UNITED WATER CONSERVATION DISTRICT
"Conserving Water Since 1927"

Fish Passage Monitoring and Studies
Freeman Diversion Facility
Santa Clara River, Ventura County, California

Annual Report
2013 Monitoring Season

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Annual Report
2013 Monitoring Season

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2013

Cover Photos (by United Water Conservation District staff): clockwise from top*:* Freeman Diversion Structure May 2013, fathead minnow and arroyo chub, 2013 young of the year resident coastal rainbow trout

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The water year of 2013 was considered a dry year. Rainfall in wet years can exceed 40 inches in the lower coastal plain and even more in the mountain areas. Rainfall in dry years can range from close to zero to a few inches. A total of 5.96 inches of rain was measured at the Santa Paula Wilson Ranch gauge (Station 245B) located in Santa Paula during the 2013 water year. A water year spans from October 1 of the previous year to October 1 of the current year. The highest monthly rain total was 1.94 inches in December 2012.

The sandbar at the Santa Clara River Estuary (SCRE) was closed during the entire steelhead migration season (January through June). Smolt trapping at the Freeman Diversion started on January 14 and ended on June 1, 2013. The trap was also operated for one day on December 5, 2012 to test a modified trap chute and a resident rainbow trout was trapped and relocated. No steelhead smolts were observed in the fish trap in 2013. A total of one young-of-the-year, and one resident rainbow trout (December 2012 fish) were captured in the fish trap. Due to low flows and minimal rain, bypass flows were not triggered and the fish ladder was not operated in 2013. Consequently, no adult steelhead or Pacific lamprey passed through the fish ladder during the 2013 migration season.

Table 1, Appendix A summarizes the daily operations as well as the *O. mykiss* and physical data collected during monitoring activities in 2013.

Water temperature monitoring in 2013 occurred in the mainstem Santa Clara River, Santa Paula Creek, Sespe Creek, and lower Piru Creek. Temperature loggers deployed in the estuary cannot be accessed until the estuary breaches.

1.1 FREEMAN DIVERSION FACILITY

The Freeman Diversion Facility was constructed in 1991 and is located approximately 10.7 miles upstream from the Pacific Ocean. The main purpose of the facility is to divert surface water from the Santa Clara River to conserve groundwater resources in the Oxnard plain through percolation to the groundwater aquifer. The facility is comprised of a concrete structure, Denil fishway (fish ladder), fish screen bay, downstream migrant trap, and various canals and spreading grounds (Figure 1, Appendix A). The concrete structure is a complete barrier to steelhead and a potential barrier to Pacific lamprey upstream migration. The structure is only a potential barrier to Pacific lamprey because these fish can traverse vertical obstructions if water is flowing over the surface and there are no sharp edges that prevent attachment of the oral sucker disc. The fish ladder was constructed to facilitate anadromous migration over the Freeman Diversion structure. The fish screen bay is located directly downstream of where flow enters the diversion facility and its function is to keep fish out of the canals and spreading grounds and to direct fish to the downstream migrant trap or to a fish bypass pipe. The fish bypass pipe is located at the end of the fish screen bay and can be used to direct fish back to the river when there is sufficient flow to allow for volitional migration to the estuary.

1.2 FISH SPECIES COMPOSITION

The Santa Clara River is home to two native, anadromous fish species, the southern California steelhead trout (*Oncorhynchus mykiss irideus*) and the Pacific lamprey (*Entosphenus tridentatus*). Steelhead and resident rainbow trout are known collectively as coastal rainbow trout. Steelhead is another common name for anadromous coastal rainbow trout. The term “anadromy” describes a life cycle or life history trait where species live as adults in the ocean and return to freshwater to spawn. Resident coastal rainbow trout live their entire lives in freshwater. Both resident as well as anadromous coastal rainbow trout exist in the Santa Clara River. A steelhead that migrates from freshwater where it was born to the ocean typically between the ages of one to three years is referred to as a smolt. The term smolt reflects the physical and physiological changes coastal rainbow trout experience when preparing for life in saltwater. Because smolts are regularly captured at the Freeman Diversion following multiple years without adult steelhead migrants, it appears that resident rainbow trout produce progeny that will migrate to the ocean. A kelt is an adult steelhead that enters freshwater to spawn and later the same year (or the following year) returns to the ocean. Unlike Pacific salmon, steelhead do not necessarily die after spawning and can return to the ocean and again to freshwater to spawn again. Southern steelhead are federally listed as endangered.

Pacific lamprey are strictly anadromous and cannot persist in freshwater alone. Juvenile lamprey, which live in freshwater for up to seven years before migrating to the ocean, are referred to as ammocoetes. A downstream migrant Pacific lamprey is referred to as a macropthalmia. The term macropthalmia, similar to smolt, reflects the physical and physiological changes juvenile Pacific lamprey experience when preparing for life in saltwater. Pacific lamprey currently have no federal protection, but lamprey numbers have dropped precipitously since the early 2000's in the Santa Clara River and in many drainages on the west coast of the United States (Swift and Howard 2009).

There are two additional native fish species in the Santa Clara River, the federally-endangered tidewater goby (*Eucyclogobius newberryi*), which lives in the estuary, and the threespine stickleback (*Gasterosteus aculeatus*), which is distributed throughout the river system. The threespine stickleback is comprised of two sub-species in the Santa Clara River, the partially-armored (*Gasterosteus aculeatus microcephalus*) and unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*). The partially-armored stickleback, which is plentiful and has no federal protection, exists in the Ventura county reach and the unarmored threespine stickleback exists in the Los Angeles county reach of the Santa Clara River. The unarmored threespine stickleback sub-species is a federal and California endangered species and a California fully-protected species. Additional fish species known to occur in the Santa Clara River include: Arroyo chub (*Gila orcutti*), Santa Ana sucker (*Catostomus santaanae*), Owens sucker (*Catostomus fumeiventris*), Santa Ana-Owens sucker hybrids (*C. santaanae x fumeiventris*), largemouth bass (*Micropterus salmoides*), green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus*), brown bullhead (*Ameiurus nebulosus*), black bullhead (*Ameiurus melas*), prickly sculpin (*Cottus asper*), fathead minnow (*Pimephales promelas*), Mississippi (inland) silverside (*Menidia audens*), threadfin shad (*Dorosoma petenense*), common carp (*Cyprinus carpio*), goldfish (*Carassius auratus*), crappie (*Pomoxis spp*.) and mosquitofish (*Gambusia affinis*). See Table 2, Appendix A.

1.3 ENVIRONMENTAL SETTING

The Santa Clara River is the second largest watershed in southern California south of Point Conception and drains an area of approximately 1600 square miles. Its headwaters originate on the north slope of the San Gabriel Mountains near Acton, California in Los Angeles County and the river flows approximately 116 miles from east to west to its estuary in the City of Ventura. The Santa Clara River and its tributaries have high annual flow variability, from extreme flood events to multi-year droughts.

1.3.1 RAINFALL

During the 2013 rain season (10/1/2012-9/30/2013), Santa Paula had 34.4% of normal rainfall totaling 5.96 inches (Ventura Watershed Protection District website, Santa Paula-Wilson Ranch 245B). The most rainfall in a 24 hour period was 0.85 inches on March 8, 2013 and the second highest was 0.80 inches on January 24, 2013. The highest monthly rainfall was 1.94 inches in December. (Figure 2, Appendix A). Southern California can have cold or warm winters depending on ocean currents and other factors. Cold winters, tend to produce moderate storms and snow on local mountains. Warm winters, such as 2005, produce storms that produce large amounts of rain in a short period of time, typically resulting in flood conditions. Cold winters can be beneficial to *O. mykiss* because of sustained flows from snow melt and sustained cold water into the summer months. Warm winters may have negative effects on *O.mykiss* due to redd scouring but can also be beneficial when high flows remove excess vegetation (both exotic and native), scour and transport fine sediments, deposit clean gravels, and provide extended migration opportunities.

Tributaries

The major tributaries of the Santa Clara River include Santa Paula Creek, Sespe

Creek, and Piru Creek. Santa Paula Creek has two fish passage facilities located within the first four miles of the lower creek (USACE and Canyon Irrigation's Harvey Diversion fish ladders). These facilities have numerous physical and operational problems that result in restricted upstream passage either intermittently or completely depending on maintenance or damage in any given year. Sespe Creek is free-flowing, but illegal road crossings when present within the lower river can potentially block both upstream and downstream passage at certain flows. Piru Creek has two major dams (Santa Felicia Dam and Pyramid Dam) that do not include fish passage facilities and are complete barriers to upstream fish passage and intermittent barriers to downstream passage (fish can move downstream during spills over dams).

Santa Paula and Sespe Creeks are considered to be the primary steelhead-bearing drainages in the Santa Clara River watershed and are the closest major tributaries to the ocean. These tributaries did not have surface flow connection to the Santa Clara River during much of the 2013 migration season. It is unknown when steelhead smolts emigrate from the tributaries to the mainstem Santa Clara River. Currently, it is assumed that smolts emigrate from the tributaries following storm pulses, based on smolt trapping in the Santa Ynez River (Tim Robinson, Cachuma Operations and Maintenance Board, pers. comm.). Steelhead smolts are typically observed at the Freeman Diversion from January to June but the majority of these fish are observed in March, April, and May. In 2013, no smolts were observed at the Freeman Diversion.

1.4 REGULATORY STATUS (STEELHEAD)

NOAA Fisheries, otherwise known as the National Marine Fisheries Service (NMFS), listed the southern California steelhead, *Oncorhynchus mykiss irideus*, as endangered in 1997 (NMFS 1997) under the Endangered Species Act (ESA) of 1973. Steelhead were organized into stocks (i.e., groups) of evolutionary significant units (ESU) that represented groupings considered to be substantially reproductively isolated from other steelhead stocks and an important part of the evolutionary legacy of the species. Currently, the southern California steelhead ESU includes populations from the Santa Maria River in San Luis Obispo County south to the US/Mexican border in San Diego County (NMFS 2003). NOAA Fisheries later recognized the anadromous life history form of *O. mykiss* as a distinct population segment (DPS) under the ESA (NMFS 2006). The DPS policy differs from the ESU by delineating a group of organisms by "marked separation" rather than "substantial reproductive isolation." In the case of *O. mykiss* of the southern California steelhead ESU, this marked separation between the two life history forms was considered valid because of physical, physiological, ecological, and behavioral factors related to its anadromous life history characteristics. Both resident and anadromous *O. mykiss*, where the two forms co-occur and are not reproductively isolated and exist below complete barriers, are still part of the ESU; however, the anadromous *O. mykiss* (steelhead) are now part of a smaller subset identified as the southern California steelhead DPS (CMWD 2008).

The remainder of this report summarizes the monitoring study methods and results at the United Water Conservation District (hereafter, District) Freeman Diversion Fish Passage Facility on the Santa Clara River in 2013.

2.1 INTRODUCTION

In southern California, steelhead and Pacific lamprey migrate downstream from their natal streams to the Pacific Ocean in the spring. Smolts collected from 1991 to 2013 at the Freeman Diversion downstream migrant trap indicate that the majority of downstream migration occurs in March, April, and May, although migration can occur from January through June or later (in 2009 and 2010 migration was observed into July). Migration past the Freeman Diversion often occurs when flows in the Santa Clara River are rapidly receding. When this occurs, it is necessary to trap all downstream migrant steelhead and Pacific lamprey and relocate them to the estuary or other appropriate habitats (based on individual life stages) to prevent fish stranding in dewatered sections of the river below the Freeman Diversion.

The primary objective for trapping and transporting downstream migrants is to avoid impacts to steelhead smolts, kelts, and Pacific lamprey macropthalmia during their downstream migration to the Pacific Ocean when there is not sufficient flow in the lower river. This reduction in flow could be natural and/or the result of diversions at the Freeman Diversion and by other water users in the watershed. Another important objective is to gather data regarding anadromous downstream migration in the Santa Clara River. Since there is a lack of knowledge regarding steelhead in southern California, these data can be useful during the steelhead recovery planning process and for managers of anadromous fishes in the Santa Clara River as well as the region as a whole. Additionally, trapping activities aid in monitoring fish movement and assemblages within the Santa Clara River and can potentially prevent stranding and predation when conditions are not favorable in the lower river (due to natural low flow conditions and diversions occurring at the Freeman Diversion and elsewhere in the watershed).

2.2 Methods

2.2.1 Downstream Migrant Trap Checks

Trapping occurred from January 14 to June 1, 2013. Fish relocation would be triggered if there was not sufficient flow in the lower river based on depth criteria at critical riffles; however, no storms triggered bypass flows in 2013. The current smolt target flow is 120 cfs measured approximately 5.5 mi downstream of the Freeman Diversion within a sandy glide habitat in the lower Santa Clara River. This target flow threshold was developed from the analysis of depth, velocity and wetted width taken at a range of flows within long, sandy glides. These results were used to develop a smolt target flow (120 cfs) where more than 50% of the wetted stream channel was greater than 0.5 feet deep. Trapping and transporting would commence when flow receded to 80 cfs at the sandy glide flow measurement site. A trapping trigger or critical passage flow of 80 cfs was developed because only a narrow width (10 % or less of the wetted stream channel) was equal to or greater than 0.5 feet deep during the depth, velocity and wetted width study. A smolt radio telemetry study is in development to address uncertainties regarding smolt migration behavior and rate of migration in the lower Santa Clara River. This study is planned to be included in the District's Multi-Species Habitat Conservation Plan (MSHCP). The primary objective of this study will be to evaluate smolt migration rates and success at various flows to inform and potentially modify the smolt target flows and trapping operations.

Downstream migrant steelhead smolts, kelts, Pacific lamprey macropthalmia, and other fish entering the fish screen bay within the diversion facility are prevented from entering the diversion canal by a self-cleaning, 1.75 mm (0.07 inch) mesh wedge wire screen which directs the fish to a downstream migrant fish trap. From January 14 to June 1, 2013, fish were collected in the downstream migrant trap. Typically, steelhead smolts and kelts trapped at the facility are transported in aerated coolers by truck to the Santa Clara River Estuary when flows are less than 80 cfs at the critical riffle, or released in the Santa Clara River below the Freeman Diversion when migration flows are released. No steelhead kelts or smolts were observed or captured in 2013. No lamprey macropthalmia or ammocoetes were observed or trapped. Typically, resident coastal rainbow trout not exhibiting smolting characteristics are transported, depending on flow conditions, to the Santa Clara River, Santa Paula

Creek, or Sespe Creek. Currently, the Santa Clara River above Santa Paula is the preferred relocation site for resident coastal rainbow trout and lamprey ammocoetes. All other native aquatic species are returned to the river upstream of the diversion. Non-native and exotic aquatic species are removed from the river unless they are considered special status species in neighboring watersheds (e.g., Santa Ana sucker and Arroyo chub).

