Final

Piru Creek Geomorphology Study Report

October 5, 2012

Prepared For
United Water Conservation District

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Prepared for

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Executive Summary

This report has been prepared for the Santa Felicia Project (Federal Energy Regulatory Commission [FERC] Project No. 2153) to present the methods and findings of the *Study Plan to Characterize Geomorphic Effects of Santa Felicia Dam on Lower Piru Creek* (Geomorphology Study Plan) [UWCD 2010]) dated October 2010. Following submittal of the Geomorphology Study Plan, the scope of the Geomorphology Study was modified based on observations made during field reconnaissance surveys conducted on March 24, 2011 and May 10, 2011. With concurrence from the National Marine Fisheries Service (NMFS), the proposed modifications to the initial scope of work were submitted by United Water Conservation District (United) to the Federal Energy Regulatory Commission (FERC) in a letter dated August 9, 2011 and were subsequently approved by FERC in an order issued on September 1, 2011.

The scope of work for the Geomorphology Study was developed to build upon the information and data collected during the FERC hydroelectric relicensing process as provided in Exhibit E of the license application and involved the following:

- reviewing and incorporating data into this study that was collected in 2004 during the FERC relicensing process;
- conducting a field reconnaissance survey to assess baseline conditions, and select representative Study Sites;
- establishing and monitoring representative Study Sites to evaluate changes in channel geometry and substrate composition;
- conducting a spawning gravel inventory, collecting bulk gravel samples, and performing a tracer gravel study to evaluate the amount and quality of spawning gravel and characterize gravel transport; and,
- preparing hydraulic models for each Study Site to evaluate sediment transport conditions under varying flow conditions, and assist in determining the magnitude of overbank flows required to re-work the channel morphology and support riparian vegetation.

The scope of work in the Geomorphology Study Plan involved collecting data prior to and after the annual conservation release to evaluate changes in channel conditions associated with the conservation release, during the wet season to evaluate changes in channel conditions associated with runoff events, and at the end of the wet season to characterize channel conditions. However, in consultation with NMFS and in consideration of access limitations along lower Piru Creek, the scope was modified to consist of collecting data prior to and following two release events, the annual conservation release with a maximum flow of 425 cubic feet per second (cfs) and, following the conservation release, a second release event with a maximum flow of 591 cfs, which United considered at the time to be the highest feasible flow release from the Santa Felicia Dam outlet works. The conservation release was conducted over a period of approximately 46 days between September 12, 2011 and October 28, 2011. A second release event was conducted over a period of approximately 7 days between November 2 and November 9, 2011. The study included three primary field efforts as follows: 1) prior to the 425 cfs conservation release between August 30 and September 1, 2011 to characterize pre-release channel conditions; 2) following the 425 cfs conservation release between October 30 to November 1, 2011, to characterize potential changes in channel conditions following the conservation release and prior to the second release event; and, 3) following the 591 cfs release event between November 7 to November 9, 2011, to characterize potential changes in channel conditions following this event.

The specific objectives of the Geomorphology Study and the findings associated with each objective are as follows:

- **Objective 1 –** Evaluate potential effects of Santa Felicia Dam and its operations on:

  a) The quantity, quality and availability of spawning gravel;

  The sediment supply to lower Piru Creek is limited as both Pyramid Lake and Lake Piru trap sediment transported from the upper Piru Creek watershed. Based on storage capacity surveys, the storage volume in Lake Piru has decreased approximately 18,000 acre-feet (AF) between 1957 and 2005 and approximately 7,700 AF between 1975 and 2005 after the construction of Pyramid Lake in 1972. These data indicate that on average approximately 257 AF per year of sediment is trapped behind Santa Felicia Dam from the watershed area situated between Pyramid Lake and Lake Piru. The watershed area between Pyramid Lake and Lake Piru is approximately 141 square miles, and based on the Lake Piru storage data from 1975 to 2005, the approximate sedimentation rate within this watershed area is approximately 1.8 AF per square mile per year. Since sediment in Lake Piru is isolated behind the dam, the sediment supply to lower Piru Creek is limited to contributing sources situated downstream of the Project. Based on the estimated sedimentation rate from the Lake Piru storage data and the effective watershed area situated downstream of the Project (i.e. lower Piru Creek, approximately 15 square miles), the estimated sedimentation rate for lower Piru Creek is approximately 27 AF per year.

  Since the construction of Santa Felicia Dam in 1955, the primary sources of spawning gravel consist of in-channel sources and the tributary drainages. Of these sources, the most significant contribution is likely from tributary drainages as the channel bed is relatively well-armored and erosion of the banks is relatively limited. The tributaries include Modelo Canyon, Holser Canyon, Blanchard Canyon, Lime Canyon, and five unnamed drainages. These drainages are intermittent with surface flows occurring in response to seasonal rainfall events and agricultural irrigation. Accordingly, substantial sediment delivery from these areas is primarily limited to the wet season between November and April of each year. Based on observations during the field reconnaissance surveys, these drainages appear to primarily deliver fine sediment (i.e. material less than 0.074 mm [USBOR 2012]), sand, and small gravels.

  In regard to the quality and availability of spawning gravel, pre-Project data are not available for comparison with post-Project data which precludes accurate direct assessment of potential effects associated with the Project. The data collected during this study indicate that the quality and availability of spawning gravels increase following the flow release events as compared to pre-release conditions. This increase is likely due in large part to the flushing of overlying fine sediments delivered from the tributaries to expose the underlying gravels.

b) The deposition and flushing of fine sediments;

Project operations have altered the pre-Project hydrologic regime. Specifically, under post-Project operations, flows are more consistent year-round and the timing of annual extreme flows has been modified. Under post-Project operations prior to implementation of the *Santa Felicia Water Release Plan* (UWCD 2012) in 2011 and with the exception of spill events which occur approximately every 5 years on average, the highest mean monthly flows occurred in September and October in response to the annual conservation water release rather than between January and April in response to seasonal storm events, and the lowest mean monthly flows occurred between December and March rather than July through October at the end of the dry season. The change in the hydrologic regime associated with Project operations has also modified the sediment transport regime in lower Piru Creek. As discussed previously, the primary sources of sediment to lower Piru Creek under post-Project conditions are the tributary drainages situated downstream of the Project. These drainages deliver sediment to the channel during the wet season through runoff associated with storm events. During the wet season, Project flow releases to lower Piru Creek have been fixed based on rates specified in United's FERC licenses for the Project. Prior to implementation of the *Santa Felicia Water Release Plan* (UWCD 20112), the releases did not mimic the "flashy" nature of flows in the tributaries. Accordingly, with the exception of years with ample spill events, flows in lower Piru Creek have not typically been sufficient to transport the sediment delivered to lower Piru Creek by the tributaries during wet season storm events which result in deposition of sediment in the lower Piru Creek channel. This deposition of sediment can impact instream habitat by filling-in pools, thereby reducing available rearing habitat, and in-filling riffles with fine sediment and sand which impacts spawning habitat. Except during years with ample spill events, this sediment has remained in the lower Piru Creek channel until the annual conservation releases in September and October which serve to mobilize and transport the material through the system. The current version of the *Santa Felicia Water Release Plan* (UWCD 2012) approved by NMFS on July 3, 2012, includes provisions for increased minimum flows during normal and wet water years to address habitat needs and minimum releases of 200 cfs under certain conditions to allow for migration of steelhead into and out off Piru Creek.

c) The adequacy of overbanking flows in supporting riparian vegetation along lower Piru Creek.

A pre-Project aerial photograph taken in March 1949 (approximately 7 years prior to construction of the Project) depicts a relatively unstable channel with very little riparian vegetation. In addition, a stream survey conducted by the California

Department of Fish and Game (CDFG) in 1949 (CDFG 1949) characterizes the "shelter" in lower Piru as poor with few willows and alders along the margin. In contrast, the present day channel consists of a relatively stable channel with a well vegetated riparian corridor.

A survey of riparian vegetation along lower Piru Creek was conducted during the FERC relicensing process as discussed in *Section 3.3 Report on Botanical Resources* of the FERC Exhibit E relicensing documentation. The survey was conducted along lower Piru Creek, between Santa Felicia Dam and the Santa Clara River. The vegetation along this portion of Piru Creek was reported as a patchwork of stands dominated primarily by mulefat and stands dominated by a mix of mulefat, arroyo willow, sandbar willow, white alder, or Fremont cottonwood. Vegetative cover along the channel ranged from 10 to 100 percent with the upper portions of lower Piru Creek exhibiting areas of primarily 90 to 100 percent cover and the lower reaches having much more sparse vegetation and lower cover. Seedling willows were observed on the occasional sandbar in or adjacent to the channel, but most of the channel banks were too densely vegetated to provide sites for seedling development. Mulefat generally varied from 5-6 feet in height, while the Fremont cottonwood reached heights of 55 feet. The willows ranged from three to 35 feet in height, while the white alders were generally between 15-20 feet in height. The data indicate a greater amount of riparian vegetation under post-Project conditions as compared to pre-Project conditions which suggests improved habitat conditions associated with the frequency and magnitude of overbanking flows that have occurred under past Project operations.

- **Objective 2 –** Based on the findings of Objective 1, determine the flow releases that are necessary to restore, or in the case of lower Piru Creek, enhance the geomorphic processes that promote a dynamic river ecosystem that will support steelhead trout including:

  a) Mobilizing the streambed every 1-2 years to promote pool scour and mobilization of the coarse layer on riffles;

  The data indicate that a flow of 380 cfs is sufficient to mobilize the D_{84} at all cross-sections at Study Sites 1 and 2, and three of the six cross-sections at Study Site 3. In regard to surficial fine sediments, flows less than 100 cfs are sufficient to mobilize these sediments.

  The repeat cross-section surveys showed only very small changes in the bed topography following the 425 cfs and 591 cfs flow releases. These results do not mean that bed material did not move as the tracer gravel study results indicate mobilization and transport of gravels between 19 mm and 76 mm half-phi sizes during both the 425 cfs and 591 cfs release events. Rather, the cross-sectional area and dimensions of the channel remained stable after the flow release events. A channel in equilibrium will, over the long-term, not trend toward aggradation or degradation, but will maintain its overall form. As sediments are transported through a reach, new sediments from upstream are transported into the reach. As such, the cross-section surveys did not indicate any particular trend toward aggradational/degradational processes or changes in the channel form or dimensions with either the 425 cfs or 591 cfs flows; channel morphology will likely remain stable through this range of flows.

Although it is likely that as little as 100 cfs will mobilize the median size bed material at most sites (based on the modeling results), a flow of 380 cfs will ensure mobilization of the coarser bed material such as gravels and will account for moving the bed material through both riffles and pools.

b) Flushing sand from the gravel framework during the spawning and rearing season; and,

The study results indicate that a greater amount of spawning size gravels (6 mm to 80 mm per Bovee 1978; Hampton 1997; Reiser 1985; Hosey & Associates 1986; Dettman and Kelley 1986; DWR 2004; USFWS 2007; and USFWS 2010) were available with lower fine sediment embeddedness following the 425 cfs event which occurred over a period of approximately 46 days and the 591 cfs flow event was conducted over a period of approximately 7 days. The vast majority of the increase in gravel availability and reduced embeddedness was associated with the 425 cfs flow release with only small improvements following the 591 cfs flow event. The increase in gravel availability following the 425 cfs event is primarily due to the flushing of fine sediment from the surface of the bed, revealing spawning size material that had previously been buried.

Mobilization of the spawning size material (represented by the bulk samples) will also mobilize finer sediment from within the gravel matrix as the bed material begins transport. The bulk sample results collected before and after each release event provide an indication of the potential for the 425 cfs and 591 cfs release to flush sand and silt from the coarser gravel framework. The bulk sample results did not show a consistent trend to flush fines from the spawning material following either the 425 cfs flow or the 591 cfs flow. Accordingly, the bulk sampling results are inconclusive as to the net effectiveness and feasibility of flushing fines from within the gravel framework.

However, the tracer gravel study results indicate mobilization and transport of gravels between 19 mm and 76 mm half-phi sizes during both of the release events which provides direct evidence of gravel movement at 425 cfs and 591 cfs. Accordingly, based on the tracer gravel data, the 380 cfs flow required to mobilize the D_{84} bed material through both riffles and pools should be sufficient to mobilize gravel and flush fine sediments from within the gravel matrix.

c) Re-working the channel morphology via overbank flows at a frequency of approximately every 5 years.

The morphology of lower Piru Creek has been altered from the pre-Project condition due to encroachment by roads and agriculture, a modified flow and sediment regime, and direct relocation of the channel (e.g. Study Site 1). The current channel is relatively stable in regards to lateral migration with a well vegetated riparian corridor in comparison with pre-Project conditions in which the channel appears braided with limited riparian vegetation and evidence of lateral migration. Based on these changes, traditional floodplain surfaces related to naturally occurring runoff events are not prevalent in lower Piru Creek. Rather, the current channel features are primarily defined by the annual conservation flow releases with re-working of the channel morphology limited to past years with ample spill events.

A total of 10 spill events have occurred between the construction of the Project in 1956 and 2005 or, on average, a spill approximately every 5 years. The flows required to overtop the banks in lower Piru Creek range from 1,000 cfs to 10,000 cfs with most areas being overtopped at flows of 1,000 to 2,000 cfs. The spill data indicate that maximum mean daily flows exceed 1,000 cfs approximately every 6 years and over 2,000 cfs approximately every 7 years. In addition, instantaneous peak flows during spill events likely exceed 1,000 to 2,000 cfs much more frequently. Accordingly, based on the spill frequency, it appears that the channel morphology has the potential to be re-worked approximately every 5 years, depending on the spill flows and duration.

In addition, as discussed previously, a survey of riparian vegetation along lower Piru Creek was conducted during the FERC relicensing process (*Section 3.3 Report on Botanical Resources* of the FERC Exhibit E relicensing documentation). The survey indicated that vegetative cover along lower Piru Creek ranged from 10 to 100 percent with the upper portions of lower Piru Creek exhibiting areas of primarily 90 to 100 percent cover and the lower reaches having much more sparse vegetation and lower cover. Seedling willows were observed on the occasional sandbar in or adjacent to the channel, but most of the channel banks were too densely vegetated to provide sites for seedling development. Mulefat generally varied from 5-6 feet in height, while the Fremont cottonwood reached heights of 55 feet. The willows ranged from three to 35 feet in height, while the white alders were generally between 15-20 feet in height. Given the range in species present and the density of vegetation, lower Piru Creek supports a greater amount of riparian vegetation under post-Project conditions as compared to pre-Project conditions which suggests that the frequency and magnitude of overbanking flows that have occurred under past operations support more riparian vegetation than pre-Project conditions.

Chapter 1

Introduction

This report has been prepared for the Santa Felicia Project (FERC Project No. 2153) to present the methods and findings of the *Study Plan to Characterize Geomorphic Effects of Santa Felicia Dam on Lower Piru Creek* (Geomorphology Study Plan) [UWCD 2010] dated October 2010. The Geomorphology Study was conducted to comply with *Reasonable and Prudent Alternative 1(a)* (RPA 1(a)) in Appendix B of the *Order Issuing the New License* dated September 12, 2008. The Project is located in eastern Ventura County approximately 5 miles north of Piru, California and is owned and operated by the United Water Conservation District (United *or* Licensee).

RPA 1(a) requires United to quantify the type, the amount, and extent of geomorphic effects of Santa Felicia Dam and its operations on the quality and quantity of steelhead habitat in Piru Creek downstream of the dam (lower Piru Creek). The lower Piru Creek area is presented in Figure 1. According to *Section 3.1 Report on Aquatic Resources* of the FERC Exhibit E relicensing documentation, existing aquatic habitat in lower Piru Creek is not conducive to the production and rearing of steelhead under current conditions due to poor habitat quality and limiting physical characteristics including poor quality spawning substrate, a lack of instream cover for refuge, a limited number of deep pools, and a lack of overhanging canopy. Spawning habitat is reportedly poor due to the limited amount of spawning gravel in lower Piru Creek and the presence of fine sediment which embeds available spawning gravels. Fine sediment deposition also affects rearing habitat by reducing instream cover (embeds larger substrate) and decreasing pool volumes and depths. Rearing habitat is also affected by the lack of canopy cover which further limits available refuge.

In consideration of these issues and in accordance with RPA 1(a), United prepared the Geomorphology Study Plan which was reviewed and approved by the National Marine Fisheries Service (NMFS) prior to submittal to the Federal Energy Regulatory Commission (FERC). Following submittal of the Study Plan, the scope of the Geomorphology Study was modified based on observations made during field reconnaissance surveys conducted on March 24, 2011 and May 10, 2011. With concurrence from NMFS, the proposed modifications to the initial scope of work were submitted to FERC in a letter dated August 9, 2011 and were subsequently approved by FERC. The specific objectives of the Geomorphology Study were as follows:

- **Objective 1 –** Evaluate potential effects of Santa Felicia Dam and its operations on: a) the quantity, quality and availability of spawning gravel; b) the deposition and flushing of fine sediments; and, c) the adequacy of overbanking flows in supporting riparian vegetation along lower Piru Creek.

- **Objective 2 –** Based on the findings of Objective 1, determine the flow releases that are necessary to restore, or in the case of lower Piru Creek, enhance the geomorphic processes that promote a dynamic river ecosystem that will support steelhead trout including: a) mobilizing the streambed every 1-2 years to promote pool scour and mobilization of the coarse layer on riffles; b) flushing sand from the gravel framework during the spawning and rearing season; and, c) re-working the channel morphology via overbank flows at a frequency of approximately every 5 years.

The scope of work for the Geomorphology Study was developed to build upon the information and data collected during the FERC hydroelectric relicensing process as provided in Exhibit E of the license application and involved the following:

- reviewing and incorporating data into this study that was collected in 2004 during the FERC relicensing process;
- conducting a field reconnaissance survey to assess current, baseline conditions, and select representative Study Sites;
- establishing and monitoring representative Study Sites to evaluate changes in channel geometry and substrate composition;
- conducting a spawning gravel inventory, collect bulk gravel samples, and perform a tracer gravel study to evaluate the amount and quality of spawning gravel and characterize gravel transport; and,
- preparing hydraulic models for each Study Site to evaluate sediment transport conditions under varying flow conditions, and assist in determining the magnitude of overbank flows required to re-work the channel morphology and support riparian vegetation.

The scope of work in the Geomorphology Study Plan dated October 2010 involved collecting data prior to and after the annual conservation release to evaluate changes in channel conditions associated with the conservation release, during the wet season to evaluate changes in channel conditions associated with runoff events, and at the end of the wet season to characterize channel conditions. However, in consultation with NMFS and in consideration of access limitations along lower Piru Creek, the scope was modified to consist of collecting data prior to and following two release events, an approximately 400 cubic feet per second (cfs) release during the annual conservation release and, following the conservation release, a second release event with a targeted maximum flow of approximately 600 cfs, which United considered to be the highest feasible flow release from the Santa Felicia Dam outlet works. The conservation release was conducted between September 12, 2011 and October 28, 2011, and the second release event was conducted between November 2 and November 9, 2011. The study included three primary field efforts as follows: 1) prior to the approximately 400 cfs conservation release between August 30 and September 1, 2011 to characterize pre-release channel conditions; 2) following the approximately 400 cfs conservation release between October 30 to November 1, 2011 to characterize potential changes in channel conditions following the conservation release and prior to the second release event; and, 3) following the second release event between November 7 to November 9, 2011 to characterize potential changes in channel conditions following the event which had a targeted maximum flow of 600 cfs.

This report provides background information to assist in understanding the Project and the physical characteristics of lower Piru Creek, the methods and results for each component of the study, and the study findings relative to the objectives referenced above. The remainder of the report is organized as follows:

- Section 2.0 provides background information regarding the Project and physical setting;
- Section 3.0 presents the methods for each study component;
- Section 4.0 discusses the results for each study component; and,
- Section 5.0 presents the study findings relative to the defined objectives.

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Chapter 2

Project Description and Physical Setting

This section provides a description of the Project and the physical setting with regard to the hydrology, geomorphology, and aquatic habitat in lower Piru Creek.

2.1 Project Description

The Santa Felicia Project was constructed in 1955 and is used in conjunction with other United facilities to recharge downstream groundwater supplies in basins that have been depleted due to overdraft and to prevent saltwater intrusion in aquifers located near the Pacific Ocean. The Project is located along the lower reaches of Piru Creek which is a tributary to the Santa Clara River. The Project facilities include the Santa Felicia Dam which is located approximately 6.2 miles upstream of the confluence with the Santa Clara River and consists of an earth-filled dam that is 200 feet high and 1,260 feet long. The water impounded by the dam forms Lake Piru, a surface water reservoir, which had an original maximum capacity of 101,225 acre-feet (AF) upon completion of construction. Based on an analysis performed in 2005, the most recent maximum capacity is estimated to be 83,284 AF. During the winter and spring months, water is retained and stored in Lake Piru when downstream groundwater basins are at their fullest level. Conservation releases from Santa Felicia Dam are conducted in the fall of each year. The releases average approximately 270 cfs and are designed to maximize the amount of water that reaches the Freeman Diversion structure which is located on the Santa Clara River approximately 40 miles downstream of the Piru Creek confluence. The released water is used to recharge the coastal groundwater basins and supply agricultural water demands to prevent overdraft and saline intrusion to local aquifer systems.

2.2 Overview of the Piru Creek Watershed

The Piru Creek watershed encompasses approximately 500 square miles with the majority of the watershed situated within Ventura County and smaller portions within Los Angeles and Kern Counties. The watershed has a Mediterranean climate, with variable wet winters and hot, dry summers. The majority of precipitation falls during the winter months, generally between October and April. The average annual precipitation at Lake Piru is 19.8 inches per year. Topographic relief in the watershed is significant, with the majority of watershed covered by steep sided canyons and ridges and flat lands found in canyon bottoms and on top of ridgelines. Elevations within the watershed range from 8,831 feet mean sea level (msl) at the summit of Mount Pinos to approximately 647 feet msl at the confluence with the Santa Clara River near the town of Piru, California. Land use within the watershed consists of urban, agricultural, and open space land uses.

The watershed is characterized by broad alluvial subbasins alternating with gorges incised in bedrock, and, in general, the creek flows along structural trends (USGS 1968). The headwaters of the creek are located in Lockwood Valley within the Los Padres National Forest and the upper portion of the watershed consists of rugged, undisturbed terrain. From its headwaters, the creek meanders eastward approximately 30 miles while dropping 2,200 feet in elevation through a series of open valleys and steep gorges before reaching the Pyramid Lake. The watershed area contributing to Pyramid Lake is approximately 284 square miles (USGS 1968).

The creek continues south below Pyramid Lake approximately 15 miles through the Los Padres National Forest to Lake Piru. The watershed between Pyramid Lake and Lake Piru is more mountainous and contains fewer valley flats than the area situated upstream of Pyramid Lake (USGS 1968). Major tributaries to Piru Creek situated below Pyramid Lake include Fish Creek, which is located approximately 3 miles below Frenchman's Flat just south of Pyramid Lake, and Agua Blanca Creek, which is located approximately one mile upstream from the Blue Point Campground. The contributing watershed area to Lake Piru is approximately 425 square miles (USGS 1968).

Downstream of Lake Piru, the creek continues south approximately 6 miles to its confluence with the Santa Clara River. The lower portion of Piru Creek consists of a relatively low gradient, broad alluvial valley surrounded by agricultural land use. Lower Piru Creek has been altered from an intermittent drainage to a perennial drainage by sustained base flows. The flow regime has varied since completion of the Santa Felicia Dam in 1956 as water resource management strategies have evolved. Major tributaries below Lake Piru include Modelo Canyon, Holser Canyon, Lime Canyon, Blanchard Canyon, and five unnamed tributaries.

2.3 Geology and Soils

The Piru Creek watershed is located in the Transverse Ranges physiographic province. This geologic province is composed of parallel, east-west trending mountain ranges and sediment-filled valleys that are principally composed of a variety of consolidated marine and terrestrial sedimentary and volcanic rocks of Late Cretaceous through Quaternary age. The Transverse Ranges are relatively young in geological terms and are tectonically active with recent uplift and erosion. In general, the geology of the watershed consists of areas of highly erodible and highly resistant formations which results in broad alluvial subbasins alternating with gorges incised in bedrock (USGS 1968).

The basin is bisected by the northwest-trending San Gabriel Fault which intersects Piru Creek approximately two miles downstream of Pyramid Lake (USGS 1968). The portion of the watershed situated above Pyramid Lake, between the San Gabriel and San Andreas Faults, is formed by the Ridge stratigraphic basin (USGS 1968). This basin is composed of non-marine sedimentary groups of Miocene and Pliocene age which are generally soft and readily erodible (USGS 1968). The geology of the watershed situated between Pyramid Lake and Lake Piru is predominantly composed of Mesozoic granitic rock and Eocene marine sedimentary units and the geology of the watershed situated downstream of the Project is predominantly composed of Upper Miocene and Upper Pliocene marine units. The predominant formations within the watershed situated between Pyramid Lake and the Santa Clara River include the Sespe Formation comprised of interbedded sandstone and claystone and the Vaqueros Formation comprised of marine sedimentary strata. Other formations in the region include the Modelo, Pico, and San Pedro (Saugus) Formations.

Major soil formations occurring in the Project area include: cortina stony sandy loam, metz loamy sand, mocho clay loam, and anacapa sandy loam. These soil formations are predominantly derived from sedimentary parent rock and are typically found on valley floors and alluvial fans with slopes ranging from 2 to 15 percent. Coarse sand and gravel alluvium occurs throughout the Piru basin and extends to a depth of approximately 60-80 feet below ground surface. The underlying San Pedro Formation consists of permeable sand and gravel that reaches depths of approximately 8,000 feet below ground surface (UWCD 2000). Permeability is typically rapid to moderately rapid with slow surface runoff and the erosion hazard rating is moderate to high.

2.4 Hydrology of Lower Piru Creek

The hydrology of lower Piru Creek is best described in terms of pre-Project and post-Project conditions. For lower Piru Creek, pre-Project conditions consist of the period prior to the construction of the Project in 1955 and post-Project conditions reflect the regulated flow regime associated with the operations of Santa Felicia Dam and the Pyramid Reservoir Project, which was constructed in 1972. The following characterization of the hydrology is based on the information provided in *Section 2.3 Report on Hydrology* of the FERC Exhibit E relicensing documentation. Pre-Project conditions are described using the data collected at USGS Gauge No. 11110000 between 1928 and 1955, and post-Project conditions are characterized using the data collected at USGS Gauge No. 11109800 between 1956-1968 and 1974-2002. Since the winter of 2011, Project operations and associated flow releases have changed substantially in accordance with the *Santa Felicia Water Release Plan* (UWCD 2012) which includes provisions for increased minimum flows during normal and wet water years as well as minimum migration releases of 200 cfs under certain conditions.

In lower Piru Creek, downstream of the Project, the pre-Project hydrology is best characterized as “flashy” with the highest flows occurring between January and April in response to seasonal storm events and the lowest flows occurring in July through October at the end of the dry season. In regard to the monthly mean streamflows, the highest occurred in March at approximately 207 cfs and lowest occurred in August at approximately 5.6 cfs. Depending on the water year, lower Piru Creek also went dry for periods during the dry season. The results of the flood frequency analysis for pre-Project flows in lower Piru Creek indicated 2-year, 5-year, and 10-year recurrence interval flows of 2,086 cfs, 6,924 cfs, and 12,908 cfs, respectively.

An analysis of the post-Project hydrology for lower Piru Creek indicates more consistent flows year-round and a change in the timing of annual extreme flows in comparison to the pre-Project conditions. Under post-Project operations prior to implementation of the *Santa Felicia Water Release Plan* (UWCD 2012) during the winter of 2011 and with the exception of spill events which occur approximately every 5 years on average, the highest mean monthly flows occurred in September and October in response to the annual conservation water release rather than between January and April in response to seasonal storm events, and the lowest mean monthly flows occurred between December and March rather than July through October at the end of the dry season. In regard to the monthly mean streamflows, the highest occurred in September at approximately 114 cfs and lowest occurred in January at approximately 12.4 cfs. The results of the flood frequency analysis for post-Project flows in lower Piru Creek indicated 2-year, 5-year, and 10-year recurrence interval flows of 379 cfs, 521 cfs, and 618 cfs, respectively. It should be noted that the post-Project flood frequency analysis does not account for spills from Piru Reservoir since the USGS stream gauge is situated upstream of the confluence of the spillway and the creek. Between the commencement of Project operations in 1956 and 2005, a total of ten spill events (1969, 1978, 1979, 1980, 1983, 1992, 1993, 1995, 1998, and 2005) have occurred at the dam. The spill records indicate that total mean daily flows (i.e. releases and spills) in excess of 1,000 cfs occurred in lower Piru Creek in 1969, 1978, 1980, 1983, 1993, 1995, 1998, and 2005 for periods ranging from two days in 1983 to 16 days in 1993. Total mean daily flows between 500 and 1000 cfs occurred in each of the recorded spill years for periods ranging between two days in 1992 and 36 days in 1983.

2.5 Geomorphology of Lower Piru Creek

The geomorphology of lower Piru Creek was characterized during the FERC hydroelectric relicensing process and is presented in *Section 2.4 Report on Geomorphology* of the FERC Exhibit E relicensing documentation. The characterization included an evaluation of pre-Project and post-Project channel conditions, the segregation of lower Piru Creek into three representative stream reaches based on the planform and fluvial features of the channel, an estimate of bankfull discharge and riparian maintenance flows, and a description of the sediment transport regime. This information is summarized below. The stream reaches and referenced stationing along lower Piru Creek (based on distance from the confluence with the Santa Clara River which is designated as River Miles [RM] 0.0) are shown in Figure 1.

2.5.1 Evaluation of Pre-Project and Post-Project Channel Conditions

In 2004, an evaluation of the pre- and post-Project channel conditions in lower Piru Creek was conducted using aerial photographs. The pre-Project aerial photograph was taken in March 1949, approximately 7 years prior to construction of the Project, and the post-Project aerial photograph was taken in 2002. The pre-Project aerial photograph is presented in Figure 2 and the post-Project aerial photograph is shown in Figure 1.

The 1949 photograph depicts a braided channel with multiple channel braids situated within a largely unvegetated and wide braid plain. As is typical for braided channel morphology, the locations of the individual channel braids would likely have laterally shifted often in response to peak flows and erosion and deposition of sediment. The lower portion of Piru Creek near the confluence with the Santa Clara River is much larger than the present day channel and appears to laterally migrate throughout present day agricultural fields. The channel appears to meander through the valley with remnant and high flow/side channels present between RMs 1.7 and 3.0 and significant braiding occurs between RMs 4.3 and 5.3.

The present-day Piru Creek channel appears significantly different than the 1949 channel. The current channel is confined to a narrower zone with reduced lateral migration due to encroachment of the historic braid plain by agriculture fields and Piru Canyon Road. In many areas, the encroachment appears to have contributed to channel incision and disconnect from former floodplain surfaces. The regulated flow regime in lower Piru Creek also appears to have allowed encroachment of the channel by riparian vegetation that further restricts lateral movement and loss of channel complexity. Comparison of the 1949 and 2002 photographs depicts a simplification of channel pattern over the past 50 plus years. Channel braiding is greatly reduced with much of the channel having only a single thread, sometimes with high-flow channels only active during flood events. Large areas of the 1949 photograph that appear within the active channel braid zone are now terrace features 10 feet or higher above the channel. When the dam was constructed the channel downstream of the dam was relocated to the east side of the valley where it now conveys flow released from the dam outlet valve. A spillway channel was also constructed on the west side of the valley. Even though the lower portion of the channel near the confluence with the Santa Clara River has been confined by agricultural fields, it still exhibits a braided channel pattern more similar to the 1949 channel than in channel reaches upstream.

2.5.2 Stream Reach Classification

Rosgen Level I and II methodologies (Rosgen 1996) were used to stratify lower Piru Creek into three representative stream reaches according to the Rosgen classification system (Rosgen 1996). The stream reaches and associated stationing along lower Piru Creek are shown in Figure 1 and are described below.

RM 0.0 to RM 1.7 - Rosgen D3-Type Channel

This reach was designated as a Rosgen D3-type channel that may be trending towards an F-type channel as a result of channelization. The channel is described as consisting of a relatively wide and shallow braided channel with plane bed/pool-riffle morphology. Sediment storage is present in floodplain areas and in lateral and mid-channel bars. The streambanks along this reach are primarily composed of silt/clay and sand and are unstable in areas with slumping occurring. Riparian vegetation in this reach is primarily composed of alder, willow, mulefat, and perennial herbaceous species which are situated along the streambanks, in floodplain and bar areas, and between braided channels. The density of riparian vegetation ranges from low in the lower portion of this reach below the railroad trestle at RM 1.30 to high between RM 1.30 and RM 1.7. Pebble count results along this reach indicate a D_{16} particle size in the sand/fines range (less than 2 millimeter [mm]), a D_{50} particle size in the very coarse gravel range (between 45 and 64 mm), and a D_{80} particle size in the small cobble range (between 90 and 128 mm). Field observations of embeddedness indicate that the gravel and cobbles are significantly embedded by sand and fines. The grain size analysis results of a fine sediment sample collected in this reach indicated a composition of approximately 24 percent sand and 76 percent silt/clay.

RM 1.7 to RM 3.0 - Rosgen C4/C6-Type Channel

This reach was designated as a Rosgen C4/C6-type channel with a relatively wide and shallow channel with plane bed/pool-riffle morphology. High flow/side channels are present throughout the reach. Rancho Temescal diverts water in the lower end of this reach by pumping water from an impound located at approximately RM 1.7. The influence of this impound extends from approximately RM 1.7 to RM 1.9. Sediment storage is present in floodplain areas and bars. Riparian vegetation is present at a moderate to high density and consists of willow, alder, mulefat, and perennial herbaceous species which are present along the streambanks, floodplain areas, and between channels. Pebble count results along this reach indicate a D_{16} particle size in the sand/fines range (less than 2 mm), a D_{50} particle size ranging between the sand/fines range (less than 2 mm) and the very coarse gravel range (between 32 and 45 mm), and a D_{80} particle size ranging between the coarse gravel range (between 22.6 and 32 mm) and the small cobble range (between 90 and 128 mm). Field observations of embeddedness indicate that the gravel and cobbles are significantly embedded by sand and fines. The grain size analysis results of a fine sediment sample collected in this reach indicated a composition of approximately 1 percent gravel, 94 percent sand, and 5 percent silt/clay.

RM 3.0 to RM 6.0 –Rosgen Bc3-Type Channel

This reach was designated as a Rosgen Bc3-type channel with a relatively wide and shallow channel with plane bed/pool-riffle morphology. High flow/side channels are present throughout much of this reach with the exception of between approximately RMs 3.1 and 3.5 which flows between a steep bedrock slope along the left bank and a constructed levee along the right bank and RMs 4.0 and 4.2 which flows between Piru Canyon Road on the left bank and a steep bedrock slope on the right bank. Sediment storage is present in floodplain areas and bars. The streambanks appear relatively stable with some unstable areas along the release channel situated downstream of the dam. Riparian vegetation is present at a moderate to high density and consists of willows, shrubs, and perennial herbaceous species which are primarily present along the streambanks, floodplain areas, and between channels. Pebble count results along this reach indicate a D_{16} particle size between the sand/fines range (less than 2 mm) and the medium gravel range (between 11.3 and 16 mm), D_{50} particle sizes ranging the coarse gravel range (between 22.6 and 32 mm) and the small cobble range (between 64 and 90 mm), and D_{80} particle sizes ranging between the small cobble range (between 90 and 128 mm) and the large cobble range (between 128 and 180 mm). Field observations of embeddedness indicate that the gravel and cobbles are moderately embedded by sand and fines. The grain size analysis results of fine sediment samples collected in this reach indicated a composition primarily within the sand range with minor percentages of silt/clay.

2.5.3 Sediment Transport Regime

The following presents a description of the sediment sources in lower Piru Creek and a conceptual framework of the sediment transport regime as described in *Section 2.4 Report on Geomorphology* of the FERC Exhibit E relicensing documentation.

Sediment Supply

The sediment supply to lower Piru Creek is limited as both Pyramid Reservoir and Piru Reservoir trap sediment transported from the upper Piru Creek Watershed. Approximately 75 percent of Piru Creek's total watershed area is situated upstream of Santa Felicia Dam. Based on storage capacity surveys, the storage volume in Lake Piru has decreased approximately 18,000 AF between 1957 and 2005, and approximately 7,700 AF between 1975 and 2005 after the construction of Pyramid Lake in 1972 (Appendix A). These data indicate that on average approximately 257 AF per year of sediment is trapped behind Santa Felicia Dam from the watershed area situated between Pyramid Lake and Lake Piru. The watershed area between Pyramid Lake and Lake Piru is approximately 141 square miles, and based on the Lake Piru storage data from 1975 to 2005, the approximate sedimentation rate within this watershed area is approximately 1.8 AF per square mile per year. Since sediment in Lake Piru is isolated behind the dam, the sediment supply to lower Piru Creek is limited to contributing sources situated downstream of the Project. Based on the estimated sedimentation rate from the Lake Piru storage data and the effective watershed area situated downstream of the Project (i.e. lower Piru Creek, approximately 15 square miles), the estimated sedimentation rate for lower Piru Creek is approximately 27 AF per year.

The primary sources of sediment supply to lower Piru Creek consists of in-channel sources associated with channel incision and bank erosion, sediment delivered by tributaries and small drainages situated downstream of the Project, and direct input by surface runoff from developed and undeveloped land in the lower watershed.

In regard to in-channel sediment sources, the most prominent areas of bank erosion and channel incision were observed between approximately RMs 0.0 and 1.3, and RMs 5.4 and 6.0. The reach situated between RMs 0.0 and 1.3 flows adjacent to agricultural property and the streambanks are unstable in areas with active slumping occurring. These streambanks are primarily composed of fine-grained material. The reach situated between RMs 5.4 and 6.0 consists of the release channel from Santa Felicia Dam and appears to be incised. The streambanks are comprised of alluvial and colluvial material and are unstable in areas. These areas appear to deliver a range of substrate including fines, sand, gravels, and cobbles.

