road Drain. The manhole for Spanish Land Grant Drain is in the back of the picture.

Figure 5: Flow station shed for Marshall Road, Spanish Land Grant, and Moran Drains.



EERP Site No. DO-64

Site Description	**64. Moran Drain** Located within Patterson Irrigation District at the east end of Marshall Road. Carries agricultural return flows from adjacent fields.
Power	Solar Panel with 12-volt battery
Datalogger	Design Analysis datalogger
EC Sensor	YSI 600XL temperature compensated EC probe
Flow Measurement	Flow over a sharp crested weir using weir equation and stage to compute discharge (primary) Unidata STARFLOW integrated stage/velocity acoustic Doppler transducer (secondary)
Depth	Design Analysis H350XL with H355 Smartgas system (primary) Unidata STARFLOW stage (secondary)
Velocity	Unidata STARFLOW velocity.
Telecommunications	GOES Telemetry installed but not operational.

Figure 6: Manhole for Moran Drain. Manhole is about 50 ft south west of manhole for Spanish Land Grant Drain.

EERP Site No. DO-65

Site Description	**65. Spanish Land Grant Drain** Located within Patterson Irrigation District at the east end of Marshall Road. Carries agricultural return flows from Patterson Irrigation District.
Power	Solar Panel with 12-volt battery
Datalogger	Design Analysis datalogger
EC Sensor	YSI 600XL temperature compensated EC probe
Flow Measurement	Flow over a sharp crested weir using weir equation and stage to compute discharge (primary) Unidata STARFLOW integrated stage/velocity acoustic Doppler transducer (secondary)
Depth	Design Analysis H350XL with H355 Smartgas system (primary) Unidata STARFLOW stage (secondary)
Velocity	Unidata STARFLOW velocity.
Telecommunications	GOES Telemetry installed but not operational.

Figure 7: Manhole for Spanish Land Grant Drain.

EERP Site No. DO-36

Site Description	**36. Del Puerto Creek** Ephemeral stream from the Coast Range that flows into the SJR through Patterson Irrigation District.
Power	Solar Panel with 12-volt battery
Datalogger	Design Analysis datalogger
EC Sensor	YSI 600XL temperature compensated EC probe
Flow Measurement	Stage-discharge relationship developed for a straight, narrowly incised and steep channel segment.
Depth	Design Analysis H350XL with H355 Smartgas system;
Velocity	n/a
Telecommunications	GOES Telemetry installed but not operational.

Figure 8: Flow station shed and stream channel for Del Puerto Creek.

EERP Site No. DO-57

Site Description	**57. Ramona Lake Drain** Drain receiving pumped discharge from a small lake that acts as a drainage sump to surrounding fields. Site located on top of the levee adjacent to the SJR
Power	Solar Panel with 12-volt battery Auxiliary solar panels to power a 24 volt analog to digital transducer attached to the propeller meter.
Datalogger	Design Analysis datalogger
EC Sensor	YSI 600XL temperature compensated EC probe
Flow Measurement	Stage-discharge relationship developed for a sharp crested weir with no contractions.
Depth	Design Analysis H350XL with H355 Smartgas system.
Velocity	n/a
Telecommunications	GOES Telemetry installed but not operational.

Figure 9: Kyle Kearney inspecting the damage to Ramona Lake Drain flow station. River flooding backed up into the culvert and decommissioned the station.

Figure 10: Ramona Lake Drain flow station shed and manhole after repairing the damage from San Joaquin River flooding during 2005/2006.

EERP Site No. DO-35

Site Description	**35. Westley Wasteway** Located along River Road within the West Stanislaus Irrigation District
Power	Solar Panel with 12-volt battery
Datalogger	Design Analysis datalogger
EC Sensor	YSI 600XL temperature compensated EC probe
Flow Measurement	Previously used a combination of STARFLOW acoustic Doppler transducer and bubbler stage. Current retrofit uses a regular contracted weir located approximately 30ft downstream. Flow measured using equation for contracted sharp crested weir.
Depth	Design Analysis H350XL with H355 Smartgas system (primary)
Velocity	n/a
Telecommunications	GOES Telemetry installed but not operational.

Figure 11: Old culvert at Westley Wasteway. Original culvert and acoustic Doppler system at site provided low quality data.

Figure 12: Irrigation district installing a new weir structure and culvert to provide higher quality flow data at Westley Wasteway.