The downstream migrant trap consists of 3/16-inch mesh metal screens. Flow enters through a weir gate with an opening and chute that directs fish and other aquatic species into the trap from the fish screen bay. The trap is situated to keep all intercepted fish immersed in at least two feet of flowing water.

The trap is checked daily in the morning and downstream migrants are removed from the trap with a dip net, counted, and measured. Other trapped aquatic species are counted and documented during each trap check. All fisheries personnel are trained in species identification and handling. A species identification handbook drafted by Steve Howard (senior fisheries biologist) and Mike Booth (associate ecologist) is available to confirm identification.

<u>Data Collection –</u> Steelhead smolts are measured (fork length) to the nearest millimeter on a wet fish measuring board. Measurements typically take no more than 10 seconds per individual. Lamprey ammocoetes and macropthalmia, when observed, are measured to total length from head to tail. Smolt condition factor (Wedemeyer 1996) may be quantified in the future by weighing and measuring each fish. Water temperature is measured in the fish trap prior to handling fish and monitored in the transport cooler during transport. Fish are not transported at temperatures above 20°C and transport activities are performed early in the morning to minimize stress to the fish. General fish condition is assessed as well as degree of smoltification or smolt condition. Smolt condition or level of smoltification may be quantified in the future based on methods in Haner et al. (1995). Water temperature, dissolved oxygen, pH, conductivity, salinity and turbidity are measured at the relocation sites with a multi-parameter water quality meter. When possible, photos of collected and transported steelhead and lamprey are taken with a digital camera. All data are documented on standardized datasheets and transferred daily to an electronic database.

Fish Transportation – Fish are collected from the fish trap with 1/8th inch or smaller mesh dip nets, data are collected and compiled on datasheets and the fish are typically placed in 100 quart aerated coolers. No more than 25 smolts, ammocoetes or macropthalmia are placed in an individual cooler. No more than one adult steelhead or kelt are placed in individual coolers. If a low number of smolts or macropthalmia are collected, these fish are placed in aerated buckets to minimize handling during release. Fish handling and transport time is generally no more than one hour.

2.2.2 Fish Transport Locations

Anadromous Fish

No anadromous fish were transported during 2013. The general procedure used for anadromous fish transportation is: All anadromous downstream migrant fish (steelhead smolts and kelts, Pacific lamprey macropthalmia) are transported from the Freeman Diversion to the Santa Clara River Estuary (Photo 1 Appendix B) when discharge in the Santa Clara is less than 80 cfs. When flows are greater than 80 cfs, fish are released in the Santa Clara downstream of the Freeman Diversion. The specific relocation site within the estuary depends on the condition of the estuary (open or closed to the ocean). The estuary is monitored frequently during the migration season to inform relocation activities. Generally fish are released to fresh water in the estuary that has at least one foot of depth and instream cover nearby. Areas of the estuary that are known to be low in dissolved oxygen are avoided.

Acclimation Schedule - Fish are acclimated to the receiving water using the schedule in Table 3.

Table 3 – Fish acclimation schedule.

Degree Differential (between cooler and receiving water)	Acclimation Minutes
0-2	10
3-5	20
6-7	30
8 and over*	40

* Fish transportation should not occur when the water temperature is too high (>20°C). If this occurs the fish transport time schedule will be modified. If the estuary water temperature is over 23°C the lead fisheries biologist is contacted before acclimating.

Non-Anadromous Fish

Non-anadromous fish (resident coastal rainbow trout and Pacific lamprey ammocoetes) are transported via aerated coolers to either the mainstem Santa Clara River, Sespe Creek, or Santa Paula Creek (Photo 13, 17, and 15, Appendix B). If conditions are not suitable for trout in the mainstem Santa Clara River, resident rainbow trout might be transported to Santa Paula Creek upstream of Steckel Park or Sespe Creek at Grand Avenue. All other native, non-anadromous fish and aquatic species are transported and released upstream of the Freeman Diversion structure.

2.2.3 Smolt Length Measurements

No smolts were trapped during 2013.

2.3 Results

2.3.1 Downstream Migrant Trap Checks

The downstream migrant trap was in operation from January 14 to June 1, 2013, with occasional periods where the trap was not used due to high flows or other limiting factors (one day). No smolts were captured during 2013 (Figure 3, Appendix A). Smolt surveys occurred during fish screen bay checks through the end of June. A total of one young-of-the-year (YOY) coastal rainbow trout, and one resident coastal rainbow trout (Photo 2, Appendix B) was trapped and relocated during the 2013 migration season.

Additional fish collected in the Freeman downstream migrant trap included: partially armored threespine stickleback (N=5103), Arroyo chub (N=1433), Santa Ana sucker (N=435), Owens sucker (N=354), Santa Ana/Owens sucker hybrids (N=31), crappie spp. (N=2), fathead minnow (N=1838), common carp (N=13), largemouth bass (N=2), green sunfish (N=139), brown bullhead (N=2), prickly sculpin (N=85) and mosquitofish (N=2192) (Table 4, Appendix A). Sucker species were identified based on lip morphology to the extent possible, but the validity of this method is questionable. Red swamp crayfish were regularly captured in the trap (N=2192).

Amphibians and reptiles collected in the Freeman downstream migrant fish trap included: Western toad (N=6), bullfrog (N=207, mostly larvae), African clawed frog (N=37), tree or Pacific chorus frog (N=2) and Western pond turtle (N=3) (Table 4, Appendix A). The regional and regulatory status of amphibians and reptiles collected at the Freeman Diversion can be found in Table 5 (Appendix A). A healthy pond turtle population exists in the ponded areas directly above and below the Freeman Diversion structure.

3.1 INTRODUCTION

The Freeman Diversion Facility is equipped with a Denil fish ladder (fishway) that was constructed to facilitate steelhead and Pacific lamprey upstream migration over the concrete diversion structure. Although Denil fishways are not ideal for Pacific lamprey passage, the fish ladder did pass hundreds of Pacific lamprey in the 1990’s (Chase 2001, Swift and Howard 2009). There is some uncertainty regarding how many steelhead have passed the diversion structure because of a previously inconsistent and inefficient monitoring program, as well as regulatory and extreme environmental constraints (flashy flows, high turbidity). Despite uncertainties in the data, a minimum of 11 wild adult steelhead and 2 hatchery origin adult steelhead have been observed at the diversion structure since it was constructed in 1991.

3.2 METHODS

In years with sufficient rainfall, upstream migrant monitoring is conducted to determine if adult steelhead use and effectively navigate the fish ladder. Historically, there was an active fish trap deployed within the fish ladder to monitor steelhead and lamprey upstream migration, but it was removed from the ladder after the federal listing of steelhead in 1997. In order to monitor steelhead upstream migration, the District installed a passive monitoring device that counts upstream migrant steelhead when they jump over a false weir and through an infrared (IR) scanning device (Photo 3, Appendix B) and integrated video monitoring system (Photo 4, Appendix B). Pacific lamprey likely migrate on the concrete bottom and under a grated section of the passive monitoring device, where they can’t be observed. The only other current method for monitoring steelhead or Pacific lamprey upstream migration within the diversion facility is during fish ladder shutdowns or when flow is reduced within the fish ladder. Monitoring during hour-long shutdowns of the fish ladder only allow for intermittent observations during the migration season. It would benefit steelhead recovery efforts and increase knowledge regarding steelhead and Pacific lamprey migration if an upstream migrant trap was installed within the fish ladder.

A trap would temporarily capture all upstream migrants so that information could be gathered related to ladder efficiency, migration timing, fish condition, water quality at migration, as well as other parameters of interest.

3.2.1 Bypass Flow Monitoring and Ladder Operation

The current minimum flow threshold for steelhead upstream migration is 160 cfs, measured at critical riffles in the lower Santa Clara River. This threshold was developed from the results of a steelhead migration instream flow study conducted by Thomas R. Payne and Associates (now Normandeau Associates) in the lower Santa Clara River (TRPA 2005). This study evaluated surface water depths at various flows to understand what minimum flows would be required for steelhead to successfully migrate from the ocean to the Freeman Diversion Fish Ladder.

During fish ladder operations, bypass flows are monitored at two sites between the Freeman Diversion and Highway 101 to ensure that a minimum of 160 cfs is maintained at the most downstream monitoring site located approximately 0.6 miles upstream of the Highway 101 Bridge. The two monitoring sites are located approximately 0.14 miles below the Freeman Diversion structure and 5.5 miles downstream of the Freeman Diversion (0.6 miles upstream of the 101 Bridge) (Figure 6, Appendix A). The most downstream monitoring site is located near the end of the losing reach of the river where the highest percolation rates of surface water are believed to occur.

Flow is measured with a YSI/SonTek FlowTracker Acoustic Doppler Velocimeter. Flow measurements are conducted using USGS standards for measuring flow using acoustic Doppler technology in open channels (Rehmel 2007). The measurement site (critical riffle area) is located within a long and wide sandy glide. The numerous shallow glides found in the Santa Clara River potentially result in migration bottlenecks and delay for steelhead migration (S. Howard, personal observations of physical habitat). The actual critical riffles (typical area to measure shallow conditions) have narrower active channels (wetted width) than glide habitats, resulting in deeper, more suitable migration conditions compared to the wide, sandy glides.

The Freeman Diversion Fish Ladder operations are based on negotiations between NMFS biologists and the District hydrologist and biologists. These operating criteria were revised in the United States Bureau of Reclamation's *Biological Assessment of the Operation of the Vern Freeman Diversion Dam and Fish Ladder, Santa Clara River, Ventura County, California*, and later revised in the Proposed 2009 Interim Operations Plan and 2010 Smolt Bypass Flow Plan.

The operating criteria are as follows:

When United starts diverting water after a storm (turn-in), diversion rates are limited at total river flow less than or equal to 750 cfs. When turning in at total river flow greater than 635 cfs and between 750 cfs, only 30% of the remaining river can be diverted providing that the required bypass flows for steelhead are met. When turning in at total river flow less than or equal to 635 cfs, only 20% of the remaining river can be diverted providing that the required bypass flows for steelhead are met. These diversion restrictions apply only to turning-in procedures undertaken during the principal steelhead migration season (January through May) when total river discharge is ≤ 750 cfs.

January 1 – March 14 Bypass Flows

After a storm event triggers migration flows, the fish ladder and auxiliary flows will be operated on the following schedule: From January 1 to March 14 (adult bypass flows), bypass flows with a target of 160 cfs including a ramp-down schedule will be maintained for 18 days. If total river flow drops below 160 cfs at the critical riffle without diversions during the 18 day flow window, the total amount of flow released will be reduced by 1/3 each day for three days and reduced to 20 cfs on the fourth day and stopped on the fifth day. If an adult steelhead is detected in the fish ladder during ramp down, flows will be maintained at the current release discharge for 24 hours and then ramp down will proceed if no adult steelhead are detected. During the ramp down period, the District may divert water not being released downstream.

March 15 – May 31 Bypass Flows

From March 15 to May 31, the District may continuously maintain critical diversions of 40 cfs during bypass flow releases. From March 15 to May 31, following a storm, a bypass flow of 160 cfs will be maintained for 7 days, reduced daily by 10 cfs until the 11^{th} day and then maintained at 120 cfs until this flow cannot be maintained. The smolt target flow of 120 cfs was developed from water depth surveys focused on providing downstream migrating smolts with safe, volitional passage through the lower river. When flows at the critical riffle fall below 120 cfs and are predicted to reach a low critical flow of 80 cfs within 5 days, smolts will be trapped and transported. After flows reach 80 cfs, bypass flows will be reduced by 1/3 each day for three days, reduced to 20 cfs on the fourth day and stopped on the fifth day. For all ramp down operations, if natural flows decline faster than the specified ramping rates and it is impossible to maintain the prescribed 1/3 daily reduction in flow, then natural flow recession will be used for that 24 hour period.

Smolts may migrate downstream regardless of storm events, so the District will provide bypass flows of 120 cfs for smolt migration from March 15 to May 31 while maintaining critical diversions of 40 cfs when there is enough flow in the river to provide such flows. If there is insufficient flow in the river to provide smolt bypass flows of 120 cfs and maintain the critical diversion of 40 cfs, smolts will be trapped and transported when river flows are predicted to recede to 80 cfs within five days. When bypass flows are not in effect and smolts are captured in the fish trap outside of the smolt bypass flow period, they will be transported to the estuary.

A detailed operations flow chart that includes the bypass flow release decision matrix will be included in the MSHCP that is currently in development.

3.2.2 Video Migration Monitoring

Upstream migration monitoring is conducted using a false weir, infrared scanners (IR scanner), and a computer-based surveillance system (Photo 3, and 4, Appendix B). The false weir creates a barrier within the fish ladder that forces upstream migrant adult steelhead to jump out of the water approximately six inches to traverse a small “fall or plunge” to continue upstream. When migrating adult steelhead jump over the false weir, they pass through infrared beams that detect the migration event. The IR scanner device is equipped with sensors on both sides of the false weir with multiple closely-spaced infrared beams. When the beams are broken by a fish jumping over the weir, the IR scanner signals the surveillance system to record the event. Each event is documented by five cameras that capture video of each fish that negotiates the weir and the surveillance system records video of the events on a computer hard drive. The weir was designed with a bar screen at the bottom of the structure to allow Pacific lamprey to pass under the false weir. It is unclear if Pacific lamprey are able to pass through the bar screen due to insufficient data regarding approach water velocities at the screen.

Prior to the deployment of the current computer surveillance system in 2010, a DVR system with a single low resolution camera was used to monitor steelhead migration through the fish ladder. The new computer based system provides substantially greater resolution and multiple functions to detect movement. IR scanners are used to detect movement over the false weir and in 2013; two cameras were installed to detect motion using the surveillance systems motion detection option. This provides some redundancy in the detection system by having the infrared scanners and the motion detection system documenting migration events. When steelhead traverse the fish ladder and jump over the false weir, the computer based monitoring system documents the event with a flashing alarm on the computer screen. Alarms and associated video footage are reviewed daily. The computer system records continuously and there is sufficient hard disk storage to save video for up to seven days, depending on the number of cameras in use. Once the hard drive is full, new data is saved over old data, starting at the beginning of the old file. Migration events are saved as short video files on the computer hard drive. The surveillance system receives digital video from low-light, high resolution cameras including two above-water cameras placed upstream and downstream of the false weir used with the infrared scanner, as well as an underwater camera placed downstream focused on the false weir. Additionally one camera was placed within the false weir and one downstream of the false weir facing static backgrounds to detect motion using the surveillance systems motion detection option. Three 25 watt fluorescent lights were used to illuminate the false weir at night.