The tributaries and small drainages situated downstream of the Project likely represent the most significant source of sediment to lower Piru Creek. These tributaries include Modelo Canyon, Holser Canyon, Blanchard Canyon, Lime Canyon, and five unnamed drainages. The drainages are intermittent with surface flows occurring in response to seasonal rainfall events. Accordingly, sediment delivery from these areas is primarily limited to the wet season between November and April of each year. Based on observations during field reconnaissance surveys, Holser Canyon, Modelo Canyon, and an unnamed drainage situated directly below the dam deliver the highest volumes of sediment to lower Piru Creek. These drainages, as well as the other local drainages, appear to primarily contribute fine silts, sands, and to a lesser degree, small gravels.

Besides tributary inputs, several areas adjacent to the creek provide direct sediment inputs due to surface erosional processes. The most prominent areas of localized surface erosion occur between RMs 3.0 and 3.6 and RMs 4.0 and 4.5. Steep bedrock slopes are present along the left bank between RMs 3.0 and 3.6 and the right bank between RMs 4.0 and 4.5. These bedrock slopes are composed of weathered mudstone and active erosion was observed in these areas. Surface erosional processes including direct precipitation, overland flow, and wind along these slopes, and in other areas with limited vegetation deliver primarily fines, sand, and gravel material but also larger substrate directly to the stream channel.

In addition to the aforementioned sediment supply sources, drainage from developed areas also contributes sediment to the channel. These areas include culverts associated with roadways, drainage along unpaved roads, and drainage from agricultural operations along the lower Piru Creek channel.

Conceptual Framework of Sediment Transport Regime

The change in the hydrologic regime associated with Project operations has also modified the sediment transport regime in lower Piru Creek. As discussed previously, the primary sources of sediment to lower Piru Creek are the tributary drainages situated downstream of the Project. These drainages deliver sediment to the channel during the wet season through runoff associated with storm events. During the wet season, Project flow releases to lower Piru Creek are fixed based on rates specified in the FERC license for the Project and do not mimic the “flashy” nature of flows in the tributaries. Accordingly, with the exception of years with ample spill events, flows in lower Piru Creek are typically not sufficient to transport the sediment delivered to lower Piru Creek by the tributaries during wet season storm events which results in deposition of sediment in the lower Piru Creek channel. This deposition of sediment impacts instream habitat by filling-in pools, thereby reducing available rearing habitat, and in-filling riffles with fine sediment and sand which impacts spawning habitat. Except during years with ample spill events, this sediment remains in the lower Piru Creek channel until the annual conservation releases in September and October which serve to mobilize and transport the material through the system. In moving forward, the *Santa Felicia Water Release Plan* (UWCD 2012) adopted in 2012 includes provisions for increased minimum flows during normal and wet water years as well as minimum migration releases of 200 cfs under certain conditions which should enhance the transport and flushing of sediment through lower Piru Creek during the wet season in the future.

2.6 Aquatic Habitat

Aquatic habitat in lower Piru Creek was characterized during the FERC hydroelectric relicensing process and is presented in *3.1 Report on Aquatic Resources* of the FERC Exhibit E relicensing documentation. The description of aquatic habitat was based on the results from a habitat survey conducted in August 2003. The estimated flow at the time of the habitat survey was 6.0 cfs (USGS 2004). Aquatic habitat results from data collected in 2003 are not currently valid as a result of the 2005 spill event that dramatically altered the morphology of lower Piru Creek. Regardless, these results characterize habitat conditions that occurred in the absence of flushing flows (ample spill event) since 1998. The results of the 2003 survey are summarized below.

Mesohabitat

The primary habitat composition within lower Piru Creek was riffles (32 percent), runs (32 percent) and scour pools (36 percent). Although the proportion of riffle habitat was 32 percent, these habitats were the limiting functional mesohabitat type in lower Piru Creek based on the low percentage of high quality riffles. The representative riffle habitat in lower Piru Creek can be characterized as low gradient (between one to two percent), layered with fine particulate organic matter (FPOM) and silts, and with little turbulence at lower flows. Water temperatures ranged from 16.5 to 29.5°C during the August 2003 habitat assessment in lower Piru Creek.

Pools

The mean pool depth for the majority of pools in lower Piru Creek below the release channel was 1.5 feet with a range of 0.3 feet to 4 feet. The mean maximum depth for all pools in lower Piru Creek was 2.6 feet with a range of 0.5 feet to 6 feet. The average length of pool habitat ranged was 124.8 feet with a range of 10 feet to 922 feet. On average the pools were shallow and inundated with FPOM and silts. Pools in the upper reach of lower Piru Creek (the release channel and the borrow area) were deeper than those downstream. These deeper pools also consisted of deep undercuts scoured by the presence of exposed root wads.

Cover

Instream cover available for fish in lower Piru Creek was limited in quantity due to highly embedded large substrate and a lack of undercut banks, surface turbulence, and terrestrial vegetation. Instream cover that was present in lower Piru Creek during the survey consisted primarily of boulders, small woody debris, and aquatic vegetation with few undercut banks. Although lower Piru Creek is densely bordered with riparian vegetation, most of the channel lacks canopy cover. On average, canopy cover was less than 5 percent within lower Piru Creek compared to a range from less than 5 to 80 percent within the release channel.

Substrate

The dominant substrate in lower Piru Creek consisted of boulder and cobble. At the time of the survey, this substrate was highly embedded with organic material and fine sediment. This exposed substrate was still highly embedded after the annual fall conservation release. Based on observations at the Instream Flow survey sites, the Piru Fire (October 2003), which burned 63,991 acres, increased the amount of fine sediment in lower Piru Creek.

Spawning Gravel

Spawning gravel was sparse in lower Piru Creek during the August 2003 habitat survey. As stated previously, most habitat units were layered with organic material and fine sediment. Gravel substrate that was observed was of poor quality for spawning because of excess fine sediments. Due to the presence of fine sediment throughout most of lower Piru Creek, the amount of spawnable gravel available to steelhead or resident rainbow trout during the time of the survey was close to zero.

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Chapter 3

Methods for Field Study Components

This section describes the methods used in implementing the field components of the Geomorphology Study. For the most part, the study followed the scope and methods outlined in the Geomorphology Study Plan. However, given the change in implementation strategy and the associated magnitude of the flow events, it was not practical and/or feasible to implement certain aspects of the study plan due to field conditions, safety issues, or both. Specifically, it was not practical to install scour chains or infiltration bags due to the channel bed armoring, and it was not feasible to collect instream flow measurements or sediment transport data during high flow release events due to safety concerns.

3.1 Field Reconnaissance Surveys and Selection of Study Sites

Field reconnaissance surveys were conducted along lower Piru Creek to assess and characterize current stream conditions and select representative Study Sites. An initial survey was conducted on March 24, 2011 and included representatives from United and NMFS. During this survey, excessive turbidity and sediment deposition were observed in the lower portion of the creek, below RM 4.5 (see Figure 1) and encompassing a portion of geomorphic reach Bc3 and downstream geomorphic reaches C4/C6 and D3. Most of this section of lower Piru Creek is also known to have high water temperatures and limited vegetative cover. Based on these findings, the Study Sites identified in the Geomorphology Study Plan were modified, with concurrence from NMFS, to focus on portions of the creek that were identified as having the greatest potential to provide suitable conditions for spawning and rearing habitat.

Accordingly, a second field reconnaissance survey was conducted on May 10, 2011 to identify and select Study Sites in the upper portions of lower Piru Creek where more suitable spawning and rearing habitat were identified. A total of four Study Sites were selected based on the following criteria: safe access, physical geomorphic features, quality of steelhead spawning and rearing habitat, and representativeness of channel type in consideration of upstream and downstream conditions. With concurrence from the NMFS representative present during the survey, four sites (Study Sites 1 through 4) were selected for the Geomorphology Study. Study Sites 1 through 3 were selected for implementation of the full scope of the Geomorphology Study and Study Site 4 was selected for a modified scope that included installation of one cross-section to evaluate temporal changes in bed degradation-aggradation and substrate composition. The proposed Study Sites and modifications to the initial scope of work were developed in conjunction with NMFS and were submitted to FERC in a letter dated August 9, 2011 for their subsequent approval. Study Site locations and characterizations from the field reconnaissance surveys are provided below.

Study Site 1

Study Site 1 is located between RM 5.8-5.9 as measured upstream from the confluence of the Santa Clara River, approximately 1,000 feet downstream of the outlet works at Santa Felicia Dam, and 0.5-miles upstream of the spillway confluence with lower Piru Creek (Figure 1). The site is situated in a portion of lower Piru Creek that was constructed as part of the Project. The site consists of pool-riffle morphology and includes seven cross-sections (XS-1 through XS-7) spaced over 230 feet. Specifically, the cross sections are located in the following habitats:

- XS-1 (the most upstream cross-section) – situated at a riffle crest;
- XS-2 – situated at a riffle tail;
- XS-3 – situated in a relatively shallow pool;
- XS-4 – situated at a riffle crest;
- XS-5 – situated across a low gradient riffle;
- XS-6 – situated in the approximate center of a lateral scour pool situated at a 90-degree bend in the channel; and,
- XS-7 – situated at a riffle crest.

The channel bed substrate varies from clean cobble and gravel on the riffles to sand with gravel in the pool at XS-7. A long profile was surveyed beginning at the concrete weir at the USGS stream gaging site (USGS Gage No. 11109800) and extending 100 feet downstream of XS-7 (Figure 3). The first 400 feet of the long profile show a plane bed channel with a relatively flat slope. The riffle starting at XS-1 continues through XS-2 and into a 1.5-feet deep pool at XS-3. Another riffle crest is located at XS-4 and the channel transitions through a low gradient riffle at XS-5 and into a 2.5 feet deep pool at XS-6. The pool quickly transitions into another steep riffle crest at XS-7. Study Site 1 contains a relatively deep pool on an approximate 90 degree bend in the channel between XS-5 and XS-7. The channel bed in Study Site 1 is situated approximately 6-9 feet below the terrace elevations along the adjacent banks. The overall bed slope along this site is 0.83 percent through the cross-sections and the channel width measured between the top of banks varies from 50-75 feet. A large gravel and cobble side bar is located along the right bank from XS-1 to XS-3 and a smaller and finer textured point bar with sand and gravel is located on the inner bend at XS-6. At XS-7, the low-flow channel is situated adjacent to the right bank and at higher flows the channel splits around a mid-channel island to flow along both the left and right banks. Relatively dense riparian vegetation is present along this site except for the right bank between XS-1 to XS-3 which consists of a graded staging area. The stream channel from XS-7 to approximately 0.2-miles downstream (RMs 5.7 to 5.8) is significantly braided with multiple channels that run through a densely vegetated area providing thick canopy cover and shading. These channels are typically composed of long runs and short scour pools, many of which were fairly deep (up to an estimated 8-feet). Downstream, from RM 5.7 to 5.6, pools became infrequent and the channel continues to braid through dense riparian vegetation heavily impacted by cattle grazing. At approximately RM 5.6, the channel converges into a single channel and the gradient increases relative to the upstream area and flows through a mature cottonwood forest with an increased occurrence of riffles.

Study Site 2

Study Site 2 is located between RM 5.2-5.3, approximately 0.7 miles downstream of the Santa Felicia Dam outlet works, and approximately 0.1 miles downstream of the confluence of the spillway channel (Figure 4). This site is situated in an active cattle grazing area and impacts of grazing were present throughout the site. The site consists of pool-riffle morphology and includes five cross-sections (XS-1 through XS-5) spaced over 380 feet. Specifically, the cross sections are located in the following habitats:

- XS-1 (the most upstream cross-section) – situated at a riffle crest;
- XS-2 – situated at a riffle tail;
- XS-3 – situated in a pool;
- XS-4 – situated near the tail of the pool; and,
- XS-5 – situated across a low gradient riffle.

The channel bed substrate is diverse with cobble and gravel material found on the riffles and sandy gravel underlying silt in the pool. In some sections, particularly along the channel margins, thick silt deposits compose the surface and sub-surface material. A long profile was surveyed beginning 530 feet upstream of XS-1 and extending 200 feet downstream of XS-5 (see Figure 4). An approximately 400-foot long shallow pool situated upstream of Study Site 2 transitions into a steep riffle crest at XS-1. The riffle continues through XS-2 and then forms a long pool roughly 1.75 feet deep. The next cross-section, XS-3 is located near the head of the pool and XS-4 is located near the pool tail. The pool tail transitions into a riffle at XS-5. This downstream riffle has a milder gradient compared to the riffle at XS-1 and XS-2. The site consists of a 50-75 feet wide low-flow channel with a 5-8 feet high terrace on the right bank. The left bank of the low-flow channel consists of cobble and gravel bar that is approximately 2-3 feet high and 75-125 feet wide. This bar contains a secondary high-flow channel along the left margin and, during higher flow events, the high-flow channel and most of the bar become inundated. The low-flow channel is slightly sinuous, but at high flow conditions the flow path through this site is generally straight. Riparian vegetation is relatively dense along the right bank while the left bank has moderate willow growth with sections of bare banks. Young willow less than 10 feet tall are established along the bar that separates the low-flow channel and the secondary high-flow channel. Approximately 100 feet downstream of XS-5, the stream channel braids into two-parallel channels, with the channel along the right bank containing the majority (estimated 70 percent) of the flow. This channel was relatively straight and confined between steep banks composed of cobbles and boulders. Much of the length of the channel along the right bank was heavily inundated with fine silt, often up to 5-8 inches deep, within the lowflow channel and along the channel margins. Evidence of heavy cattle grazing was observed in the channel along the right bank. Patches of cattails were common and the cobble/boulder banks had moderately dense stands of mule fat. The channel along the left bank had limited flow and primarily consisted of a long series of wide approximately 30-feet on average), shallow (maximum depth approximately 15 inches) glides. Substrate primarily consisted of cobbles covered with an overlying layer of fine silt. At several locations, evidence of underwater geothermal outflow was observed (discolored substrate, sulfuric odors). Thick riparian vegetation was present along both banks of the channel on the left bank.

Study Site 3

Study Site 3 is located between approximately RM 4.7-4.8, approximately 1.3 miles downstream of the Santa Felicia Dam outlet works, and approximately 0.6-miles downstream of the confluence of the spillway channel (Figure 5). The channel consists of plane bed and riffle morphology and includes six cross-sections (XS-1 through XS-6) spaced over 340 feet. Specifically, the cross sections located in the following habitat:

- XS-1 (the most upstream cross-section) – situated at transition from pocket water to a step-run;
- XS-2 – situated in a step run;
- XS-3 – situated in a step run;
- XS-4 – situated in a pocket water;
- XS-5 – situated in a pocket water; and,
- XS-6 – situated in pocket water.

The substrate at this site consists of coarse material with boulder and cobble substrate throughout the reach. During the initial survey, surficial silt and sand deposits were present overlying the cobble and boulder substrate in the lower portion of the site. A long profile was surveyed beginning 310 feet upstream of XS-1 and extending 520 feet downstream of XS-6 (see Figure 5). The upper end of the long profile consists of a steep riffle that transitions into a 200 feet long section of plane bed channel (pocket water) with at XS-1 positioned at the lower end. The confluence of a drainage channel from Blanchard Canyon is situated along the right bank approximately 50 feet downstream of XS-1. A series of steeper step runs extend for approximately 210 feet from XS-1 to XS-4 and then the channel returns to plane bed morphology through XS-5 and XS-6 and extending downstream to the bridge at Piru Canyon Road. The site is defined by a 40-50 feet wide low-flow channel with a 7-9 feet high terrace on the left bank. The left terrace is over 100 feet wide and composed of a mixture of boulder, cobble, gravel, and sand material. The right bank is over 10 feet high and composed of boulder and cobble material. A narrow floodplain, approximately 50-75 feet wide, is located right of the low-flow channel from XS-3 to XS-6. The floodplain slopes down to the low-flow edge or water and is inundated quickly as flows increase. The flow paths through the reach are straight during low and high flow conditions. Riparian vegetation is sparse to moderate throughout the reach. The left and right banks have moderate willow growth on the cobble and boulder banks. Young willow less than 10 feet tall are established on the right floodplain. The confluence of Holser Canyon is located approximately 500 feet downstream of XS-6, immediately downstream of the Piru Canyon Road bridge. The stream channel from the Piru Canyon Road bridge to approximately 0.35-miles downstream (RMs 4.25 to 4.6) consists of a single thread channel dominated by long runs and low gradient riffles with sandy gravel substrate prior to the flow releases. After the monitored flow releases, much of the sand was flushed through and the channel changed to consist of long gravelly runs in-between stretches of scoured bedrock “ridges” that formed more complex habitat of pools, riffles, and runs. The high terraces present upstream of the bridge are not present downstream of the bridge, but the stream was still relatively confined between earthen banks with intermittent stands of mulefat.

Study Site 4

Study Site 4 is located near RM 3.8-3.9, approximately 2.2 miles downstream of the Santa Felicia Dam outlet works, and approximately 1.8-miles downstream of the confluence of the spillway channel (see site layout in Figure 6). The channel at this site has pool-riffle morphology with an overall bed slope of 0.56 percent through reach. The substrate varies with sandy gravel on the riffle and plane bed sections and finer textured sand in the pool. Silt deposits are minimal in the active low-flow channel. A long profile was surveyed beginning 260 feet upstream of XS-1 and extending 330 feet downstream of XS-1 (see Figure 6). The upper end of the long profile consists of a long run up to 1.5 feet deep that transitions into a long glide with XS-1 located at the downstream end. A run-riffle complex extends for 100 feet through a small section of split channel flow around a mid-channel bar. The downstream end of the reach consists of plane bed morphology. The low-flow channel is approximately 35 feet wide. An approximately 50-foot wide floodplain is located along the left bank of the low-flow channel and is situated at an elevation of approximately 1-foot above the low-flow channel. This floodplain area has a high-flow channel situated on the far left margin that is activated as flow increases above low-flow conditions. Further increases in flow lead to inundation of the entire left floodplain area. A smaller floodplain feature, less than approximately 15 feet wide, is present along the right bank and is also inundated as flow increases above low flow conditions. The flow path through the reach is slightly sinuous at low flow conditions and generally straight at higher flows. Riparian vegetation is dense on the hillslopes along both the left and right banks and the left floodplain has moderate to dense willow growth less than 10 feet tall.

3.2 Flow Release Events and Flows During Field Surveys

As previously mentioned, the scope of work in the Geomorphology Study Plan involved collecting data prior to and after the annual conservation release to evaluate changes in channel conditions associated with the conservation release, during the wet season to evaluate changes in channel conditions associated with runoff events, and at the end of the wet season to characterize channel conditions. However, in consultation with NMFS and in consideration of access limitations along lower Piru Creek, the scope was modified to consist of collecting data prior to and following two release events, an approximately 400 cfs release during the annual conservation release and, following the conservation release, a second release event with a targeted maximum flow of approximately 600 cfs. The conservation release was conducted between September 12, 2011 and October 28, 2011. Prior to this release event, initial field surveys were conducted between August 30 and September 1, 2011 to characterize pre-release channel conditions. The channel flow during the initial survey was approximately 7 cfs, and, during the conservation release event, the highest recorded flow was 425 cfs. The flow was then reduced to below 20 cfs between October 28 and November 2, 2011 to facilitate data collection following the conservation release. This data collection effort was conducted between October 30 to November 1, 2011 at flows of approximately 12 cfs to characterize potential changes in channel conditions following the conservation release and prior to the second release event. The second release event was conducted between November 2 and November 9, 2011 and, during this release, the highest recorded flow was 591 cfs. Following the second release event, field surveys were conducted between November 7 to November 9, 2011 at flows ranging between 15-20 cfs to characterize potential changes in channel conditions due to the event. The provisional flow data collected during the period of these release events is provided in Appendix B.

3.3 Topographic Surveying of Channel Morphology

Cross-section and longitudinal profile surveys were conducted at each Study Site to characterize general channel conditions, evaluate changes in channel geometry, and assist in hydraulic model preparation. At Study Sites 1 through 3, the surveys included the cross-sections described in Section 3.1, one longitudinal profile, and additional survey points within the pool habitat, where present, at each Study Site. At Study Site 4, one cross-section and a longitudinal profile were surveyed to evaluate temporal changes in bed degradation-aggradation and substrate composition as discussed in Section 3.1. The surveys were performed during low flow conditions when the channel could be safely accessed and traversed. A total of three topographic surveys were conducted at each site as follows: 1) prior to the conservation release between August 30 and September 1, 2011 to characterize pre-release channel conditions; 2) following the conservation release between October 30 to November 1, 2011 to characterize potential changes in channel conditions following the conservation release and prior to the second release event; and, 3) following the second release event between November 7 to November 9, 2011 to characterize potential changes in channel conditions following this event.

The cross-sections were surveyed from left bank to right bank, looking downstream using a total station and prism. At each cross-section, rebar headpins were installed at the endpoints on each bank and fiberglass tapes were strung between the headpins to define the alignment of the survey, thus ensuring that all three surveys of each cross-section followed the same alignment and could be directly compared. The surveyed cross-section widths extended from left to right top of the high bank, perpendicular to the high flow path, and included survey shots on all major breaks in grade, including left and right edge of water shots, notable changes in sediment texture, and high water marks. At Study Sites 1 through 3, which included multiple cross-sections, the elevations at each cross-section were tied to a common datum. A Trimble GeoXT GPS unit was used to map the locations of the benchmarks used in the surveys at each site in order to georeference the total station data and plot on the orthophoto images shown in the site maps (see Figure 3-6).

At Study Sites 1 through 4, longitudinal profiles were surveyed over a distance of approximately 10 times the bankfull channel width and included definition of the channel thalweg and water surface elevation, positions at approximately every 10-15 feet along the profile, at major breaks in grade, and changes in geomorphic units (e.g. riffle crests, maximum pool depths). A habitat inventory survey was also conducted and habitat types were defined following the methodology in the California Salmonid Stream Habitat Restoration Manual (Flosi et al. 1998). The habitat survey was performed by walking the length of the longitudinal profile survey, identifying each habitat type, and measuring each unit’s length along the longitudinal profile.

Finally, additional survey points were collected within the pools present at Site 1 and Site 2 to provide sufficient data for generating topographic contour maps of each pool. These data were used to evaluate fine sediment scour/deposition following flow events.

3.4 Pebble Counts

Sediment characteristics at each Study Site were analyzed by conducting pebble counts of the bed surface particle size. The objective of the pebble counts was to characterize and evaluate potential changes in substrate following the 425 cfs and 591 cfs release events. Accordingly, a total of three pebble count surveys were conducted at each cross-section as follows: 1) prior to the conservation release between August 30 and September 1, 2011 to characterize pre-release substrate conditions; 2) following the conservation release between October 30 to November 1, 2011 to characterize potential changes in substrate following the conservation release and prior to the second release event; and, 3) following the second release event between November 7 to November 9, 2011 to characterize potential changes in substrate following this event.

The pebble counts were conducted in accordance with the modified Wolman (1954) pebble count method. Particles were randomly selected across the channel bed between the bottom of the left and right banks using the “first blind touch” method. A minimum of 100 different particles were measured at each cross-section. Each particle was measured on the intermediate axis (b-axis) using a ruler or gravelometer. Particle sizes greater than 256 mm were classified as a boulder and all clay, silt, and sand-sized particles were classified as “less than 2 mm”. The pebble count data was used to prepare cumulative particle size distribution curves, and the final classification of dominant particle size (i.e. sand, gravel, cobble, or boulder) for each Study Site was determined by calculating the most frequent particle size class present (as represented in the frequency histograms). The pebble count data was collected at the same time as the cross-section and longitudinal profile surveys under low flow conditions when the channel could be safely accessed and traversed.

3.5 Bulk Sampling

Bulk sampling of spawning-size gravel at Study Sites 1 through 3 was conducted to characterize and evaluate the quality of spawning gravels following the 425 cfs and 591 cfs release events. Two bulk samples of spawning-size gravels were collected at Study Sites 1 through 3 as follows: 1) prior to the conservation release between August 30 and September 1, 2011 to characterize pre-release conditions; 2) following conservation release between October 30 to November 1, 2011 to characterize potential changes following the conservation release and prior to the second release event; and, 3) following the second release event between November 7 to November 9, 2011 to characterize potential changes following this event.

The samples were collected at selected riffles at each site with gravel substrate conditions most suitable for spawning habitat. Samples were collected from the same riffles following the release events to evaluate potential changes in particle size composition. The samples were collected using a bottomless 5-gallon bucket that was worked into the bed to define the sampling area. Sediment within the defined sampling area was excavated from the bed to approximately 12-18 inches below the bed (approximately 2 times the D_{84}). The surface and subsurface layers were placed in a plastic bag to create one bulk sample. The samples were sent to Coopers Testing Laboratory in Palo Alto, CA where they were dried, sieved, and weighed.

3.6 Gravel Inventory

A qualitative gravel inventory was conducted over a 0.5 mile reach adjacent to Study Sites 1 through 3 to assess the amount of available spawning gravel and potential changes following the flow release events. The surveys were conducted: 1) prior to the conservation release between August 30 and September 1, 2011 to characterize pre-release conditions; 2) following the conservation release between October 30 to November 1, 2011 to characterize potential changes following the conservation release and prior to the second release event; and, 3) following the second release event between November 7 to November 9, 2011 to characterize potential changes following this event.

The inventory consisted of estimating the surface area of spawning gravel within the bankfull channel width. For this survey, spawning gravel areas were defined to include gravel sizes from 6 to 80 mm (Bovee 1978; Hampton 1997; Reiser 1985; Hosey & Associates 1986; Dettman and Kelley 1986; DWR 2004; USFWS 2007; USFWS 2010). A Trimble GeoXT GPS unit was used to map areas of spawning gravel for an approximate 0.5-mile reach beginning upstream of Study Sites 1 through 3 and extending through and ending downstream of the sites. For large gravel deposits (at least 25 square feet), the GPS unit was used to delineate the gravel area. Smaller deposits were mapped with GPS points and a fiberglass tape was used to measure the average dimensions of the gravel deposit, where possible. In addition to the surface area, and other relevant parameters were recorded such as the presence of fines (i.e. material less than 0.074 mm [USBOR 2012]), habitat type, embeddedness, and whether the deposit was wet or dry at the time of the survey.

3.7 Tracer Gravel Study

A tracer gravel study was conducted at two locations at Study Sites 1 through 3 to evaluate gravel transport during the flow release events. The studies were setup and conducted: 1) prior to the conservation release between August 30 and September 1, 2011 to characterize pre-release conditions; 2) following conservation release between October 30 to November 1, 2011 to evaluate gravel transport during the conservation release; and, 3) following the second release event between November 7 to November 9, 2011 to evaluate gravel transport during this event.

The tracer gravel study involved gravels from five different half-phi size classes ranging from 22.6 mm to 90 mm, which translates to geometric mean size class particles of to 19 mm to 76 mm. Ten particles of each size class were collected from the channel, sized, painted, and placed on the bed surface in a single line (50 particles per cross-section) at two riffle locations at each Study Site that contained the most suitable spawning size material. These were locations where periodic movement of gravel would be important for cleaning fines out of the substrate and loosening embedded sediment to create favorable sites for redd creation. Although it is not possible to exactly replicate the embeddedness of the undisturbed substrate, an attempt was made to place the tracers on the bed so they were embedded in a manner similar to the surrounding channel bed material.

Following the flow release events, the study locations were revisited to determine if the tracer gravels were mobilized and, if so, an attempt was made to locate the mobilized particles to determine the particle size and the distance that each mobilized particle was transported.

3.8 Hydraulic Data

Staff gages were installed at the most upstream and the most downstream cross-sections at Study Sites 1 through 3 in order to collect stage-discharge data for use in calibrating the hydraulic models for each site. The staff gages were attached to fence posts that were driven into the channel bed. The top and bottom of each staff gage was surveyed using a total station and prism, so that the elevations were tied to the common datum used for the topographic surveys at each Study Site. During the flow release events, staff gage readings were recorded at varying flows and these readings were later correlated to discharge data obtained from USGS Stream Gage No. 11109800.

3.9 Hydraulic Modeling

The field data was used to develop a hydraulic model for Study Sites 1 through 3 to assist in characterizing hydraulic conditions over a range of flows. The modeling was performed using HEC-RAS (Version 4.0) which was developed by the U.S. Army Corps of Engineers. The HEC-RAS model calculates water surface profiles for steady, gradually varied flow. The computational procedure is based on a one-dimensional energy equation. Energy losses were evaluated by friction (Manning's equation), and contraction-expansion of the channel geometry. The energy gradient and water surface profiles were calculated as a step-backwater by the model. The model required inputs for channel geometry, a roughness coefficient to account for flow resistance, and a gradient.

The channel geometry and slope data used in the HEC-RAS modeling were derived from the cross-section and longitudinal profile surveys conducted during the field studies. The models for each site were calibrated using stage-discharge data collected during the flow release events. The stage-discharge data collected during flow events were used to calibrate the models by adjusting the Manning's n-values at each Study Site so that the modeled water surface profiles matched the measured water surface elevations as closely as possible.

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Chapter 4
Geomorphology Study Results

This section presents the results of the field components of the Geomorphology Study, the hydraulic model, and the incipient motion calculations. As previously mentioned, the scope involved collecting data prior to and following two release events, the annual conservation release which had a maximum recorded flow of 425 cfs and, following the conservation release, a second release event which had a maximum flow of approximately 591 cfs. Photographs taken of each of the Study Sites during the surveys are provided in Appendix C.

4.1 Changes in Channel Geometry

The topographic survey data collected prior to the conservation release event, immediately after the conservation release event, and after the second release event were used to evaluate potential changes in channel geometry resulting from these release events. Specifically, the results were used to visually assess potential changes and quantitatively analyze changes in cross-sectional area due to channel bed scour and/or fill in response to the 425 cfs and 591 cfs flow releases. In addition, contour maps of the pools situated at Study Sites 1 and 2 were prepared to assess changes in pool volume in response to the 425 cfs and 591 cfs flow release events. The visual assessments were conducted by overlaying plots of the cross-section and longitudinal profiles from each survey and then reviewing those overlays to determine potential changes in geometry.

The quantitative assessment of potential change in geometry was performed by calculating the cross-sectional area of each cross-section relative to a common datum for each survey event and comparing the change in area relative to the prior release event. Specifically, the area between the channel bed and the water surface elevation at 591 cfs was used to calculate the cross-sectional area for each of the three surveys. The same water surface elevation was used for each of the three survey events at each cross-section to maintain a consistent upper limit on the area calculation. Rather than use the entire width of the cross-section between the headpins, the calculation was limited to the area within the bounds of the 591 cfs water surface in order to focus the calculation on the portion of the cross-section over which actual change could have occurred. Field observations confirm that topographic changes in the bank elevation above the 591 cfs water surface did not occur (e.g. bank slumping), so these areas were excluded since they would only introduce error into the calculation.

The change in cross-sectional area was calculated to evaluate two scenarios: 1) potential changes associated with the conservation release event which was calculated by subtracting the cross-sectional area after the conservation release from the pre-conservation release cross-sectional area; and, 2) potential changes associated with the second release event which was calculated by subtracting the cross-sectional area after the conservation release from the cross-sectional area after the initial conservation release. Accordingly, negative changes in cross-sectional area indicate that scour has increased the cross-sectional area between two successive surveys, while positive changes in cross-sectional area indicate that sediment deposition has reduced the cross-sectional area between the two surveys.

In performing these calculations, the cross-sections were reviewed and large boulders that appeared to have been surveyed differently between surveys (i.e. different areas of the boulders were surveyed during each event) were edited to provide consistent elevations across all survey events to provide greater accuracy in calculating changes in area since these boulders were immobile throughout the study and had the potential to introduce error into the calculations. Minor boulders and some cobbles with less obvious differences between surveys that were not edited from the cross-sections also have the potential to introduce error into the calculations since it is not possible to resurvey these features in exactly the same manner each time. Accordingly, given the potential for minor variations between the surveys, the change in cross-sectional area is used to evaluate overall trends and general magnitude of change rather than absolute values of change.

In order to evaluate the change in volume of the two pools located at Study Site 1 and one pool located at Study Site 2 in response to the flow release events, contour maps were prepared for each pool using the data collected prior to the conservation release, following the conservation release, and after the second release event. Similar to the cross-sectional area calculations, the water surface elevation at 591 cfs was used to bound the lateral extent of the pools and calculate the pool volume for each of the three surveys. Similar to the analysis of the cross-sectional areas, the change in pool volume is used to evaluate overall trends and general magnitude of change rather than absolute values of change given the potential for variations between the topographic surveys at each pool.

Comparison plots of the channel geometry at each cross-section are provided in Figures 7 to 17 and comparison plots of the longitudinal profile surveys are presented in Figures 18 to 21. The results of the quantitative analysis are presented in Tables 1 to 4 and bar graphs showing the percent change in cross-sectional area are provided in Figures 22 and 23. Lastly, Table 5 presents a summary of the change in volume of the pools at Study Sites 1 and 2 and the pool contour maps for each survey event are provided in Appendix D. A discussion of the results at each Study Site is provided below.

Study Site 1

Overall, the visual assessment of the longitudinal profile at this site indicates areas of both scour and fill and the assessment of change in area at the surveyed cross-sections indicates minor changes in channel geometry between both the pre- and post-425 cfs channel conditions and the pre- and post-591 cfs channel conditions at all of the cross-sections. In regard to the longitudinal profile, a comparison of the pre- and post-425 cfs release bed profile indicates areas of scour are present in the vicinity of Station 700 (immediately downstream of the gaging weir in run habitat) along the profile, in the vicinity of Station 175 (lateral scour pool), and at the downstream end of the profile in the vicinity of Station 50 (mid-channel pool). Areas of fill are present in the vicinity of Station 350 (run) and Station 125 (tail end of lateral scour pool). A comparison of the pre- and post-591 cfs release bed profile indicates areas of fill in the vicinity of Station 700 (run) and Station 50 (mid-channel pool) and areas of scour in the vicinity of Stations 550 (run) and 150 (lateral scour pool).

In regard to the cross-sections, the overall change in cross-sectional areas ranged between approximately -6 percent (fill at XS-2 between the pre- and post-425 cfs event) and approximately +4 percent (scour at XS-6 between the pre- and post-425 cfs event). A discussion of the results for each cross-section is provided in the following:

- XS-1 – the visual assessment indicates very little change in channel geometry between both the pre- and post-425 cfs event and the pre- and post-591 cfs event. The calculated percent change in overall cross-sectional area was -0.2 percent (fill) between the pre- and post-425 cfs event and +0.2 percent (scour) between the pre- and post-591 cfs event.

- XS-2 – the visual assessment indicates some aggradation in the center of the cross-section between the pre- and post-425 cfs event and very little change between the pre- and post-591 cfs event. The calculated percent change in overall cross-sectional area was -5.9 percent (fill) between the pre- and post-425 cfs event and +2.4 percent (scour) between the pre- and post-591 cfs event.

- XS-3 – the visual assessment indicates some scour along the left side of the cross-section between both the pre- and post-425 cfs event and the pre- and post-591 cfs event. The calculated percent change in overall cross-sectional area was +2.6 percent (scour) between the pre- and post-425 cfs event and +0.2 percent (scour) between the pre- and post-591 cfs event.

- XS-4 – the visual assessment indicates some scour in the center of the cross-section between both the pre- and post-425 cfs event and the pre- and post-591 cfs event. The calculated percent change in overall cross-sectional area was +1.1 percent (scour) between the pre- and post-425 cfs event and +2.5 percent (scour) between the pre- and post-591 cfs event.

- XS-5 – the visual assessment indicates some scour along the left side of the cross-section between both the pre- and post-425 cfs event and the pre- and post-591 cfs event. The calculated percent change in overall cross-sectional area was +2.3 percent (scour) between the pre- and post-425 cfs event and +1.3 percent (scour) between the pre- and post-591 cfs event.

- XS-6 – the visual assessment indicates some scour in the center and along the left side of the cross-section in the middle of the pool between the pre- and post-425 cfs event and additional scour in the center of the channel between the pre- and post-591 cfs event. The calculated percent change in overall cross-sectional area was +4 percent (scour) between the pre- and post-425 cfs event and +0.7 percent (scour) between the pre- and post-591 cfs event.

- XS-7 – the visual assessment indicates some scour along the right side of the cross-section (low-flow channel) and aggradation in the center and left side of the channel between the pre- and post-425 cfs event and aggradation along the right side of the cross-section (low-flow channel) between the pre- and post-591 cfs event. The calculated percent change in overall cross-sectional area was +1.9 percent (scour) between the pre- and post-425 cfs event and -2.9 percent (fill) between the pre- and post-591 cfs event.

The change in pool volume following the flow release events was calculated for the two pools present at the site: the mid-channel pool situated between XS-3 and XS-4 (Pool 1) and the lateral scour pool situated between XS-5 and XS-7 (Pool 2). The percent change in the calculated pool volumes following the 425 cfs release event were -2.2 percent (fill) in Pool 1 and -3.7 percent (fill) in Pool 2. Given the potential for variability associated with measurement techniques during the field survey, these results indicate relatively little channel change between flow release events. The percent change in the calculated pool volumes following the 591 cfs release event were +5.4 percent (scour) in Pool 1 and +18.6 percent (scour) in Pool 2. These results indicate relatively little change at Pool 1, but measureable scour in Pool 2 during the 591 cfs release event.

Study Site 2

Overall, the visual assessment of the longitudinal profile at this site indicates areas of both scour and fill and the assessment of change in area at the surveyed cross-sections indicates minor changes in channel geometry between both the pre- and post-425 cfs channel conditions and the pre- and post-591 cfs conditions at all of the cross-sections. In regard to the longitudinal profile, a comparison of the pre- and post-425 cfs release bed profile indicates areas of scour are present in the vicinity of Stations 900 (run) and 450 (mid-channel pool) and areas of fill are present in the vicinity of Stations 800 (mid-channel pool), 650 (run), and 375 (mid-channel pool). A comparison of the pre- and post-591 cfs release bed profile indicates areas of scour in the vicinity of Stations 925 (run) and 425 (mid-channel pool).