Figure 13: Current setup at Westley Wasteway. Weir structure and pond with bubbler system provide high quality flow data with very few problems.

EERP Site No. DO-33

Site Description	**33. Hospital Creek** Located along River Road within the West Stanislaus Irrigation District. Hospital Creek is an ephemeral stream originating in the Coast Range.
Power	Solar Panel with 12-volt battery
Datalogger	Design Analysis Datalogger
EC Sensor	YSI 600XL temperature compensated EC probe
Flow Measurement	Flow over a sharp crested weir with minor contractions using weir equation and stage to compute discharge
Depth	Design Analysis H350XL with H355 Smartgas system
Velocity	n/a
Telecommunications	GOES Telemetry installed but not operational.

Figure 14: Flow station shed and weir structure at Hospital Creek.

EERP Site No. DO-34

Site Description	**34. Ingram Creek** Located along River Road within the West Stanislaus Irrigation District. Ingram Creek is an ephemeral stream originating in the Coast Range.
Power	Solar Panel with 12-volt battery
Datalogger	Design Analysis datalogger
EC Sensor	YSI 600XL temperature compensated EC probe
Flow Measurement	Flow over a sharp crested weir using weir equation and stage to compute discharge
Depth	Design Analysis H350XL with H355 Smartgas system
Velocity	n/a
Telecommunications	GOES Telemetry installed but not operational.

Figure 15: Weir and flow station shed at Ingram Creek.

Figure 16: Weir is located under the bridge next to the flow station shed.

EERP Site No. DO-31

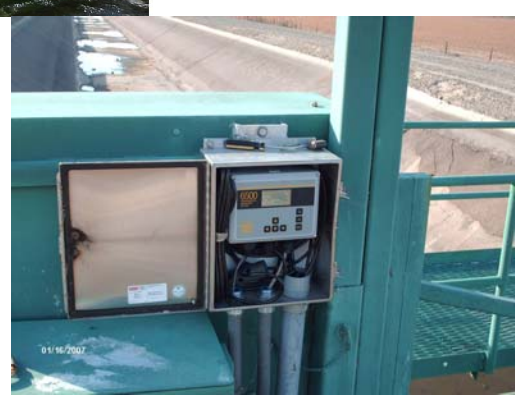
Site Description	**31. New Jerusalem Drain** Located ¼ mile north of the Banta Carbona Irrigation District fish facility
Power	Solar Panel with 12-volt battery
Datalogger	Design Analysis datalogger
EC Sensor	YSI 600XL temperature compensated EC probe
Flow Measurement	MACE integrated stage/doppler sensor providing direct discharge output (primary). Flow over a sharp crested weir using weir equation and stage to compute discharge (secondary)
Depth	Design Analysis H350XL with H355 Smartgas system (primary) MACE pressure sensor (secondary)
Velocity	MACE acoustic Doppler sensor
Telecommunications	GOES Telemetry installed but not operational.

Figure 17: Flow station shed and manhole at New Jerusalem Drain.

EERP Site No. DO-22

Site Description	**22. MID Lateral 4** Modesto irrigation district operational outflow
Power	110 volt power
Datalogger	YSI 6500 Process Monitor which send data to a Sierra Systems SCADA RTU.
EC Sensor	YSI temperature compensated EC probe located ¼ mile upstream of the weir
pH Sensor	YSI pH probe located ¼ mile upstream of the weir
Flow Measurement	Flow over a sharp crested weir using weir equation and stage to compute discharge
Depth	Sierra Systems transducer reporting directly to RTU (primary) Stevens chart recorder (secondary) YSI 600XL internal pressure sensor (tertiary)
Velocity	n/a
Telecommunications	Sierra Systems RTU SCADA Telemetry

Figure 18: (top) Weir at MID Lateral 4. (bottom) Sierra Systems RTU SCADA system.



EERP Site No. DO-23

Site Description	**23. MID Lateral 5** Modesto irrigation district operational outflow
Power	12 volt power supplied by battery and solar panel
Datalogger	Campbell Scientific CR-10 with digital to serial interface to process signal and make compatible with Sierra Systems SCADA RTU.
EC Sensor	YSI temperature compensated EC probe
pH Sensor	YSI pH probe
Flow Measurement	Flow over a sharp crested weir using weir equation and stage to compute discharge
Depth	Sierra Systems transducer reporting directly to RTU (primary) Stevens chart recorder (secondary) YSI 600XL internal pressure sensor (tertiary)
Velocity	n/a
Telecommunications	Sierra Systems RTU SCADA Telemetry

Figure 19: Weir structure and monitoring equipment at MID Lateral 5.