To evaluate the efficiency of the IR scanner device, the video monitoring system is checked daily to ensure proper function. Triggered alarms are reviewed and any necessary adjustments are made to the water levels, scanning devices, or recording equipment.

3.2.3 Ladder Shutdowns

A thorough examination of the entire fish ladder is conducted to check for the presence of any fish species during shutdown or dewatering of the ladder. The ladder is shut down for operational or maintenance reasons such as high storm flows, channel flushes, and/or removal of debris from the weir.

3.2.4 DIDSON Migration Monitoring

DIDSON monitoring did not occur in 2013 due to a lack of river flow and rain events triggering bypass flows.

3.3 Results

3.3.1 Bypass Flow Monitoring and Ladder Operation

The fish ladder did not operate in 2013 due to insufficient stream flow.

3.3.2 Video Migration Observation

The surveillance system did not operate during 2013 because the fish ladder was not in use.

3.3.3 Ladder Shutdowns

The fish ladder did not operate in 2013 due to insufficient stream flow.

3.3.4 DIDSON Migration Monitoring

The DIDSON was not deployed in 2013 due to lack of river flow and rain events triggering bypass flows.

4.1 INTRODUCTION

During high flow events when the river is highly turbid from elevated concentrations of total suspended solids (over 3000 ntu's), District operations staff "turn-out" all river flows from the facility resulting in the impound upstream of the diversion structure becoming dewatered or shallow. When the water is turned out of the facility, head gates are closed to retain sufficient depth in the fish screen bay to avoid potential predation of fish by birds until fisheries staff can survey for stranded fish. During all "turn-out" events when the fish ladder is in operation, the fish ladder must be shut down and inspected for potential stranded fish. When the fish ladder is shut down it slowly dewaters and this can result in fish becoming stranded in the fish ladder.

Additional operations and maintenance activities include "flushes" where District operations staff temporarily "turn-out" all river flows from the facility to maintain the active channel toward the facility headworks or to conduct maintenance of the canal gates and screens. During a flush, the river will pass through the flushing channel, carrying away material deposited upstream of the intake. As the flush continues, the river continues to scour sediment or headcut for a distance back from the intake, up to several hundred feet. Flushing is necessary to keep both the diversion and the fish ladder in operation. When flushes occur, head gates are closed to retain sufficient water depth in the fish screen bay to avoid potential predation of fish by birds until fisheries staff can survey for stranded fish.

The primary objective of fish stranding surveys is to rescue any fish that become stranded when diversion operations cause river flow to rapidly diminish downstream of the Freeman Diversion in the Santa Clara River and within the fish screen bay and fish ladder.

4.2 METHODS

4.2.1 FISH SCREEN BAY STRANDING SURVEYS

During turn-out and flushing events, the fish screen bay is thoroughly examined for the presence of steelhead, Pacific lamprey and other aquatic species. Two or more biologists survey the fish screen bay as it dewaters. These surveys are conducted by seining the entire area with either 1/8 or 1/4 inch mesh brailed seines that are 4 feet deep and 10 to 20 ft long (Photo 5, Appendix B). The primary objective of these surveys is to capture and relocate steelhead and Pacific lamprey stranded during dewatering of the fish screen bay to appropriate habitats either in the estuary (smolts, kelts, macropthalmia) or the Santa Clara River and associated tributaries (resident coastal rainbow trout and Pacific lamprey ammocoetes). Also, the fish screen bay is periodically dewatered opportunistically to look for steelhead and Pacific lamprey migrants that could potentially be delayed in the fish screen bay. All fish are transported via aerated coolers and non-native aquatic species are removed from the river. All data collected during stranding surveys are documented on standardized datasheets. Fish are transported utilizing methods described in Section 2.2 of this report.

4.2.2 LOWER SANTA CLARA RIVER STRANDING SURVEYS

Stranding surveys are conducted in the Santa Clara River below the Freeman Diversion when bypass flows are significantly reduced or when releases are stopped all together, due to turn-out or flushing events. These surveys are conducted by entering the non-wetted area of the floodplain via a Polaris Ranger all-terrain vehicle stocked with equipment necessary to collect, hold, and transport stranded fish. Stranded fish are captured either with dip nets or 1/8 inch to 1/4 inch mesh brailed seines and placed in aerated coolers. In 2013, no surveys were required. In years when upstream migrant steelhead and Pacific lamprey are collected during these surveys they are relocated upstream of the Freeman Diversion structure. Downstream migrant steelhead (smolts) are relocated to the Santa Clara River Estuary. In years when downstream migrant Pacific lamprey (macropthalmia) are collected during stranding surveys they are relocated to the estuary.

4.2.3 Fish Ladder Stranding Surveys

Stranding surveys are conducted in the fish ladder during turn-out events. When the fish ladder is in operation and one of these events occurs, the fish ladder becomes dewatered and the potential exists for steelhead and Pacific lamprey to become stranded either between the Denil plates or in resting pools of the fish ladder. A biologist is present and conducts surveys when these operations occur by walking the length of the ladder searching for any stranded fish as the ladder dewaters. Dip nets and buckets are used to rescue any stranded fish.

Fish ladder stranding surveys are also conducted during maintenance activities to visually survey for steelhead and Pacific lamprey that could become stranded. If a fish is observed in the Denil sections of the ladder, it is captured with a dip net, placed in a bucket and relocated to an appropriate location based on its life stage.

4.3 Results

4.3.1 Fish Screen Bay Stranding Surveys

No fish screen bay stranding surveys were required during 2013. Adequate water levels were maintained in the fish screen bay during a short turn-out that occurred on March 8, 2013.

4.3.2 Lower Santa Clara River Stranding Surveys

The short turn-out event occurred on March 8, 2013 but did not require a stranding survey below the Freeman Diversion. The turn-out was triggered by a small storm that did not trigger bypass flows. River flow at the Freeman Diversion during the turn-out was so low that all of the water that was released went subsurface and did not travel far downstream. Much of the water remained in a pool located at the base of the diversion.

4.3.3 Fish Ladder Stranding Surveys

The fish ladder was not operated during 2013.

5.1 INTRODUCTION

Water quality monitoring for 2013 was conducted to monitor water quality conditions that steelhead and Pacific lamprey are exposed to at various areas within the watershed. Water quality parameters such as dissolved oxygen, pH, conductivity, salinity, and turbidity were collected *in situ* at some sites. Water temperature monitoring was conducted at various locations in the watershed and water quality measurements were focused primarily in the Santa Clara River Estuary, Santa Paula Creek, Sespe Creek, and the mainstem Santa Clara River where coastal rainbow trout were relocated during the 2013 monitoring season. Only water temperature monitoring results are included in this report because other parameters were only measured during intermittent fish transport activities.

5.2 METHODS

Water quality monitoring in 2013 consisted of water temperature measurements utilizing Onset Hobo® temperature loggers at various sites within the Santa Clara River watershed and *in-situ* water quality measurements taken during fish relocation activities using a Hach Quanta multi-parameter water quality meter. The majority of the temperature loggers were placed in pool habitats at mid-depth and programmed to take measurements every hour. The standardized data collection dates were October 1, 2012 through September 30, 2013.

Water temperature monitoring occurred at the following sites:

- Site 2: Freeman Fish Trap Bay
- Site 3: Freeman Fish Screen Bay
- Site 4: Santa Clara River at the Ventura County bank stabilization project
- Site 4A: Santa Clara River side channel at the Ventura County bank stabilization project
- Site 6B: Santa Paula Creek upstream of Harvey Diversion
- Site 7: Santa Paula Creek at Steckel Park
- Site 8: Santa Paula Creek directly downstream of Sisar Creek confluence

Site 9B: Sespe Creek at Grand Avenue

Site 17B and 17C: Piru Creek below Santa Felicia Dam

Site P1: Piru Creek upstream of Santa Clara River confluence

Some of the other site numbers are not presented here because the loggers were either lost due to high flows or conditions were such that access to the sites was not feasible. A map identifying each current monitoring site can be found in Figure 7, Appendix A. Graphs depicting data at these ten sites are in Figures 6-15, Appendix A. Specific information regarding each site can be found in Table 6, Appendix A. An additional temperature logger was installed in the Santa Clara River Estuary, but cannot be retrieved until the breaching of the estuary occurs.

5.3 RESULTS

5.1.1 FREEMAN FISH TRAP BAY

The Santa Clara River Freeman Fish Trap Bay water temperature monitoring site is located within the fish trap bay at the Freeman Diversion in Saticoy. The logger was attached to a rung of a permanent ladder structure within the fish trap bay with zip ties approximately 1.0 feet from the bottom of the bay (Photo 6, Appendix B). The objective at this location was to monitor water temperatures in the fish trap bay where the downstream migrant fish trap is located. Temperature monitoring is critical at this location as this is where the fish remain until the daily trap check occurs. The minimum water temperature collected at this site was 6.2 ºC and the maximum temperature was 27.5 ºC (Table 7, Appendix A).

5.1.2 FREEMAN FISH SCREEN BAY

The Santa Clara River Freeman Fish Screen Bay water temperature monitoring site is located within the fish screen bay. The fish screen bay consists of a concrete channel where downstream migrants enter the diversion and migrate to the downstream migrant fish trap. The logger was located approximately 50 feet downstream from the intake to the fish screen bay and attached to an eye hook 0.5 feet from the bottom along a concrete wall (Photo 7, Appendix B). The objective at this location was to monitor water temperatures in the mainstem as river flow enters the Freeman Facility. Downstream migrant steelhead, Pacific lamprey and other aquatic species temporarily rear in the fish screen bay prior to entering the trap. The downstream migrant fish trap is typically taken out of operation between June and December and all fish that enter the facility rear in the fish screen bay until trapping operations commence in January. The minimum water temperature collected at this site was 6.2 ºC and the maximum temperature was 40.8 ºC (Table 7, Appendix A). The maximum temperature of 40.8 ºC occurred when the logger was exposed to air following the end of the steelhead and Pacific lamprey migration season. The maximum water temperature when the logger was submerged was 29.2 ºC.

5.1.3 Santa Clara River at VCWPD Project

The Santa Clara River at the Ventura County Watershed Protection District (VCWPD) Project water temperature monitoring site is located approximately 100 feet downstream from the most downstream groin at the county bank stabilization project site off South Mountain Road in Santa Paula. The logger was attached to a fence post with zip ties 0.9 feet from the bottom (Photo 8, Appendix B) in a pool about 3.5 ft deep. The objective at this location was to monitor water temperatures in the mainstem Santa Clara River between Sespe Creek and the Freeman Diversion. In the future, the District plans to add additional temperature monitoring sites throughout the Santa Clara River to closely monitor temperatures during the steelhead and Pacific lamprey migration season. The minimum water temperature collected at this site was 11.1 ºC and the maximum temperature was 25.7 ºC (Table 7, Appendix A).

5.1.4 Santa Clara River at VCWPD Project Side Channel

The Santa Clara River at the Ventura County Watershed Protection District (VCWPD) Project side channel water temperature monitoring site is located near the middle groin at the county bank stabilization project site off South Mountain Road in Santa Paula. The logger was wired to rocks on the bank and attached to a small fence post (Photo 9, Appendix B) in a pool about 3.5 ft deep. The objective at this location was to monitor water temperatures in the side channel of the Santa Clara River between Sespe Creek and the Freeman Diversion where resident coastal rainbow trout captured in the downstream migrant trap are released during the trapping season. In the future, the District plans to add additional temperature monitoring sites throughout the Santa Clara River to closely monitor temperatures during the steelhead and Pacific lamprey migration season. The minimum water temperature collected at this site was 11.0 ºC and the maximum temperature was 19.7 ºC (Table 7, Appendix A).

5.1.5 Santa Paula Creek upstream of Harvey Diversion

The Santa Paula Creek upstream of Harvey Diversion water temperature monitoring site is located in a low gradient riffle habitat approximately 500 feet upstream from Harvey Diversion along Highway 150 in Santa Paula. The logger was attached to a fence post with zip ties under a boulder 0.4 inches from the bottom (Photo 10, Appendix B). The objective at this location was to monitor water temperatures in Santa Paula Creek. The minimum water temperature collected at this site was 4.9 ºC and the maximum temperature was 36.4 ºC (Table 7, Appendix A).

5.1.6 Santa Paula Creek at Steckel Park

The Santa Paula Creek at Steckel Park water temperature monitoring site is located in a pool habitat ~50 feet upstream of the Steckel Park Bridge. The logger was attached 0.2 feet from the bottom with zip ties to a fence post. The fence post was placed under a boulder and was secured to an alder tree via a cable along the bank (Photo 11, Appendix B). This location was ideal for monitoring temperatures due to adequate flows, areas of scour and instream cover. However, the temperature logger was buried under sediment during a small storm in 2013, but continued logging. The minimum water temperature collected at this site was 8.4 ºC and the maximum temperature was 23.2 ºC (Table 7, Appendix A).

5.1.7 Santa Paula Creek Directly Downstream of Sisar Creek Confluence

The Santa Paula Creek directly downstream of Sisar Creek confluence water temperature monitoring site is located in a pool habitat approximately 35 feet downstream of the Sisar Creek confluence. The logger was attached 7.25 inches from the bottom with zip ties to a fence post (Photo 12, Appendix B). This habitat was ideal for water temperature monitoring because of the scoured pool and direct observation of resident *O. mykiss* at this site. The pool habitat filled in during the winter and the logger was moved to a pool downstream. The objective at this location was to monitor ambient water temperatures in Santa Paula Creek. The minimum water temperature collected at this site was 7.3 ºC and the maximum temperature was 23.6 ºC (Table 7, Appendix A).

5.1.8 SESPE CREEK AT GRAND AVENUE

The Sespe Creek at Grand Avenue water temperature monitoring site is located in a pool habitat approximately 150 ft downstream of the USGS Gauge along Grand Avenue. The logger was attached to a fence post between two boulders, 0.5 feet from the bottom along the bank (Photo 13, Appendix B). The objective at this location was to monitor water temperatures at the resident and young-of-the-year coastal rainbow trout release location in Sespe Creek. This was an easily accessible pool with sufficient flow creating areas of scour and abundant in-stream cover, primarily riparian vegetation and boulder substrate. The minimum water temperature collected at this site was 4.2 ºC and the maximum temperature was 29.8 ºC (Table 7, Appendix A).