In regard to the cross-sections, the overall change in cross-sectional areas indicate minor changes in channel geometry between both the pre- and post-425 cfs channel conditions and the pre- and post-591 cfs conditions at all of the cross-sections. The overall change in cross-sectional areas ranged between approximately -8.5 percent (fill at XS-3 between the pre- and post-591 cfs event) and approximately +5.0 percent (scour at XS-5 between the pre- and post-425 cfs event). A discussion of the results for each cross-section is provided in the following:

- XS-1 – the visual assessment indicates some scour along the left side (high-flow channel) and aggradation in the center of the cross-section between the pre- and post-425 cfs event and very little change between the pre- and post-591 cfs event. The calculated percent change in overall cross-sectional area was +2.8 percent (scour) between the pre- and post-425 cfs event and -1.1 percent (fill) between the pre- and post-591 cfs event;

- XS-2 – the visual assessment indicates some aggradation in the center and along the left side of the cross-section between the pre- and post-425 cfs event and additional aggradation in these areas between the pre- and post-591 cfs event. The calculated percent change in overall cross-sectional area was -6.9 percent (fill) between the pre- and post-425 cfs event and -2.5 percent (fill) between the pre- and post-591 cfs event. Note that this cross-section included several large boulders and observed cattle grazing which could impact these results;

- XS-3 – the visual assessment indicates scour along the right side of the cross-section in the middle of the pool area between the pre- and post-425 cfs event and aggradation along the left side of the cross-section on the mid-channel bar between the pre- and post-591 cfs event. The calculated percent change in overall cross-sectional area was +2.4 percent (scour) between the pre- and post-425 cfs event and -8.5 percent (fill) between the pre- and post-591 cfs event. Note that this cross-section included several large boulders and observed cattle grazing which could impact these results;

- XS-4 – the visual assessment indicates some aggradation along the left side of the cross-section on the mid-channel bar between both the pre- and post-425 cfs event and the pre- and post-591 cfs event and scour along the right site of the cross-section in the middle of the pool area between the pre- and post-591 cfs event. The calculated percent change in overall cross-sectional area was -4.1 percent (fill) between the pre- and post-425 cfs event and -2.1 percent (fill) between the pre- and post-600 cfs event; and,

- XS-5 – the visual assessment indicates some aggradation in the middle and along the right side of the cross-section between the pre- and post-425 cfs event and scour in the middle and along the left side of the cross-section between the pre- and post-591 cfs event. The calculated percent change in overall cross-sectional area was -3.1 percent (fill) between the pre- and post-425 cfs event and +5 percent (scour) between the pre- and post-591 cfs event.

The change in pool volume following the flow release events was calculated for the mid-channel pool present at the site between XS-2 and XS-5. The percent change in the calculated pool volume was +12.8 percent (scour) following the 425 cfs release event and -6.2 percent (fill) following the 591 cfs release event.

Study Site 3

Overall, the visual assessment of the longitudinal profile at this site indicates areas of both scour and fill and the assessment of change in area at the surveyed cross-sections indicates minor changes in channel geometry between both the pre- and post-425 cfs channel conditions and the pre- and post-591 cfs conditions at all of the cross-sections. In regard to the longitudinal profile, a comparison of the pre- and post-425 cfs release bed profile indicates areas of scour are present in the vicinity of Stations 1050 (riffle), 625 (pocket water), 350 (pocket water), and 150 (run) and areas of fill are present in the vicinity of Stations 950 (pocket water) and 475 (pocket water). A comparison of the pre- and post-591 cfs release bed profile indicates areas of fill in the vicinity of Station 625 (pocket water) and an area of scour in the vicinity of Station 975 (pocket water).

In regard to the cross-sections, the overall change in cross-sectional areas indicate minor changes in channel geometry between both the pre- and post-425 cfs channel conditions and the pre- and post-591 cfs conditions at all of the cross-sections. The overall change in cross-sectional areas ranged between approximately -3.9 percent (fill at XS-6 between the pre- and post-591 cfs event) and approximately +10.1 percent (scour at XS-5 between the pre- and post-425 cfs event). A discussion of the results for each cross-section is provided in the following:

- XS-1 – the visual assessment indicates very little change in channel geometry between both the pre- and post-425 cfs event and the pre- and post-591 cfs event. The calculated percent change in overall cross-sectional area was -2.2 percent (fill) between the pre- and post-425 cfs event and -1.7 percent (fill) between the pre- and post-591 cfs event;

- XS-2 – the visual assessment indicates very little change in channel geometry between both the pre- and post-425 cfs event and the pre- and post-591 cfs event. The calculated percent change in overall cross-sectional area was -2.4 percent (fill) between the pre- and post-425 cfs event and -0.1 percent (fill) between the pre- and post-591 cfs event. Note that this cross-section included several large boulders which could impact these results;

- XS-3 – the visual assessment indicates very little change in channel geometry between both the pre- and post-425 cfs event and the pre- and post-591 cfs event. The calculated percent change in overall cross-sectional area was +2.5 percent (scour) between the pre- and post-400 cfs event and -3.9 percent (fill) between the pre- and post-600 cfs event. Note that this cross-section included several large boulders which could impact these results;

- XS-4 – the visual assessment indicates very little change in channel geometry between both the pre- and post-425 cfs event and the pre- and post-591 cfs event. The calculated percent change in overall cross-sectional area was +5.7 percent (scour) between the pre- and post-425 cfs event and -0.1 percent (fill) between the pre- and post-591 cfs event. Note that this cross-section included several large boulders which could impact these results;

- XS-5 – the visual assessment indicates scour in the middle of the channel between the pre- and post-425 cfs event and relatively little change in the cross-section geometry between the pre- and post-591 cfs event. The scoured material consisted of sand and fine sediment that was delivered to the channel by Blanchard Canyon, the confluence of which is located adjacent to the Study Site to the east. The calculated percent change in overall cross-sectional area was +10.1 percent (scour) between the pre- and post-425 cfs event and +1.0 percent (scour) between the pre- and post-591 cfs event; and;

- XS-6 – the visual assessment indicates very little change in channel geometry between both the pre- and post-425 cfs event and the pre- and post-591 cfs event. The calculated percent change in overall cross-sectional area was +3.4 percent (scour) between the pre- and post-425 cfs event and -3.9 percent (fill) between the pre- and post-591 cfs event. Note that this cross-section included several large boulders which could impact these results.

Study Site 4

Overall, the visual assessment of the longitudinal profile at this site indicates areas of both scour and fill and the assessment of change in area at the surveyed cross-sections indicates minor changes in channel geometry between both the pre- and post-425 cfs channel conditions and the pre- and post-591 cfs conditions at all of the cross-sections. In regard to the longitudinal profile, a comparison of the pre- and post-425 cfs release bed profile indicates areas of significant scour are present in the vicinity of Stations 525 (run) and 425 (glide) and a comparison of the pre- and post-591 cfs release bed profile indicates areas of additional scour in the vicinity of Stations 425 (glide) and 150 (run).

This site consists of one cross-section (XS-1) that was installed to evaluate temporal changes in bed degradation-aggradation and substrate composition. The visual assessment of this site indicates scour along the right bank of the low-flow channel and scour and fill along the left side of the cross-section between both the pre- and post-425 cfs event. Little change in the channel geometry is apparent between the pre- and post-591 cfs event. The calculated percent change in overall cross-sectional area was +9.9 percent (scour) between the pre- and post-425 cfs event and -2 percent (fill) between the pre- and post-591 cfs event.

4.2 Changes in Surface Substrate Composition

The pebble count data collected prior to the 425 cfs release, immediately after the 425 cfs release, and after the 591 cfs release were used to evaluate potential changes in substrate composition resulting from these release events. The pebble count data was classified according to the Wentworth scale of particle size descriptions presented in Table 6. In addition, the data was used to calculate the D_i particle sizes which represent the cumulative frequency particle size of which *i* percent of the bed surface is finer than. For example, the D_{50} particle size, or median particle size, means that half of the bed surface is finer than the reported value. The geometric mean, like the D_{50}, is a measure of the central tendency for a heterogeneous mixture of particle sizes, and is calculated as the square root of the product of the D_{16} and D_{84} particle sizes. The extremes of the particle size distribution have more influence on the geometric mean than the D_{50}.

The pebble count data including the percent sand content of the bed surface sediment and the size class descriptions of the D_{50} and dominant particle size (i.e. the size class represented by the greatest frequency) are listed in Tables 7 to 10. In addition, cumulative particle size distribution plots and frequency histograms for each pebble count sample are provided in Appendix E. Discussions of results for each Study Site are provided below.

Study Site 1

The pebble count data for the pre-425 cfs event indicates a median particle size of medium to coarse gravel at six of the seven cross-sections and sand or finer material at one cross-section. The dominant size class consisted of sand or finer material at all of the cross-sections except for XS-1 where coarse gravel was the dominant size class.

The pebble count data collected after the 425 cfs indicates coarsening of the median particle size at three of the seven cross-sections (from coarse gravel to very coarse gravel or medium gravel to coarse gravel), no change in two of the cross-sections, and fining at two of the cross-sections (from coarse gravel to medium gravel). In regard to the dominant particle size, sand or finer material remained the dominant particle size at five of the seven cross-sections and coarsening was indicated at two of the cross-sections (from coarse gravel to very coarse gravel and sand or finer to very coarse gravel).

After the 591 cfs event, the pebble count data indicate no change in the median particle size at four of the seven cross-sections, fining at one cross-section (from very coarse gravel to coarse gravel), and coarsening at two cross-sections (from coarse gravel to very coarse gravel and medium gravel to coarse gravel). In regard to the dominant particle size, sand or finer material remained the dominant particle size at three of the seven cross-sections, coarsening was indicated at two of the cross-sections (from sand or finer to small cobble and sand or finer to medium/coarse gravel), and fining was indicated at one cross-section (from very coarse gravel to coarse gravel).

As shown in Figure 24, the pebble count data for each of the three sampling events shows: 1) a general coarsening trend in the median particle size following each event at XS-5 (low gradient riffle) and XS-6 (lateral scour pool); 2) relatively no change at XS-1 (riffle crest), XS-2 (riffle tail), XS-3 (shallow mid-channel pool), and XS-4 (riffle crest); and, 3) variable results at XS-7 (riffle crest).

In regard to the percentage of sand or finer, the pebble count data indicate values ranging between 4 percent and 51 percent prior to the 425 cfs release, between 15 percent and 60 percent following the 425 cfs event, and between 10 percent and 52 percent following the 591 cfs event. In regard to trends between the flow release events, as shown in Figure 25, the data indicate: 1) an increasing trend in the percentage of sand or finer material following each event at XS-1 (riffle crest) and XS-3 (mid-channel pool); 2) a decreasing trend following each event at cross-section XS-5 (riffle tail); 3) little change at XS-2 (riffle tail) and XS-4 (riffle crest); and, 4) variable results at XS-6 (pool) and XS-7 (riffle crest).

Study Site 2

The pebble count data for the pre-425 cfs event indicates a median particle size of sand or finer at two of the five cross-sections, coarse gravel at one cross-section, small cobble at one cross-section, and very fine gravel at one cross-section. The dominant size class consisted of sand or finer material at three of the five cross-sections, small cobble at one cross-section, and fine gravel at one cross-section.

The pebble count data collected after the 425 cfs indicates coarsening of the median particle size at three of the five cross-sections (from sand or finer to medium/coarse gravel and very fine gravel to medium gravel), no change in one of the cross-sections, and fining at one of the cross-sections (from small cobble to very coarse gravel). In regard to the dominant particle size, no change in the dominant particle size was recorded at three of the five cross-sections and coarsening was recorded at two of the cross-sections (from fine gravel to coarse gravel and sand or finer to medium gravel).

After the 591 cfs event, the pebble count data indicate no change in the median particle size at three of the five cross-sections and coarsening at two cross-sections (from coarse gravel to very coarse gravel and medium gravel to coarse gravel). In regard to the dominant particle size, no change in the dominant particle size was recorded at two of the five cross-sections, coarsening was recorded at one of the cross-sections (from medium gravel to very coarse gravel), and fining was recorded at one cross-section (from coarse gravel to medium gravel).

As shown in Figure 24, the pebble count data for each of the three sampling events shows a general coarsening trend in the median particle size following each event at four of the five cross-sections (XS-1 (riffle crest), XS-3 (pool), XS-4 (pool tail), and XS-5 (low gradient riffle)) and a fining trend at XS-2 (riffle tail).

In regard to the percentage of sand or finer, the pebble count data indicate values ranging between 8 percent and 100 percent prior to the 425 cfs release, between 5 percent and 47 percent following the 425 cfs event, and between 0 percent and 44 percent following the 591 cfs event. In regard to trends between the flow release events, as shown in Figure 25, the data indicate a generally decreasing trend following each event at all of the cross-sections and a significant decrease in sand or finer material at XS-3 and XS-4, which are situated in pool habitat, following the 425 cfs event.

Study Site 3

The pebble count data for the pre-425 cfs event indicates a median particle size of sand or finer at two of the six cross-sections, small cobble at two cross-sections, and medium/coarse gravel at two cross-sections. The dominant size class consisted of sand or finer material at all of the cross-sections.

The pebble count data collected after the 425 cfs event indicates coarsening of the median particle size at all of the cross-sections with the exception of cross-section XS-1 for which there was no change in the median particle size. In regard to the dominant particle size, no change in the dominant particle size was recorded at three of the six cross-sections and coarsening was recorded at the remaining three cross-sections (from sand or finer to large cobble).

After the 591 cfs event, the pebble count data indicate no change in the median particle size at one of the cross-sections, coarsening at three of the cross-sections (from medium gravel to coarse gravel, very coarse gravel to small cobble, and coarse gravel to very coarse gravel), and fining at two of the cross-sections (from large cobble to very coarse gravel). In regard to the dominant particle size, no change in the dominant particle size was recorded at three of the six cross-sections, coarsening was recorded at two of the cross-sections (from sand or finer to large cobble), and fining was recorded at one cross-section (from large cobble to small cobble).

As shown in Figure 24, the pebble count data for each of the three sampling events shows: 1) a general coarsening trend in the median particle size following each event at cross-sections XS-3 (step run), XS-5 (pocket water), and XS-6 (pocket water); and, 2) relatively no change at cross-sections XS-2 (step run) and XS-4 (pocket water) after the 425 cfs event, but a decrease in median grain size following the 591 cfs event.

In regard to the percentage of sand or finer, the pebble count data indicate values ranging between 28 percent and 80 percent prior to the 425 cfs release, between 6 percent and 43 percent following the 425 cfs event, and between 5 and 32 percent following the 591 cfs event. In regard to trends between the flow release events, as shown in Figure 25, the data indicate a generally decreasing trend following each event at all of the cross-sections and a significant decrease in sand or finer material at XS-2, XS-3, XS-4, XS-5, and XS-6 following the 425 cfs event.

Study Site 4

The pebble count data for the pre-425 cfs event indicates a median and dominant particle size of sand or finer. For the median particle size, the pebble count data collected after the 425 cfs indicated coarsening with a change from sand or finer material to coarse gravel. In regard to the dominant particle size, no change was recorded as the dominant particle size remained sand or finer material. After the 591 cfs event, the pebble count data indicate a fining in the median particle size from coarse gravel to find gravel and no change in the dominant particle size which remained as sand or finer.

In regard to the percentage of sand or finer, the pebble count data indicate values of 83 percent prior to the 425 cfs release, 62 percent following the 425 cfs event, and 48 percent following the 591 cfs event. In regard to trends between the flow release events, as shown in Figure 25, the data indicate a generally decreasing trend following each event.

Bulk Sampling Results

The bulk sample data collected prior to the 425 cfs release, immediately after the 425 cfs release, and after the 591 cfs release were used to evaluate potential changes in surface and subsurface gravel composition resulting from these release events. The bulk sample particle size distribution plots are provided in Appendix F, and a summary of the bulk sediment analysis is presented in Tables 11 to 13 for Study Sites 1 through 3, respectively. A discussion of the results at each Study Site is provided below.

Study Site 1

At Study Site 1, bulk samples were collected at XS-1 and XS-7. The bulk sampling data for the pre-425 cfs event indicates a median particle size of coarse gravel at both cross-sections and dominant particle sizes of coarse to very coarse gravel at XS-1 and small cobble at XS-7. Following the 425 cfs release, the median and dominant particle size at XS-1 remained as coarse gravel and coarse/very coarse gravel, respectively, but decreased at XS-7 to medium gravel and coarse/very coarse gravel, respectively. After the 591 cfs event, the median particle size increased at both cross-sections from coarse gravel to very coarse gravel at XS-1 and from medium gravel to coarse gravel at XS-7. In addition, the dominant particle size increased to very coarse gravel at both cross-sections.

As shown in Figure 26, the bulk sample data for each of the three sampling events show a decrease in median particle size after the 425 cfs event and an increase in median particle size after the 591 cfs event. In regard to the percentage of sand or finer, the bulk sample data indicate values of 18.7 percent and 25.2 percent prior to the 425 cfs release, 27.9 percent and 30 percent following the 425 cfs event, and 15.9 percent and 17.8 percent following the 591 cfs event. In regard to trends between the flow release events, as shown in Figure 27, the data at both cross-sections indicates an increase in the percentage of sand or finer material following the 425 cfs event and a decrease following the 591 cfs event.

Study Site 2

At Study Site 2, bulk samples were collected at XS-1 and XS-5. The bulk sampling data for the pre-425 cfs event indicates a median particle size of coarse gravel at XS-1 and very coarse sand at XS-5 and dominant particle sizes of very coarse gravel at XS-1 and fine/medium sand at XS-5. Following the 425 cfs release, the median and dominant particle size at XS-1 remained as coarse gravel and coarse/very coarse gravel, respectively, and increased at XS-5 to medium gravel and coarse/very coarse gravel, respectively. After the 591 cfs event, the median and dominant particle sizes at XS-1 did not change and remained as coarse gravel and coarse/very coarse gravel, respectively. However, at XS-5, the median particle size decreased from medium gravel to fine gravel and the dominant particle size decreased from coarse/very coarse gravel to coarse/very coarse sand.

As shown in Figure 26, the bulk sample data for each of the three sampling events show relatively no change in the median particle size at XS-1 and an increase in the median particle size at XS-7 after the 425 cfs release and little change after the 591 cfs release. In regard to the percentage of sand or finer, the bulk sample data indicate values of 27.1 percent and 60.6 percent prior to the 425 cfs release, 21.9 percent and 42.2 percent following the 425 cfs event, and 23.9 percent and 44.9 percent following the 591 cfs event. In regard to trends between the flow release events, as shown in Figure 27, the data at both cross-sections indicates a decrease in the percentage of fines after the 425 cfs release. Following the 591 cfs release, the percentage of fines increased at XS-1 and remained relatively stable at XS-7.

Study Site 3

At Study Site 3, bulk samples were collected at XS-3 and XS-5 prior to the 425 cfs release. However, due to significant coarsening of the bed through the mobilization and transport of aggraded fine material during the 425 cfs release, subsequent bulk samples could not be collected at these locations after the 425 cfs release. Accordingly, bulk samples were only collected from XS-6 after the 425 cfs and the 591 cfs releases. Cross-section XS-6 is situated in pocket water habitat similar to XS-5. Prior to the 425 cfs release, the data for XS-3 and XS-5 indicates median particle sizes of very coarse sand and medium sand, respectively, and dominant particle sizes of fine/medium gravel and fine/medium sand, respectively. The bulk sample data collected at XS-6 following the 425 cfs release and the 591 cfs release indicate a median particle size of small cobble and a dominant particle size of large cobble.

Figure 26 shows the bulk sample data for XS-5 prior to the 425 cfs release and the data for XS-6 after the 425 cfs and 591 cfs releases. This chart shows a significant coarsening in the median grain size from medium sand to small cobble following the 425 cfs release event. In regard to the percentage of sand or finer, as shown in Figure 27, the bulk sample data for XS-5 prior to the 425 cfs release indicates a value of 93.4 percent and the data for XS-6 indicates a significant decrease to 5.9 percent and 7.9 percent after the 425 cfs and 591 cfs releases, respectively. The data indicate a significant flushing of fines following the 425 cfs and little change following the subsequent 591 cfs release.

4.3 Gravel Inventory Results

The gravel inventory data were used to evaluate potential changes in the amount and availability of spawning gravels following these events. The evaluation involved comparing the overall area of spawning gravel at each Study Site between events and reviewing the location of these gravel areas between events. A summary of the collected data are presented in Tables 14 to 17, and plots of the gravel inventory areas are provided in Figures 28 to 30. Discussions of the findings from assessments at each Study Site are provided below.

Study Site 1

At Study Site 1, the results from the spawning gravel inventory conducted prior to the 425 cfs release indicate the presence of approximately 4,734 square feet of spawning gravels that were primarily situated in riffle habitat. The gravel embeddedness by fines ranged between 10 to 90 percent and the overall average embeddedness of the gravels was 36 percent.

The survey conducted after the 425 cfs conservation release event indicated the presence of approximately 9,968 square feet of spawning gravels, which is an increase in area of approximately 110 percent in comparison with the pre-conservation release survey results. The gravels were primarily situated in pool and riffle habitat. The gravel embeddedness by fines ranged between 10 percent to 25 percent and the overall average embeddedness of the gravels was 15 percent. These data indicate that the amount and quality of available spawning gravels increased following the 425 cfs release event relative to pre-event conditions. The increase in available spawning gravels is likely due to the flushing of fine sediments by the release flows to reveal gravels that were previously overlain by fine sediments. In addition, it appears that gravels were mobilized and flushed into pool habitats by the conservation release flows. The reduction of embeddedness is likely due to the flushing of fines from the gravel framework.

Finally, the results of the survey conducted after the second, approximately 591 cfs release indicated the presence of approximately 10,012 square feet of spawning gravels which is an increase in area of less than 0.5 percent in comparison with the post-conservation release survey results. The gravels were primarily situated in pool and run habitat. The gravel embeddedness by fines ranged between less than 20 to 30 percent and the overall average embeddedness of the gravels was 23 percent. These data indicate that relatively little change in the availability and quality of spawning gravels occurred following the second, approximately 591 cfs release event relative to the conditions following the 425 cfs conservation release.

Study Site 2

At Study Site 2, the results from the spawning gravel inventory conducted prior to the 425 cfs release indicate the presence of approximately 2,702 square feet of spawning gravels that were primarily situated in run and riffle habitats. The gravel embeddedness by fines ranged between less than 20 to 30 percent and the overall average embeddedness of the gravels was 24 percent.

The survey conducted after the 425 cfs conservation release event indicated the presence of approximately 11,703 square feet of spawning gravels, which is an increase in area of over 300 percent in comparison with the pre-conservation release survey results. The gravels were primarily situated in riffle and pool tail habitats. The gravel embeddedness by fines ranged between 15 percent to 40 percent and the overall average embeddedness of the gravels was 27 percent. These data indicate that the amount of available spawning gravels increased significantly following the 425 cfs release event relative to pre-event conditions. The increase in available spawning gravels is likely due to the flushing of fine sediments by the conservation release flows to reveal gravels that were previously overlain by fine sediments.

Finally, the results of the survey conducted after the second, approximately 591 cfs release indicated the presence of approximately 13,324 square feet of spawning gravels, which is an increase in area of approximately 14 percent in comparison with the post-conservation release survey results. The gravels were primarily situated in riffle and pool tail habitats. The gravel embeddedness by fines ranged between 15 percent to 40 percent and the overall average embeddedness of the gravels was 28 percent. These data indicate that relatively little change in the availability and quality of spawning gravels occurred following the second, approximately 591 cfs release event relative to the conditions following the 425 cfs conservation release.

Study Site 3

At Study Site 3 the results for the spawning gravel inventory conducted prior to the 425 cfs release indicated the presence of approximately 17,805 square feet of spawning gravels that were primarily situated in pool tail and run habitats. The gravel consisted of a relatively uniform layer of gravel along the channel bed from the confluence of Holser Canyon to approximately 15,000 linear feet downstream. This gravel was underlain by a bed of fine sediment. The gravel and fine sediment appeared to be delivered to the channel by Holser Canyon. The gravel embeddedness by fines ranged between 0 to 10 percent.

The survey conducted after the 425 cfs conservation release event indicated the presence of approximately 17,939 square feet of spawning gravels, which is an increase in area of less than 1 percent in comparison with the pre-conservation release survey results. The gravels were primarily situated in riffle and run habitats. The gravel embeddedness by fines ranged between less than 20 to 40 percent and the overall average embeddedness of the gravels was 26 percent. These data indicate that relatively little change in the availability of spawning gravels occurred following the 425 cfs release event relative to pre-event conditions. However, the fine sediment that underlay the gravels during the initial survey had been flushed out and the remaining gravels were situated in more discrete habitat units rather than over the length of the channel.

Finally, the results of the survey conducted after the second, approximately 591 cfs release indicated the presence of approximately 18,455 square feet of spawning gravels, which is an increase in area of less than 3 percent in comparison with the post-conservation release survey results. The gravels were primarily situated in riffle and run habitats. The gravel embeddedness by fines ranged between less than 10 to 40 percent and the overall average embeddedness of the gravels was 24 percent. These data indicate that relatively little change in the availability and quality of spawning gravels occurred following the second, approximately 591 cfs release event relative to the conditions following the 425 cfs conservation release.

4.4 Tracer Gravel Study Results

The tracer gravel data collected after the 425 cfs release and after the 591 cfs release were used to evaluate gravel transport during these flow release events. Following each event, an attempt was made to locate the tracer gravel particles at each Study Site and record the number, size, and distance that any dislocated particles traveled. The tracer line was checked, and in the event that aggradation had occurred, the area along the cross-section was cleared of sediment to ensure that no tracers recorded as missing had actually been buried in place during the course of the release event, in particular the 425 cfs release which occurred over a 46 day period. Gravels that could not be found in place or were not recovered downstream from the cross-section were recorded as missing, and are presumed to have been mobilized and reburied downstream. The tracer gravel study results are presented in Tables 18 to 20 and Figures 31 to 33, and discussions of the results from assessments at each Study Site are provided below.

Study Site 1

At Study Site 1, tracer gravels were placed at XS-1 and XS-4 in riffle habitat. The results for XS-1 indicate that 50 percent or greater of the tracer gravels within each particle size category were mobilized during the 425 cfs release including 70 percent of the particles in the 76 mm half-phi size class. The maximum measured distance the particles moved ranged from 6.3 feet for the 54 mm half-phi size class to 131 feet for the 76 mm half-phi size class. At XS-4, the results indicate that 70 percent or greater of the tracer gravels within the 19 mm, 27 mm, 38 mm, and 54 mm particle size categories were mobilized during the 425 cfs release and 40 percent f the particles in the 76 mm half-phi size class were mobilized. The maximum measured distance the particles moved ranged from 1.4 feet for the 76 mm half-phi size class to 33.5 feet for the 38 mm half-phi size class.

During the 591 cfs release, the data indicate that 40 percent or greater of the tracer gravels within each particle size category were mobilized at XS-1 including 90 percent of the particles in the 76 mm half-phi size class. The maximum measured distance the particles moved ranged from 4.7 feet for the 76 mm half-phi size class to 60 feet for the 19 mm half-phi size class. At XS-4, the results indicate that 60 percent or greater of the tracer gravels within each particle size category were mobilized including 70 percent of the particles in the 76 mm half-phi size class. The maximum measured distance the particles moved ranged from 2.8 feet for the 54 mm half-phi size class to 104 feet for the 19 mm half-phi size class.

Study Site 2

At Study Site 2, tracer gravels were placed at XS-1 and XS-5 in riffle habitat. The results for XS-1 indicate that 70 percent or greater of the tracer gravels within the 19 mm, 27 mm, 38 mm, and 54 mm particle size categories were mobilized during the 425 cfs release and 50 percent of the particles in the 76 mm half-phi size class were mobilized. The maximum measured distance the particles moved ranged from 1.7 feet for the 54 mm half-phi size class to 4.8 feet for the 38 mm half-phi size class. At XS-5, the results indicate that 90 percent or greater of the tracer gravels within the 19 mm, 27 mm, 38 mm, and 54 mm particle size categories were mobilized during the 425 cfs release and 60 percent of the particles in the 76 mm half-phi size class were mobilized. The maximum measured distance the particles moved ranged from 3 feet for the 76 mm half-phi size class to 27.6 feet for the 19 mm half-phi size class.

During the 591 cfs release, the data indicate that 40 percent or greater of the tracer gravels within the 19 mm, 27 mm, 38 mm, and 54 mm particle size categories at XS-1 were mobilized during the 425 cfs release and 10 percent of the particles in the 76 mm half-phi size class were mobilized. The maximum measured distance the particles moved ranged from 0.7 feet for the 76 mm half-phi size class to 105 feet for the 19 mm half-phi size class. At XS-5, the results indicate that 60 percent or greater of the tracer gravels within each particle size category were mobilized. The maximum measured distance the particles moved ranged from 13 feet for the 76 mm half-phi size class to 61 feet for the 38 mm half-phi size class.

Study Site 3

At Study Site 3, tracer gravels were placed at XS-1 and XS-5 in riffle habitat. The results for XS-1 indicate that 50 percent or greater of the tracer gravels within the 19 mm, 27 mm, 38 mm, and 54 mm particle size categories were mobilized during the 425 cfs release and 80 percent of the particles in the 76 mm half-phi size class were mobilized. The maximum measured distance the particles moved ranged from 2 feet for the 19 mm half-phi size class to 7 feet for the 27 mm half-phi size class. At XS-5, the results indicate that 80 percent or greater of the tracer gravels within the 19 mm, 27 mm, 38 mm, and 54 mm particle size categories were mobilized during the 425 cfs release and 20 percent of the particles in the 76 mm half-phi size class were mobilized. The maximum measured distance the particles moved ranged from 4 feet for the 38 mm half-phi size class to 5 feet for the 54 mm half-phi size class.

During the 591 cfs release, the data indicate that 80 percent of the 19 mm half phi size class, 50 percent of the 27 mm size class, 40 percent of the 38 mm size class, 30 percent of the 54 mm size class, and 20 percent of the 76 mm size class were mobilized. The maximum measured distance the particles moved ranged from 0.9 feet for the 76 mm half-phi size class to 4.4 feet for the 27 mm half-phi size class. At XS-5, the results indicate that 60 percent or greater of the tracer gravels within each particle size category were mobilized including 80 percent of the 76 mm half phi size class. The maximum measured distance the particles moved ranged from 1.2 feet for the 54 mm half-phi size class to 5.3 feet for the 19 mm half-phi size class.

4.5 Hydraulic Modeling

As discussed in Section 3.9, hydraulic models for Study Sites 1 through 3 were prepared to assist in characterizing hydraulic conditions over a range of flows. The modeling effort was undertaken for two primary purposes: 1) to determine the water surface elevation (stage) associated with different magnitude flow events and assess how much flow is needed for overbanking onto geomorphic surfaces; and 2) to calculate bed shear stresses that were used to predict the flow magnitude needed to mobilize the bed sediment (incipient motion analysis). A discussion of the model for each Study Site is provided below and a summary table of the model input and output data are provided in Appendix G.

Study Site 1

The HEC-RAS model for cross-sections at this site was developed using the survey data for XS-1 through XS-7 and was calibrated using the observed water surface elevations at XS-1 and XS-7 (measured at the most upstream and downstream cross-sections) on September 21, 2011 at a flow of 415 cfs and on November 3, 2011 at a flow of 591 cfs. Manning’s N-values used in the model at each cross-section are as follows:

- XS-1 – a Manning's N-value of 0.035 for the wetted channel and 0.06 for the overbank areas;
- XS-2 – a Manning's N-value of 0.035 for the wetted channel and 0.06 for the overbank areas;
- XS-3 – a Manning's N-value of 0.035 for the wetted channel and 0.06 for the overbank areas;
- XS-4 – a Manning's N-value of 0.035 for the wetted channel and 0.06 for the overbank areas;
- XS-5 – a Manning's N-value of 0.2 for the wetted channel and 0.2 for the overbank areas to account for the backwater associated with the approximately 90-degree bend in the creek at this location;
- XS-6 – a Manning's N-value of 0.05 for the wetted channel and 0.06 for the overbank areas; and,
- XS-7 – a Manning's N-value of 0.05 for the wetted channel and 0.06 for the overbank areas.

The model was used to determine flows required to inundate selected geomorphic channel features. As previously discussed, Study Site 1 is situated in a portion of lower Piru Creek that was constructed as part of the Project. Accordingly, no historic or current floodplain area is present. The left bank consists of a relatively steep bank that transitions to upland habitat and the right bank consists of a relatively steep bank that transitions to a graded staging area between XS-1 and XS-3 and a densely vegetated area between XS-4 and XS-7. A gravel and cobble bar is situated along the right bank between XS-1 and XS-2. This bar is inundated relatively frequently with flows of 50 cfs and greater. Flows required to overtop the adjacent banks range from approximately 1,500 cfs to greater than 3,500 cfs as presented in Table 21 and the model output data provided in Appendix G.

Study Site 2

The HEC-RAS model for cross-sections at this site was developed using the survey data for XS-1 through XS-5 and was calibrated using the observed water surface elevations at XS-1 and XS-5 (measured at the most upstream and downstream cross-sections) on September 21, 2011 at a flow of 415 cfs and on November 3, 2011 at a flow of 591 cfs. Manning's N-values used in the model at each cross-section are as follows:

- XS-1 – a Manning's N-value of 0.055 for the wetted channel and 0.25 for the left overbank area to account for the densely vegetated mid-channel bar in this area and 0.20 for the right overbank area;
- XS-2 – a Manning's N-value of 0.055 for the wetted channel and 0.25 for the left overbank area to account for the densely vegetated mid-channel bar in this area and 0.20 for the right overbank area;
- XS-3 – a Manning's N-value of 0.055 for the wetted channel and 0.25 for the left overbank area to account for the densely vegetated mid-channel bar in this area and 0.20 for the right overbank area; and,
- XS-4 – a Manning's N-value of 0.055 for the wetted channel and 0.25 for the left overbank area to account for the densely vegetated mid-channel bar in this area and 0.20 for the right overbank area.

- XS-5 – a Manning's N-value of 0.035 for the wetted channel and 0.1 for the left and right overbank areas.

The model was used to determine flows required to inundate selected geomorphic channel features. The mid-channel bar/island present at Study Site 2 that separates the low-flow channel along the right bank from the high-flow channel along the left bank is inundated at flows ranging from 900 cfs at XS-3 to as low as 75 cfs at the most downstream XS-5. Flows required to overtop the adjacent banks range from approximately 1,000 cfs to 2,500 cfs as presented in Table 22 and the model output data provided in Appendix G.

Study Site 3

The HEC-RAS model for cross-sections at this site was developed using the survey data for XS-1 through XS-6 and was calibrated using the observed water surface elevations at XS-1 and XS-6 (measured at the most upstream and downstream cross-sections) on September 21, 2011 at a flow of 415 cfs and on November 3, 2011 at a flow of 591 cfs. Manning's N-values used in the model at each cross-section are as follows:

- XS-1 – a Manning's N-value of 0.085 for the wetted channel to account for the large substrate present at this site and 0.15 for the left and right overbank areas;
- XS-2 – a Manning's N-value of 0.085 for the wetted channel to account for the large substrate present at this site and 0.15 for the left and right overbank areas;
- XS-3 – a Manning's N-value of 0.085 for the wetted channel to account for the large substrate present at this site and 0.15 for the left and right overbank areas;
- XS-4 – a Manning's N-value of 0.085 for the wetted channel to account for the large substrate present at this site and 0.15 for the left and right overbank areas;
- XS-5 – a Manning's N-value of 0.085 for the wetted channel to account for the large substrate present at this site and 0.15 for the left and right overbank areas; and,
- Xs-6 – a Manning's N-value of 0.035 for the wetted channel and 0.06 for the left and right overbank areas.

The model was used to determine flows required to inundate selected geomorphic channel features. A minor inset floodplain less than 15 ft wide is present at XS-2 and is inundated at flows of approximately 125 cfs. The inset floodplain at XS-2 widens in a downstream direction to approximately 40-50 feet at XS-3 and continues at the same approximate width through XS-6. The flow required to inundate this inset floodplain varies from 100 cfs to 400 cfs. Flows required to overtop the adjacent banks range from approximately 2,000 cfs to 10,000 cfs as presented in Table 23 and the model output data provided in Appendix G.

4.6 Equation-Based Incipient Motion Calculations

In this section, the hydraulic modeling and tracer gravel study results are used to characterize sediment mobility in lower Piru Creek. The tracer gravels provide empirical data on the bed sediment mobility of different size particles at the cross-sections for which they were deployed and, specifically, provide information on the ability of Piru Creek to initiate motion of bed sediment at flows of 425 cfs and 591 cfs. The output from the hydraulic models was used to calculate and better understand the initiation of motion of bed sediment over a wider range of flows than the tracer gravels study provided.

The output of the hydraulic modeling coupled with incipient motion equations were used to calculate bed shear stress and determine the flow level necessary to initiate motion of the bed sediment. Using equations to predict bed mobility requires shear stress data and a clear statement of the assumptions since different approaches can lead to substantially different results. This section summarizes the methods used to calculate the shear stress exerted on the bed and discusses how these values were used to predict bed mobility. Appendix H shows a more detailed description of how the incipient motion calculations were performed.

4.6.1 Shear Stress Calculation

The following equation (Wilcock 1996), which is derived from Keulegan's (1938) resistance law for rough flow, was used to calculate shear velocity (a measure of the velocity gradient near the bed) in this study:

(1)

$$\frac{U}{u*} = \frac{1}{\kappa}\ln\left(\frac{h}{ez_0}\right)$$

where U is mean flow velocity, h is flow depth, and z_0 (the bed roughness length where local flow velocity u is 0) is calculated from:

(2)

$$z_o = \frac{3D_{84}}{30}$$

where D_{84} is the particle size at which 84 percent of the bed surface is finer.

The equation shows that an increase in velocity for a given depth and grain size will result in a higher shear stress on the bed whereas an increase in depth for a given velocity and grain size will result in lower shear stress. This equation, or variations of it, is commonly used to calculate shear velocity values for use in incipient motion and sediment transport analysis.