EERP Site No. DO-24

Site Description	**24. MID Lateral 6** Modesto irrigation district operational outflow
Power	Solar Panel with 12-volt battery
Datalogger	Campbell Scientific CR-10 with digital to serial interface to process signal and make compatible with Sierra Systems SCADA RTU.
EC Sensor	YSI temperature compensated EC probe located upstream of the weir
pH Sensor	YSI pH probe located upstream of the weir
Flow Measurement	Flow over a sharp crested weir using weir equation and stage to compute discharge
Depth	Sierra Systems transducer reporting directly to RTU (primary) Stevens chart recorder (secondary) YSI 600XL internal pressure sensor (tertiary)
Velocity	n/a
Telecommunications	Sierra Systems RTU SCADA Telemetry

Figure 20: Weir structure and monitoring equipment at MID Lateral 6.

EERP Site No. DO-25

Site Description	**25. MID Miller Lake Outfall** Modesto irrigation district operational outflow. MID Main Drain canal empties into Miller Lake.
Power	110 volt power supplied to YSI and SCADA 12 volt power supplied by battery and solar panel to Design Analysis Smartgas system.
Datalogger	Design Analysis datalogger/YSI 6500 Process Monitor which send data to a Sierra Systems SCADA RTU
EC Sensor	YSI temperature compensated EC probe
Flow Measurement	Flow over a sharp crested weir using weir equation and stage to compute discharge
Depth	Design Analysis H350XL with H355 Smartgas system (primary) Stevens chart recorder (secondary)
Velocity	n/a
Telecommunications	Sierra Systems RTU SCADA Telemetry

Figure 21: Stevens chart recorder and YSI EC probe next to bridge over the weir structure at MID Miller Lake Outfall.

Figure 22: A Design Analysis Smartgas system was added to the Stevens chart recorder in late 2007, providing higher quality data.

EERP Site No. DO-26

Site Description	**26. TID Highline Canal** Turlock Irrigation District operational spill/drainage site
Power	110 volt power
Datalogger	Sierra Controls RTU with SCADAPACK
EC Sensor	YSI 600XL temperature compensated EC probe
Flow Measurement	Flow over a long sharp crested weir using weir equation and stage to compute discharge
Depth	Sierra Controls float and shaft encoder
Velocity	n/a
Telecommunications	Sierra Controls SCADAPACK Telemetry

Figure 23: Sierra Controls SCADAPACK and weir structure at TID Highline Canal.