5.1.9 PIRU CREEK BELOW SANTA FELICIA DAM

The Piru Creek below Santa Felicia Dam water temperature monitoring site is located in a pool habitat approximately 500 ft downstream of the Santa Felicia Dam outlet works. Two data loggers were deployed at this site. The temperature logger (17C) was placed inside a standpipe above a pool water level logger (17B) which is at the deepest part of the pool (about 3 ft), 0.3 feet from the bottom along the bank (Photo 14, Appendix B). The objective at this location was to monitor water temperatures in the trout-bearing reach of Piru Creek below the dam. This was an easily accessible pool with sufficient flow creating areas of scour and abundant in-stream cover, primarily riparian vegetation and boulder substrate. The minimum water temperature collected at this site was 7.7 ºC and the maximum temperature was 23.9 ºC (Table 7, Appendix A).

5.1.10 PIRU CREEK UPSTREAM OF THE SANTA CLARA RIVER CONFLUENCE

The Piru Creek upstream of the Santa Clara River confluence water temperature monitoring site is located in Piru Creek in a pool habitat approximately 1500 ft upstream of the Santa Clara River confluence. The data was taken from a water level logger inside a standpipe at the deepest part of the pool (about 2.0 ft), 0.2 feet from the bottom in the middle of the stream channel (Photo 15, Appendix B). The objective at this location was to monitor water temperatures near the terminus of Piru Creek where water temperatures can be very high in the summer months. The minimum water temperature collected at this site was 7.1

ºC and the maximum temperature was 33.8 ºC (Table 7, Appendix A).

5.4 DISCUSSION

The maximum water temperatures at most sites extend above what many believe to be the chronic or incipient upper lethal temperature limit of 25 ºC for many anadromous salmonids, although higher temperatures reaching 29 ºC can be tolerated for a short period of time (Myrick and Cech 2001) if water quality conditions are favorable and food is available. The maximum water temperature of 36.4 ºC occurred in Santa Paula Creek upstream of Harvey Diversion during the summer. However, this logger was placed in a shallow pool in Santa Paula Creek, which experienced extremely low flows during summer 2013. These extreme water temperatures are not uncommon in small streams of southern California, particularly during drought periods. Southern California coastal rainbow trout have adapted to a wide variation in water temperatures by seeking out thermal refuges when available. Other behavioral responses to upper thermal extremes include increase feeding when food is available to offset the cost of an elevated metabolic rate, although feeding does decline after about 19 ºC but growth can still occur up to 25 ºC (Myrick and Cech 2000). The duration of exposure is important because these fish will experience upper thermal limits over a period of a few hours during any given day but can maintain body weight at 25 ºC for 30 days (Myrick and Cech 2000). In drainages where thermal refuge is limited or absent and low food production occurs, thermal stress alone can cause mortalities.

Additional temperature monitoring sites will be located throughout the watershed as needed and to replace those lost due to storms.

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Appendix A

Tables and Figures

Table 1 - Freeman Diversion Operations and Steelhead Monitoring Data

January

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Ladder Operation																															
Smolt Trapping																															
Smolts																															
Adult Steelhead																															
Steelhead Kelt																															
Turbidity (ntu)														20.1	33.5	25.7	22.5	19.3	18.8	11.1	10.5	9.76	8.15	289	153	207	77.9	50.6	40.2	35.1	33
Estuary	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed

February

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Ladder Operation																												
Smolt Trapping																												
Smolts																												
Adult Steelhead																												
Steelhead Kelt																												
Turbidity (ntu)	30.3	28.5	28.6	26.3	26.4	28	23.9	21.6	27.4	20.6	20.6	18.9	16.3	15	18.3	14.4	22.2	21	20.4	26	25.2	22.2	18	20.5	23.7	18.4	14.7	12.1
Estuary	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed

March

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Ladder Operation																															
Smolt Trapping																															
Smolts																															
Adult Steelhead																															
Steelhead Kelt																															
Turbidity (ntu)	12.5	10.4	10.5	11.5	9.83	16.7	11.4	273	86.9	55.2	64.8	32.2	25.2	21.4	21	19	18.7	22.1	18.7	15	11.7	10.6	9.34	10.4	11.9	10	9.01	7.75	7.82	7.87	8.66
Estuary	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed

April

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ladder Operation																														
Smolt Trapping																														
Smolts																														
Adult Steelhead																														
Steelhead Kelt																														
Turbidity (ntu)	12.6	10.7	9.34	9.3	8.31	10	27.5	33.7	11.1	18.1	94.2	84.9	6.47	6.24	8.82	13.6	29.4	8.51	8.04	13.8	27.5	10.7	9.59	14.1	15.6	12.4	30.3	15	17.3	13.7
Estuary	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed

May

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Ladder Operation																															
Smolt Trapping																															
Smolts																															
Adult Steelhead																															
Steelhead Kelt																															
Turbidity (ntu)	13.9	14	8.78	8.79	8.4	12	17.1	13.1	12.4	10.6	10.5	13.4	10.9	9.01	8.69	8.47	8.68	8.13	7.47	6.46	6.41	6.7	6.02	6.04	5.48	5.87	5.89	5.81	6.08	5.59	5.68
Estuary	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed

*Blank cells mean no activity or no data collected on that day

Table 1 Continued - Freeman Diversion Operations and Steelhead Monitoring Data

	June																													
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*
Ladder Operation																														
Smolt Trapping																														
Smolts																														
Adult Steelhead																End of Monitoring season														
Steelhead Kelt																														
Turbidity (ntu)	5.24																													
Estuary	Closed																													

*Blank cells mean no activity or no data collected on that day

Table 2 - Santa Clara River Fish Species

Common Name	Scientific Name	Status	Resident - Anadromous	Regulatory Status
Tidewater Goby	*Eucyclogobius newberryi*	Native	Resident	FE, DFG: SSC
Partially Armored Stickleback	*G. a. microcephalus*	Native	Resident	--
Unarmored Stickleback	*G.a. williamsoni*	Native	Resident	FE, SE, DFG: FP
Arroyo Chub	*Gila orcuttii*	Native	Resident	DFG: SSC
Pacific Lamprey	*Entosphenus tridentatus*	Native	Anadromous	--
Rainbow Trout	*Oncorhynchus mykiss*	Native	Resident	--
Steelhead Trout	*Oncorhynchus mykiss irideus*	Native	Anadromous	FE, DFG: SSC
Black Bullhead	*Ameiurus melas*	Introduced	Resident	--
Brown Bullhead	*Ameiurus nebulosus*	Introduced	Resident	--
Santa Ana Sucker	*Catostomus santaanae*	Introduced*	Resident	*FT, DFG: SSC
Owens Sucker	*Catostomus fumeiventris*	Introduced	Resident	**DFG: SSC
Hybrid Sucker	*C.santaanae x C. fumeiventris*	Introduced	Resident	--
Prickly Sculpin	*Cottus asper*	Introduced	Resident	--
Common Carp	*Cyprinus carpio*	Introduced	Resident	--
Goldfish	*Carassius auratus*	Introduced	Resident	--
Threadfin Shad	*Dorosoma petenense*	Introduced	Resident	--
Mosquitofish	*Gambusia affinis*	Introduced	Resident	--
Channel Catfish	*Ictalurus punctatus*	Introduced	Resident	--
Green Sunfish	*Lepomis cyanellus*	Introduced	Resident	--
Bluegill	*Lepomis macrochirus*	Introduced	Resident	--
Mississippi Silverside	*Menidia audens*	Introduced	Resident	--
Largemouth Bass	*Micropterus salmoides*	Introduced	Resident	--
Fathead Minnow	*Pimephales promelas*	Introduced	Resident	--
Black Crappie	*Pomoxis nigromaculatus*	Introduced	Resident	--
White Crappie	*Pomoxis annularis*	Introduced	Resident	--
Brown Trout	*Salmo trutta trutta*	Introduced	Resident	--

FE = Federally Endangered Species; FT = Federally Threatened Species; SE = State Endangered Species; DFG: FP = California Department of Fish and Game - Fully Protected Species; DFG: SSC = California Department of Fish and Game - Species of Special Concern.

*Santa Ana Sucker is listed as FT and DFG:SSC in its native drainage; this does not include the Santa Clara River.

**Owens Sucker is listed as DFG: SSC in its native drainage; this does not include the Santa Clara River.

Table 4 - Freeman Diversion Fish Monitoring Species Totals 2013

Fish Species: **STK** = Steelhead Adult Kelt, **ST =** Steelhead Adult**, RS =** Smolt**, RT =** Resident Rainbow**, YOY** = Young of the Year *O. mykiss* , **PL (Adult) =** Lamprey Adult**, PL (Am) =** Lamprey Ammocoete**, TS =** Stickleback**, AC =** Arroyo Chub**, SS =** Santa Ana Sucker**, OS =** Owens Sucker**, SSxOS =** Sucker Hybrid**, FM =** Fathead Minnow**, LB =** Largemouth Bass**, GS =** Green Sunfish**, BB=** Brown Bullhead**, BC =** Black Bullhead**, PS =** Prickly Sculpin**, MF =** Mosquitofish **CR =** Crappie spp.

Amphibian & Reptile Species: WT* = Western Toad, **AT*** = Arroyo Toad, **SFT*** = Spadefoot Toad, **BF** = Bullfrog, **CRLF** = Red-legged Frog, **PT*** = Pond Turtle, **AF** = African Clawed Frog, **TF*** = Tree Frog

Native species indicated with an asterisk*

Other: RSC = Red swamp crayfish

	Native Fishes									Non-native Fishes										
	STK	ST	RS	RT	YOY	PL (Adult)	PL (Am)	TS	AC	SS	OS	SS x OS	FM	LB	GS	BB	CC	PS	MF	CR
Total	0	0	0	0	1	0	0	5103	1433	435	354	31	1838	2	139	2	13	85	2192	2

	Amphibians and Reptiles								
	WT*	AT*	SFT*	CRLF*	BF	AF	TF*	PT*	RES
Total	6	0	0	0	207	37	2	3	1

Other	
RSC	
2192	

Biologists: Mike Booth, Steve Howard **Fish Technicians:** Dave Wilson, Cameron DeMaranville, Emily Chase, Evan Lashly, Fletcher Sams, Jerry Hidalgo

Table 5 - Santa Clara River Reptile and Amphibian Species

Common Name	Scientific Name	Status	Regulatory Status
Two-striped Garter Snake	*Thamnophis couchi hammondi*	Native	DFG: SSC
Southwestern Pond Turtle	*Clemmys marmorata pallida*	Native	DFG: SSC
Red-eared Slider	*Chrysemys scripta elegans*	Introduced	--
California Treefrog	*Hyla cadaverina*	Native	--
Pacific Treefrog	*Hyla regilla*	Native	--
Western Toad	*Bufo boreas*	Native	--
Bullfrog	*Rana catesbeiana*	Introduced	--
African Clawed Frog	*Xenopus laevis*	Introduced	--
DFG: SSC = California Department of Fish & Game - Species of Special Concern			

Table 6. Temperature Monitoring Sites

Location	Logger #	Date deployed	Max Depth	Logger depth (ft from bottom)	Habitat Type	Photo (Appendix B)
Freeman Fish Trap Bay	1269160	5/16/2008	3.0	1.0	pool	6
Freeman Fish Screen Bay	1269166	12/8/2008	2.5	0.5	pool	7
Santa Clara River at VCWPD Project	2270563	1/11/12	3.5	2.0	pool	8
Santa Clara River at VCWPD Project side channel	9947131	8/01/12	3.5	0.6	pool	9
Santa Paula Creek upstream of Harvey Diversion	2270574	1/13/12	0.9	0.3	riffle	10
Santa Paula Creek at Steckel Park	1269161	3/27/08	1.8	0.2	pool	11
Santa Paula Creek directly downstream of Sisar Creek confluence	2250248	1/16/2009	2.25	0.7	pool	12
Sespe Creek at Grand Avenue	2270588	1/11/12	1.5	0.5	pool	13
Piru Creek at Santa Felicia Dam (level logger)	10185710	9/6/12	1.75	0.2	pool	14
Piru Creek at Santa Felicia Dam	2267160	11/6/12	1.75	0.2		14
Piru Creek at Santa Clara River confluence	10185717	9/6/12	2.0	0.2	pool	15

Table 7. Water Temperature Statistics by Monitoring Site.

Location	Max Temp (°C)	Date Max Temp	Min Temp (°C)	Date Min Temp	Mean Temp (°C)
Freeman Fish Trap Bay	27.5	5/13/13	6.2	1/14/13	17.1
Freeman Fish Screen Bay	40.8*	9/23/13	6.2	1/14/13	18.3
Santa Clara River at VCWPD Project	25.7	10/1/12	11.1	1/14/13	16.9
Santa Clara River at VCWPD Project side channel	19.7	8/31/13	11.0	1/15/13	15.6
Santa Paula Creek upstream of Harvey Diversion	36.4	9/5/13	4.9	1/14/13	16.5
Santa Paula Creek at Steckel Park	23.2	10/1/12	8.4	1/15/13	16.0
Santa Paula Creek directly downstream of Sisar Creek confluence	23.6	8/31/13	7.3	1/13/13	15.5
Sespe Creek at Grand Avenue	29.8	6/29/13	4.2	1/14/13	18.2
Piru Creek at Santa Felicia Dam (level logger)	23.9	8/30/13	8.9	2/26/13	16.7
Piru Creek at Santa Felicia Dam	23.8	8/30/13	7.7	1/14/13	15.1
Piru Creek at Santa Clara River confluence (level logger)	33.8	6/29/13	7.1	2/21/13	20.4

* Logger out of water.