Local bed shear stress (τ) was calculated from the shear velocity (u*) and water density (ρ) as:

(3)

$$\tau = u*^2\ \rho$$

4.6.2 Shield's Number Selection

Whether or not a particle on the stream bed will be entrained by the flow or remain in place largely depends on: 1) randomness (grain placement and turbulence), and 2) balance of driving fluid drag (F_D) and resisting gravity forces (F_G)

(4)

$$F_D \propto \tau_0 D^2, \text{ and } F_G \propto (\rho_s - \rho) g D^3$$

and

(5)

$$\frac{F_D}{F_G} \propto \frac{\tau_0}{(\rho_s - \rho)gD} = \Theta = \tau^*$$

Where D is grain diameter and ρ_s is sediment density. The dimensionless bed shear stress (Θ, commonly called the Shields number, or τ^*) is a measure of sediment mobility. If τ^* is greater than the threshold required for sediment motion (τ^*_c, critical dimensionless bed shear stress), then sediment motion is predicted to occur. The equation does not predict how far a particle will move once mobilized. It could simply roll over and come to a rest again, slide a short distance along the bed, or hop or roll a longer distance downstream.

Selection of τ^*_c is not a minor task. Much research continues to be performed in the field of sediment movement initiation. For sediment mixtures of coarse and fine particles, the coarser particles (e.g. gravel) in the mixture will be relatively easier to mobilize than if all the sediment was the same size because the coarser grains protrude higher into the water column where flow velocities are greater, and they have relatively lower pivoting angles (with reference to the grain and its contact point with underlying material). By contrast, the smaller particles in the sediment mixture have higher pivot angles, and are shielded from the higher flow velocities by the larger particles. Therefore, the finer (e.g. sand) particles in a mixture can be relatively harder to mobilize than if all the sediment was the same size.

Additionally, research has shown the importance of the percentage of sand in a sediment mixture on the critical shear stress needed to mobilize both sand and gravel particles (Wilcock 1998; Wilcock and Crowe 2003). Less shear stress is needed to mobilize the gravels in a gravel-sand mixture than in a homogeneous mixture of all gravel. The Wilcock and Crowe (2003) method for calculating the critical shear stress needed to initiate sediment movement for mixed-size sediment was used for this study since it best represents the bed material at the Study Sites. The method takes into account how particle size variation within the sediment mixture and sand content influence sediment mobility.

4.6.3 Initiation of Motion Results

The modeled hydraulic output for Study Sites 1 through 3 was used in the calculation of the bed shear stress. The HEC-RAS model option for separating the main channel into distinct subsections was utilized. This approach has the advantage of distinguishing velocities and depths over specific areas of the channel bed pertinent to where bed movement was analyzed rather than using a single cross-section averaged value which does not capture any local variability in the channel hydraulics. The channel bed was divided into three sub-sections at each cross-section. The subsection with the highest shear stress value of the three total sub-sections was used in the analysis. The highest value was used because the HEC model does not account for random turbulence that results in shear stress spikes on the bed. Accordingly, the highest value was used to account for the tendency of the model to under-represent these shear stress spikes associated with turbulent flow, since the objective was to determine the largest particle size that could be mobilized at a given discharge.

The local grain shear stress (τ) using the D_{84} from the sediment sampling and the Wilcock (1996) equation presented above was calculated at each modeling cell using the HEC-RAS output data for the sub-section flow depth and velocity. Therefore, rather than calculating an average boundary shear stress using the average hydraulics of the entire cross-section, a shear stress value was calculated for each of the three subsections across the transect to obtain more accurate results.

Results are presented for both the cross-sections where tracer gravels were deployed and the non-tracer gravel locations. At cross-sections where bulk sediment samples were collected, separate incipient motion calculations were made using both the bulk sediment and pebble count grain size distributions to evaluate how differences in the relative particle sizes, the D_{84} grain size, and the percent sand in the channel bed affect the results. At several cross-sections, the D_{84} grain size from the pebble count is larger than the D_{84} from the bulk sample since coarse boulders in the channel were included in the pebble count samples, but purposefully excluded in the bulk samples. In such cases, the calculated shear stress for the cross-section would be higher for the pebble count since the coarser D_{84} produces a higher shear velocity.

For this study, the initiation of motion results are based on both the pebble counts and the bulk sampling particle size distribution. When interpreting the data, the incipient motion calculations based on the pebble counts can be considered the shear stress needed to mobilize the average D_{50} and D_{84} grain size of the surface of the low-flow channel, while the calculations based on the bulk samples are focused on the shear stress necessary to mobilize the specific areas on the cross-section containing spawning gravel where the bulk sample was collected. Estimates of the shear stress necessary to mobilize spawning gravel based on the bulk sample results and to flush fine sediments at depth are considered to be the most pertinent since the D_{84} value used in the shear stress calculation and the percent sand content used in the Shields number is specific to the area where the bulk sample was collected, unlike the pebble counts in which the D_{84} and sand content values are influenced by the sorting of sediment sizes across the entire channel width which often includes distinct zones of coarser and finer sediment. The bulk sample material better represents the range of particle sizes that, at depth below the ground surface, is the same range of particle sizes that spawning steelhead and trout would encounter when constructing a redd. Thus, the pebble counts are indicative of the particle size distribution only at the surface of the bed, while the bulk sample is more indicative of the particle size distribution at depth.

The particle size gradations used in the incipient motion calculations are based on the post-425 cfs sediment sampling. The post-425 cfs gradation is considered a better representation of the actual bed substrate conditions since at many cross-sections the sand and silt overlying the coarser gravel and cobble bed was flushed through the system during the 425 cfs release, thus exposing the coarser substrate.

Finally, it should be noted that while the tracer gravel study is compatible with the findings of the initiation of motion model results presented herein, the tracer gravel study results cannot be used to empirically confirm that flows less than 425 cfs predicted by the model are adequate to mobilize the specified particle sizes, since the tracer gravel study did not test flows less than 425 cfs. The initiation of motion results for each Study Site are presented below.

Study Site 1

The critical shear stress values required for initiation of motion were calculated using the Wilcock and Crowe (2003) method and the representative sediment sample collected for each transect. The D_{50} and D_{84} particles are theoretically mobilized when the modeled shear stress (τ) exceeds the shear stress required for initiation of motion (τ_c) (see Section 5.2.1.5). A minimum flow of 100 cfs was analyzed (at all sites) in the model for capacity to initiate motion. Figure 34 presents the flows at which the critical shear stress (τ_c) required to mobilize the D_{50} (solid horizontal lines) and D_{84} (dashed horizontal lines) at XS-1 and XS-7 occur. The plots show results based on both the bulk sample and pebble count sediment size gradations. The incipient motion results for all cross-sections are provided in Table 24 and a summary of the results for each cross-section is as follows:

- At XS-1, which is located at a riffle crest, flows less than 100 cfs are capable of mobilizing the D_{50} and the D_{84} based on both the bulk sample and pebble count particle size gradations. The shear stress at XS-1 does not exhibit a linear increase in bed shear stress with increasing flow magnitude. This cross-section is located on a riffle crest with gravel and cobble and under low-flow conditions the channel here has a steep energy grade with shallow flow depths and high velocities. These conditions result in a steep water column velocity gradient over coarse D_{84}, and thus a higher bed shear stress than compared with higher flows (see Figure 34). As flow magnitude increases there is backwatering from the downstream pool over the riffle crest which decreases the energy grade and reduces bed shear stress. The modeling shows that the shear stress required to move the bed material based on the bulk sediment sample flattens out around 15 Pascals (Pa), and that all flows greater than 100 cfs are capable of mobilizing the D_{50} (19.4 mm) and D_{84} (47.9 mm) particles. For comparison, two-thirds of all the tracers moved, including seven of the ten total 76 mm tracer gravels placed on the cross-section were mobilized at the 400 cfs flow (see Table 18);

- At XS-2, which is located at a riffle tail, flows less than 100 cfs are capable of mobilizing the D_{50} and a minimum flow of 250 cfs is required to mobilize the D_{84} (pebble count size gradation only);

- At XS-3, which is located in a relatively shallow pool, a minimum flow of 100 cfs is required to mobilize the D_{50} and a minimum flow of 225 cfs is required to mobilize the D_{84} (pebble count size gradation only);

- At XS-4, which is located at a riffle crest, flows less than 100 cfs are capable of mobilizing the D_{50} and the D_{84} (pebble count size gradation only). This cross-section is located on a riffle with gravel and cobble, and similar to XS-1, the high energy grade with relatively high velocities in shallow flow depths produce high bed shear stresses at lower discharges. Flows of less than 100 cfs are capable of mobilizing the D_{50} (32.6 mm) and D_{84} (77.5 mm) particle sizes (see Table 24). For comparison, three-quarters of all tracers moved, including three of the ten total 76 mm tracer gravels placed on the cross-section that were mobilized at the 400 cfs flow, and one presumed to have moved downstream was not recovered. Although there is relatively good correspondence between the tracer study and modeling results, considering that more than half the 76 mm tracer gravels did not move at 400 cfs, the hydraulic modeling appears to over-predict bed mobility at this cross-section;

- At XS-5, which is located across a low gradient riffle, flows less than 100 cfs are capable of mobilizing the D_{50} and the D_{84} (pebble count size gradation only);

- At XS-6, which is located through a lateral scour pool, a minimum flow of 150 cfs is required to mobilize the D_{50} and a minimum flow of 380 cfs is required to mobilize the D_{84} (pebble count size gradation only); and,

- At XS-7, which is located near the downstream end of a riffle, flows less than 100 cfs are capable of mobilizing the D_{50} based on both the bulk sample and pebble count particle size gradations. Based on the pebble count gradation, flows less than 100 cfs are capable of mobilizing the D_{84}, and, based on the bulk sample data, a minimum flow of 185 cfs is required to mobilize the D_{84}.

In summary, the flows required to mobilize the D_{50} particle sizes at this site range from less than 100 cfs at XS-2 (riffle) to 150 cfs at XS-6 (pool) and the flows required to mobilize the D_{84} particle sizes range from less than 100 cfs at XS-1, XS-2, XS-4, and XS-5 to 380 cfs at XS-6 (pool).

Study Site 2

The critical shear stress values required for initiation of motion were calculated using the Wilcock and Crowe (2003) method and the representative sediment sample collected for each transect. The D_{50} and D_{84} particles are theoretically mobilized when the modeled shear stress (τ) exceeds the shear stress required for initiation of motion (τ_c) (see Section 5.2.1.5). A minimum flow of 100 cfs was analyzed (at all sites) in the model for capacity to initiate motion. Figure 35 presents the flows at which the critical shear stress (τ_c) required to mobilize the D_{50} (solid horizontal lines) and D_{84} (dashed horizontal lines) at XS-1 and XS-5 occur. The plots show results based on both the bulk sample and pebble count sediment size gradations. The incipient motion results for all cross-sections are provided in Table 25 and a summary of the results for each cross-section is as follows:

- At XS-1, which is located on a steep gravel and cobble riffle crest, the calculations based on the bulk sample sediment gradation show that a minimum flow of 100 cfs is required to mobilize the D_{50} (23.4 mm), and a minimum flow of 320 cfs is required to mobilize the D_{84} (77.9 mm) particles (see Table 25). For comparison, most of the tracer particles smaller than 76 mm moved, and four of the ten 76 mm tracer gravels placed on the cross-section were mobilized at the 400 cfs flow (see Table 19), and one presumed to have moved downstream was not recovered. Although there is reasonably good correspondence between the tracer study and modeling results, considering that half the 76 mm tracer gravels did not move at 425 cfs, the hydraulic modeling appears to somewhat over-predict bed mobility at this cross-section;

- At XS-2, which is located at a riffle tail, minimum flows of less than 100 cfs are capable of mobilizing the D_{50} and the D_{84} (pebble count size gradation only);

- At XS-3, which is through a pool, minimum flows of less than 100 cfs are capable of mobilizing the D_{50} and a minimum flow of 375 cfs is required to mobilize the D_{84} (pebble count size gradation only);

- At XS-4, which is near the tail end of a pool, minimum flows of less than 100 cfs are capable of mobilizing the D_{50} and a minimum flow of 160 cfs is required to mobilize the D_{84} (pebble count size gradation only); and,

- At XS-5, which is located on a riffle with a mild gradient, the calculations based on the bulk sample sediment gradation show that minimum flows of less than 100 cfs are capable of mobilizing the D_{50} (8.2 mm) and a minimum flow of 170 cfs is required to mobilize the D_{84} (29.1 mm) particles (see Table 25). For comparison, nearly every tracer particle size less than 76mm moved, and six of the ten 76 mm tracer gravels placed on the cross-section were mobilized at the 400 cfs flow (see Table 19).

In summary, minimum flows of less than 100 cfs mobilize the range of D_{50} particle sizes at this site. The minimum flows required to mobilize the range of D_{84} particle sizes at this site range from less than 100 cfs at XS-2 (riffle) to 375 cfs at XS-3 (pool head).

Study Site 3

The critical shear stress values required for initiation of motion were calculated using the Wilcock and Crowe (2003) method and the representative sediment sample collected for each transect. The D_{50} and D_{84} particles are theoretically mobilized when the modeled shear stress (τ) exceeds the shear stress required for initiation of motion (τ_c) (see Section 5.2.1.5). A minimum flow of 100 cfs was analyzed (at all Study Sites) in the model for capacity to initiate motion. Figure 36 shows the flow critical shear stress (τ_c) required to mobilize the D_{50} (solid horizontal lines) and D_{84} (dashed horizontal lines) particle sizes measured at XS-3, XS-5 and XS-6. Study Site 3 is by far the steepest channel reach of all the sites and after the 425 cfs release the substrate conditions were significantly changed. Scour had removed much of surficial fine sediment deposits and exposed the underlying gravel, cobble and boulder substrate. The bulk samples were collected at XS-3 and XS-5 during the initial survey. It was not feasible to collect repeat bulk samples at the same cross-sections following the 425 cfs release since the bed at these cross-sections contained very little spawning gravel once the scouring by the 425 cfs flow exposed a coarse cobble and boulder bed. Thus, the bulk sampling location was moved downstream to the next most suitable location at XS-6, which contained a small pocket of spawning gravel. Unlike the other incipient motion results presented for Study Sites 1 and 2, the data used for the XS-3 and XS-5 calculations is based on the pre-425 cfs sample (results for XS-6 are based on the post-425 cfs sample). The results obtained from both the bulk sample and pebble count sediment gradations are shown in Figure 36. The incipient motion results for all cross-sections are provided in Table 26 and a summary of the results for each cross-section is as follows:

- At XS-1, which is located at a transition from pocket water to a step-run, minimum flows of less than 100 cfs are capable of mobilizing the D_{50} and a minimum flow of 250 cfs is required to mobilize the D_{84} (based on pebble count particle size gradations);

- At XS-2, which is located at a step-run, a minimum flow of 450 cfs is required to mobilize the D_{50} (cobble) and flows greater than 1,000 cfs are required to mobilize the D_{84} (small boulder), based on pebble count particle size gradations;

- At XS-3, which is located at a transition from a section of plane bed morphology and a steep gradient riffle crest, minimum flows of less than 100 cfs are capable of mobilizing the D_{50} based on both the bulk sample and pebble count particle size gradations. Based on the bulk sample data, flows of less than 100 cfs are capable of mobilizing the $D_{84,}$ while the pebble count data indicate that minimum flows between 700 cfs to 1,025 cfs are required to mobilize the D_{84} (large cobble size category). The bed prior to the 425 cfs release contained boulders and cobbles intermixed with a layer of sand and fine to medium gravel deposits. The calculations based on the bulk sample sediment gradation show that flows less than 100 cfs are capable of mobilizing the D_{50} (1.7 mm) and the D_{84} (10.2 mm) particles;

- At XS-4, which is located at a pocket water, a minimum flow of 525 cfs is required to mobilize the D_{50} (cobble) and flows greater than 1,000 cfs are required to mobilize the D_{84} (small boulder), based on pebble count particle size gradations;

- At XS-5, which is located at the tail end of a steep riffle where the channel transitions into a section of plane bed morphology, flows less than 100 cfs are capable of mobilizing the D_{50} and D_{84} based on both bulk sample and pebble count particle size gradations. The bed surface prior to the 425 cfs release was composed primarily of sandy sediment. The calculations based on the bulk sample sediment gradation shows that minimum flows of less than 100 cfs are capable of mobilizing the D_{50} (0.33 mm) and the D_{84} (2.0 mm) particles. For comparison, nearly all of the tracer particles smaller than 76 mm were missing, presumed to have moved downstream during the 425 cfs release;

- At XS-6, which is located at the transition from a section of plane bed morphology into a moderately steep and long riffle that extends to the downstream bridge, a minimum flow of 700 cfs is required to mobilize the D_{50} based on the bulk sample data while the pebble count data indicate that minimum flows of less than 100 cfs are capable of mobilizing the D_{50}. The D_{84} (cobble size category) is mobilized at 1,200 cfs based on the bulk sample particle data while the pebble count data indicate that minimum flows of less than 100 cfs are capable of mobilizing the D_{84}. The bed surface was altered from a sandy substrate into a cobble with gravel bed after the 425 cfs release. The calculations based on the bulk sample sediment gradation show that a minimum flow of 700 cfs is required to mobilize the D_{50} (104.0 mm), and 1,200 cfs is required to mobilize the D_{84} (139.2 mm) particles. Although no rocks as large as the D_{50} or the D_{84} were used, the tracer study found that over 80 percent of the tracers moved, including 80 percent of the 76 mm size cobbles after the 591 cfs release; and,

- In summary, the minimum flows required to mobilize the D_{50} particle sizes at this site range from less than 100 cfs to 525 cfs, and the minimum flows required to mobilize the D_{84} range from 250 cfs to more than 1,000 cfs.

Chapter 5

Study Findings

This section discusses the findings of the Geomorphology Study with specific respect to the following two objectives of the study:

- **Objective 1 –** Evaluate potential effects of Santa Felicia Dam and its operations on: a) the quantity, quality and availability of spawning gravel; b) the deposition and flushing of fine sediments; and, c) the adequacy of overbanking flows in supporting riparian vegetation along lower Piru Creek;

- **Objective 2 –** Based on the findings of Objective 1, determine the flow releases that are necessary to restore, or in the case of lower Piru Creek, enhance the geomorphic processes that promote a dynamic river ecosystem that will support steelhead trout including: a) mobilizing the streambed every 1-2 years to promote pool scour and mobilization of the coarse layer on riffles; b) flushing sand from the gravel framework during the spawning and rearing season; and, c) re-working the channel morphology via overbank flows at a frequency of approximately every 5 years.

Objective 1 is discussed in Section 5.1 and Objective 2 is addressed in Section 5.2.

5.1 Evaluation of Potential Effects of Santa Felicia Dam and Its Operations on the Geomorphology of Lower Piru Creek

The hydrology and geomorphology of lower Piru Creek have been affected by Santa Felicia Dam and its operations as well as other changes in the Piru Creek watershed including the Lake Pyramid Project and changes in land use. Sections 2.4 and 2.5 of this report and *Section 2.3 Report on Hydrology* and *Section 2.4 Report on Geomorphology* of the FERC Exhibit E relicensing documentation provide discussions of the pre-Project and post-Project hydrology and geomorphology of lower Piru Creek. In regard to the hydrology, the pre-Project hydrology of lower Piru Creek is characterized as "flashy" with the highest flows occurring between January and April in response to seasonal storm events and the lowest flows occurring in July through October at the end of the dry season. In contrast, the post-Project hydrology for lower Piru Creek indicates more consistent flows year-round and a change in the timing of annual extreme flows in comparison to the pre-Project conditions. Under post-Project operations prior to implementation of the *Santa Felicia Water Release Plan* (UWCD 2012) during the winter of 2011 and with the exception of spill events which occur approximately every 5 years on average, the highest mean monthly flows occurred in September and October in response to the annual conservation water release rather than between January and April in response to seasonal storm events, and the lowest mean monthly flows occurred between December and March rather than July through October at the end of the dry season. Since the winter of 2011, Project operations and associated flow releases have changed substantially in accordance with the *Santa Felicia Water Release Plan* (UWCD 2012) which includes provisions for increased minimum flows during normal and wet water years as well as minimum migration releases of 200 cfs under certain conditions.

In regard to geomorphology, a pre-Project aerial photograph taken in March 1949 (approximately 7 years prior to construction of the Project) depicts a relatively unstable channel with very little riparian vegetation. The historic photograph shows the presence of significant braiding and evidence of lateral migration. In contrast, the present day channel consists of a relatively stable channel with a well vegetated riparian corridor. Encroachment of the historic braid plain by agriculture fields and Piru Canyon Road has confined lower Piru Creek to a narrower zone with reduced lateral migration.

This general overview of changes in hydrology and geomorphology provides a context for the remainder of this section which provides an evaluation of potential effects of Santa Felicia Dam and its operations on: a) the quantity, quality and availability of spawning gravel; b) the deposition and flushing of fine sediments; and, c) the adequacy of overbanking flows in supporting riparian vegetation along lower Piru Creek.

5.1.1 Evaluation of Effects on Spawning Gravel

The sediment supply to lower Piru Creek is limited as both Pyramid Lake and Lake Piru trap sediment transported from the upper Piru Creek watershed. Based on storage capacity surveys, the storage volume in Lake Piru has decreased approximately 18,000 acre-feet (AF) between 1957 and 2005 and approximately 7,700 AF between 1975 and 2005 after the construction of Pyramid Lake in 1972. These data indicate that on average approximately 257 AF per year of sediment is trapped behind Santa Felicia Dam from the watershed area situated between Pyramid Lake and Lake Piru. The watershed area between Pyramid Lake and Lake Piru is approximately 141 square miles, and based on the Lake Piru storage data from 1975 to 2005, the approximate sedimentation rate within this watershed area is approximately 1.8 AF per square mile per year. Since sediment in Lake Piru is isolated behind the dam, the sediment supply to lower Piru Creek is limited to contributing sources situated downstream of the Project. Based on the estimated sedimentation rate from the Lake Piru storage data and the effective watershed area situated downstream of the Project (i.e. lower Piru Creek, approximately 15 square miles), the estimated sedimentation rate for lower Piru Creek is approximately 27 AF per year.

Since the construction of Santa Felicia Dam in 1955, the primary sources of spawning gravel consist of in-channel sources and the tributary drainages. Of these sources, the most significant contribution is likely from tributary drainages as the channel bed is relatively well-armored and erosion of the banks is relatively limited. The tributaries include Modelo Canyon, Holser Canyon, Blanchard Canyon, Lime Canyon, and five unnamed drainages. These drainages are intermittent with surface flows occurring in response to seasonal rainfall events and agricultural irrigation. Accordingly, substantial sediment delivery from these areas is primarily limited to the wet season between November and April of each year. Based on observations during the field reconnaissance surveys, these drainages appear to primarily deliver fine sediment (i.e. material less than 0.074 mm [USBOR 2012]), sand, and small gravels.

In regard to the quality and availability of spawning gravel, pre-Project data are not available for comparison with post-Project data which precludes accurate direct assessment of potential effects associated with the Project. The data collected during this study indicate that the quality and availability of spawning gravels increase following the flow release events as compared to pre-release conditions. This increase is likely due in large part to the flushing of overlying fine sediments delivered from the tributaries to expose the underlying gravels.

5.1.2 Evaluation of Effects on the Deposition and Flushing of Fine Sediments

As previously discussed, Project operations have altered the pre-Project hydrologic regime. Specifically, under post-Project operations, flows are more consistent year-round and the timing of annual extreme flows has been modified. Under post-Project operations prior to implementation of the *Santa Felicia Water Release Plan* (UWCD 2012) in 2011 and with the exception of spill events which occur approximately every 5 years on average, the highest mean monthly flows occurred in September and October in response to the annual conservation water release rather than between January and April in response to seasonal storm events, and the lowest mean monthly flows occurred between December and March rather than July through October at the end of the dry season. The change in the hydrologic regime associated with Project operations has also modified the sediment transport regime in lower Piru Creek. As discussed previously, the primary sources of sediment to lower Piru Creek under post-Project conditions are the tributary drainages situated downstream of the Project. These drainages deliver sediment to the channel during the wet season through runoff associated with storm events. During the wet season, Project flow releases to lower Piru Creek have been fixed based on rates specified in United's FERC licenses for the Project. Prior to implementation of the *Santa Felicia Water Release Plan* (UWCD 2012), the releases did not mimic the "flashy" nature of flows in the tributaries. Accordingly, with the exception of years with ample spill events, flows in lower Piru Creek have not typically been sufficient to transport the sediment delivered to lower Piru Creek by the tributaries during wet season storm events which result in deposition of sediment in the lower Piru Creek channel. This deposition of sediment can impact instream habitat by filling-in pools, thereby reducing available rearing habitat, and in-filling riffles with fine sediment and sand which impacts spawning habitat. Except during years with ample spill events, this sediment has remained in the lower Piru Creek channel until the annual conservation releases in September and October which serve to mobilize and transport the material through the system. The current version of the *Santa Felicia Water Release Plan* (UWCD 2012) approved by NMFS on July 3, 2012, includes provisions for increased minimum flows during normal and wet water years to address habitat needs and minimum releases of 200 cfs under certain conditions to allow for migration of steelhead into and out off Piru Creek.

5.1.3 Evaluation of Effects on the Adequacy of Overbanking Flows in Supporting Riparian Vegetation

As discussed above, a pre-Project aerial photograph taken in March 1949 (approximately 7 years prior to construction of the Project) depicts a relatively unstable channel with very little riparian vegetation. In addition, a stream survey conducted by CDFG in 1949 (CDFG 1949) characterizes the "shelter" in lower Piru as poor with few willows and alders along the margin. In contrast, the present day channel consists of a relatively stable channel with a well vegetated riparian corridor.

A survey of riparian vegetation along lower Piru Creek was conducted during the FERC relicensing process as discussed in *Section 3.3 Report on Botanical Resources* of the FERC Exhibit E relicensing documentation. The survey was conducted along lower Piru Creek, between Santa Felicia Dam and the Santa Clara River. The vegetation along this portion of Piru Creek was reported as a patchwork of stands dominated primarily by mulefat and stands dominated by a mix of mulefat, arroyo willow, sandbar willow, white alder, or Fremont cottonwood. Vegetative cover along the channel ranged from 10 to 100 percent with the upper portions of lower Piru Creek exhibiting areas of primarily 90 to 100 percent cover and the lower reaches having much more sparse vegetation and lower cover. Seedling willows were observed on the occasional sandbar in or adjacent to the channel, but most of the channel banks were too densely vegetated to provide sites for seedling development. Mulefat generally varied from 5-6 feet in height, while the Fremont cottonwood reached heights of 55 feet. The willows ranged from three to 35 feet in height, while the white alders were generally between 15-20 feet in height. The data indicate a greater amount of riparian vegetation under post-Project conditions as compared to pre-Project conditions which suggests improved habitat conditions associated with the frequency and magnitude of overbanking flows that have occurred under past Project operations.

5.2 Flow Releases Necessary to Enhance Geomorphic Processes

This section addresses Objective 2 of this study and presents an evaluation of flow releases that are necessary to enhance the geomorphic processes in lower Piru Creek to promote a dynamic river ecosystem. The flows needed to address the specified objectives were developed using the data collected during the field studies and the results of the hydraulic models prepared for each Study Site. Accordingly, Section 5.2.1 discusses the hydraulic model for each Study Site and the incipient motion calculations used to evaluate the sediment transport characteristics at each site. This information provides a context for the remainder of this section which presents an evaluation of flow releases that are necessary to: a) mobilize the streambed every 1-2 years to promote pool scour and mobilization of the coarse layer on riffles; b) flush sand from the gravel framework during the spawning and rearing season; and, c) re-work the channel morphology via overbank flows at a frequency of approximately every 5 years.

5.3 Flows Needed to Mobilize the Streambed, Promote Pool Scour and Mobilize the Coarse Layer on Riffles

The hydraulic modeling and tracer gravel study results indicate that flows less than 425 cfs will mobilize the D_{50} particle size at each of the Study Sites. At all of the cross-sections at Study Sites 1 and 2 and most of the cross-sections at Study Site 3, a flow of 150 cfs is sufficient to mobilize the D_{50}. Based on the hydraulic modeling and corroborated by the tracer study results, a flow of 380 cfs is sufficient to mobilize the D_{84} at all cross-sections at Study Sites 1 and 2. At Study Site 3, a flow of 250 cfs will mobilize the D_{84} at three of the cross-sections, but over 1,000 cfs is required to move the D_{84} at the other three cross-sections where the bed material consists of large cobble to small boulder. The hydraulic modeling data indicate a greater discharge is needed to mobilize the bed material in pool habitats, which are used for rearing habitat, versus riffle habitats, which are used for spawning and feeding. Of the cross-sections located in pool habitats (two at Study Site 1 and two at Study Site 2), the model results indicate that a minimum flow of 380 cfs is needed to mobilize the D_{84} through these transects.

In regard to surficial fine sediments, localized areas are mobilized before the coarser underlying gravel and cobble material begins transport. Sand deposits were effectively transported at nearly all of the cross-sections at Study Sites 2, 3, and 4 following the 425 cfs and the 591 cfs releases based on the pebble count results. However, the data at Study Site 1 indicate an opposite trend where the proportion of surficial sand actually increased after the 425 cfs release, while the 591 cfs flow release decreased the proportion of sand on the bed at some of the cross-sections but increased sand at a couple of the cross-sections. Although finer sediments such as sand will be readily mobilized with flows lower than 425 cfs, there may not be a discharge which can be expected to uniformly and consistently flush fine sediments at all locations.

The repeat cross-section surveys showed only very small changes in the bed topography following the 425 cfs and 591 cfs flow releases. These results do not mean that bed material did not move as the tracer gravel study results indicate mobilization and transport of gravels between 19 mm and 76 mm half-phi sizes during both the 425 cfs and 591 cfs release events. Rather, the cross-sectional area and dimensions of the channel remained stable after the flow release events. A channel in equilibrium will, over the long-term, not trend toward aggradation or degradation, but will maintain its overall form. As sediments are transported through a reach, new sediments from upstream are transported into the reach. As such, the cross-section surveys did not indicate any particular trend toward aggradational/degradational processes or changes in the channel form or dimensions with either the 425 cfs or 591 cfs flows; channel morphology will likely remain stable through this range of flows.

Although it is likely that as little as 100 cfs will mobilize the median size bed material at most sites (based on the modeling results), a flow of 380 cfs will ensure mobilization of the coarser bed material and will account for moving the bed material through both riffles and pools.

5.4 Flow Release to Flush Sand from the Gravel Framework during the Spawning and Rearing Season

Mobilization of the spawning size material (represented by the bulk samples) will also mobilize finer sediment from within the gravel matrix as the bed material begins transport. The bulk sample results collected before and after each release event provide an indication of the potential for the 425 cfs and 591 cfs release to flush sand and silt from the coarser gravel framework. Unfortunately, the bulk sample results did not show a consistent trend to flush fines from the spawning material following either the 425 cfs flow or the 591 cfs flow. At Study Site 1, the bulk sample data indicate a slight increase in fine sediment content after the 425 cfs flow, and a slight decrease in fine sediment content after the 591 cfs, but neither test flow resulted in an appreciable change in fine sediment content. At Study Site 2, the bulk sample data indicate a decrease in fine sediment content after the 425 cfs flow (significantly at one location), while a small increase in fine sediment was observed following the 591 cfs release. The bulk samples collected at Study Site 3 showed a significant decrease in fine sediment content following the 425 cfs release and little change after the 591 cfs release.

In summary, the bulk sampling results are inconclusive as to the net effectiveness and feasibility of flushing fines from within the gravel framework. However, the tracer gravel study results indicate mobilization and transport of gravels between 19 mm and 76 mm half-phi sizes during both of the release events which provides direct evidence of gravel movement at 425 cfs and 591 cfs. Accordingly, based on the tracer gravel data, the 380 cfs flow required to mobilize the D_{84} bed material through both riffles and pools should be sufficient to mobilize gravel and flush fine sediments from within the gravel matrix. It is important to recognize that flows which regularly mobilize spawning size material have, over time, the potential to result in coarsening of the streambed and reduction in the available gravel deposits, particularly where former gravel supply sources have been interrupted by reservoir construction. Research has documented this type of potential channel change and other textural shifts, such as poorly sorted bed sediments with abundant fines, downstream from reservoirs (Grant et al. 2003).

5.5 Flows Needed to Re-Work Channel Morphology

As discussed in Section 5.1, the morphology of lower Piru Creek has been altered from the pre-Project condition due to encroachment by roads and agriculture, a modified flow and sediment regime, and direct relocation of the channel (e.g. Study Site 1). The current channel is relatively stable in regards to lateral migration with a well vegetated riparian corridor in comparison with pre-Project conditions in which the channel appears braided with limited riparian vegetation and evidence of lateral migration. Based on these changes, traditional floodplain surfaces related to naturally occurring runoff events are not prevalent in lower Piru Creek. Rather, the channel features are primarily defined by the annual conservation flow releases with re-working of the channel morphology occurring during years with ample spill events. As discussed in *Section 2.3 Report on Hydrology* in the FERC Exhibit E relicensing documentation, a total of 10 spill events have occurred between the construction of the Project in 1956 and 2005 or, on average, a spill approximately every 5 years. The spills occurred in 1969, 1978, 1979, 1980, 1983, 1992, 1993, 1995, 1998, and 2005.

The physical location of the current operating stream gauge downstream of Santa Felicia Dam (USGS #11109800) is situated upstream of the confluence of the dam spillway with Piru Creek, so the records from this gauge do not account for spills. Accordingly, with the exception of the spill in 1998, the duration and magnitudes of the spill events are based on surface water elevations in Lake Piru and the spillway rating curve for Santa Felicia Dam. The flows associated with the 1998 spill are derived from data collected at USGS Gauge No. 11109801 which was installed downstream of the spillway channel confluence with lower Piru Creek and was operated between October 1, 1997 and September 30, 1998. The records indicate maximum mean daily recorded flows ranging from 220 cfs in 1992 to 8,760 cfs in 2005 with maximum flows in excess of 1,000 cfs in 8 of the 10 spill events and greater than 2,000 cfs in 7 of the 10 spill events. In 2005, an instantaneous peak flow was recorded at 14,404 cfs during the spill event as compared to the maximum mean daily flow of 8,760 cfs. Similarly, the instantaneous peak flows associated with the other spill events are likely much higher than the maximum recorded mean daily flows. A summary of the maximum recorded flows during each of these spill events is provided in Table 27. As discussed in Section 5.2, flows required to overtop the banks in lower Piru Creek range from 1,000 cfs to 10,000 cfs with most areas being overtopped at 1,000 to 2,000 cfs. The spill data indicate that maximum mean daily flows exceed 1,000 cfs approximately every 6 years and over 2,000 cfs approximately every 7 years. In addition, instantaneous peak flows during spill events likely exceed 1,000 to 2,000 cfs much more frequently. Accordingly, based on the spill frequency, it appears that the channel morphology has the potential to be re-worked to some degree approximately every 5 years.

In addition, as discussed previously, a survey of riparian vegetation along lower Piru Creek was conducted during the FERC relicensing process (*Section 3.3 Report on Botanical Resources* of the FERC Exhibit E relicensing documentation). The survey indicated that vegetative cover along lower Piru Creek ranged from 10 to 100 percent with the upper portions of lower Piru Creek exhibiting areas of primarily 90 to 100 percent cover and the lower reaches having much more sparse vegetation and lower cover. Seedling willows were observed on the occasional sandbar in or adjacent to the channel, but most of the channel banks were too densely vegetated to provide sites for seedling development. Mulefat generally varied from 5-6 feet in height, while the Fremont cottonwood reached heights of 55 feet. The willows ranged from three to 35 feet in height, while the white alders were generally between 15-20 feet in height. Given the range in species present and the density of vegetation, lower Piru Creek supports a greater amount of riparian vegetation under post-Project conditions as compared to pre-Project conditions which suggests that the frequency and magnitude of overbanking flows that have occurred under past operations support more riparian vegetation than pre-Project conditions.