EERP Site No. DO-27

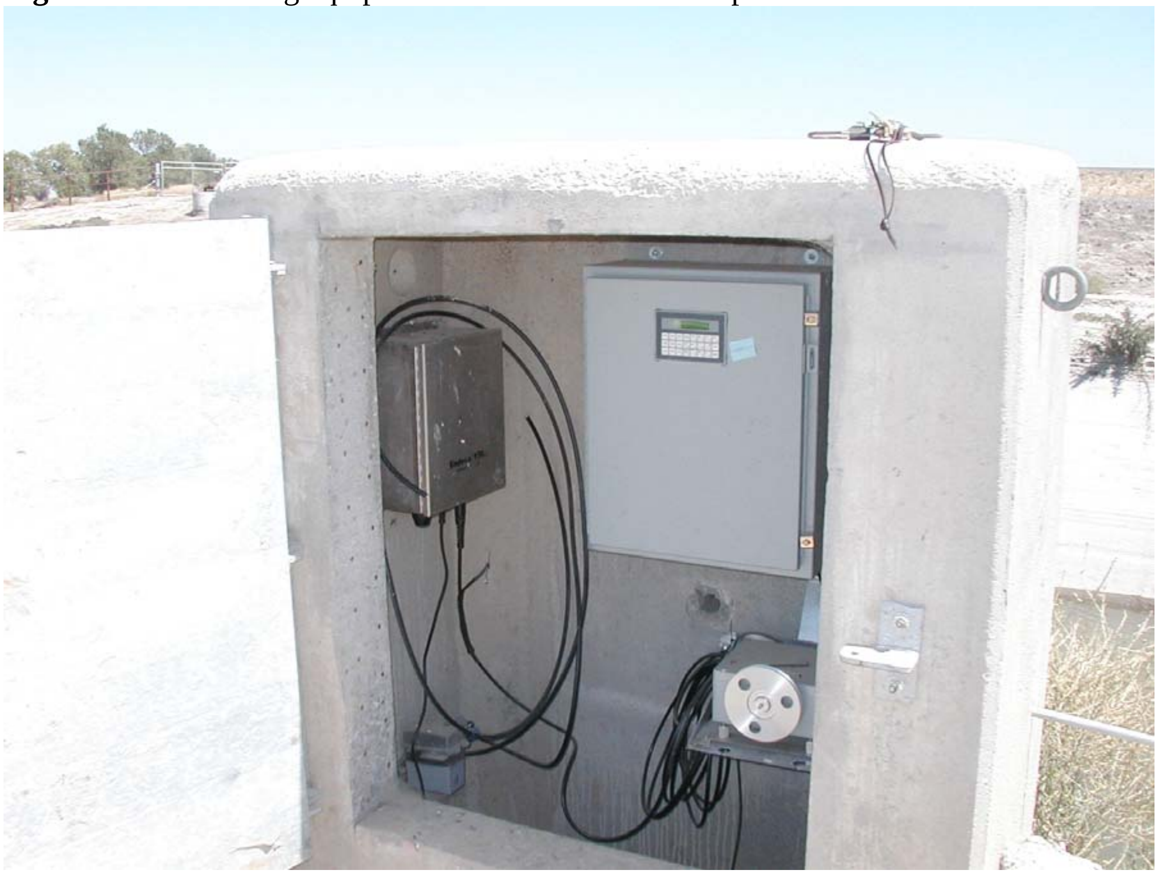
Site Description	**27. TID Lateral 2** Turlock Irrigation District operational spill/drainage site
Power	110 volt power
Datalogger	Sierra Controls RTU with SCADAPACK
EC Sensor	YSI 600XL temperature compensated EC probe
Flow Measurement	Flow over a long sharp crested weir using weir equation and stage to compute discharge
Depth	Sierra Controls float and shaft encoder
Velocity	n/a
Telecommunications	Sierra Controls SCADAPACK Telemetry

Figure 24: Flow monitoring equipment and weir structure at TID Lateral 2.

EERP Site No. DO-28

Site Description	**28. TID Lateral 3 Westport Drain** Turlock Irrigation District operational spill/drainage site
Power	110 volt power
Datalogger	Sierra Controls RTU with SCADAPACK
EC Sensor	YSI 600XL temperature compensated EC probe
Flow Measurement	Flow through a flume.
Depth	Sierra Controls float and shaft encoder (primary) YSI 600XL internal pressure sensor (secondary)
Velocity	n/a
Telecommunications	Sierra Controls SCADAPACK Telemetry

Figure 25: Monitoring equipment at TID Lateral 3 Westport Drain.



EERP Site No. DO-29

Site Description	**29. TID Lateral 5 Harding Drain at Carpenter Rd.** Turlock Irrigation District drainage site
Power	110 volt power
Datalogger	Sierra Controls RTU with SCADAPACK
EC Sensor	YSI 600XL temperature compensated EC probe
Flow Measurement	Flow over a long sharp crested weir using weir equation and stage to compute discharge
Depth	Sierra Controls float and shaft encoder
Velocity	n/a
Telecommunications	Sierra Controls SCADAPACK Telemetry

Figure 26: (right) Monitoring equipment and (left) weir structure at TID Lateral 5 Harding Drain at Carpenter Road.

EERP Site No. DO-30

Site Description	**30. TID Lateral 6 & 7** Turlock Irrigation District operational spill/drainage site
Power	110 volt power
Datalogger	Sierra Controls RTU with SCADAPACK
EC Sensor	YSI 600XL temperature compensated EC probe
Flow Measurement	No flow measurement at site. Combined flow of Lat 6 and Lat 7 are used to estimate flow
Depth	YSI 600XL internal pressure sensor
Velocity	n/a
Telecommunications	Sierra Controls SCADAPACK Telemetry

Figure 27: (left) Inside of monitoring shed and (right) culvert at TID Lateral 6 & 7.