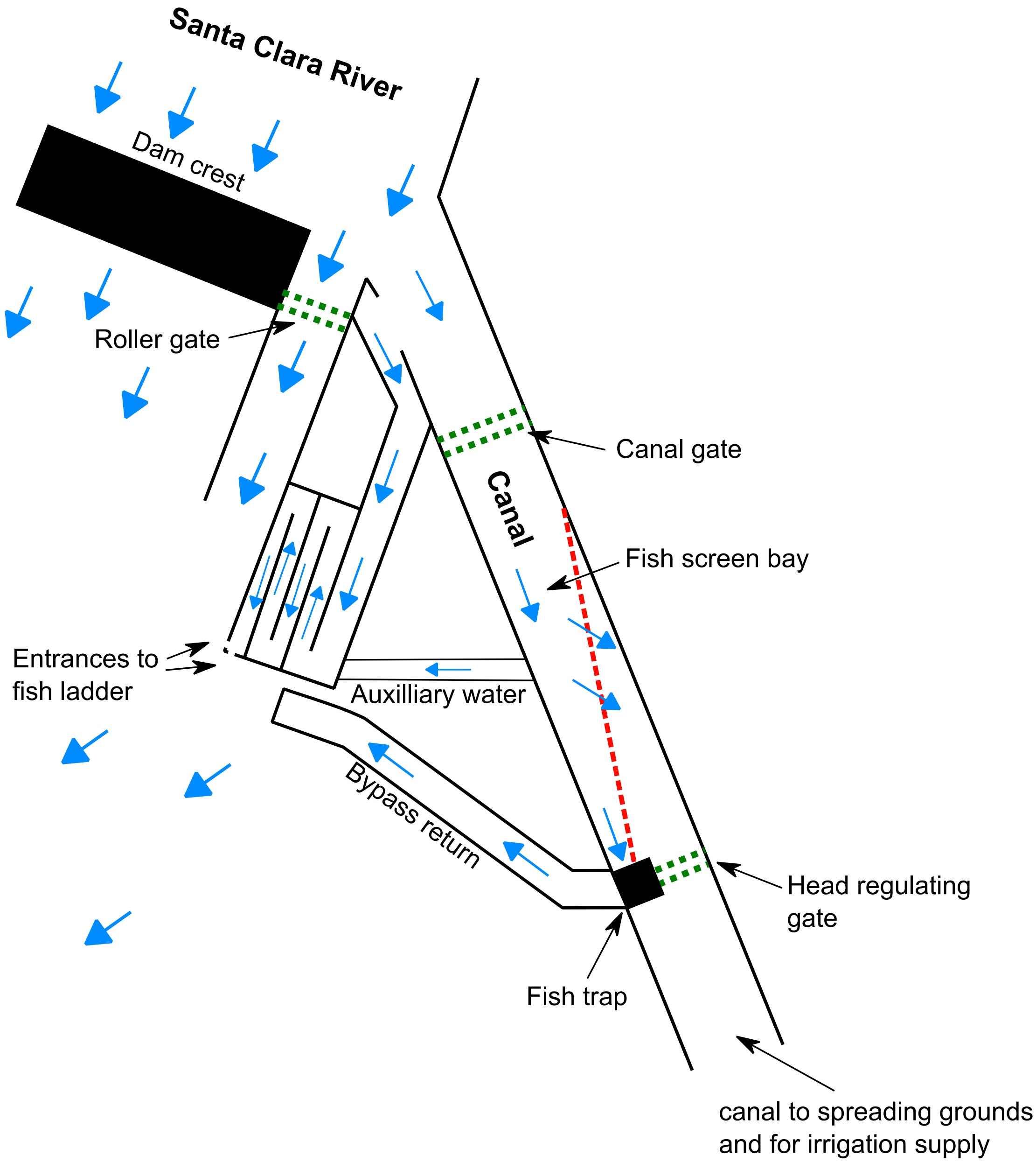


Figure 1. Schematic of Freeman Diversion Facility

Figure 2 - Daily Rainfall Totals in Santa Paula, CA

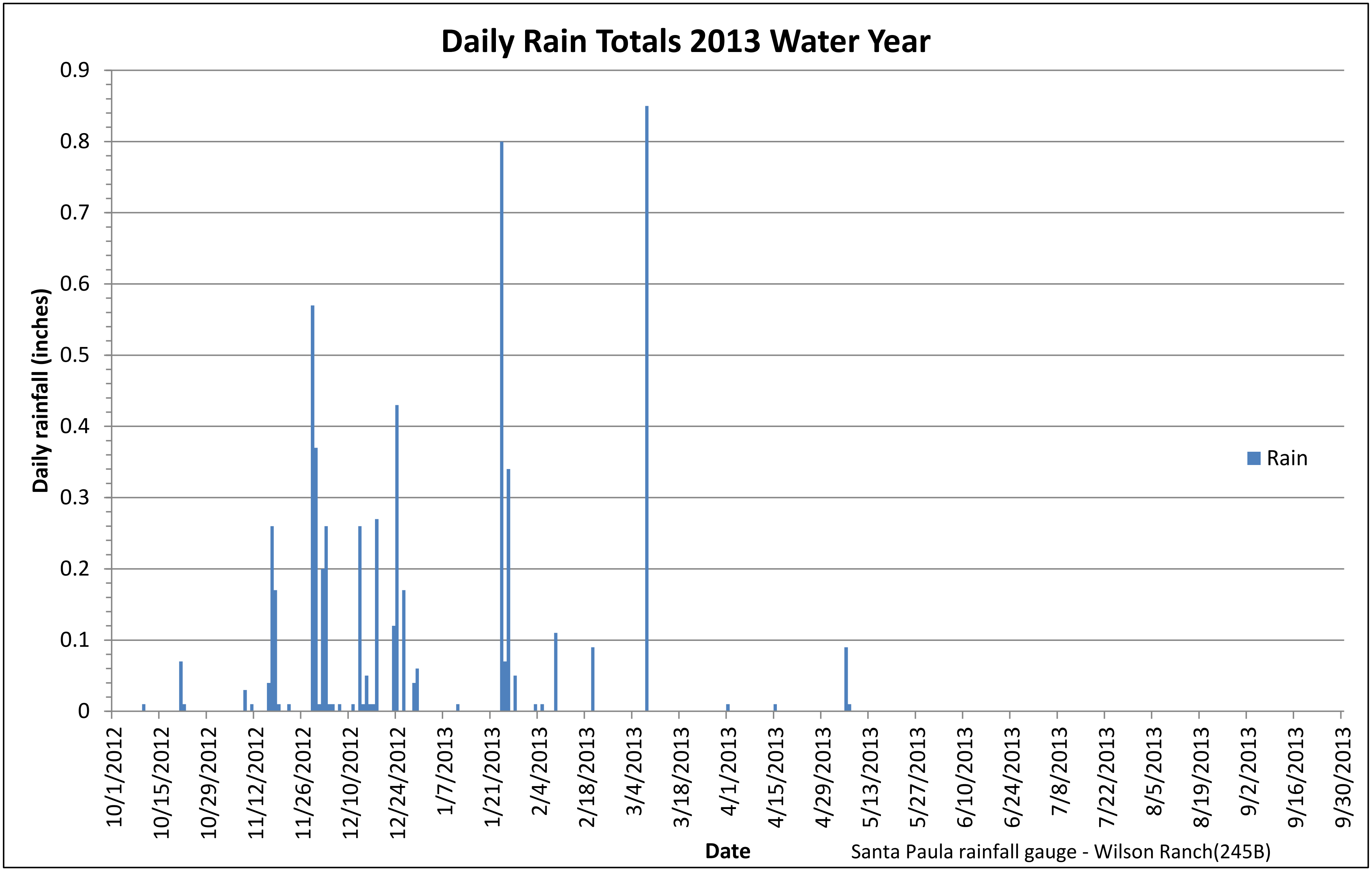
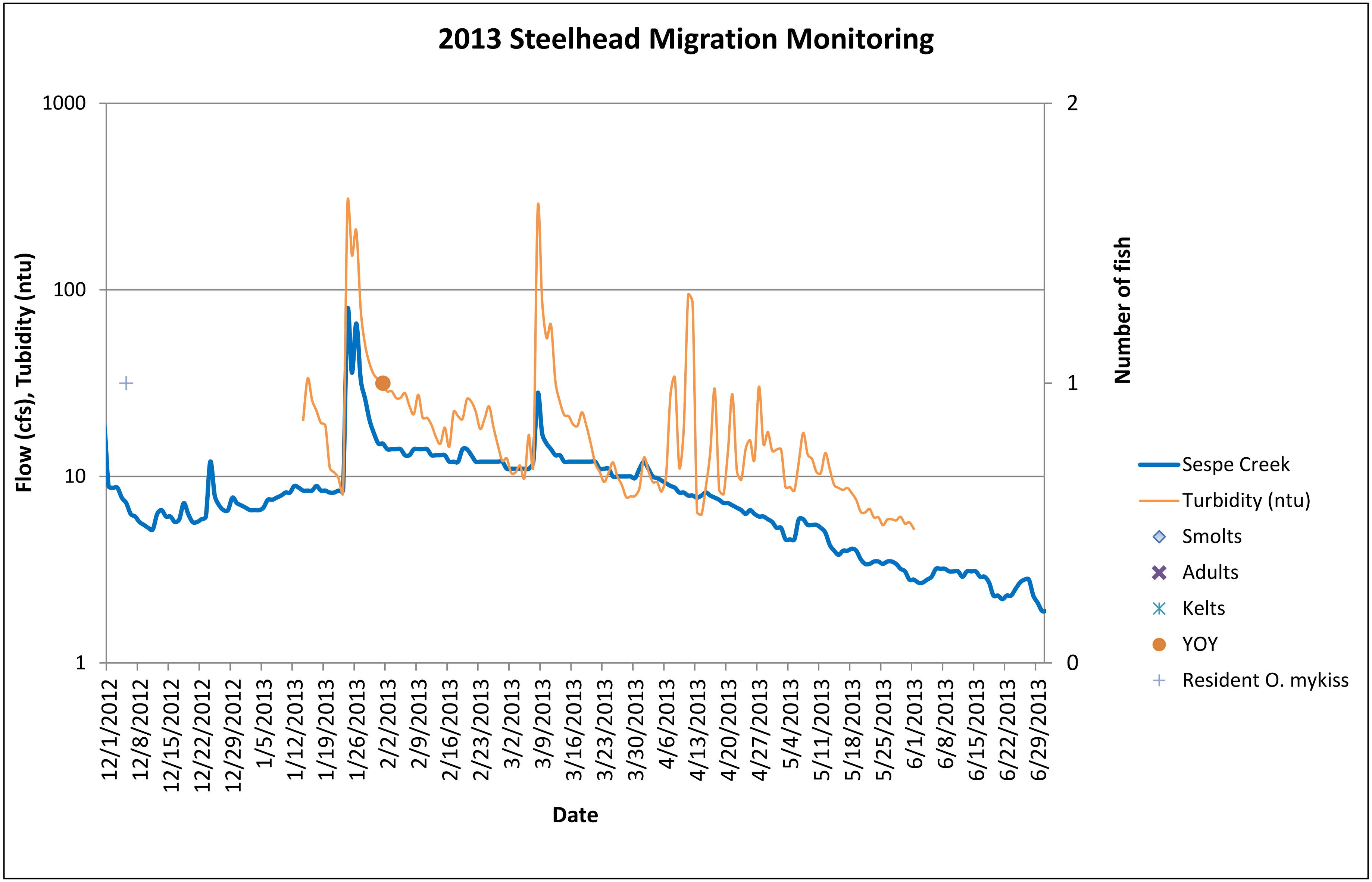