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Chapter 6

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Figures

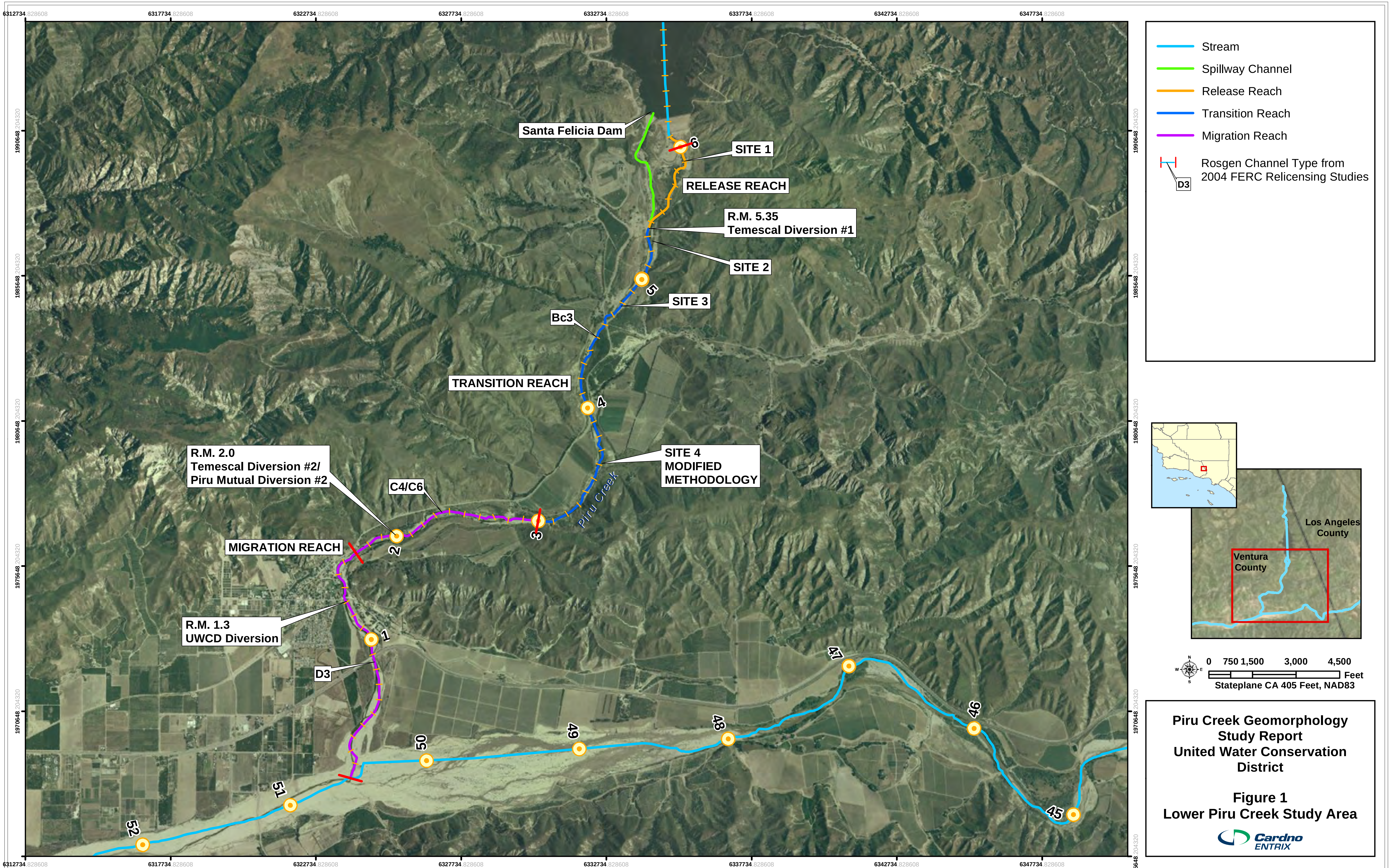

Figure 1
Lower Piru Creek Study Area

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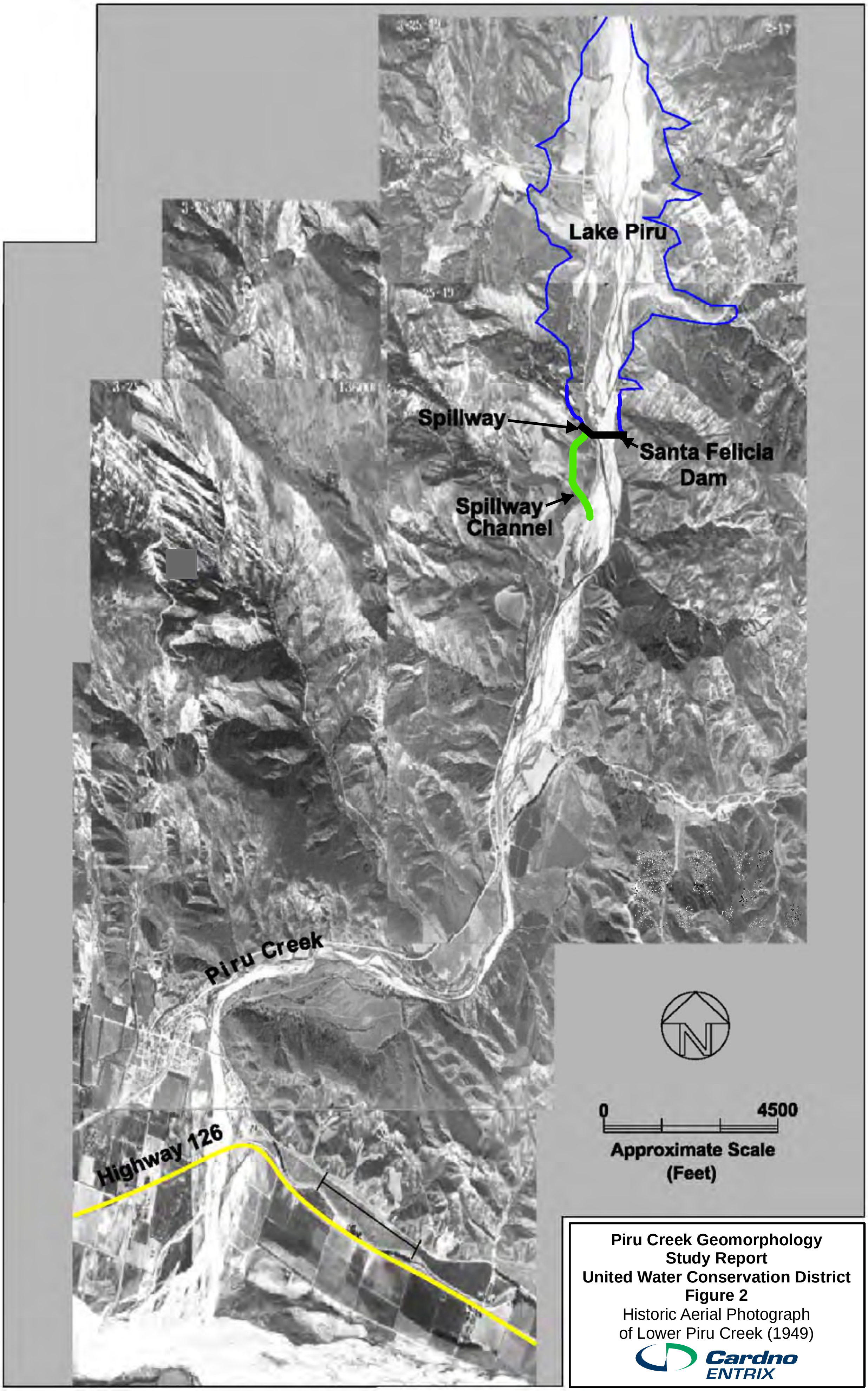

Piru Creek Geomorphology Study Report
United Water Conservation District
Figure 2
Historic Aerial Photograph of Lower Piru Creek (1949)

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Figure 3

Legend

Site 1 cross-sections

Site 1 long profile alignment

Piru Creek - Study Site 1
Piru Creek Geomorphology Study Report

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0 50 100 Feet

201 N. Calle Cesar Chavez, Ste 203
Santa Barbara, CA 93103 ph (805) 962-7679
www.entrix.com

Coordinate System: NAD 1983 CA State Plane Zone 5 ft
Imagery: 2010 USDA NAIP Map Created: 12/22/11

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Figure 4

Legend

Site 2 cross-sections

Site 2 long profile alignment

Piru Creek - Study Site 2
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0 50 100 Feet

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Santa Barbara, CA 93103 ph (805) 962-7679
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Figure 5

Piru Creek - Study Site 3
Piru Creek Geomorphology Study Report

Legend

Site 3 cross-sections
Site 3 long profile alignment

0 50 100 Feet

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Figure 6

Piru Creek - Study Site 4
Piru Creek Geomorphology Study Report

Legend

Site 4 cross-sections

Site 4 long profile alignment

0 50 100 Feet

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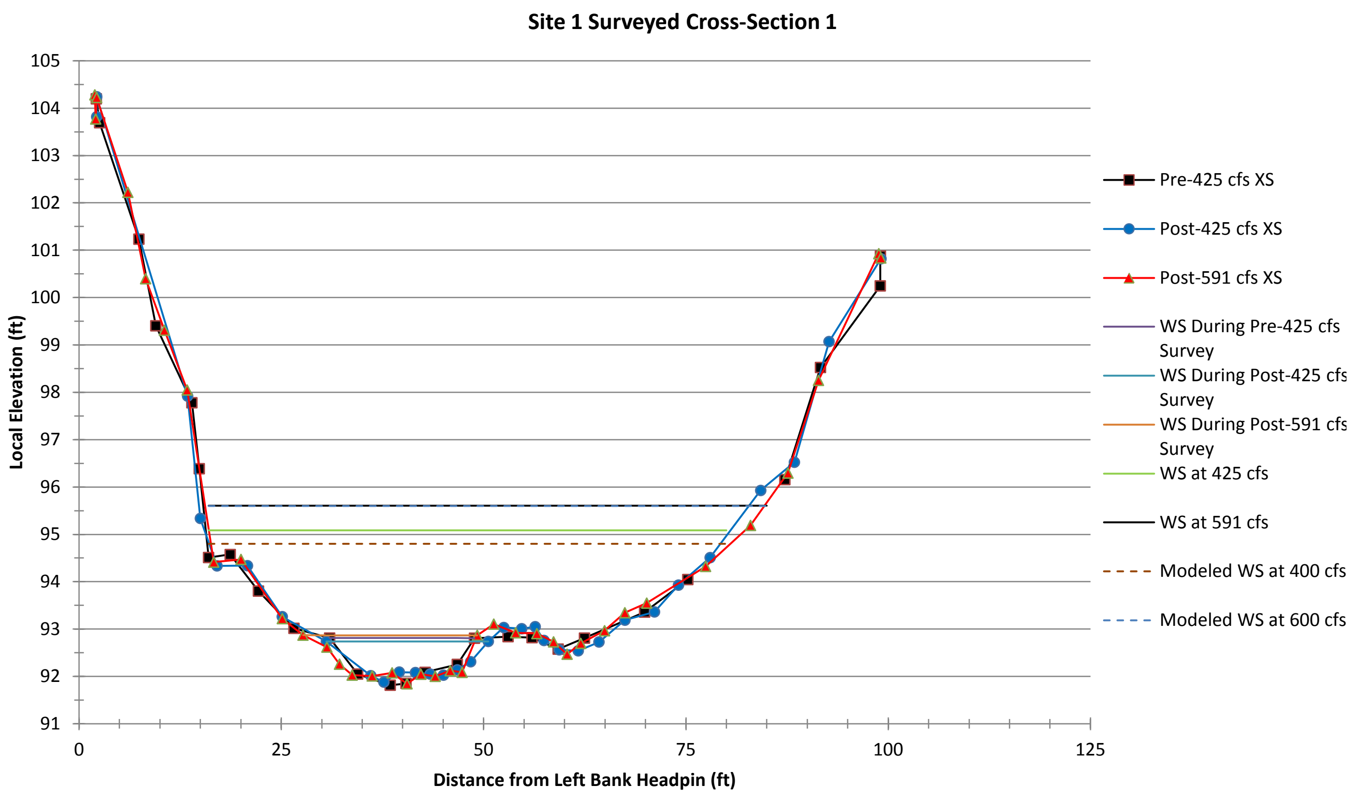

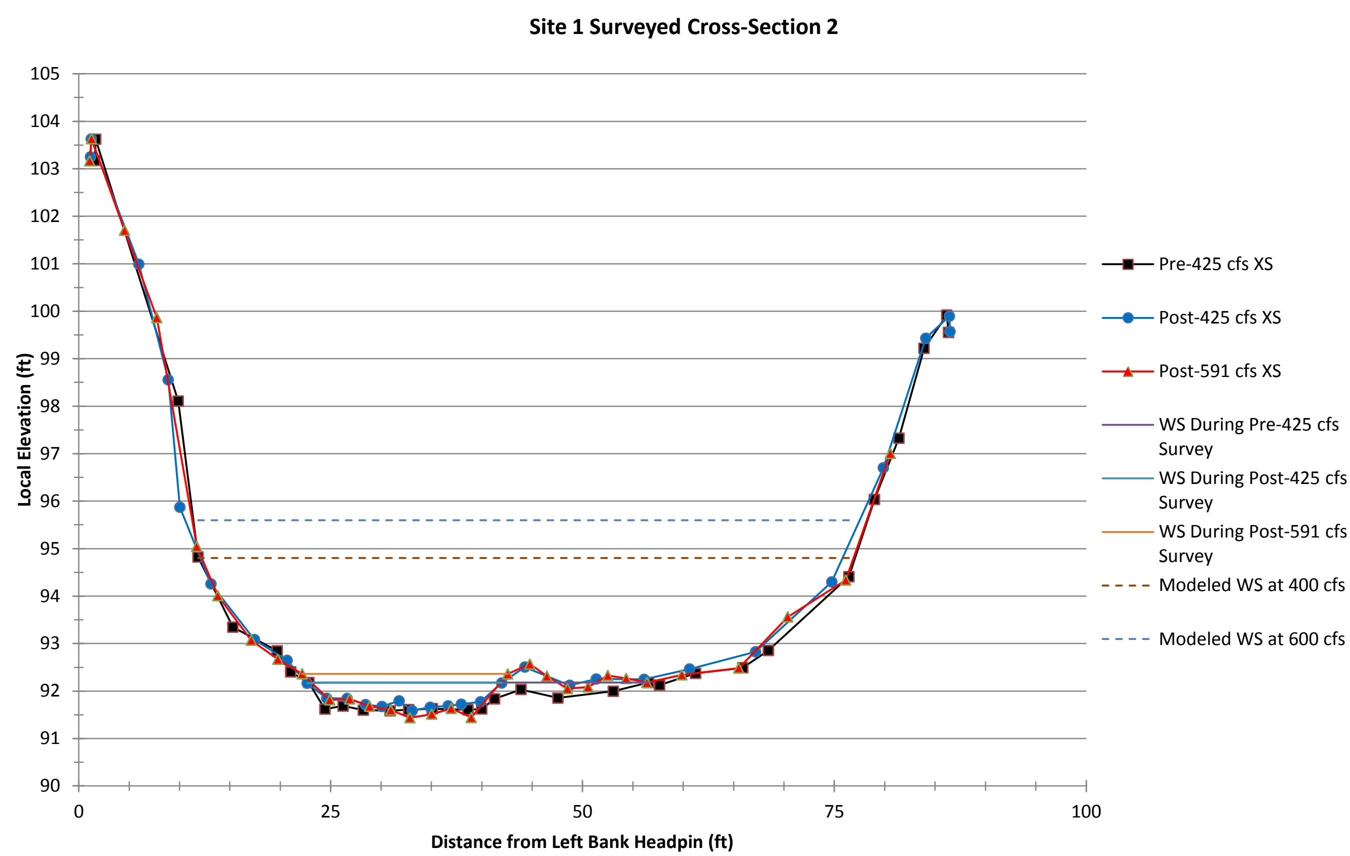

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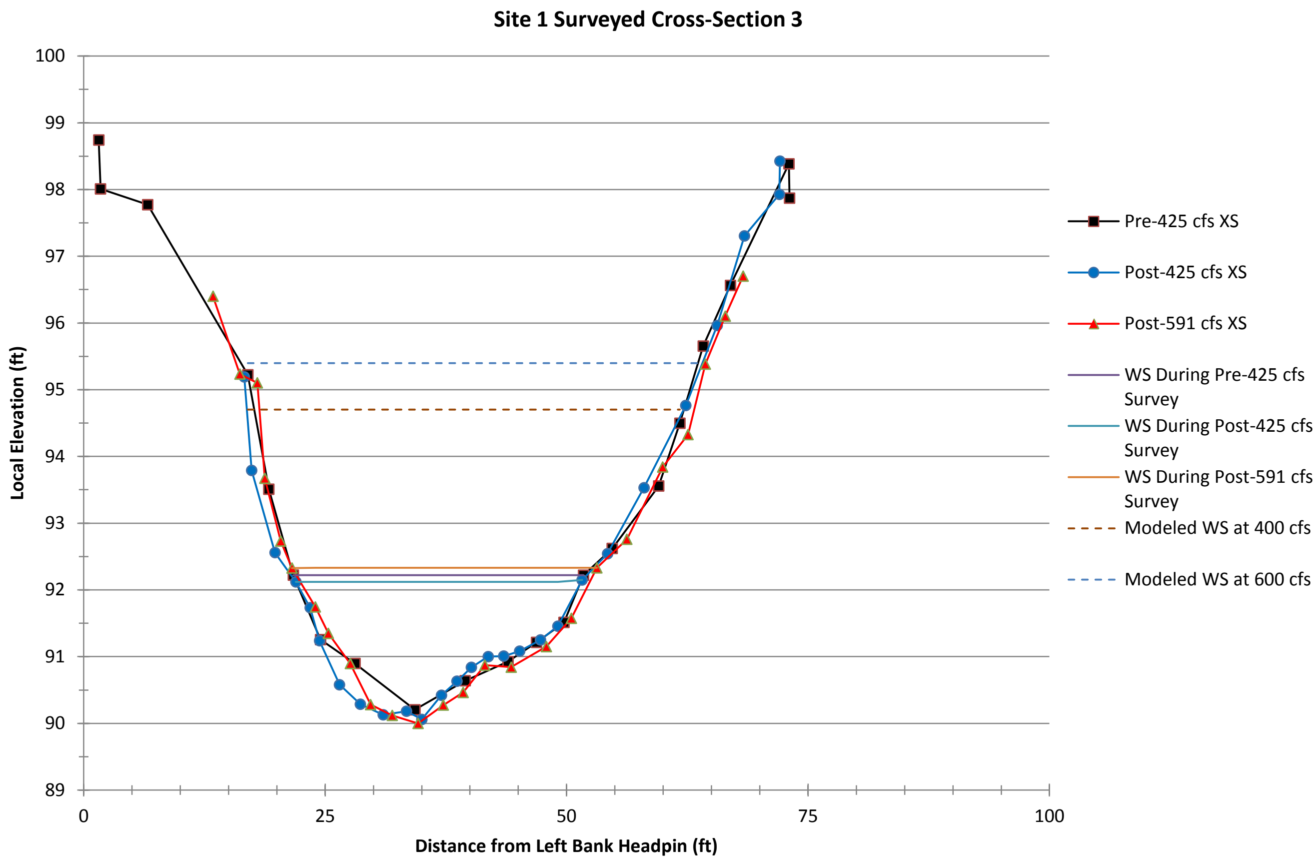
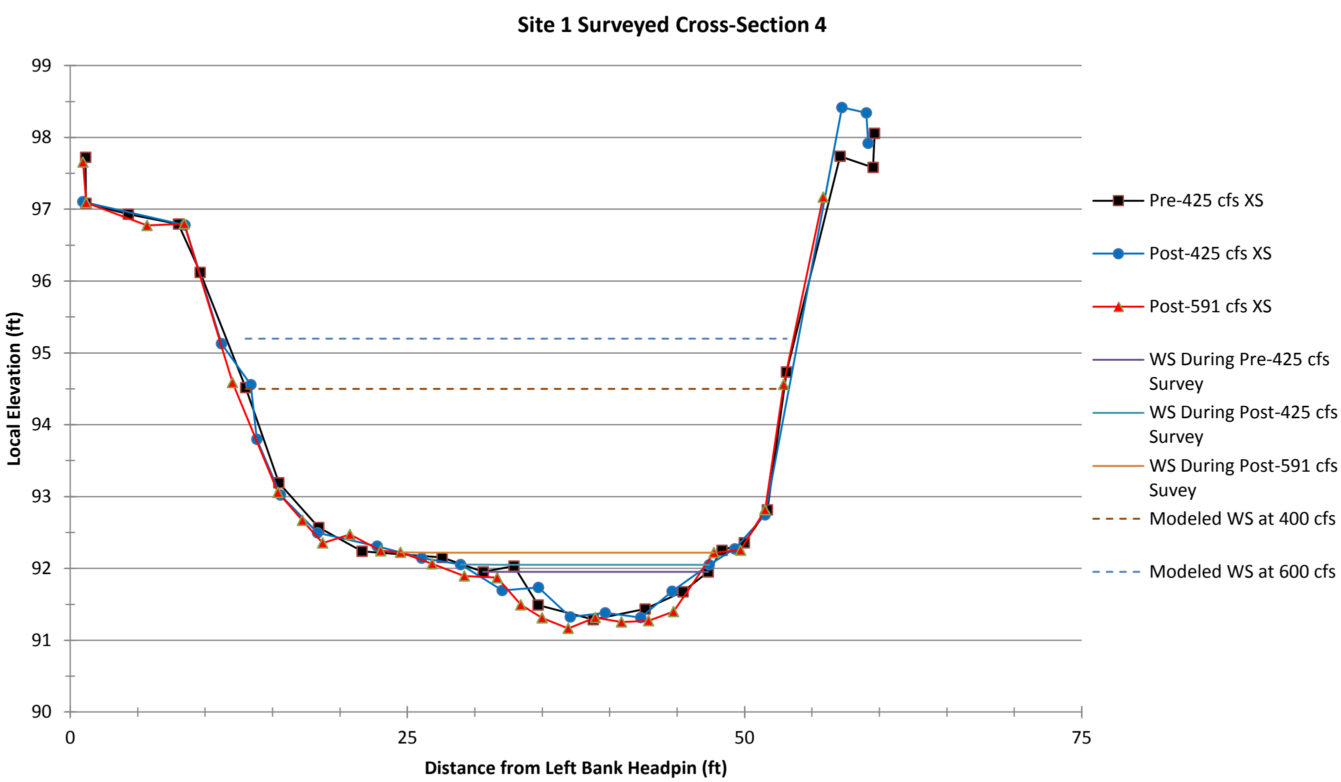
Site 1 Channel Cross-Sections

Piru Creek Geomorphology

Study Report

Figure 7





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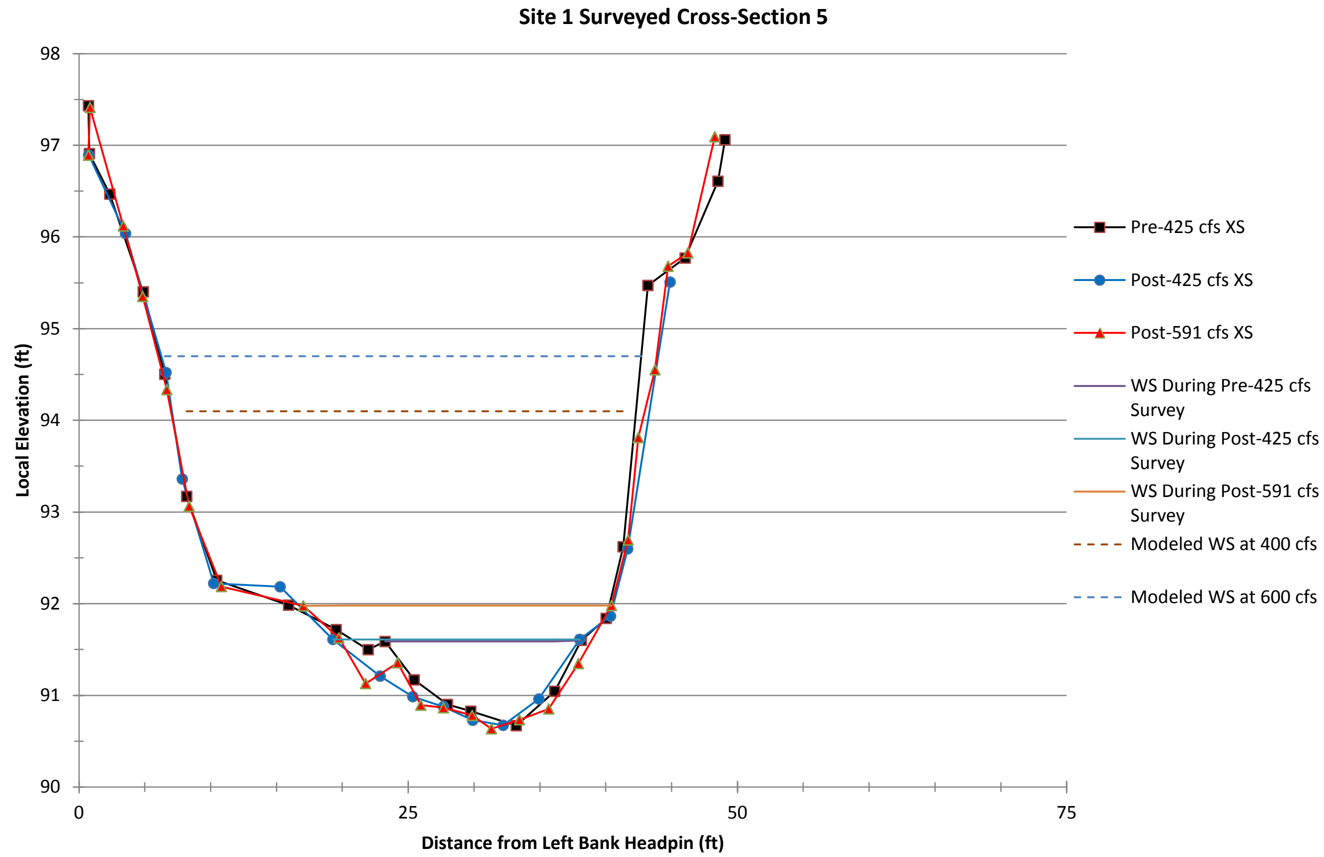
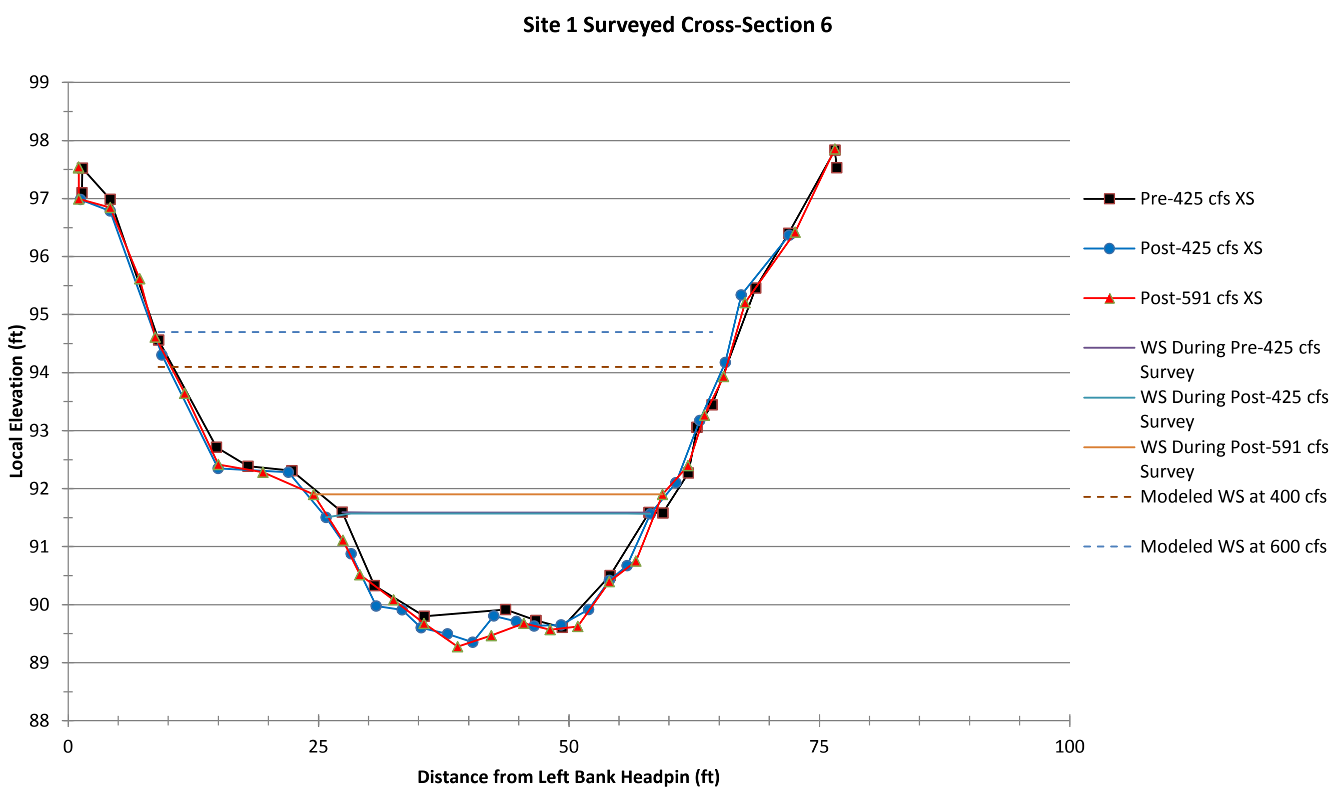
Site 1 Channel Cross-Sections

Piru Creek Geomorphology Study Report

Figure 8





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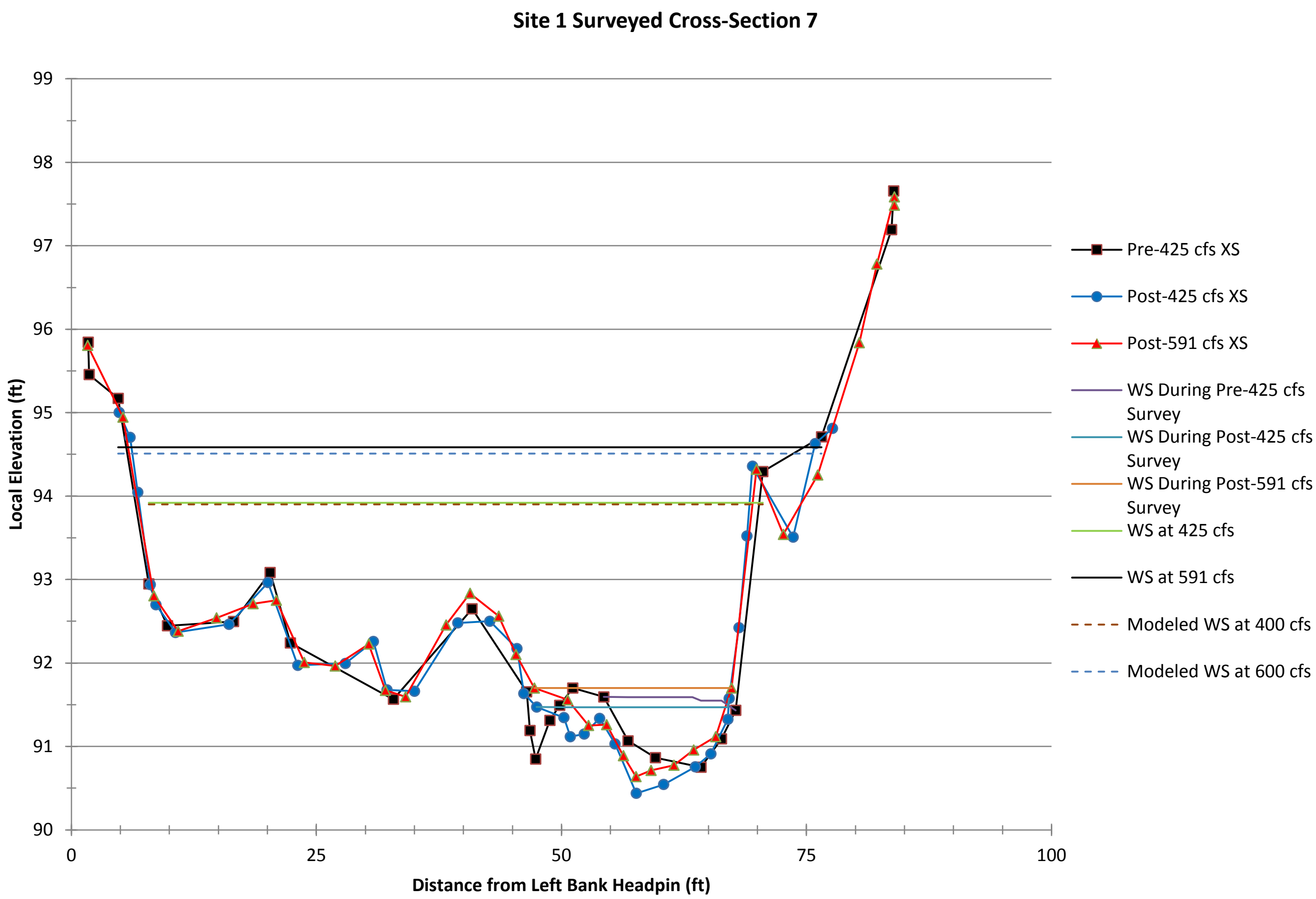
Site 1 Channel Cross-Sections

Piru Creek Geomorphology Study Report

Figure 9



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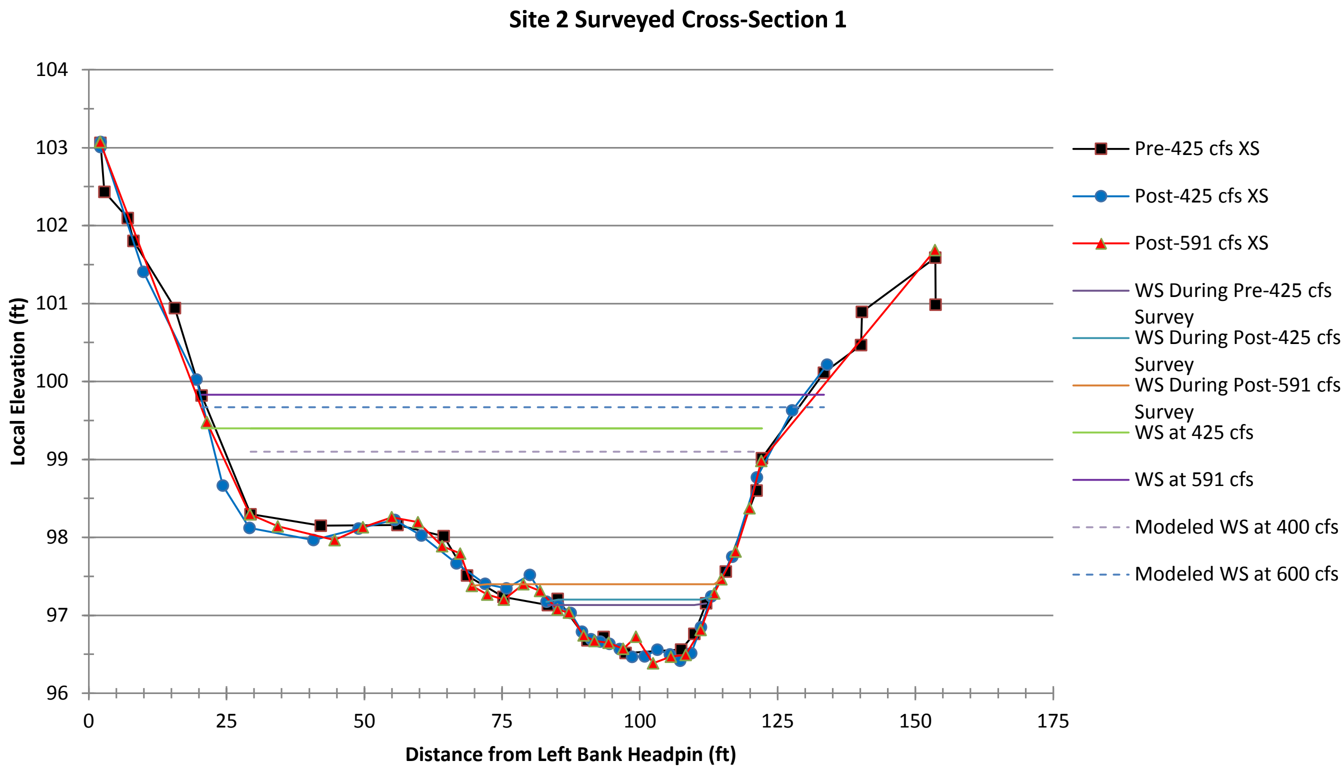
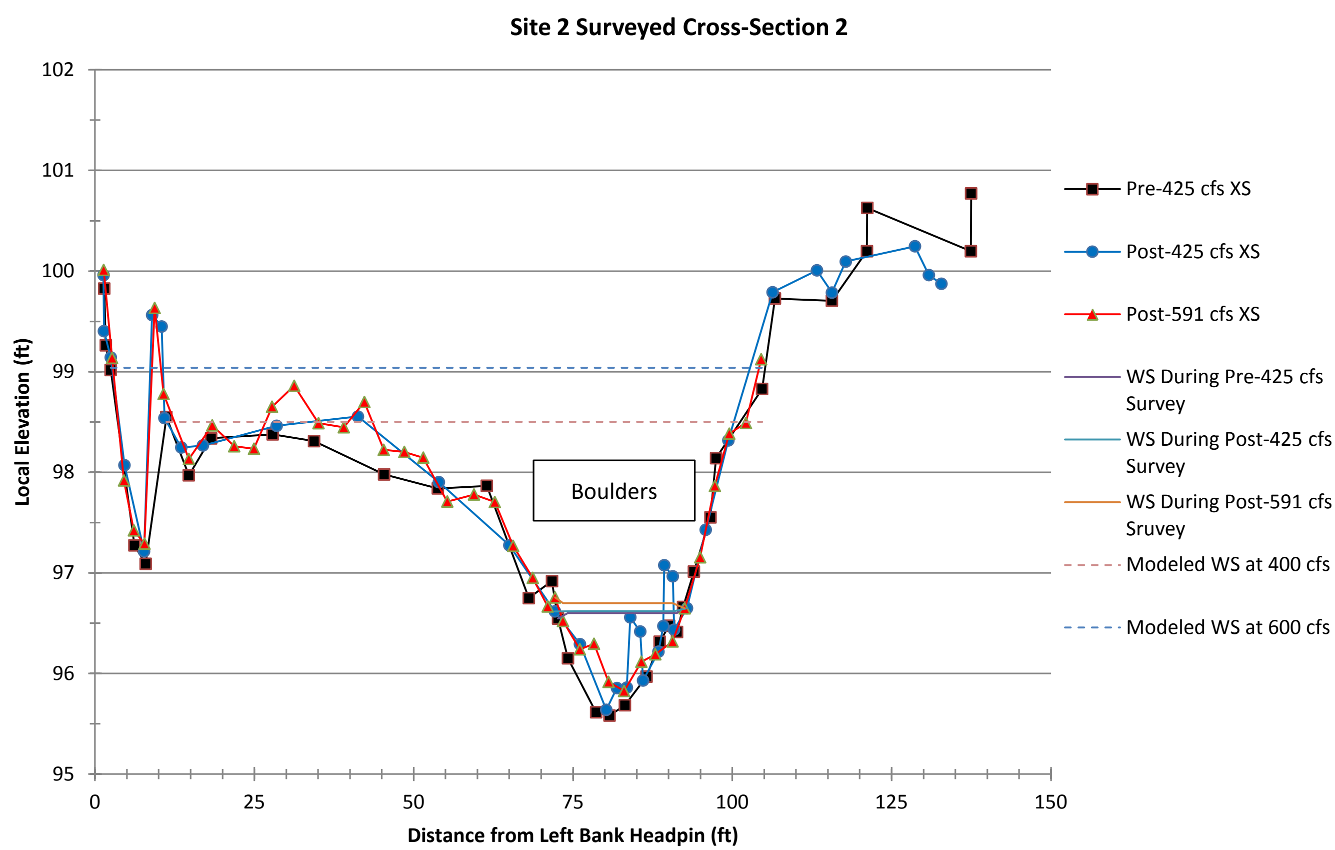
Site 1 Channel Cross-Sections

Piru Creek Geomorphology Study Report

Figure 10





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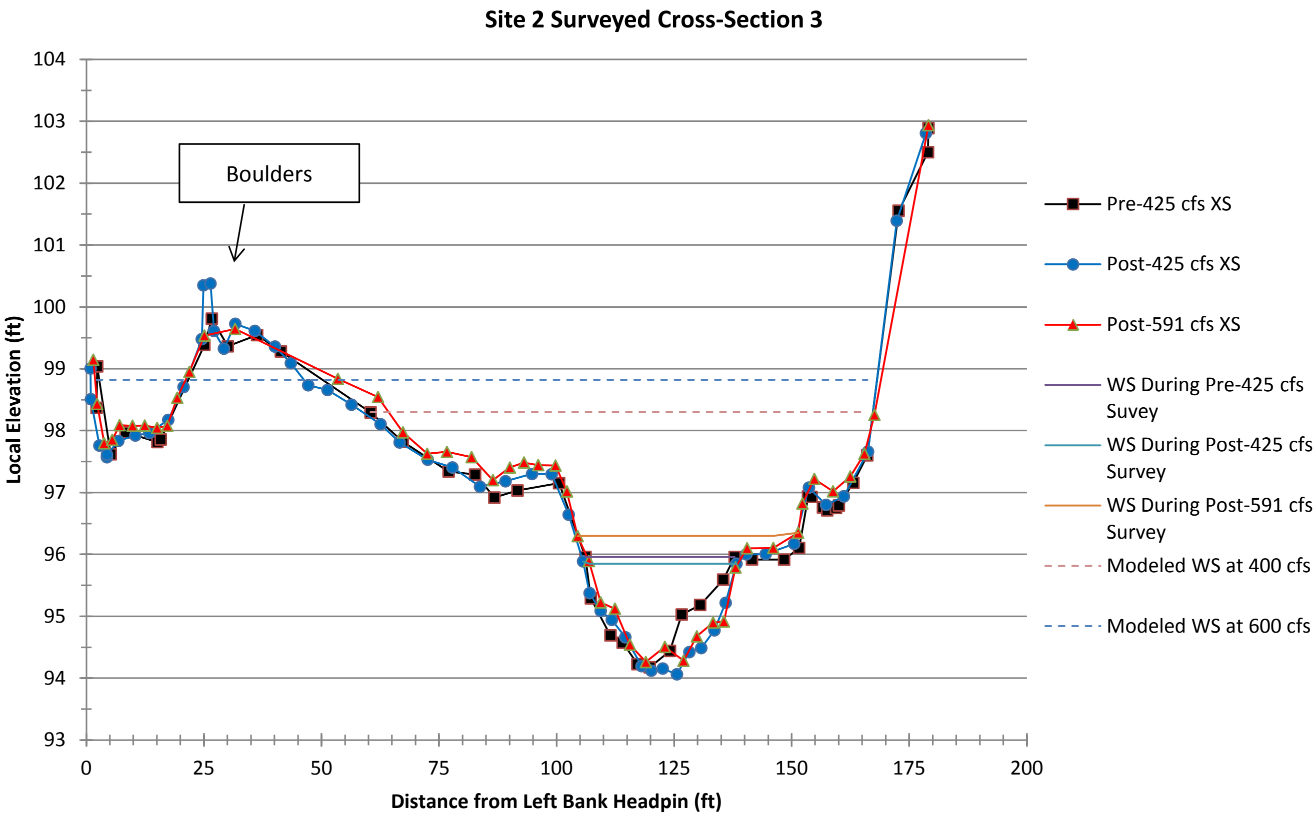
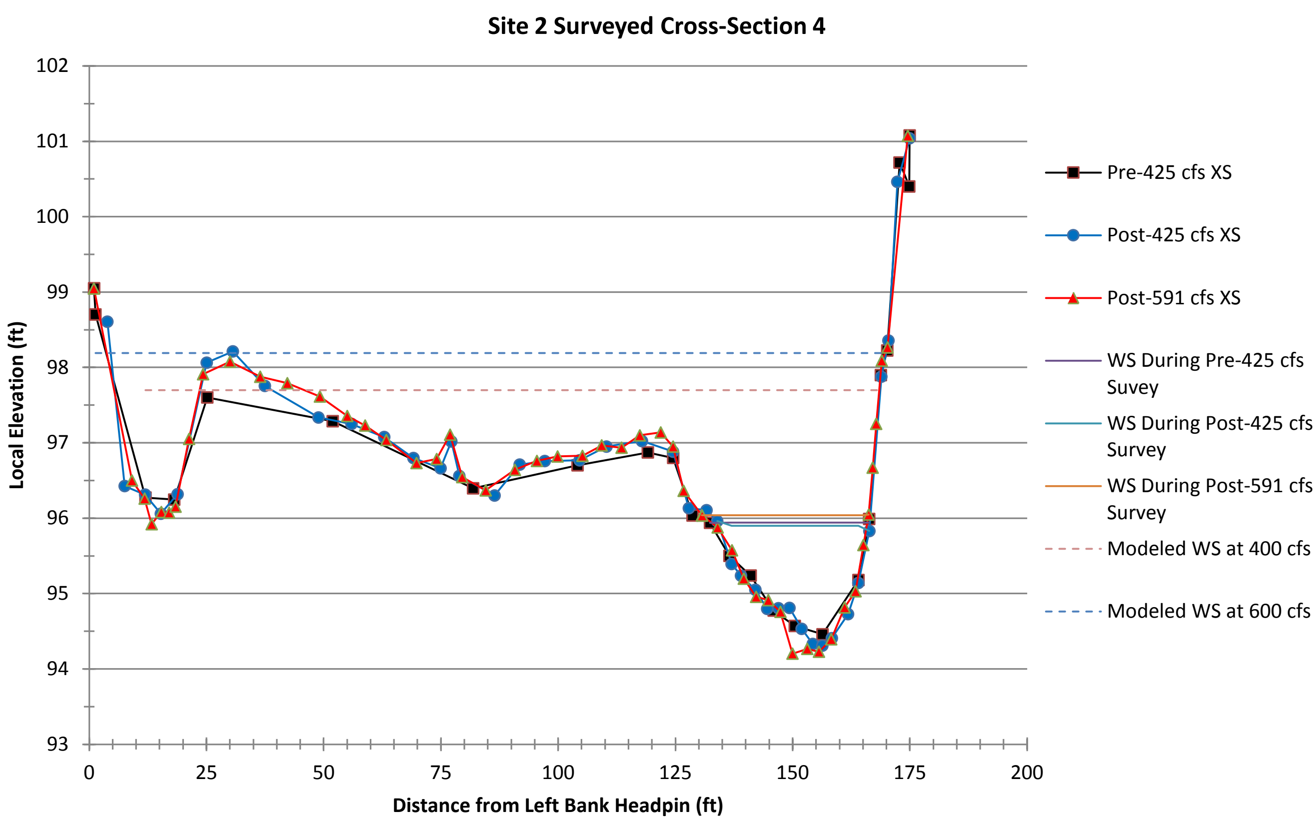
Site 2 Channel Cross-Sections

Piru Creek Geomorphology Study Report

Figure 11





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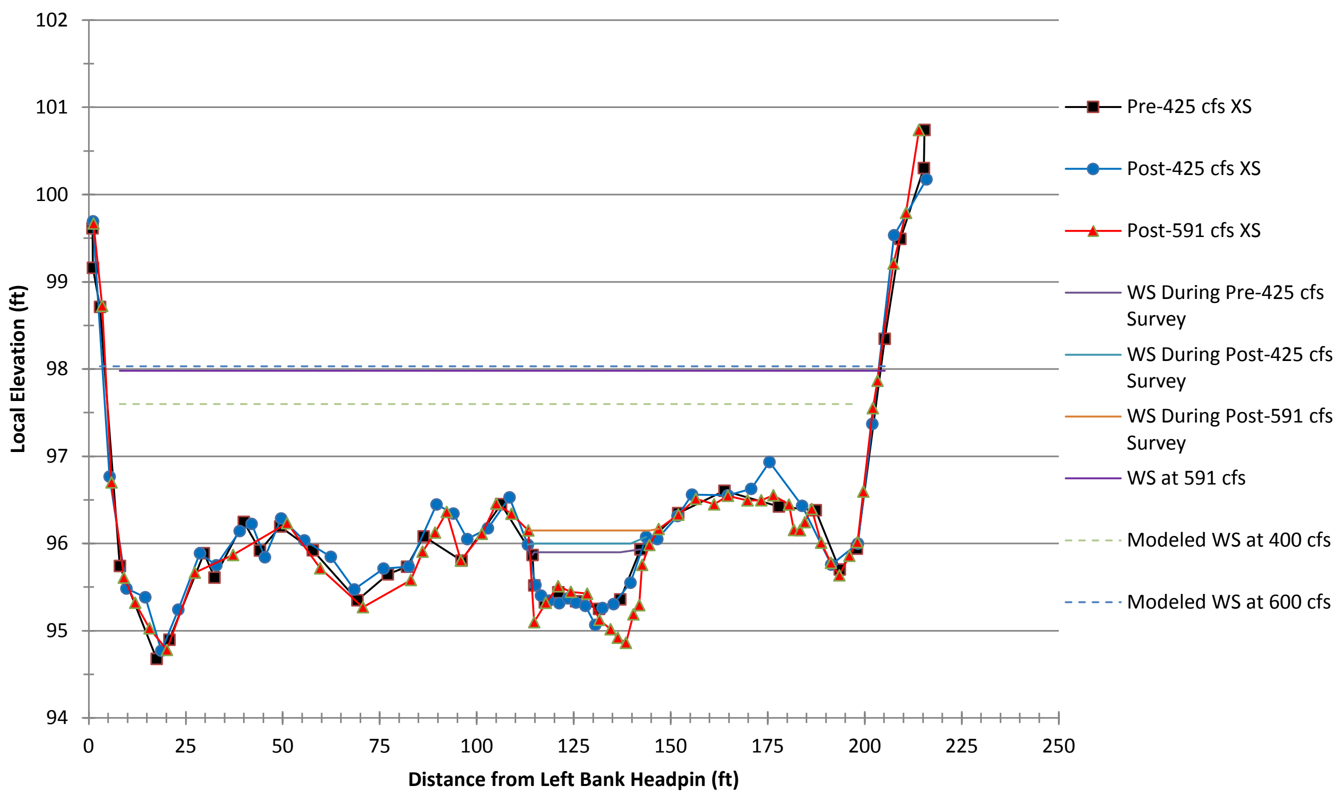
Site 2 Channel Cross-Sections

Piru Creek Geomorphology Study Report

Figure 12

Site 2 Surveyed Cross-Section 5



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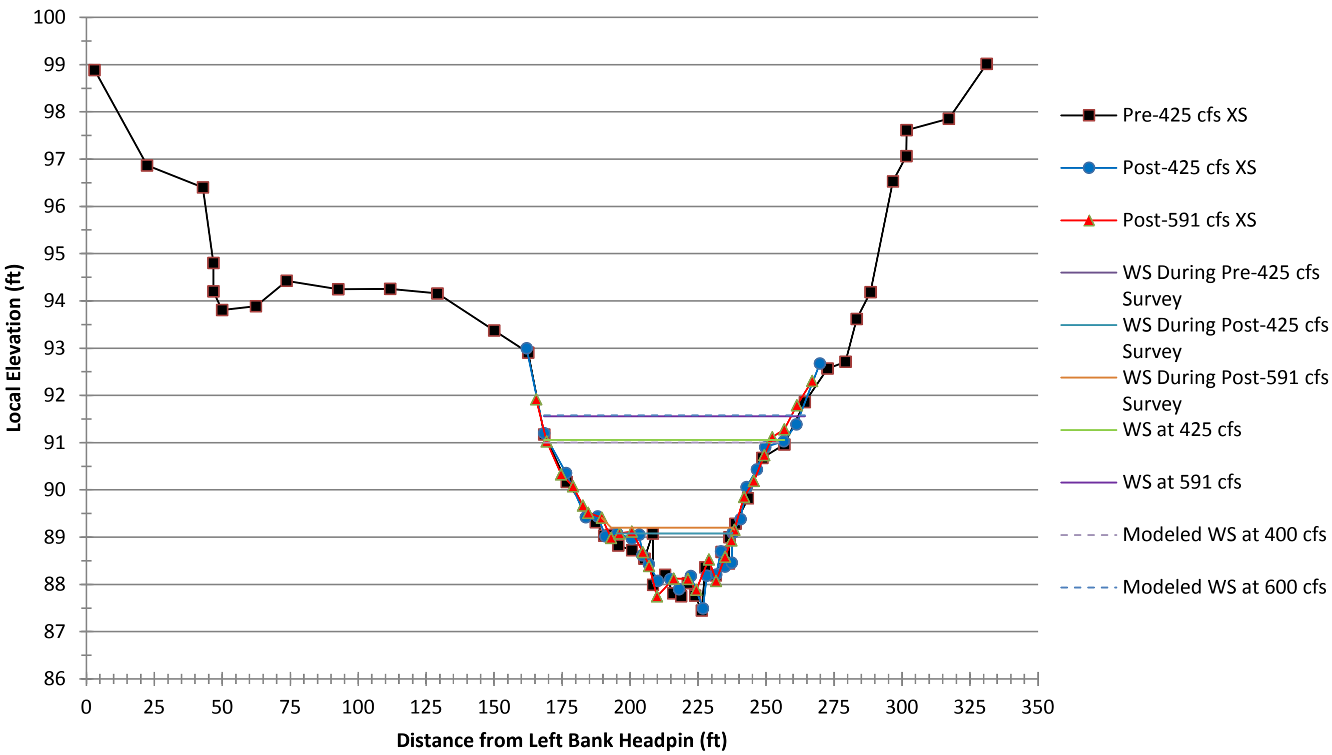
Site 2 Channel Cross-Sections

Piru Creek Geomorphology Study Report

Figure 13

Site 3 Surveyed Cross-Section 1



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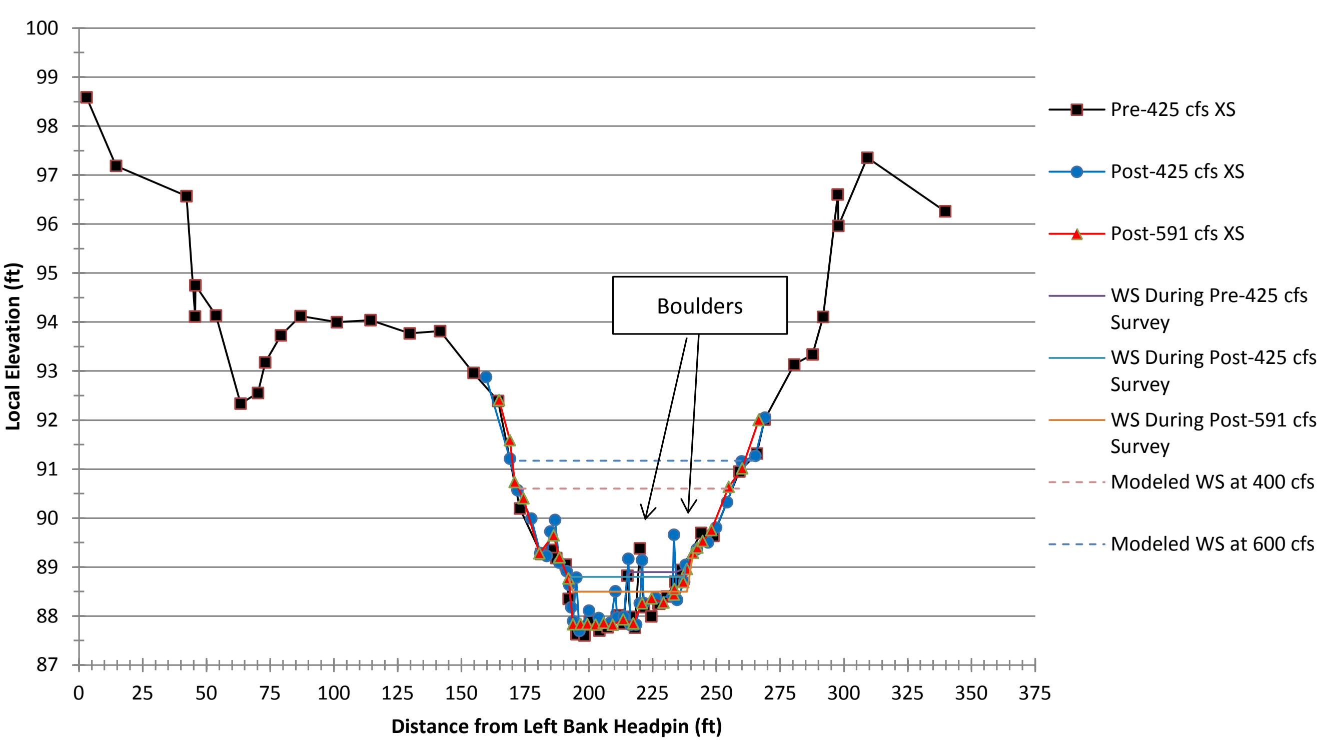

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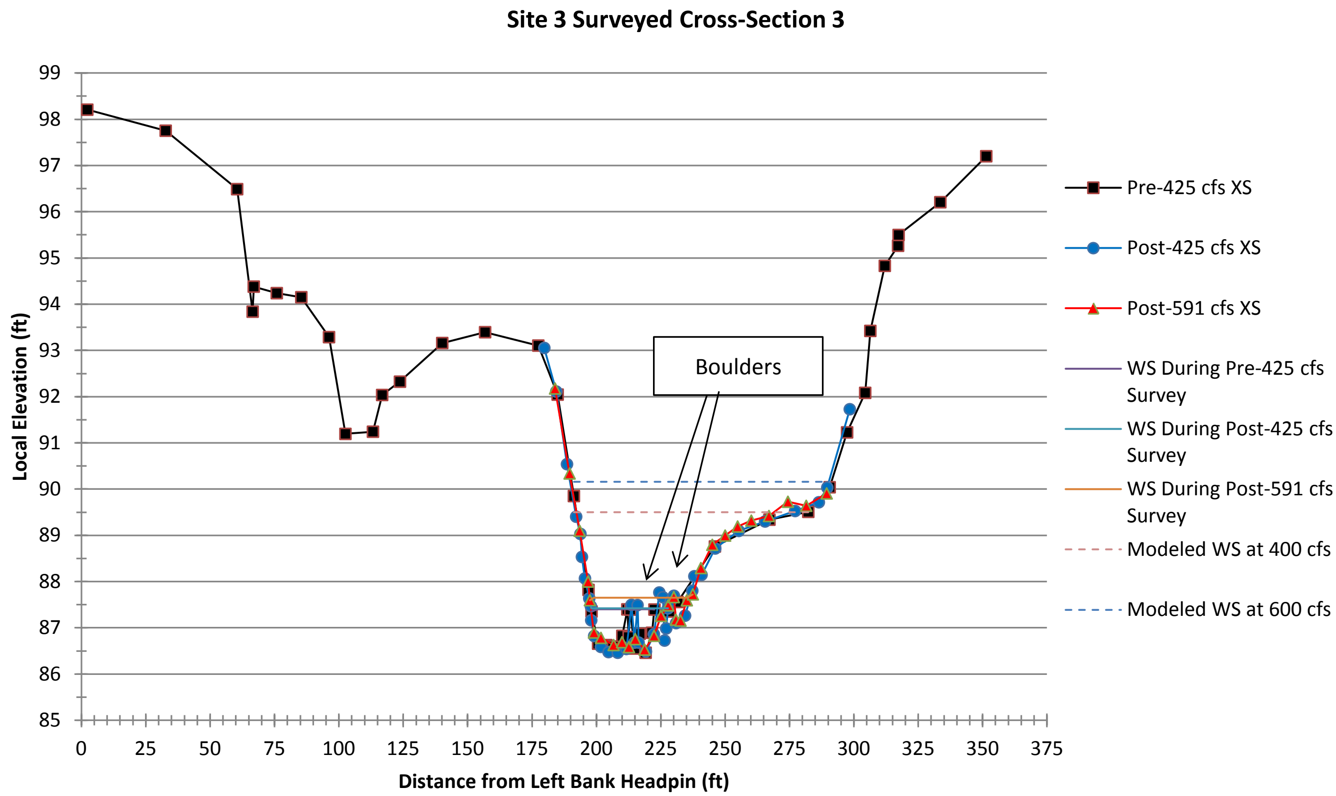
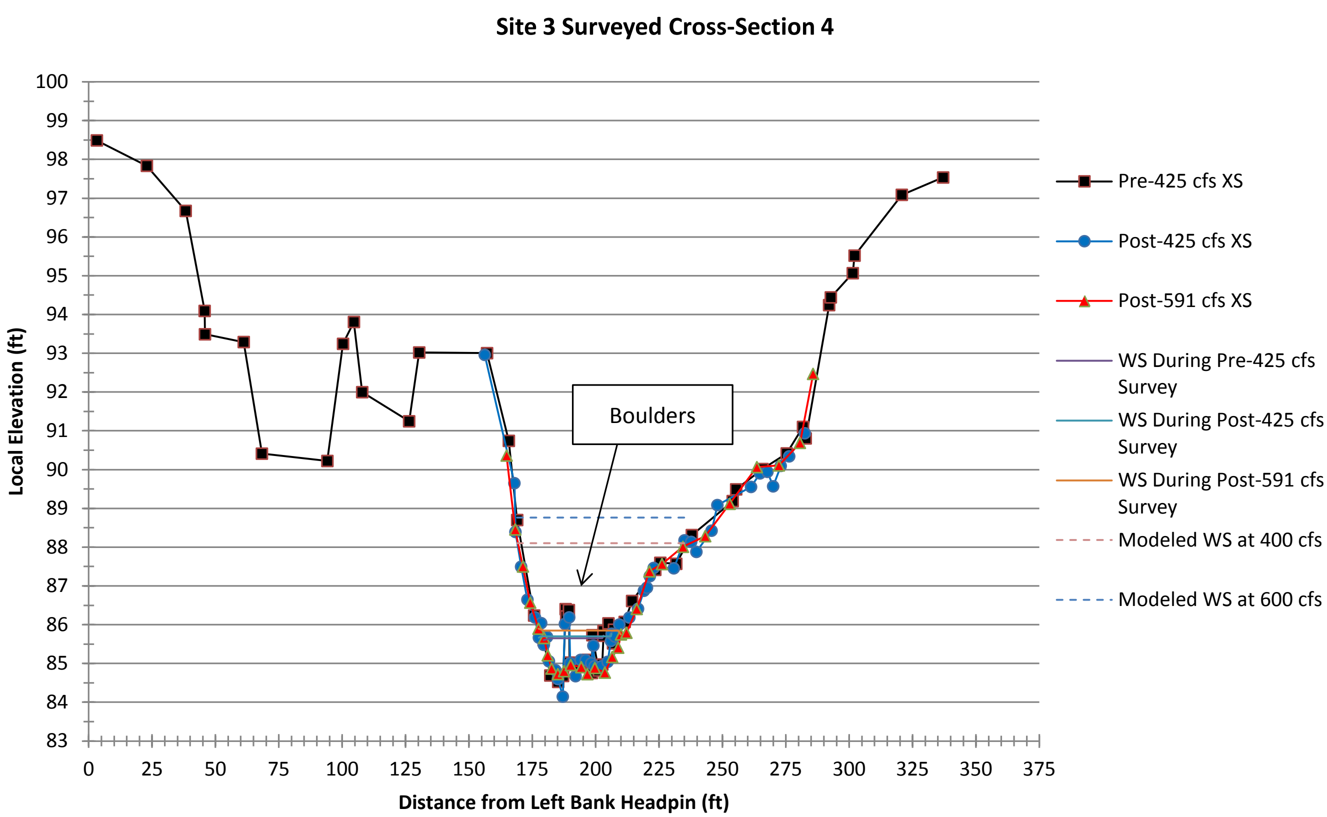
Site 3 Channel Cross-Sections

Piru Creek Geomorphology

Study Report

Figure 14





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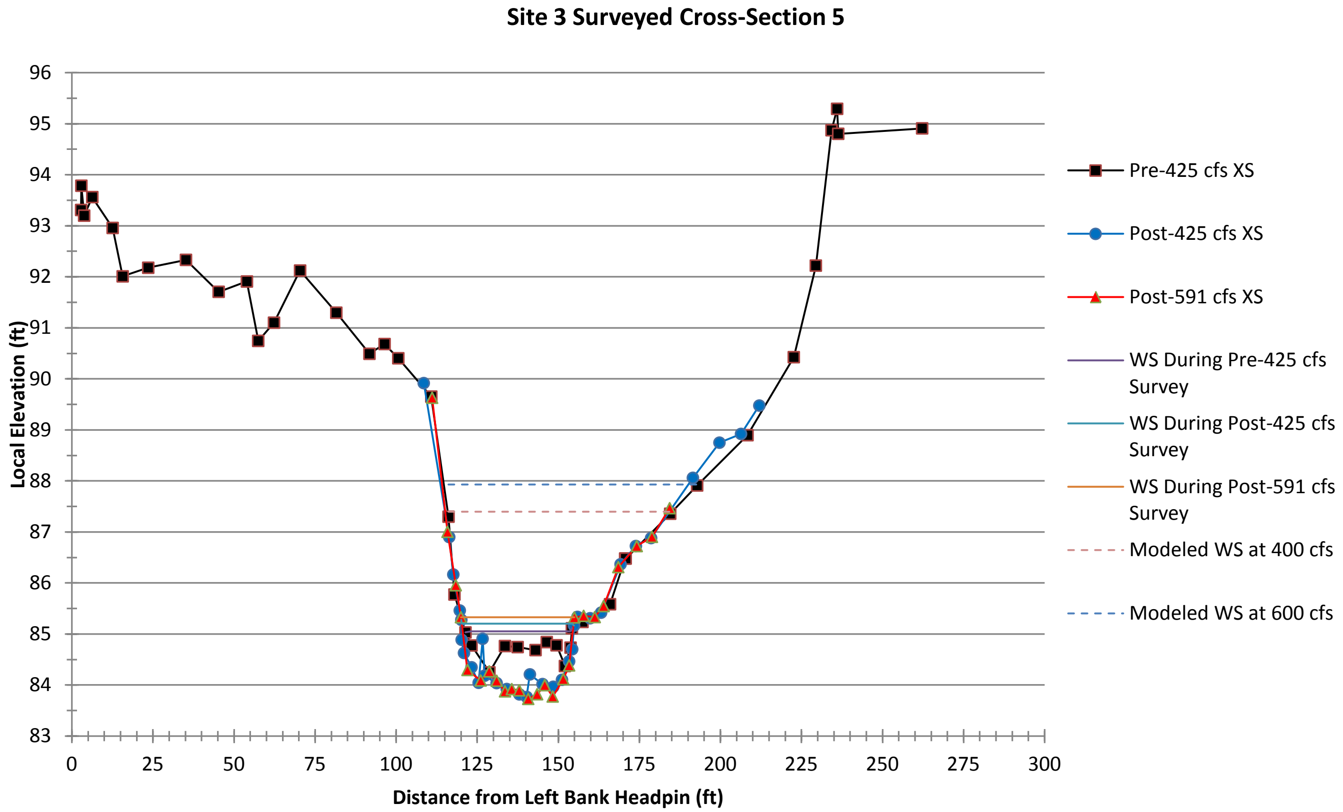
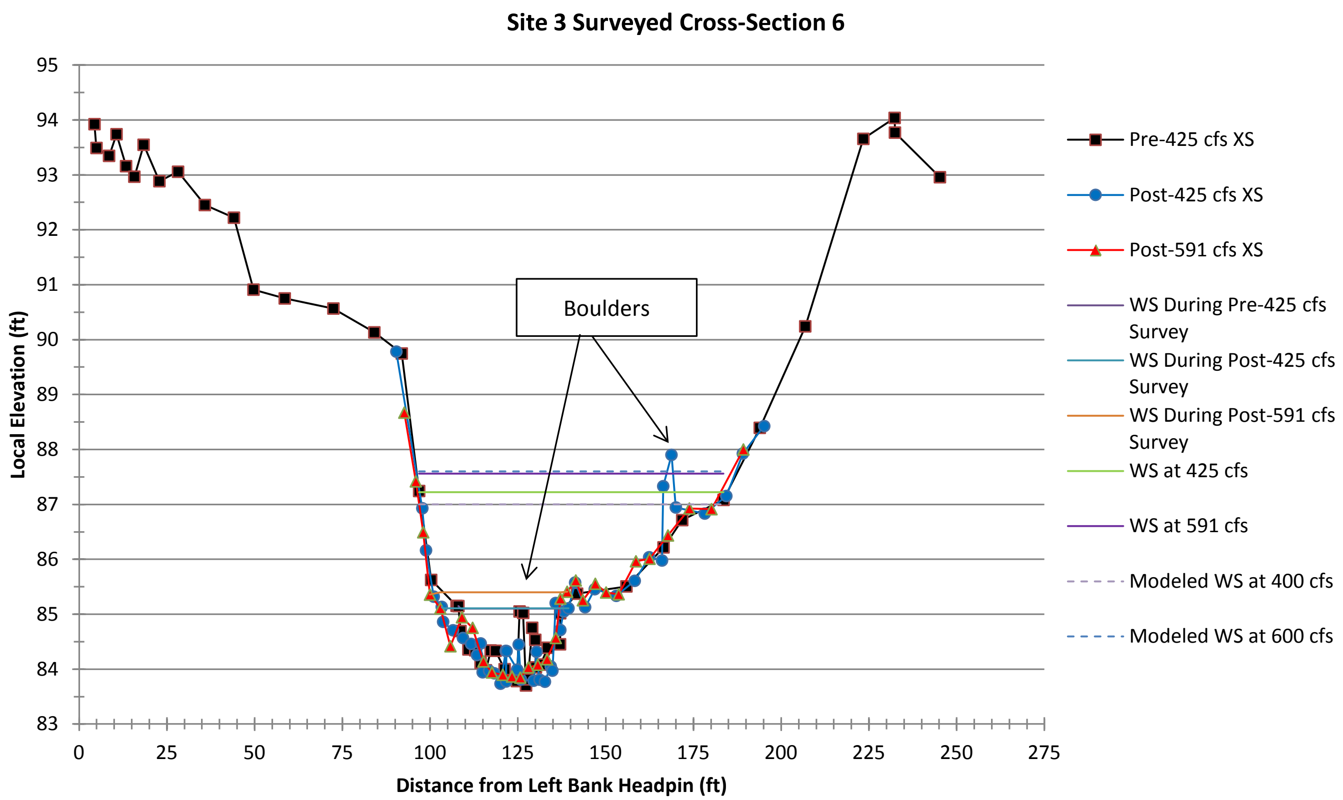
Site 3 Channel Cross-Sections

Piru Creek Geomorphology

Study Report

Figure 15





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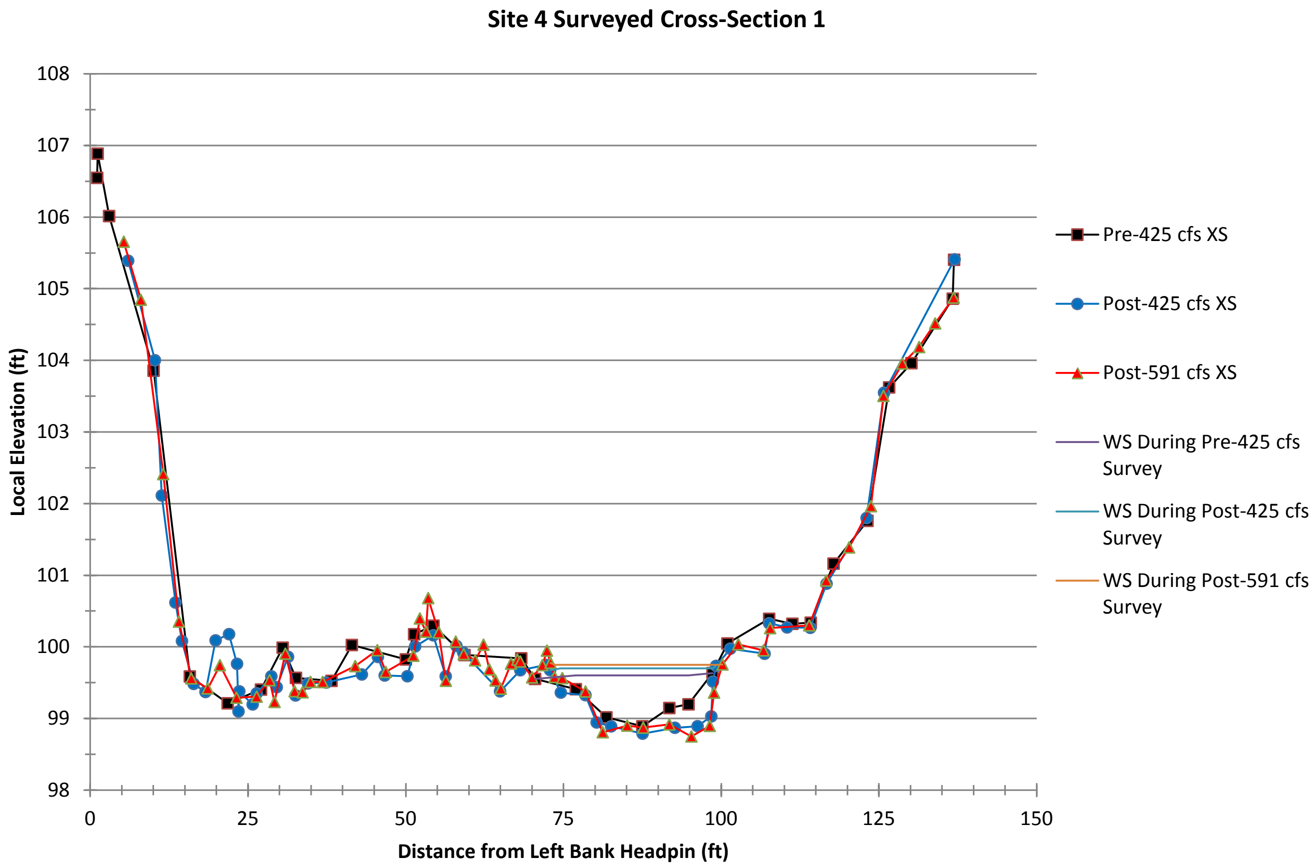
Site 3 Channel Cross-Sections

Piru Creek Geomorphology Study Report

Figure 16

Site 4 Surveyed Cross-Section 1



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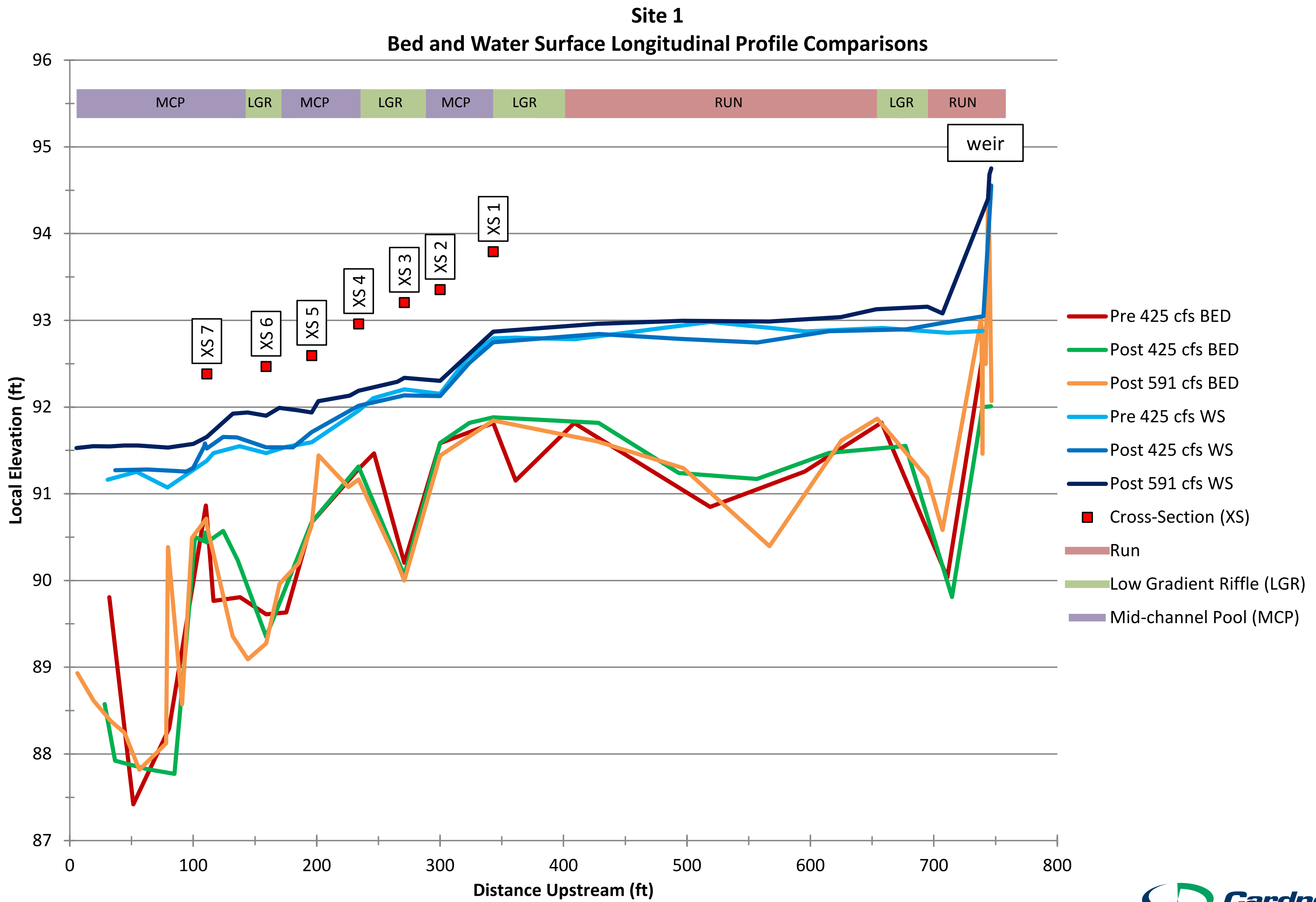
Site 4 Channel Cross-Sections