Figure 3 - Steelhead Monitoring Results



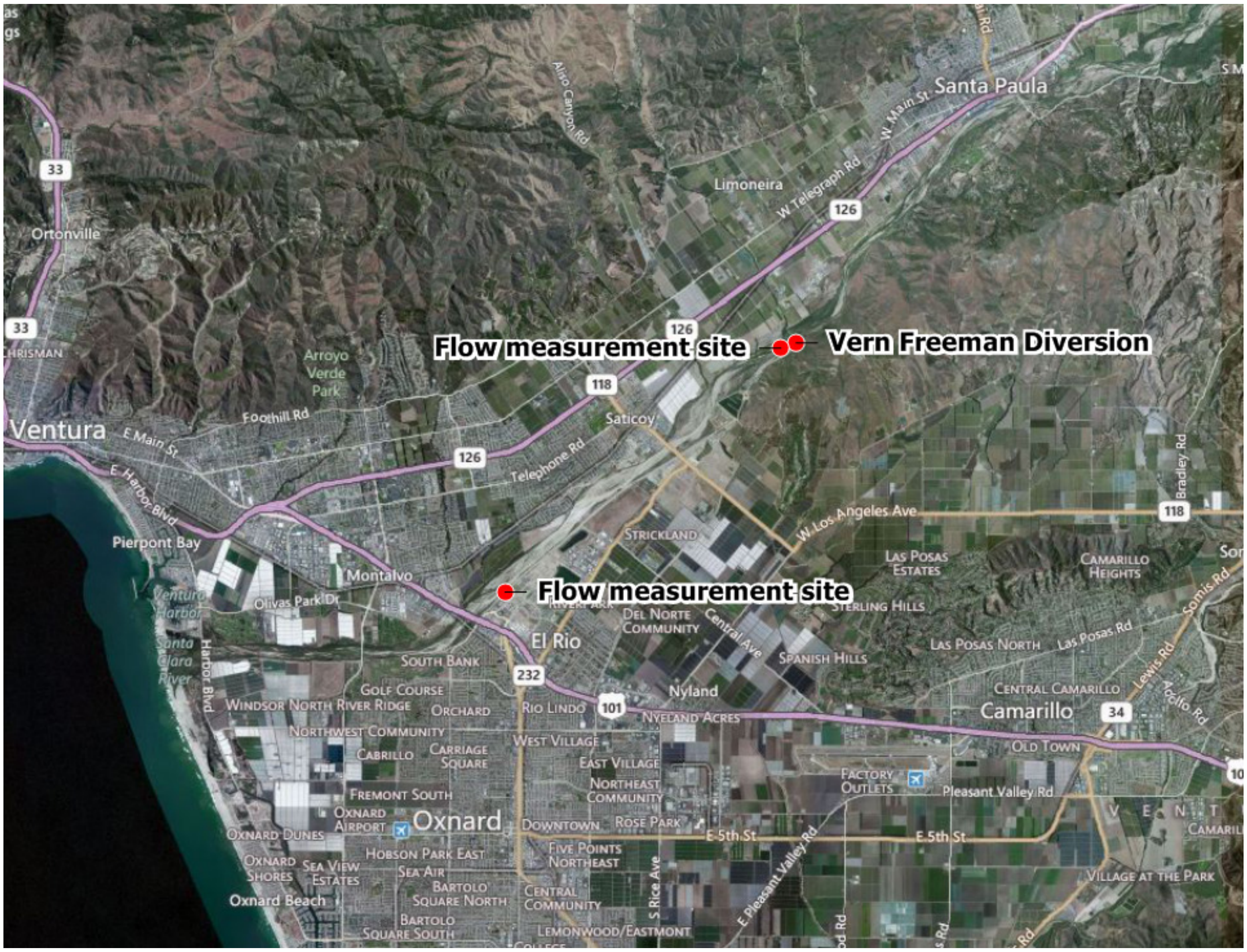


Figure 4. Freeman Bypass Flow Monitoring Sites below the Freeman Diversion

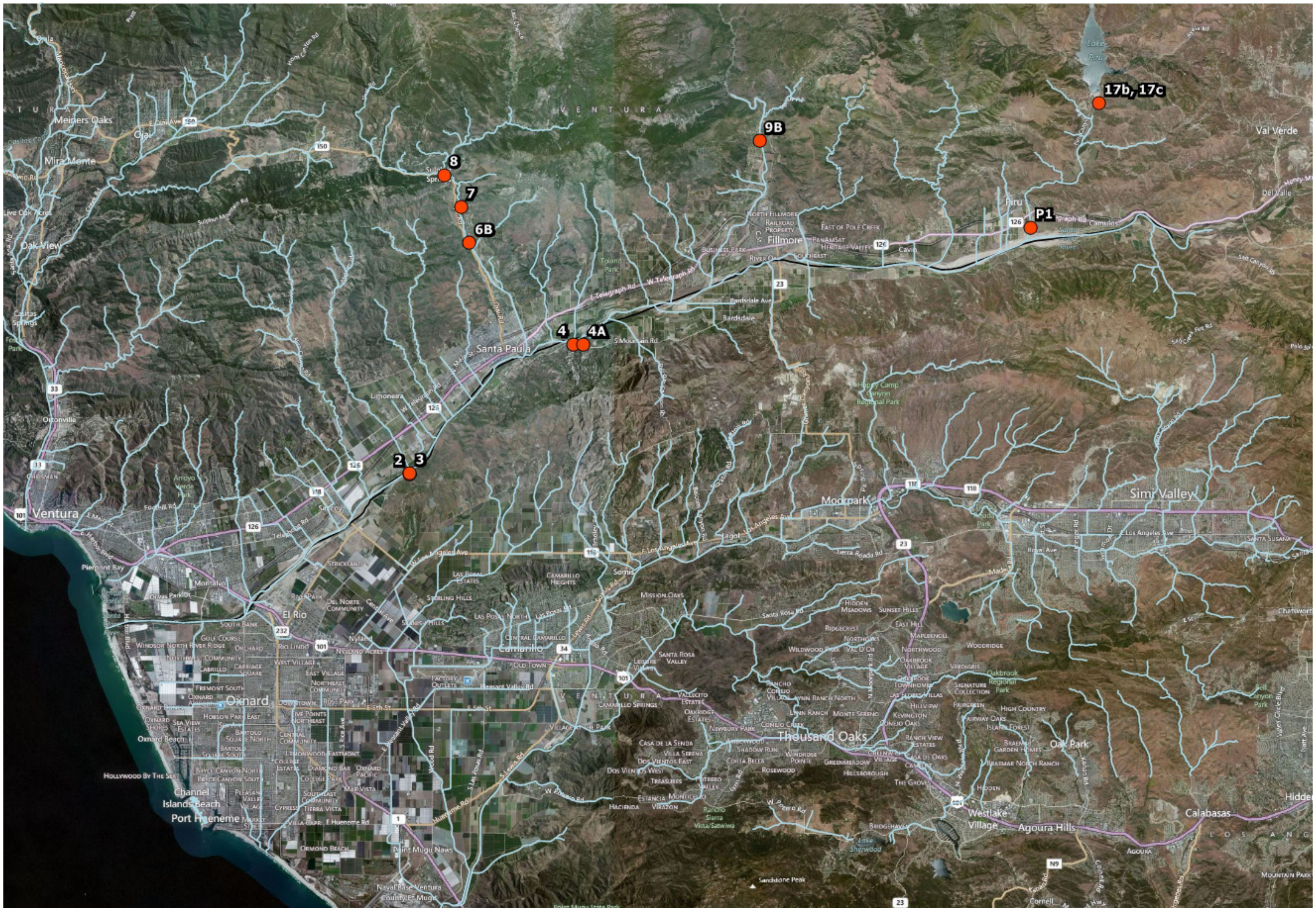


Figure 5. Water Temperature Monitoring Sites within the Santa Clara River Watershed.

Figure 6. Freeman Fish Trap Bay Water Temperature

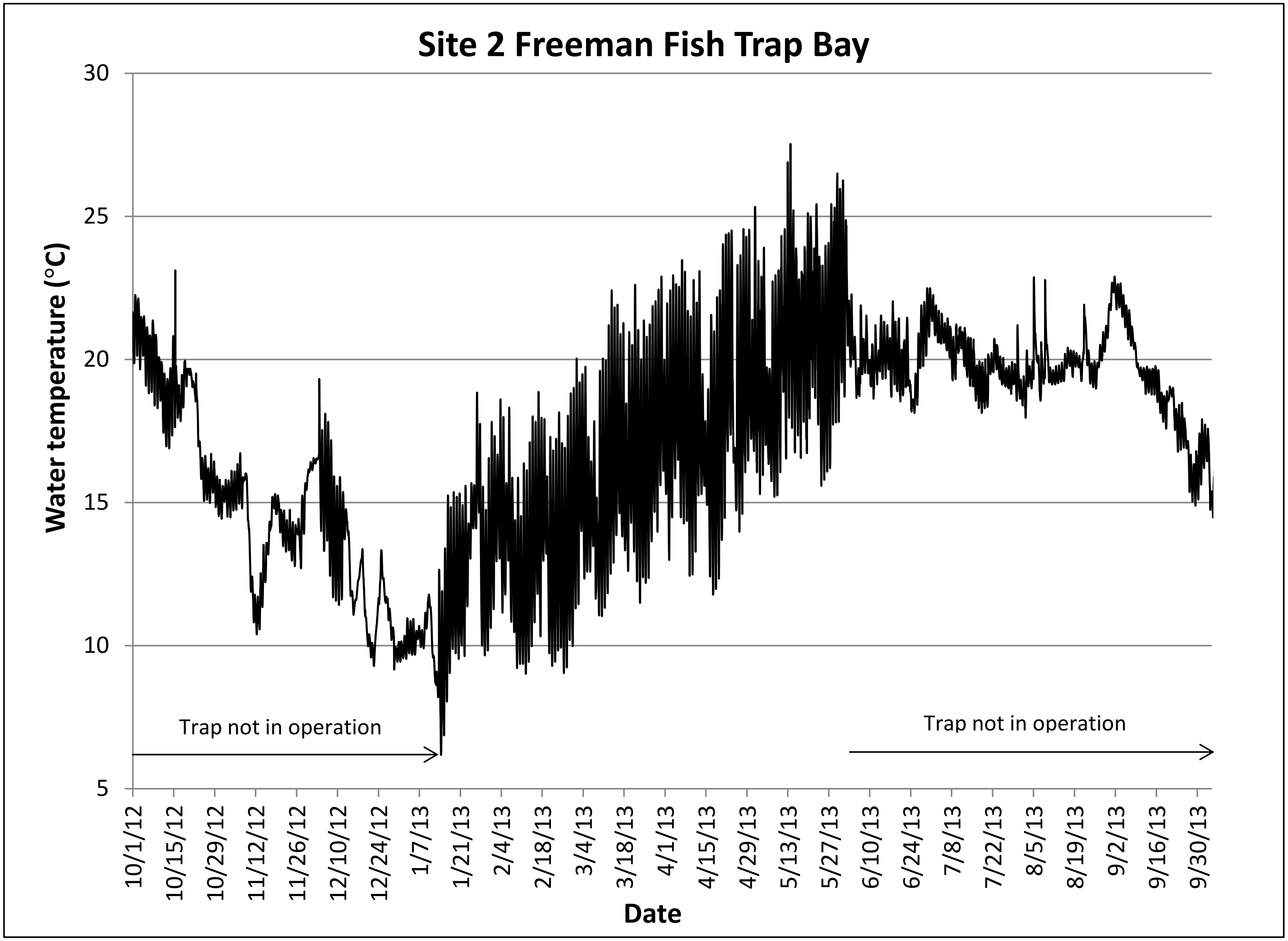


Figure 7. Freeman Fish Screen Bay Water Temperature

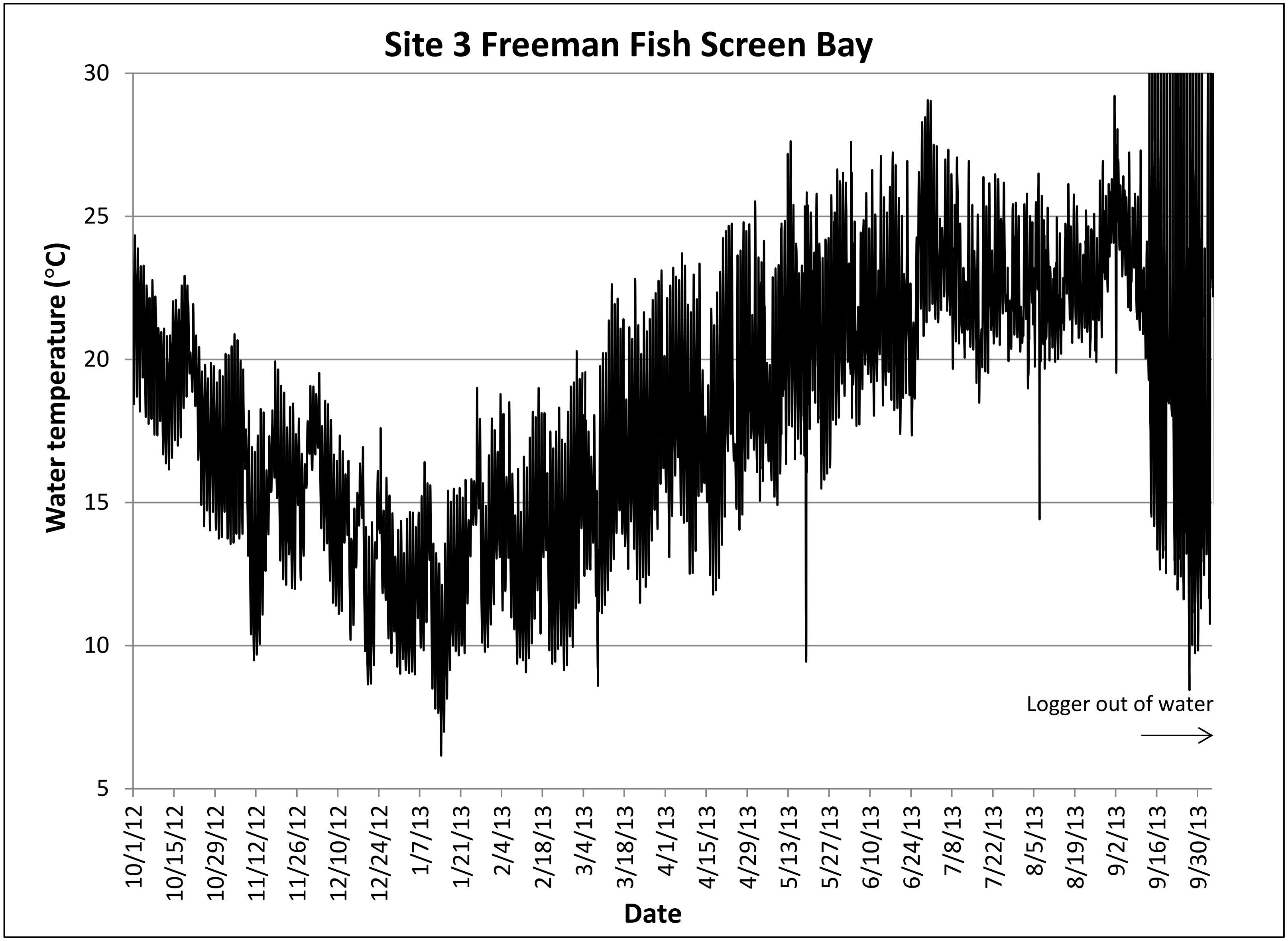


Figure 8. Santa Clara River at Ventura County Bank Stabilization Project

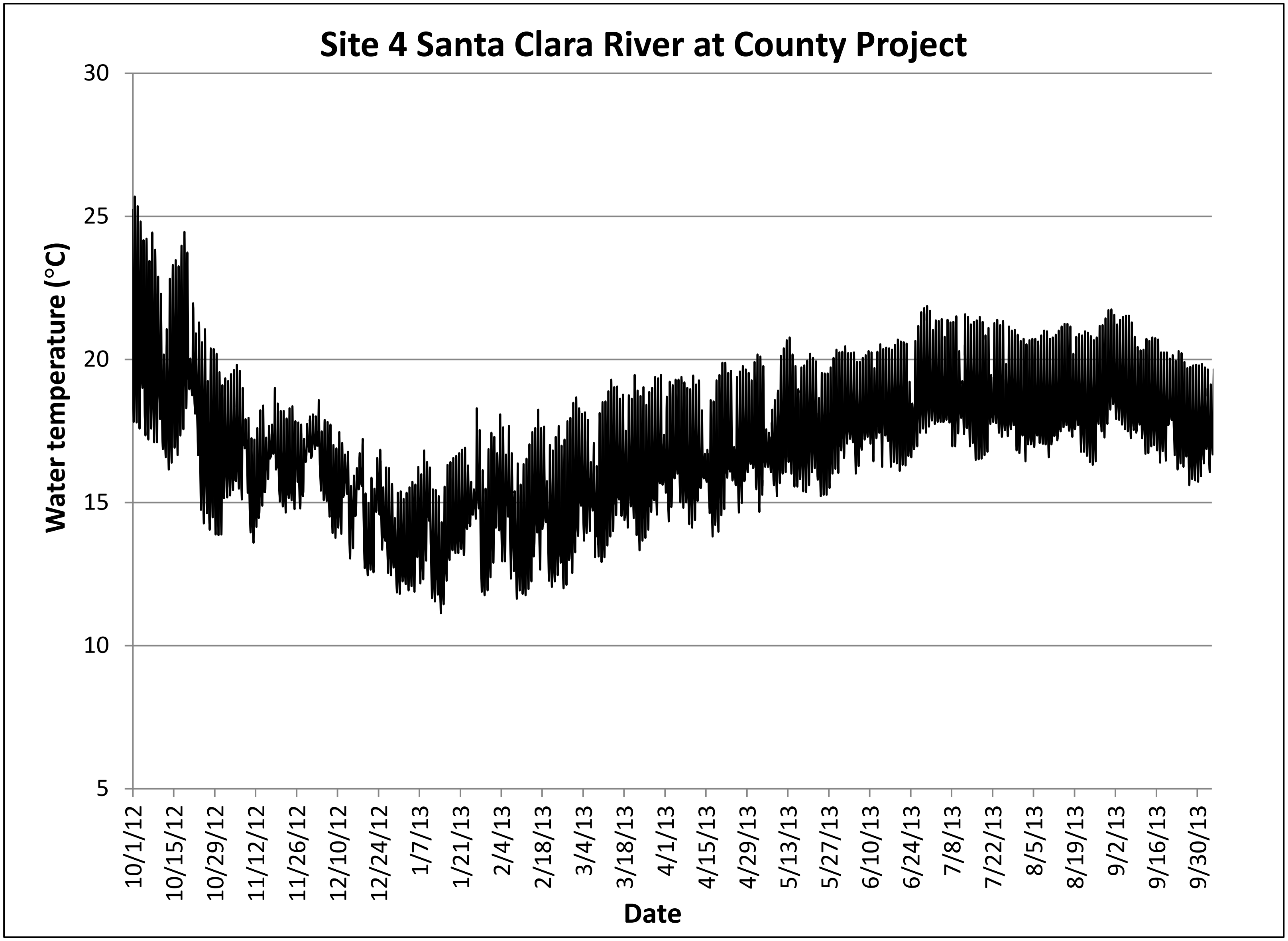


Figure 9. Santa Clara River Side Channel at Ventura County Bank Stabilization Project

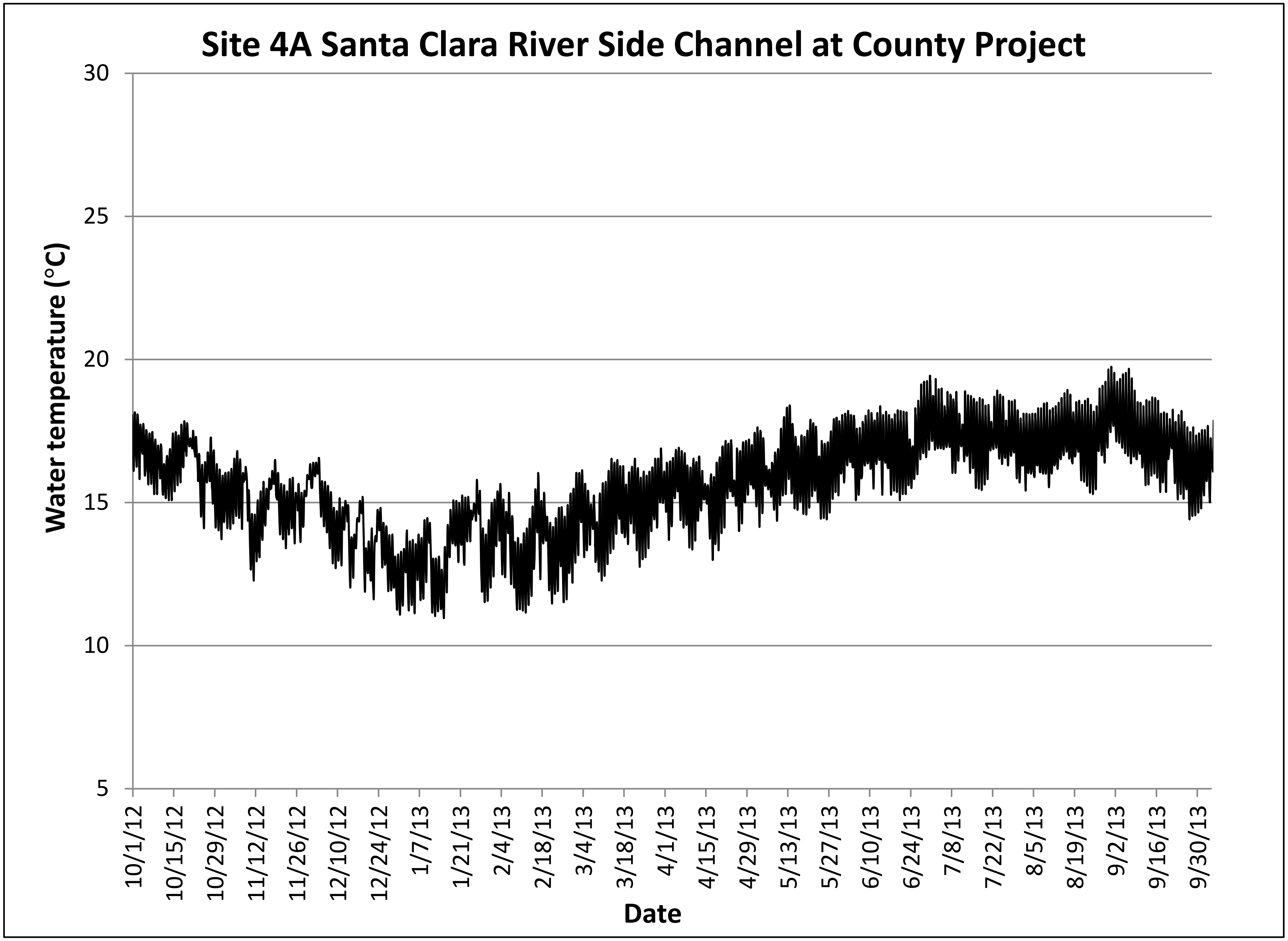


Figure 10. Santa Paula Creek Upstream of Harvey Diversion

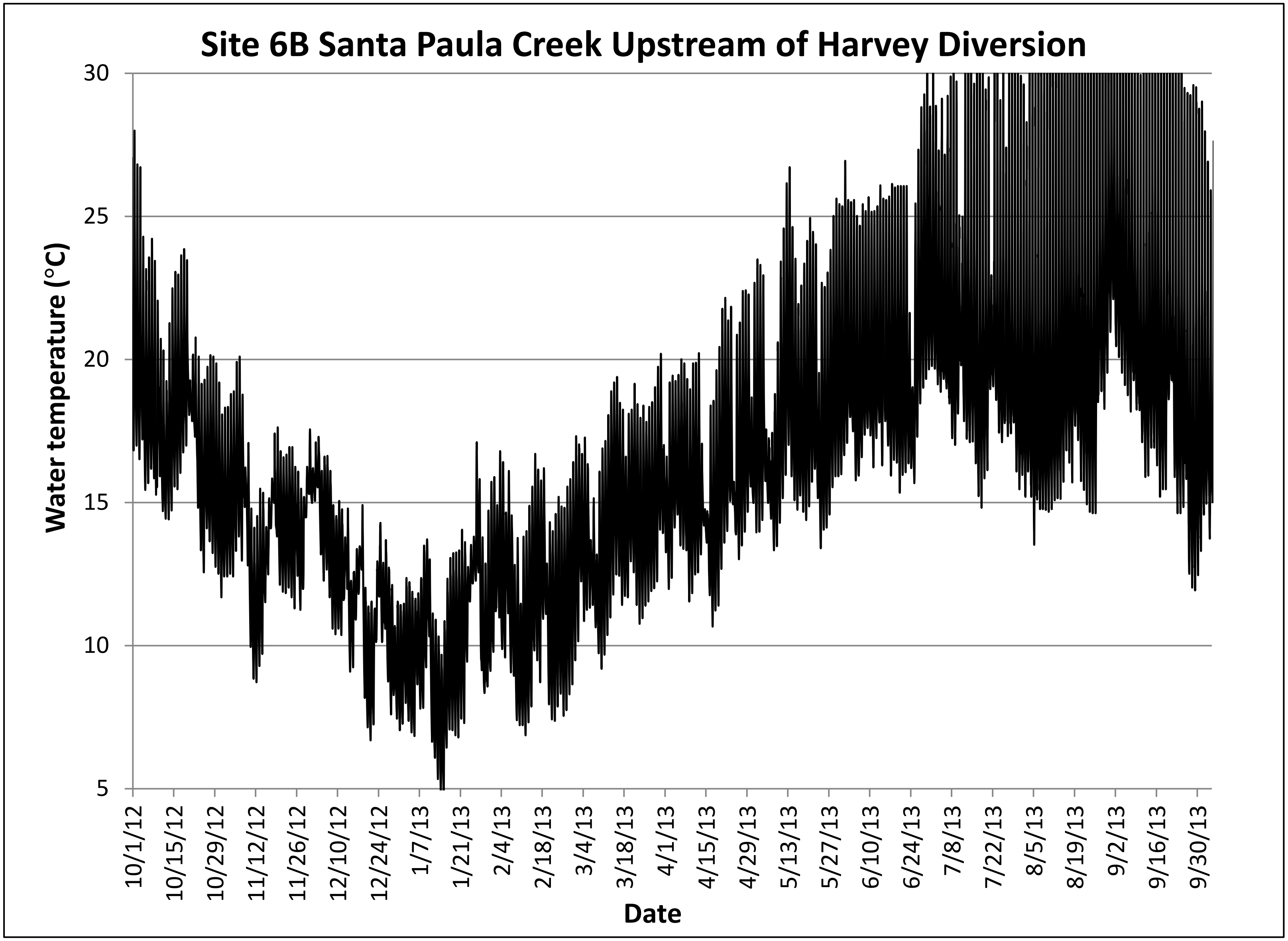


Figure 11. Santa Paula Creek at Steckel Park

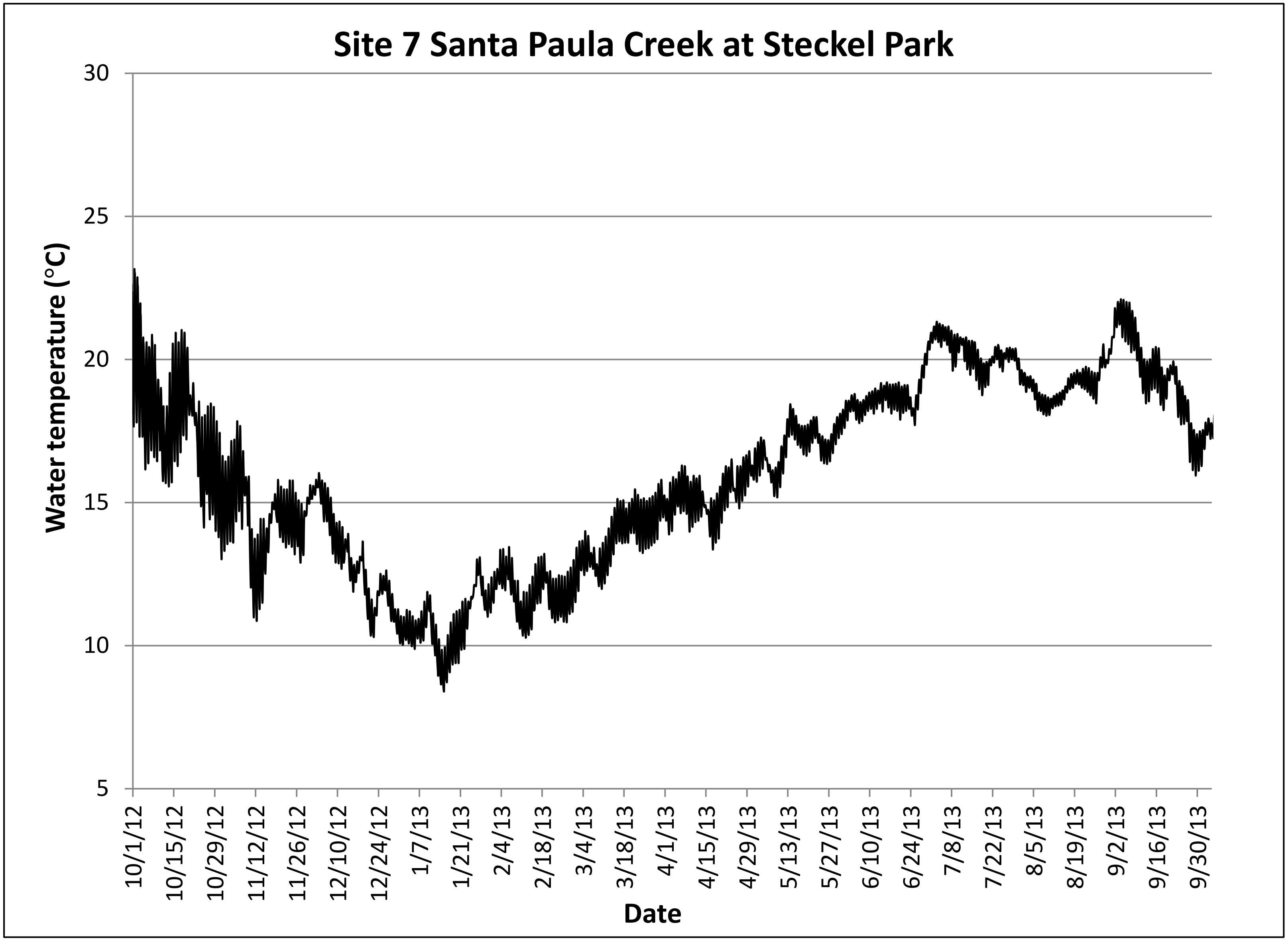


Figure 12. Santa Paula Creek at Confluence with Sisar Creek

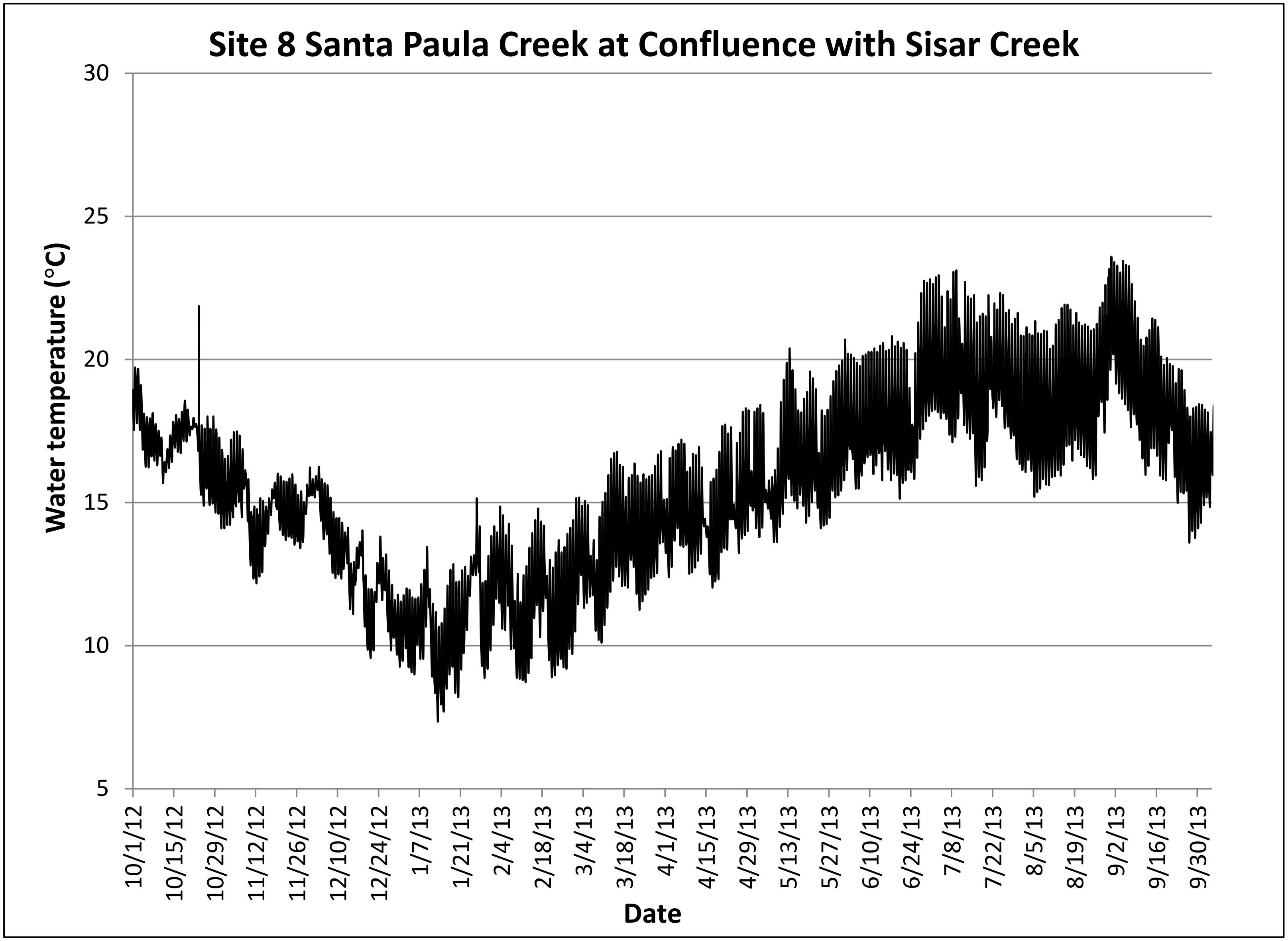


Figure 13. Sespe Creek at Grand Avenue

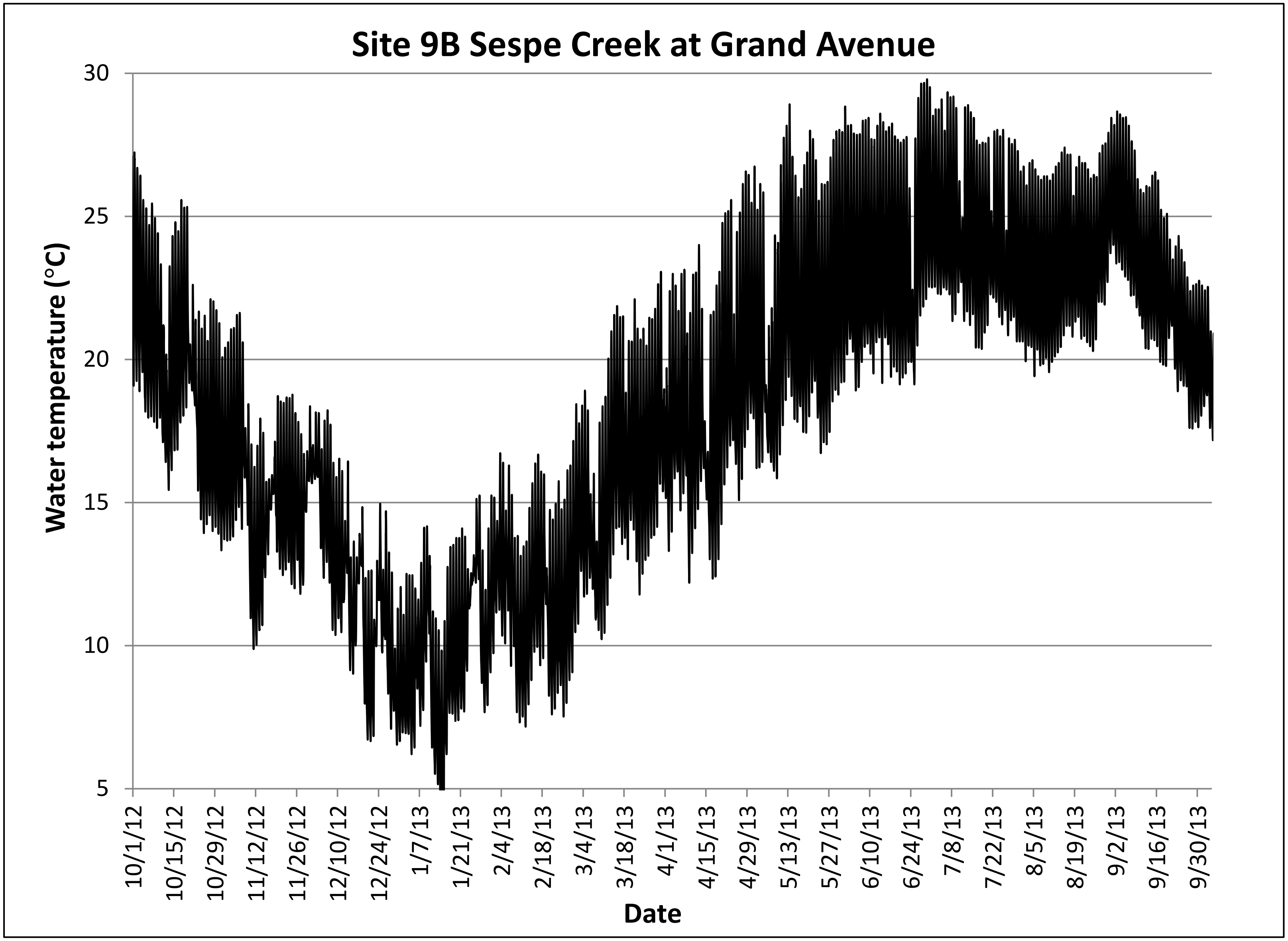


Figure 14. Piru Creek at Santa Felicia Dam - Pool

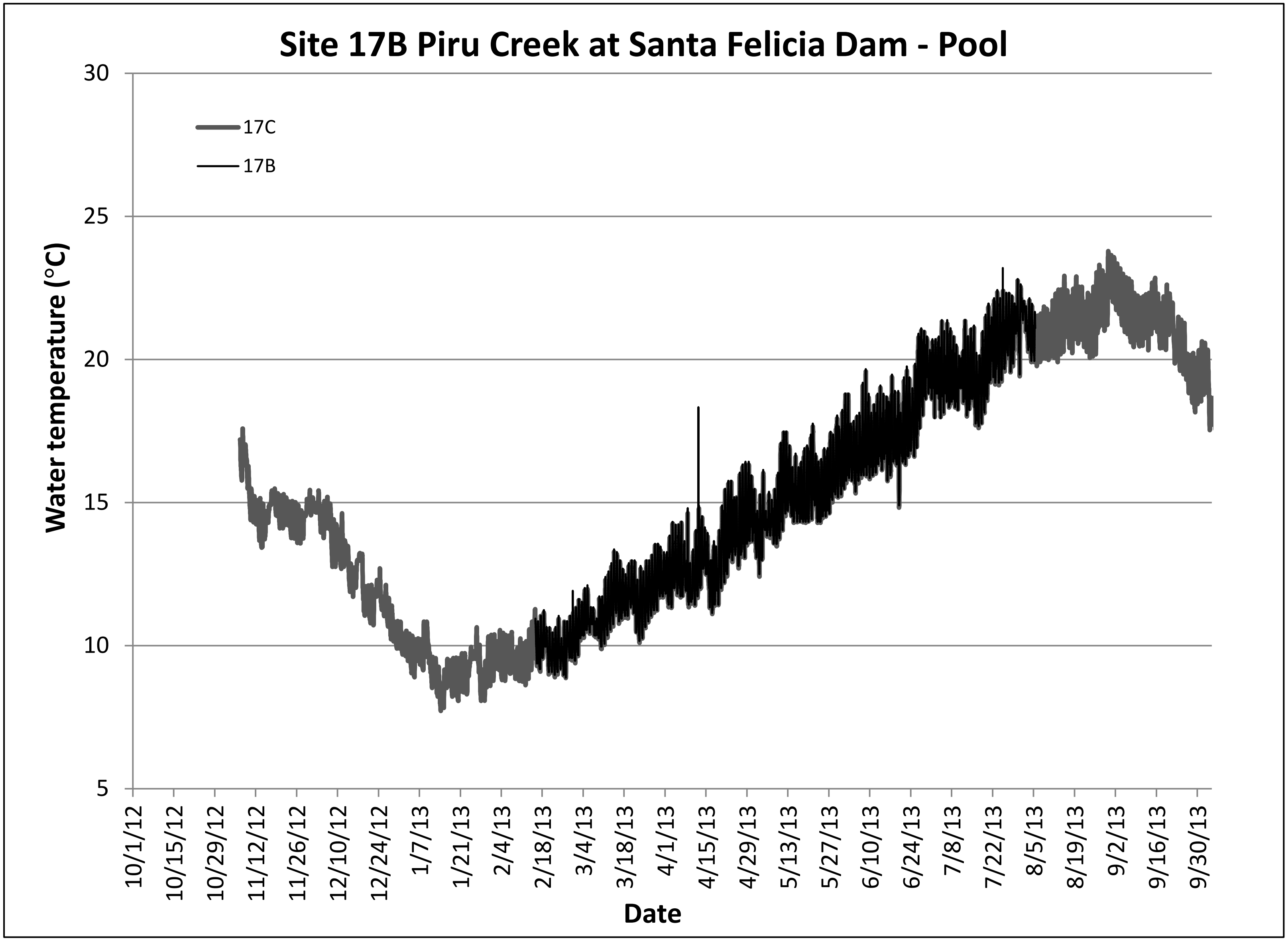
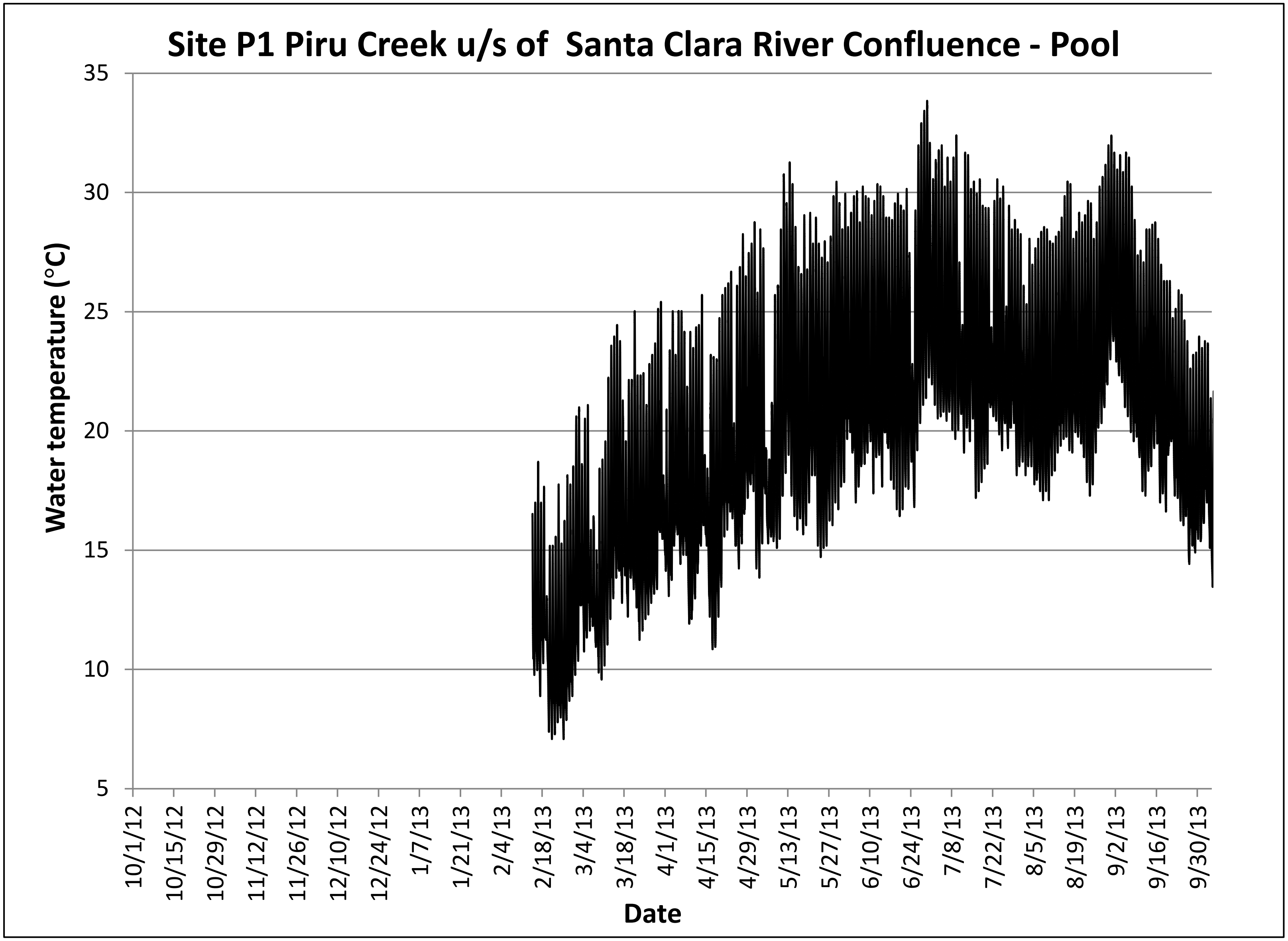


Figure 15. Piru Creek Upstream of Santa Clara River Confluence - Pool



Appendix B

Photos

Photo 1. Santa Clara River estuary release site open

Photo 2. Resident rainbow trout.

Photo 3. Upstream migration monitoring infrared scanners

Photo 4. Upstream migration monitoring surveillance system.

Photo 5. Fish screen bay stranding survey (*were not required in 2013*)

Photo 6. Fish trap bay water temperature monitoring site

Photo 7. Fish screen bay water temperature monitoring site

Photo 8. VCWPD project water temperature monitoring site

Photo 9. VCWPD project side channel water temperature monitoring site

Photo 10. Santa Paula Creek upstream of Harvey Diversion water temperature monitoring site

Photo 11. Santa Paula Creek at Steckel Park water temperature monitoring site

Photo 12. Santa Paula Creek directly downstream of Sisar Creek confluence water temperature monitoring site

Photo 13. Sespe Creek at Grand Avenue water temperature monitoring site

Photo 14. Piru Creek downstream of Santa Felicia Dam

Photo 15. Piru Creek ~1500 feet upstream of Santa Clara River confluence