Piru Creek Geomorphology Study Report

Figure 17



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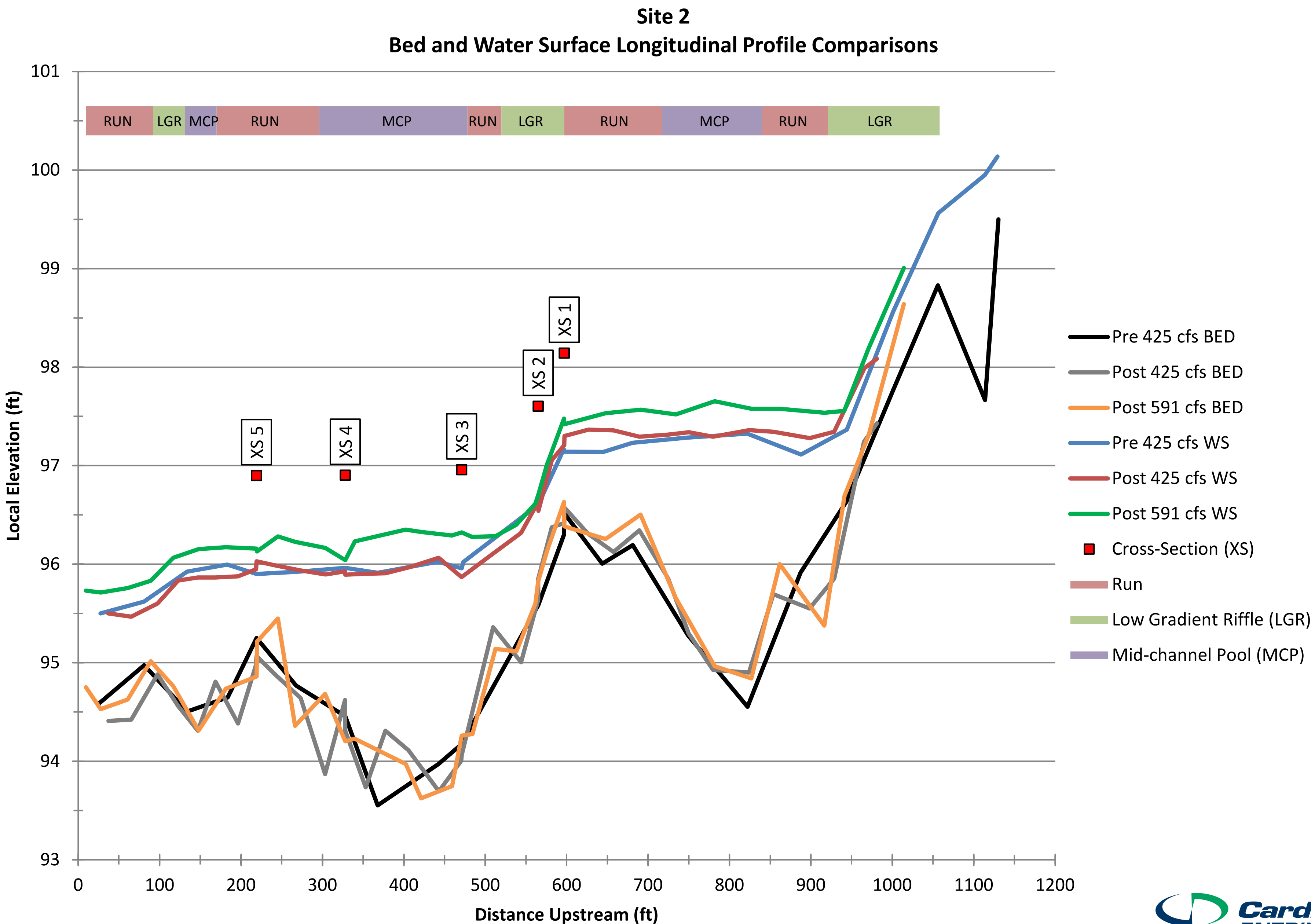
Site 1 Longitudinal Profile

Piru Creek Geomorphology Study Report

Figure 18



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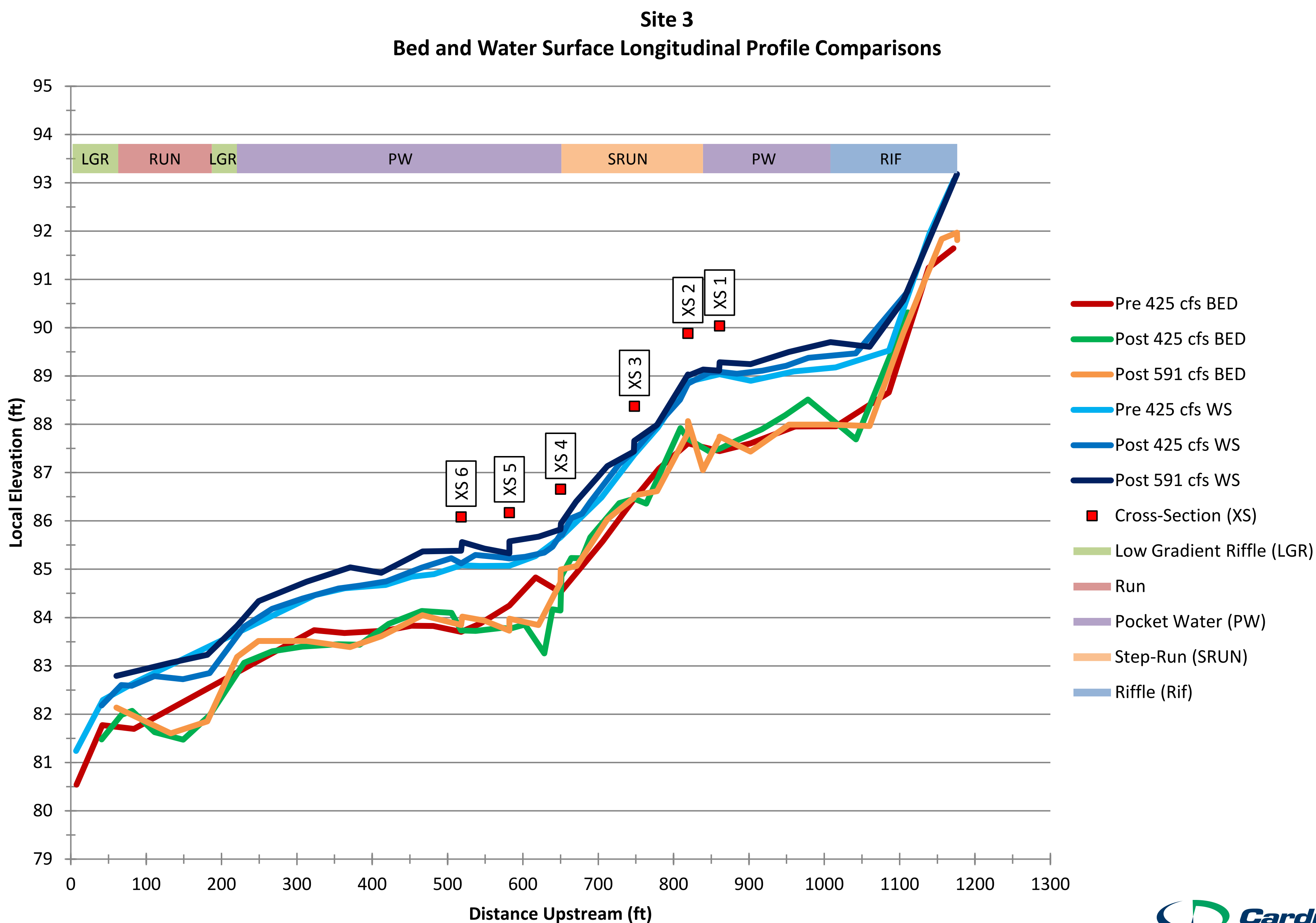
Site 2 Longitudinal Profile

Piru Creek Geomorphology Study Report

Figure 19



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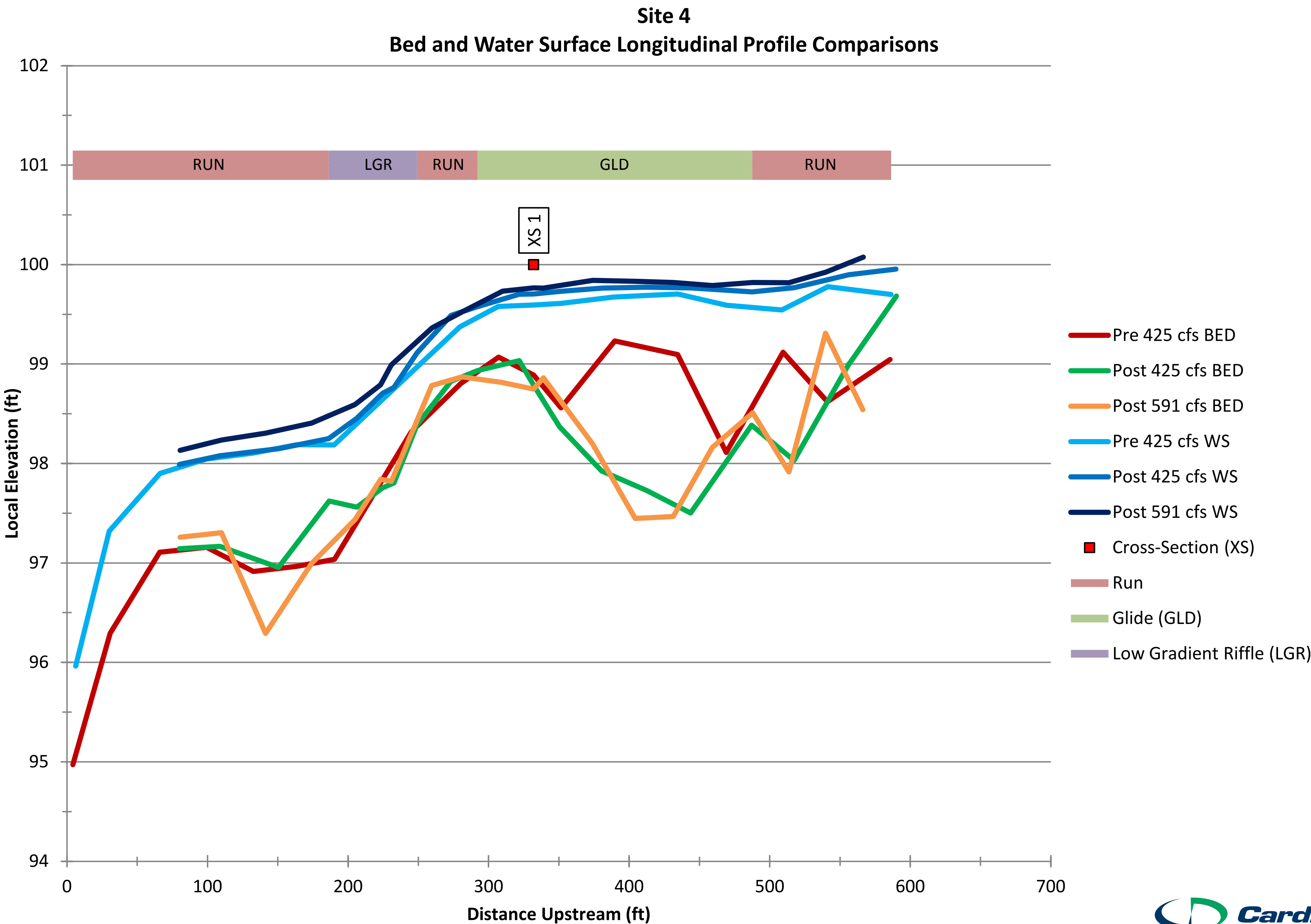
Site 3 Longitudinal Profile

Piru Creek Geomorphology Study Report

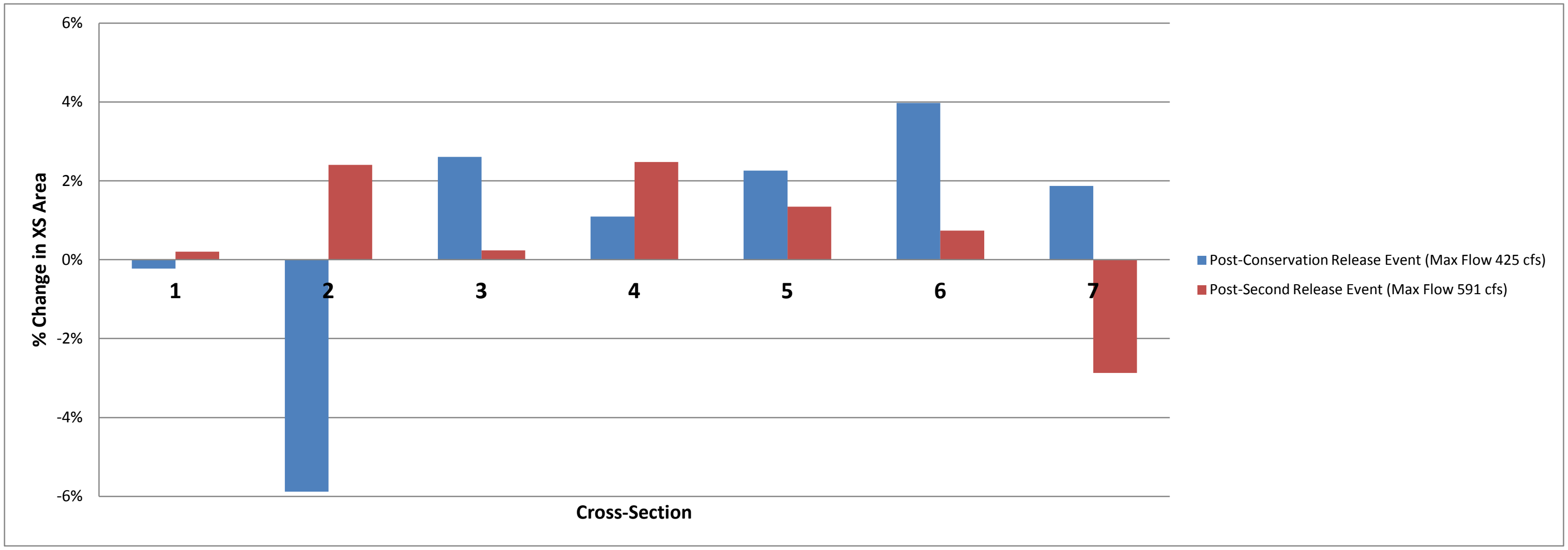
Figure 20



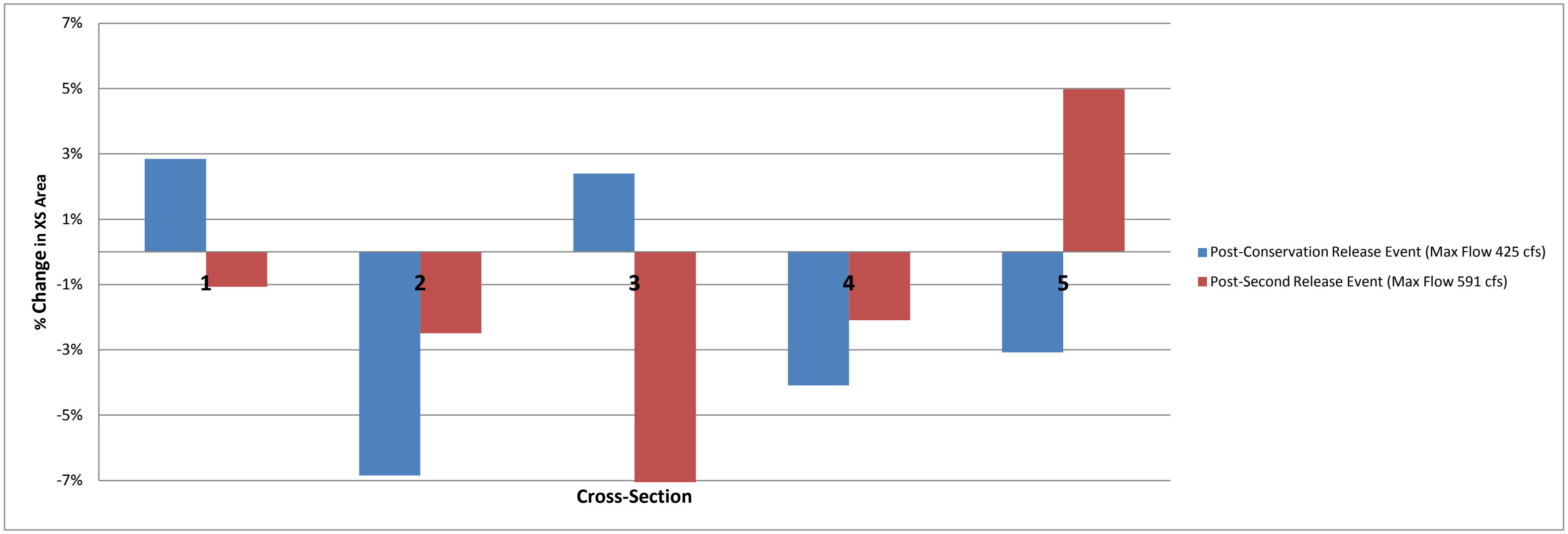
Site 4 Longitudinal Profile
Piru Creek Geomorphology
Study Report

Figure 21

Site 1



Site 2



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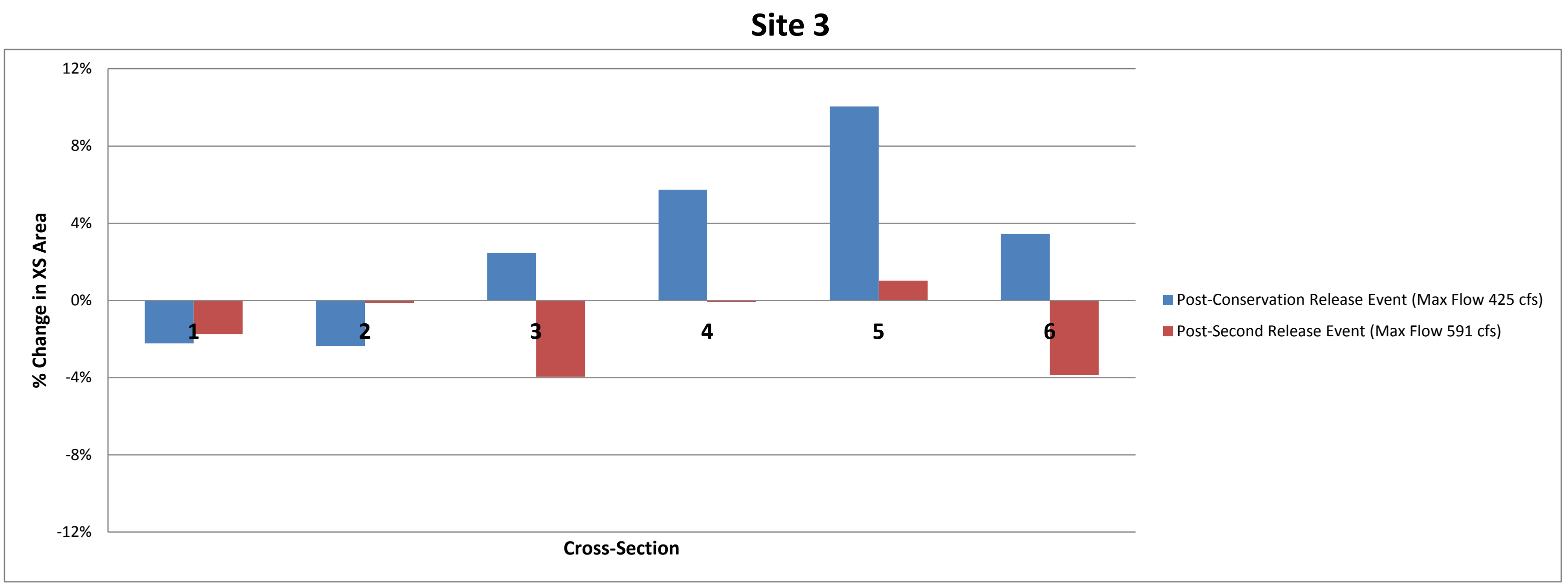
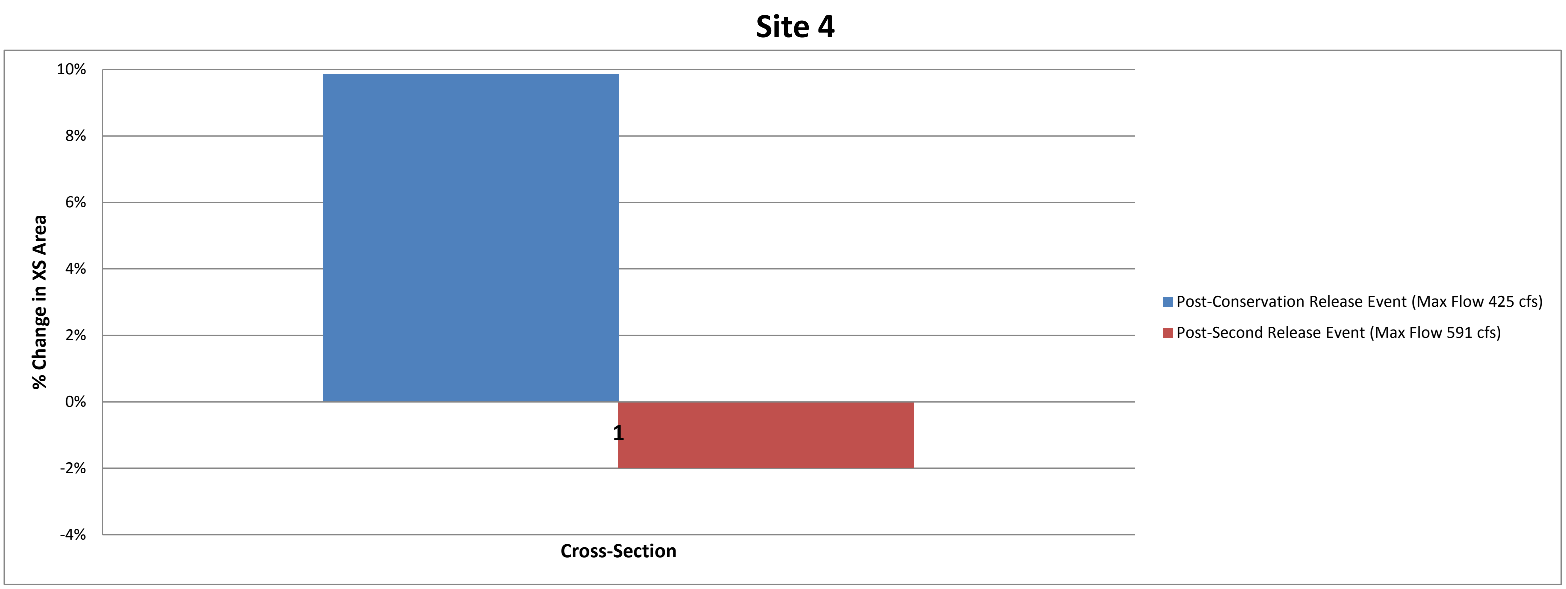
Change in Cross-Sectional Area
Sites 1 and 2
Piru Creek Geomorphology
Study Report
Figure 22





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Change in Cross-Sectional Area

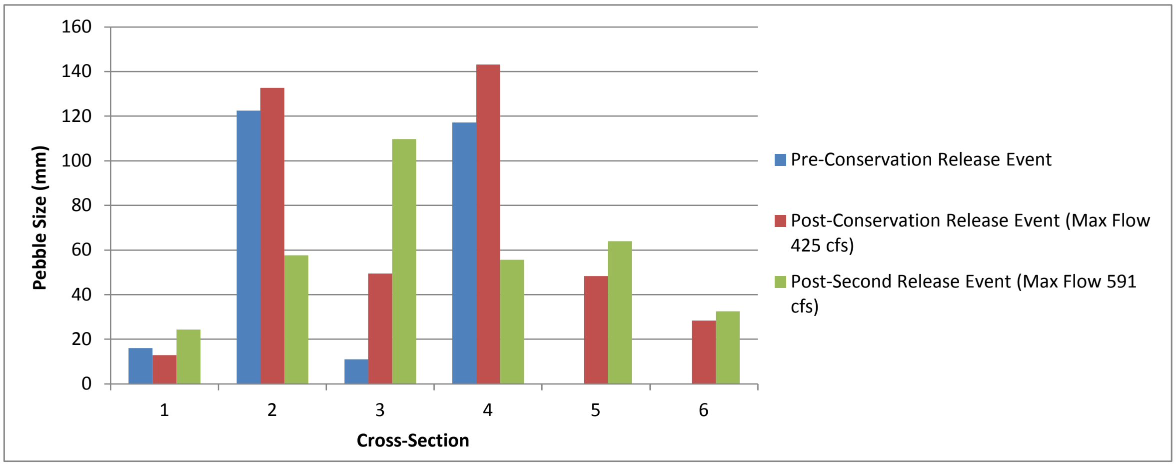
Sites 3 and 4

Piru Creek Geomorphology

Study Report

Figure 23

Site 1 - D_{50} (Pebble Count)



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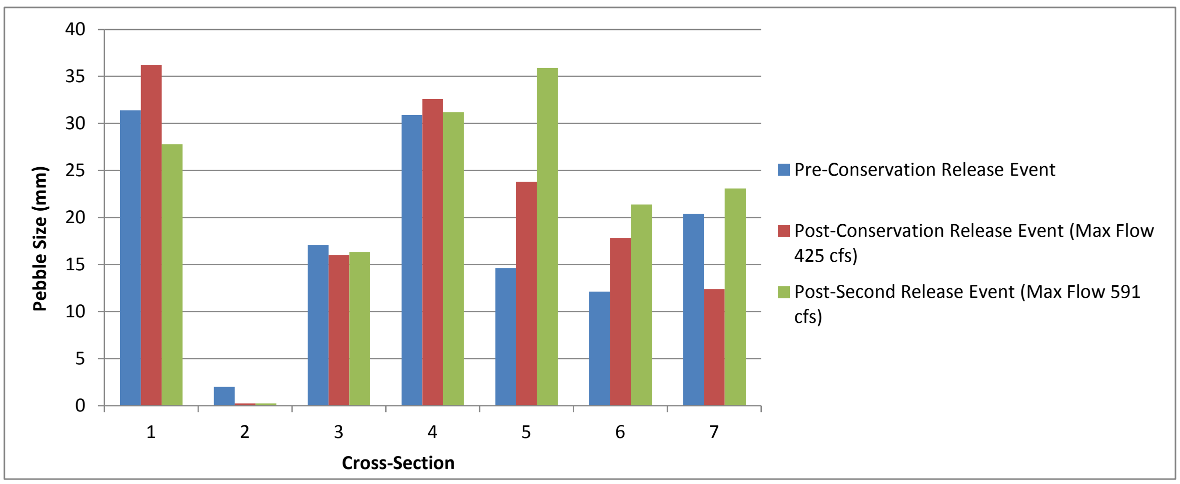
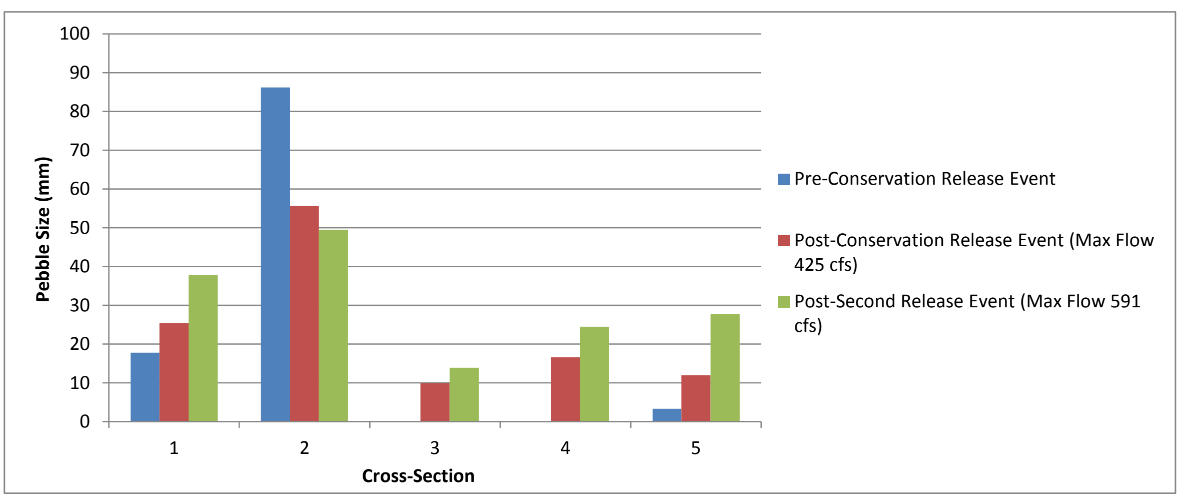


Site 3 - D_{50} (Pebble Count)



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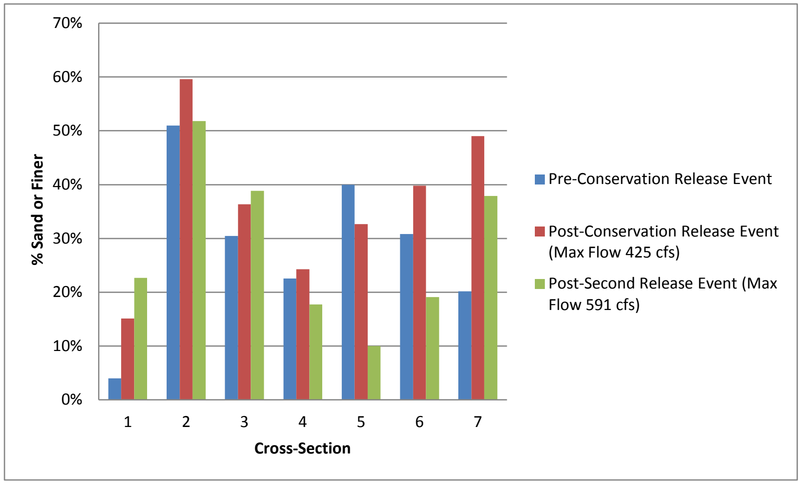
Change in D_{50} from Pebble Count Data

Piru Creek Geomorphology Study Report

Figure 24

Site 1 (Pebble Count)



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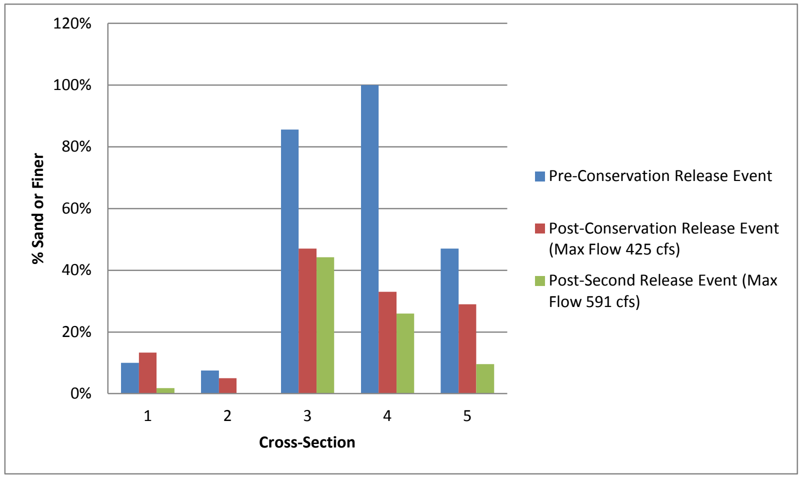
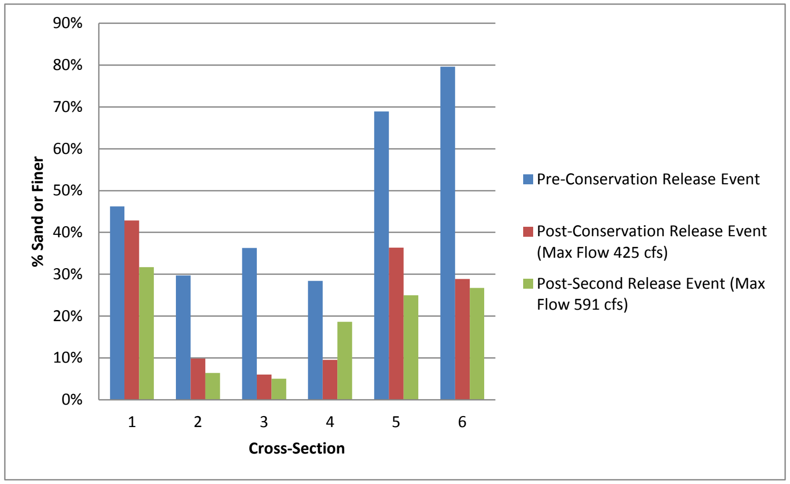
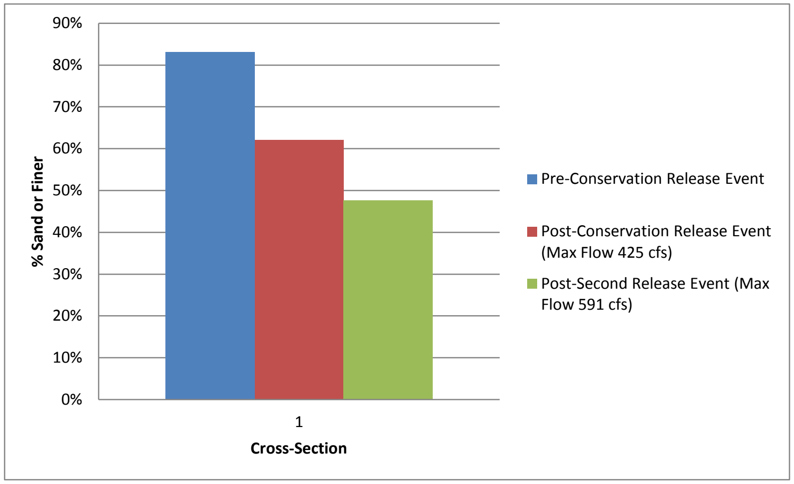


Site 3 (Pebble Count)



Site 4 (Pebble Count)



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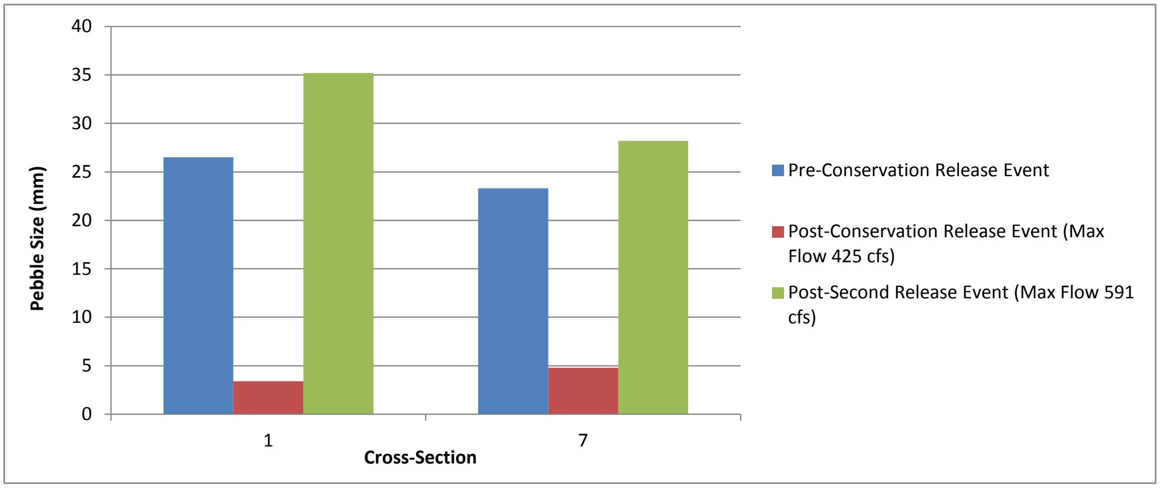
Change in Fine Sediment Composition from Pebble Count Data

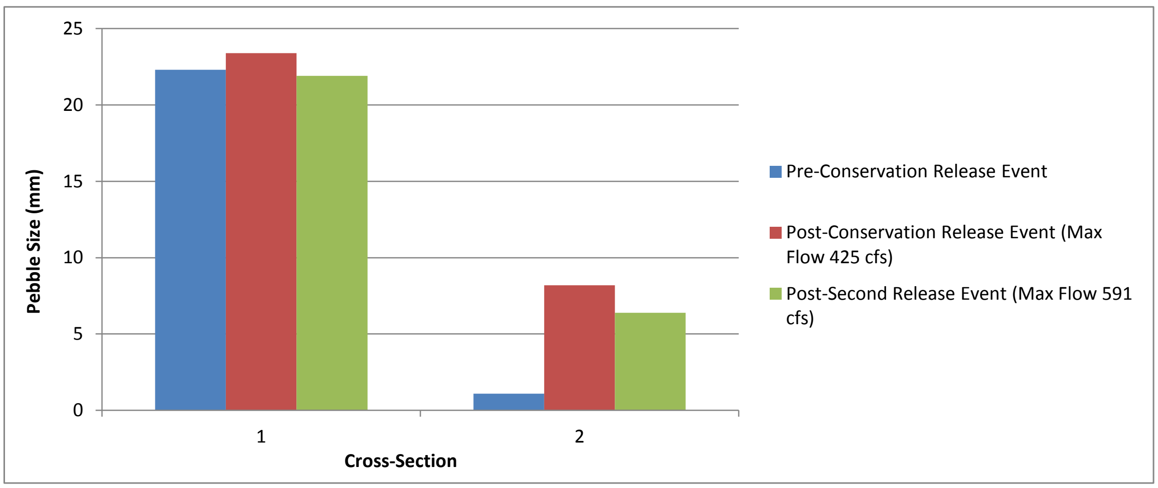
Piru Creek Geomorphology Study Report

Figure 25

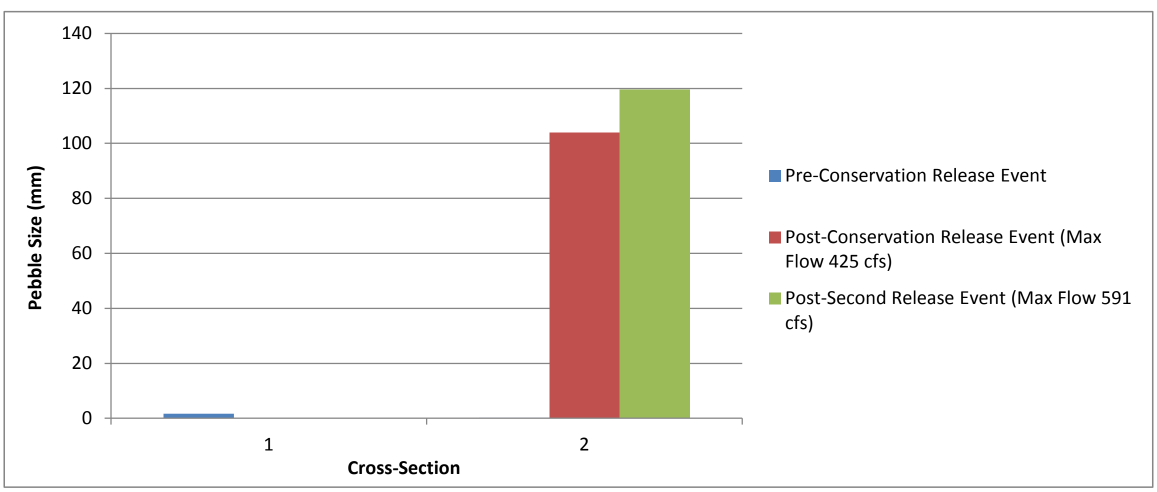
Site 1 - D_{50} (Bulk Sample)



Site 2 - D_{50} (Bulk Sample)



Site 3 - D_{50} (Bulk Sample)



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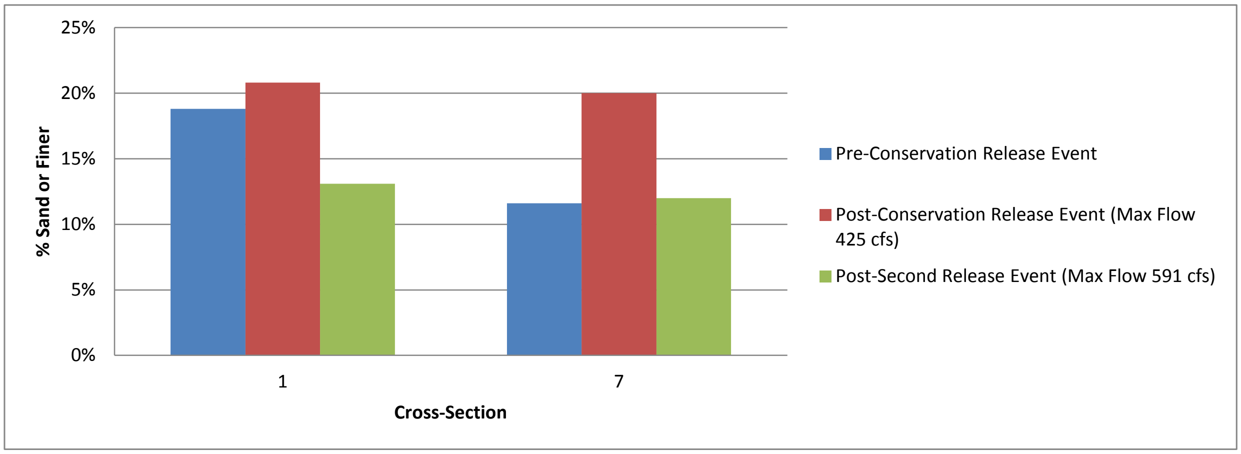
Change in D_{50} from Bulk Sample Data

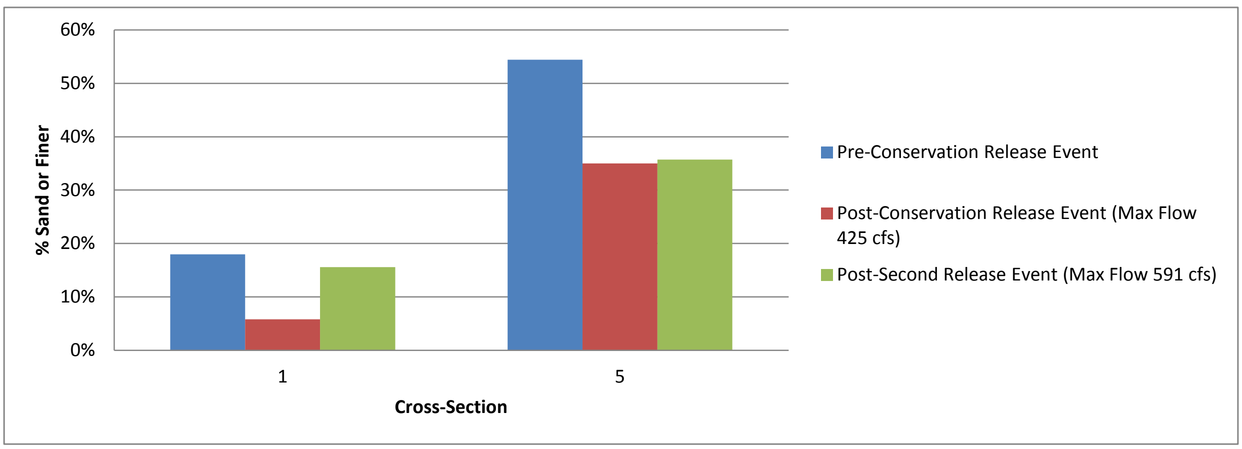
Piru Creek Geomorphology Study Report

Figure 26

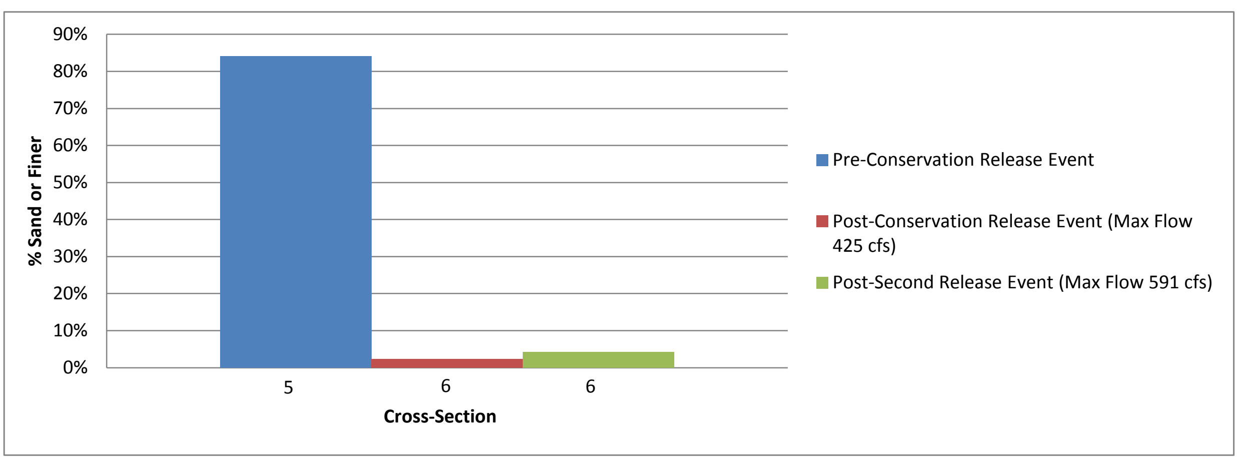
Site 1 - (Bulk Sample)



Site 2 - (Bulk Sample)



Site 3 - (Bulk Sample)



Note: No Bulk Samples were collected at Site 4

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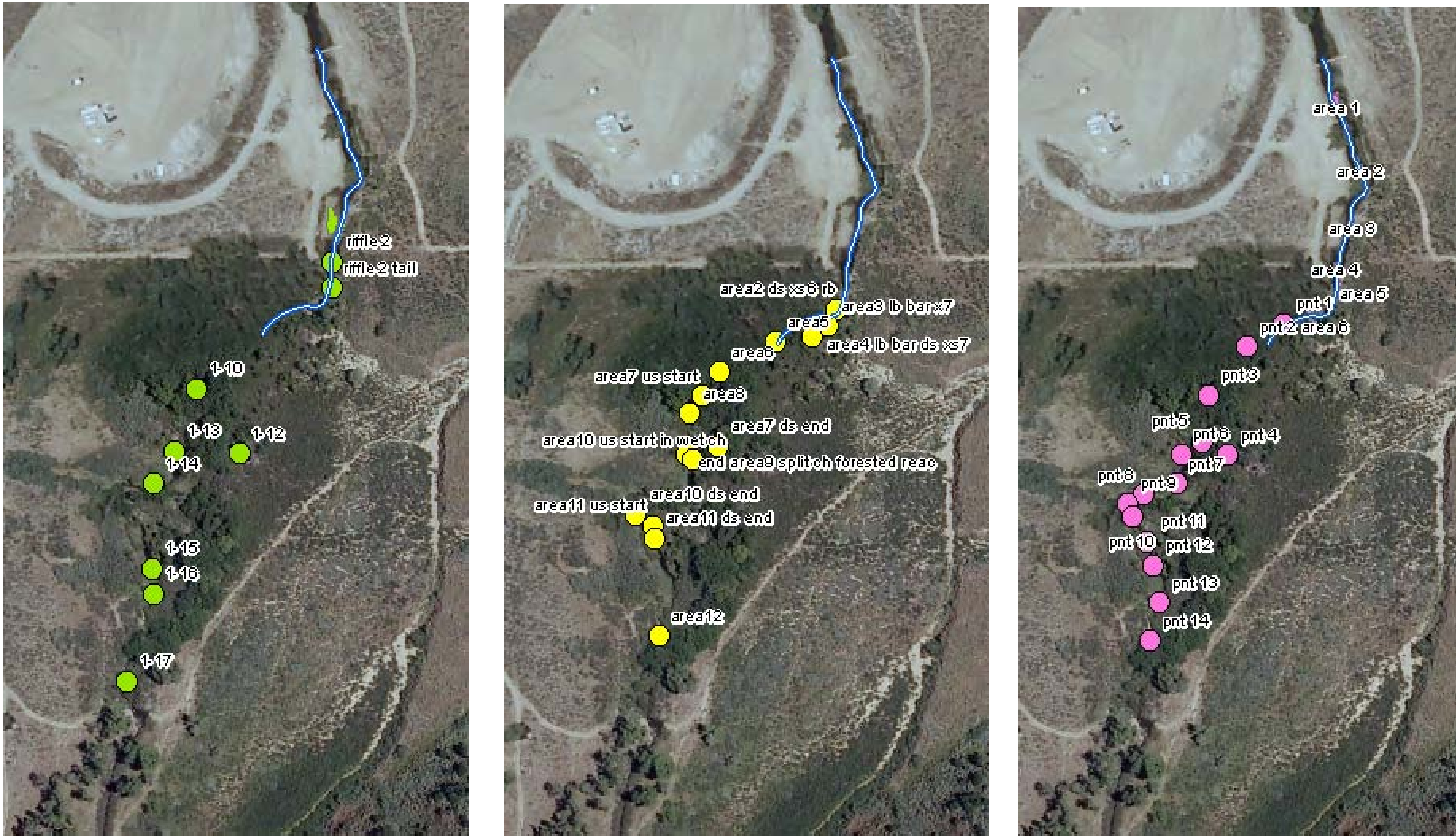
Change in Fine Sediment Composition from Bulk Sample Data

Figure 27



Legend

- Areas of Spawning Gravel Identified During Pre-Conservation Release Inventory
- Areas of Spawning Gravel Identified During Post-Conservation Release Inventory (Max Flow 425 cfs)
- Areas of Spawning Gravel Identified During Post-Second Release Inventory (Max Flow 591 cfs)

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Site 1 - Spawning Gravel Inventory Map

Piru Creek Geomorphology Study Report

Figure 28

Legend

- Areas of Spawning Gravel Identified During Pre-Conservation Release Inventory
- Areas of Spawning Gravel Identified During Post-Conservation Release Inventory (Max Flow 425 cfs)
- Areas of Spawning Gravel Identified During Post-Second Release Inventory (Max Flow 591 cfs)

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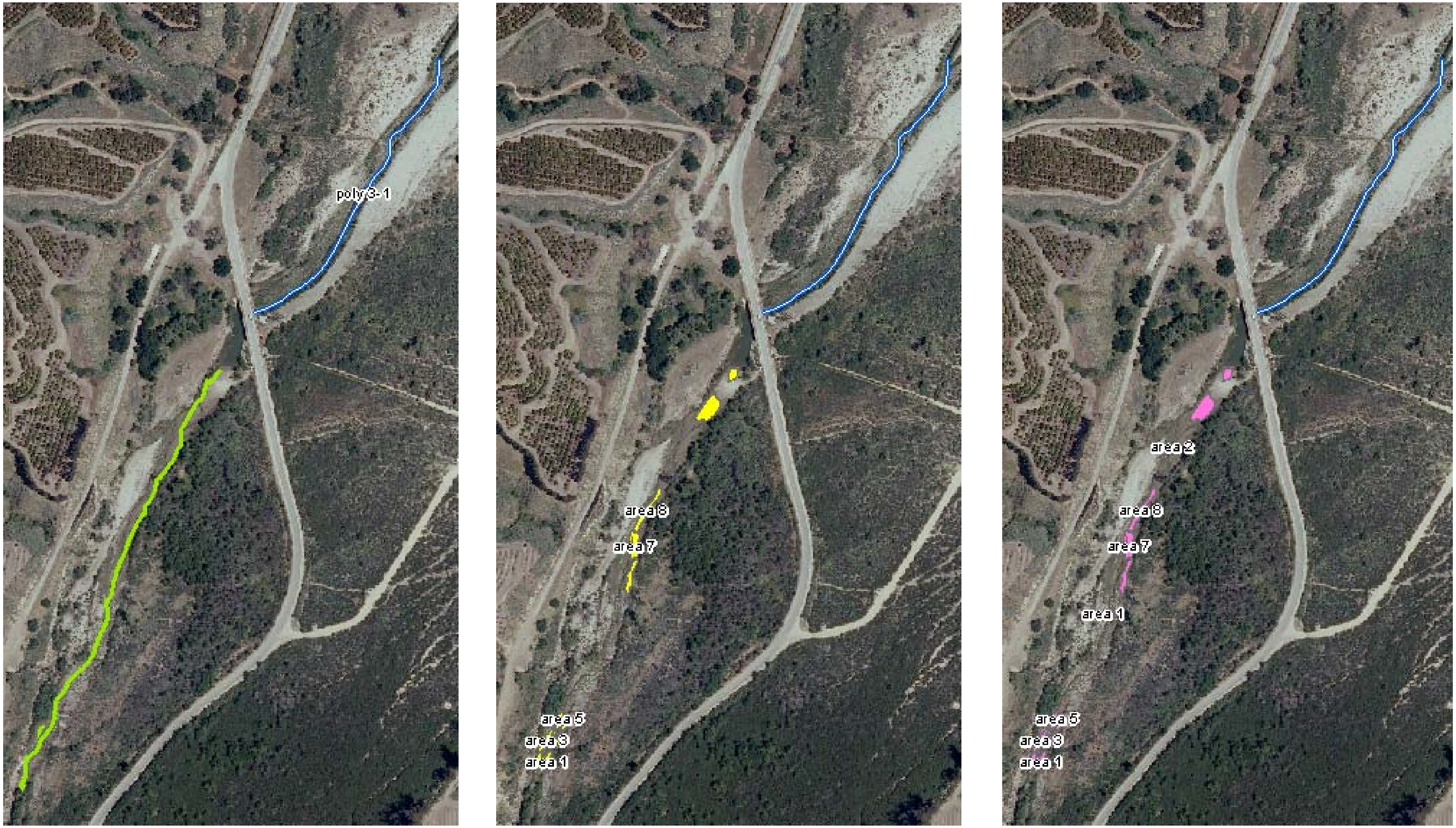
Site 2 - Spawning Gravel Inventory Map

Piru Creek Geomorphology Study Report

Figure 29



Legend

- Areas of Spawning Gravel Identified During Pre-Conservation Release Inventory
- Areas of Spawning Gravel Identified During Post-Conservation Release Inventory (Max Flow 425 cfs)
- Areas of Spawning Gravel Identified During Post-Second Release Inventory (Max Flow 591 cfs)

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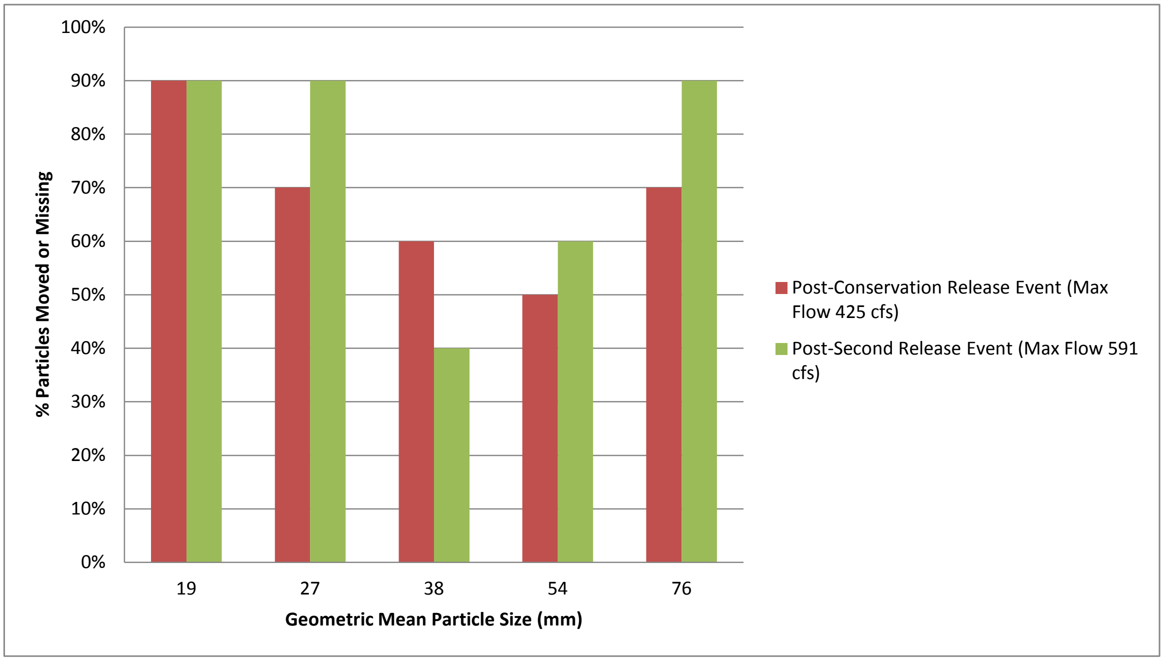
Site 3 - Spawning Gravel Inventory Map

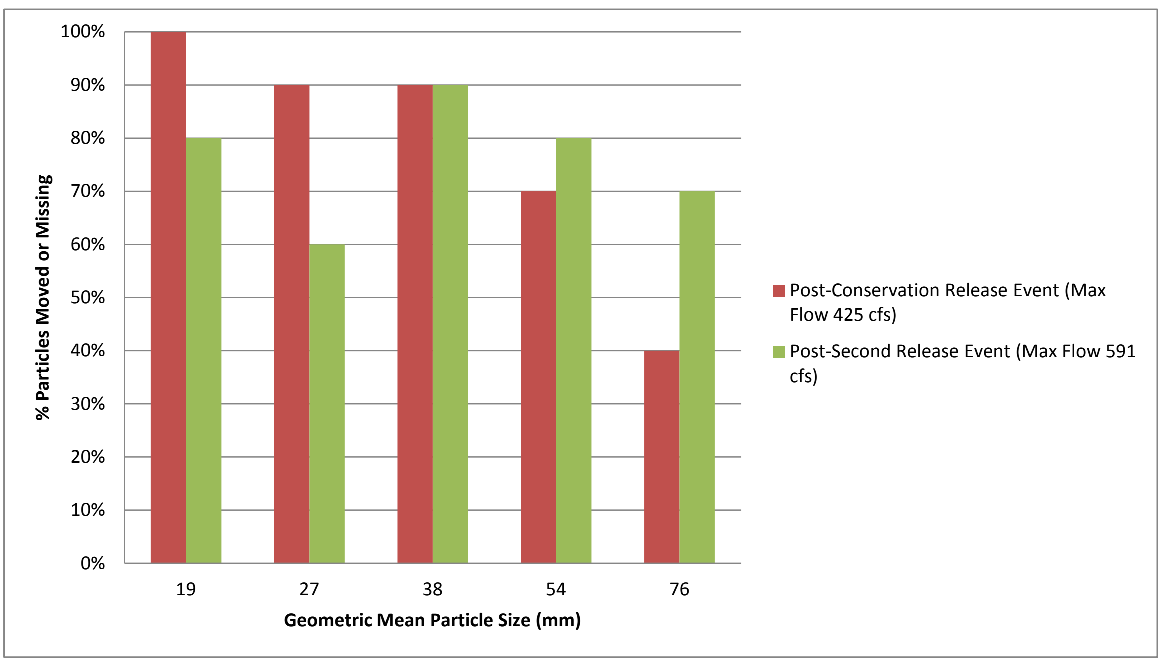
Piru Creek Geomorphology Study Report

Figure 30

Site 1 - Cross-Section 1



Site 1 - Cross-Section 4



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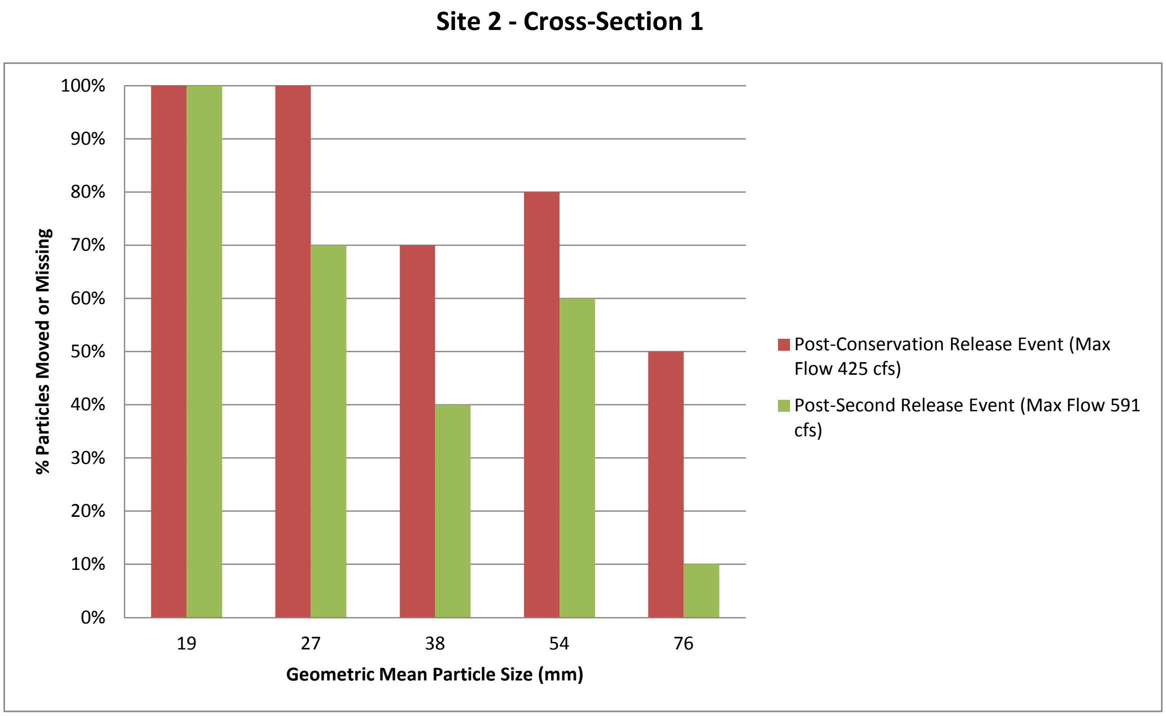
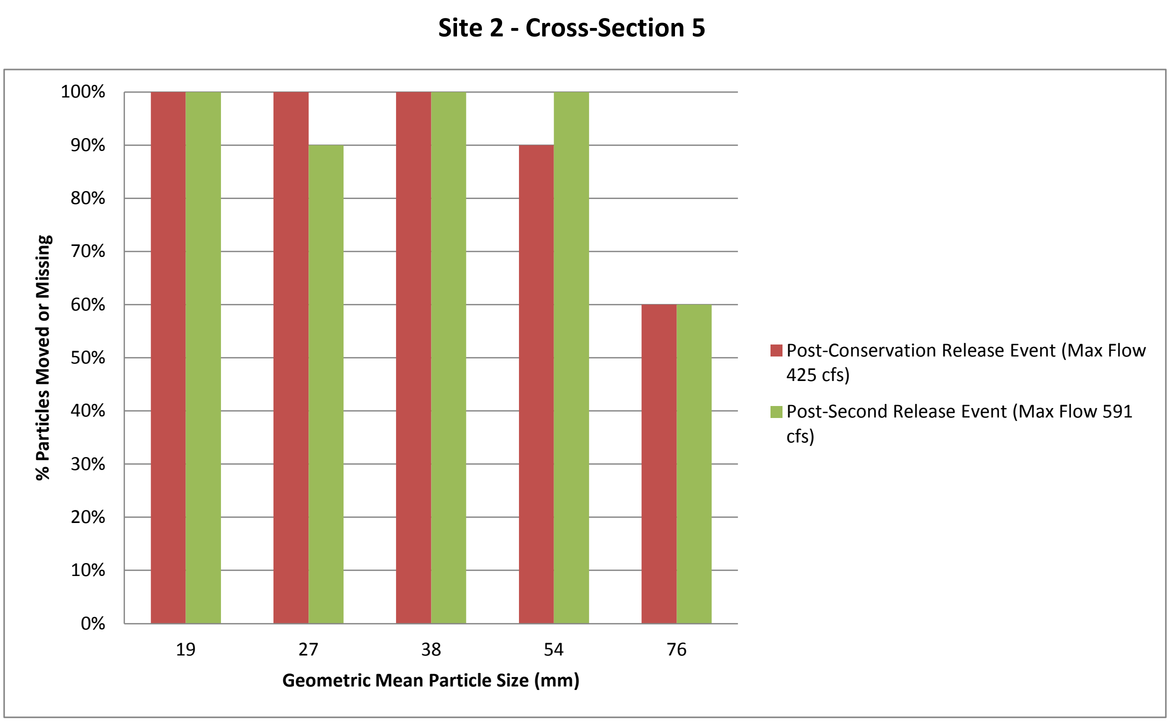
Site 1 Tracer Gravel Study Results

Piru Creek Geomorphology Study Report

Figure 31





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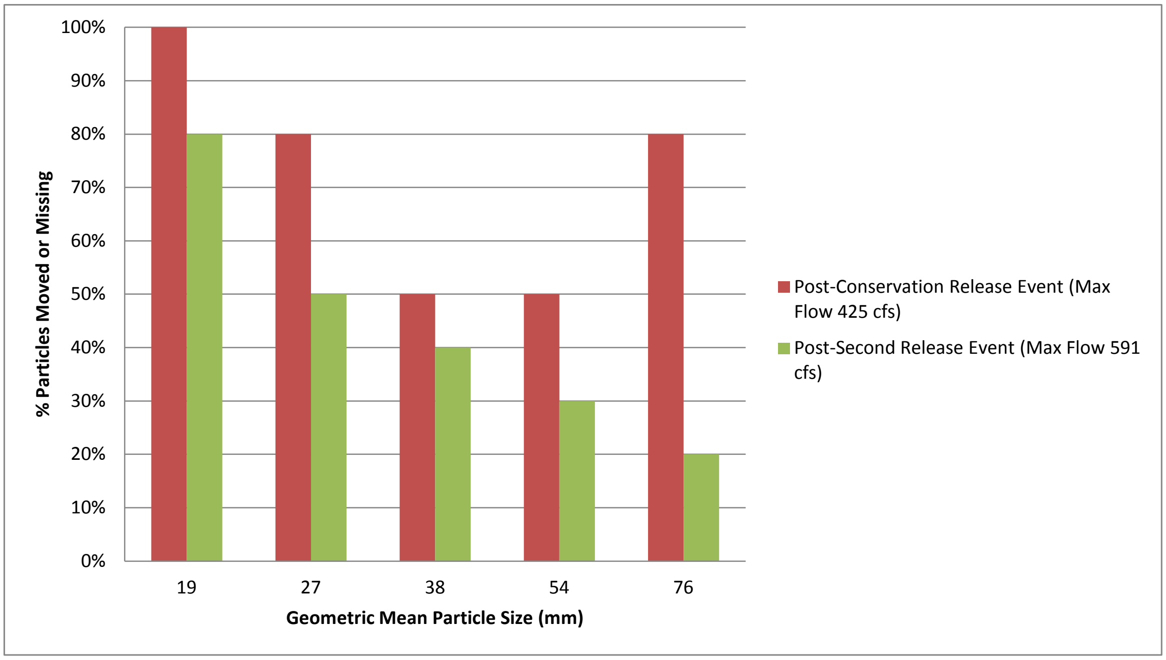
Site 2 Tracer Gravel Study Results

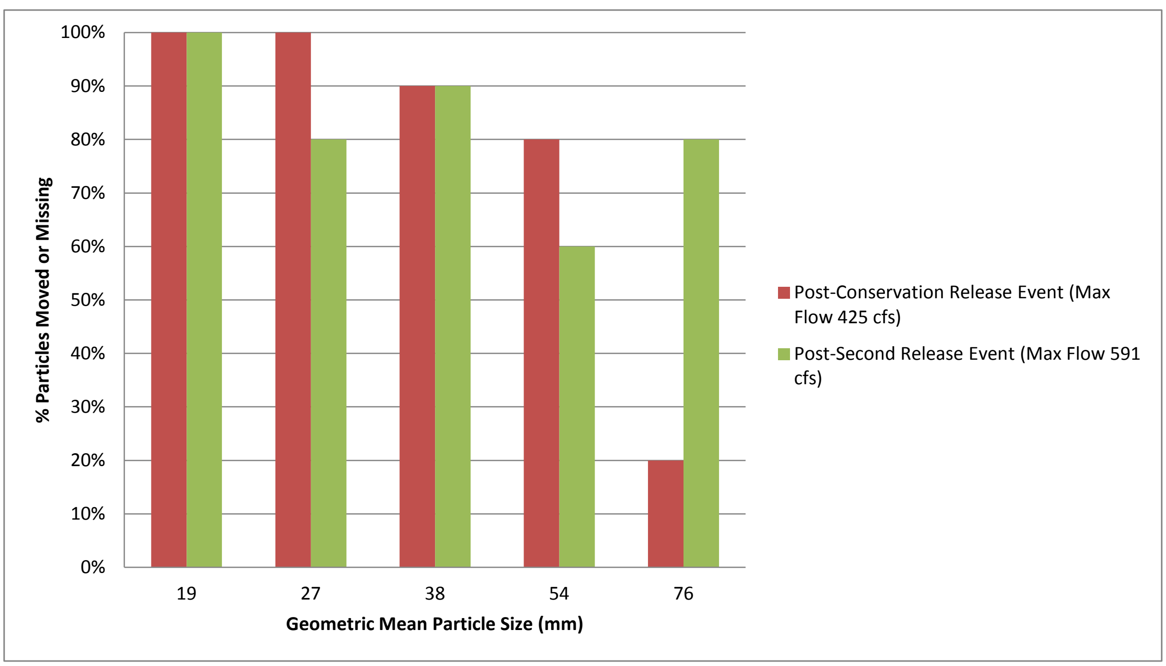
Piru Creek Geomorphology Study Report

Figure 32

Site 3 - Cross-Section 1



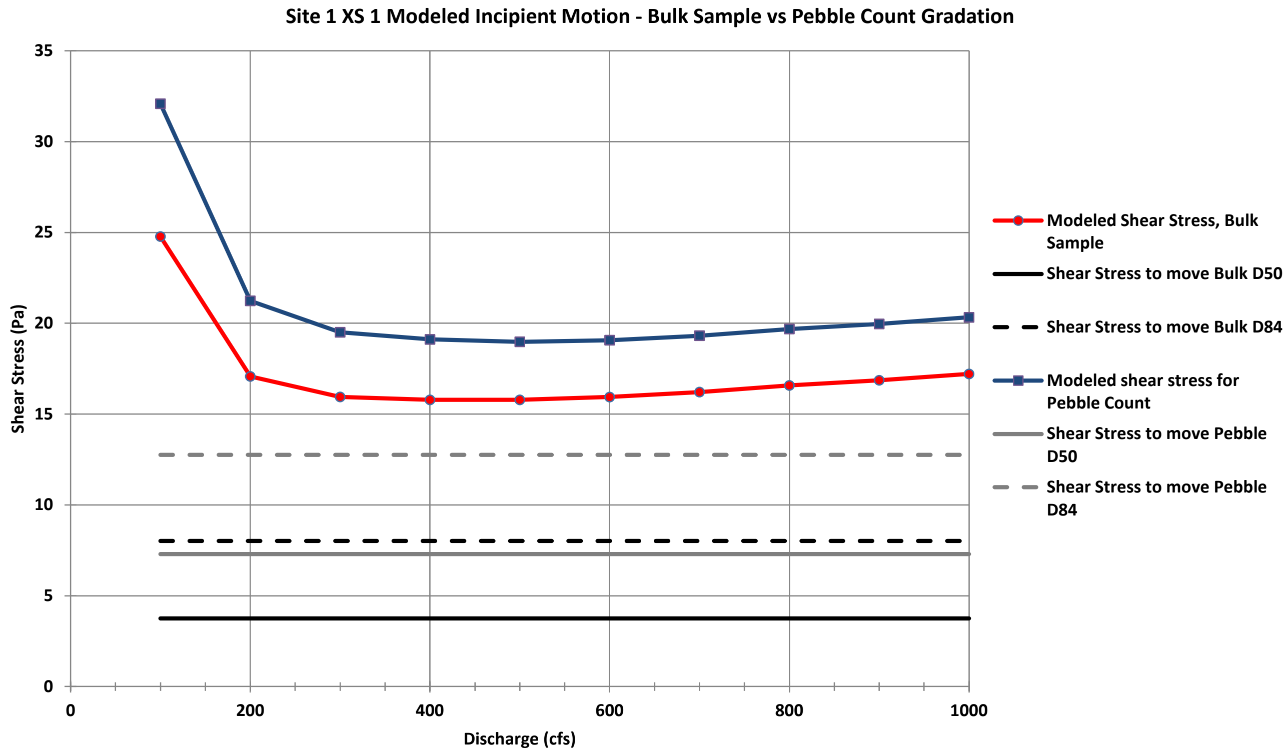
Site 3 - Cross-Section 5

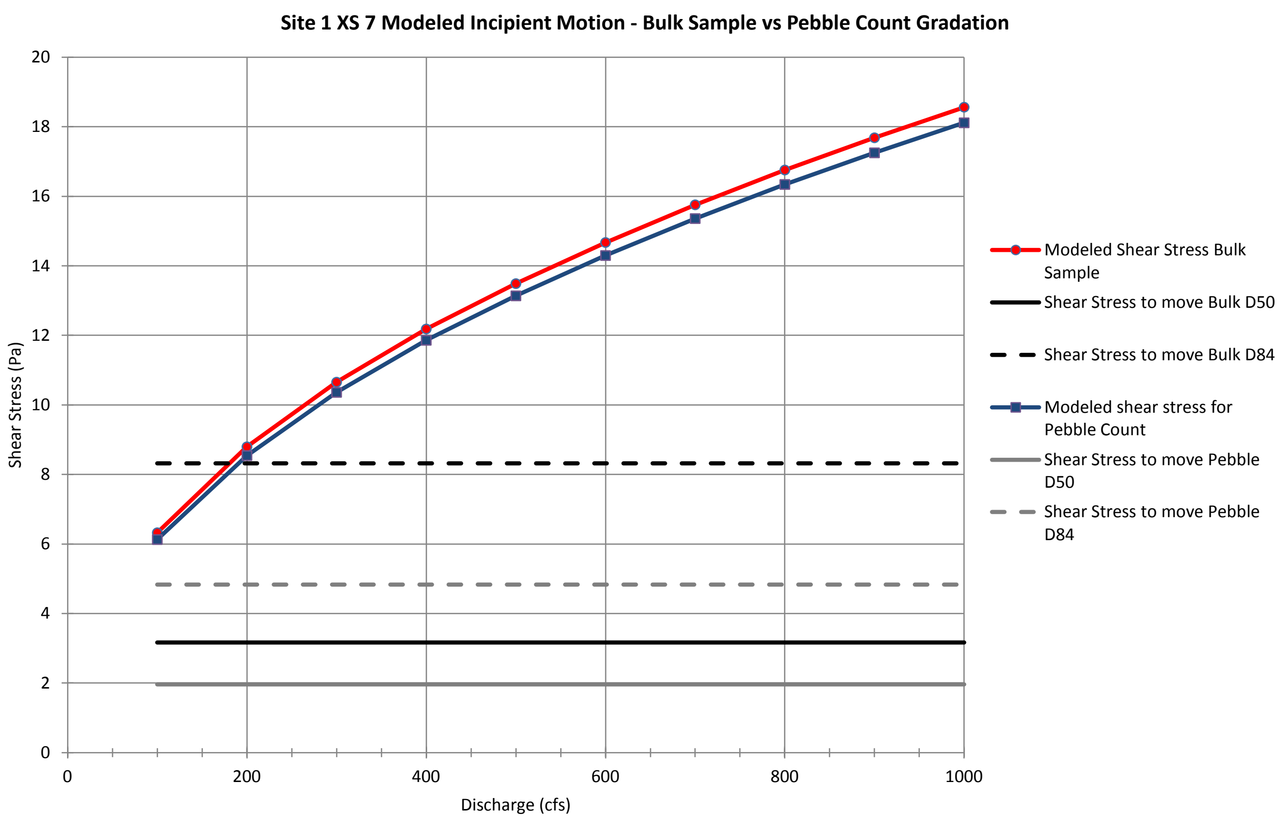


Cardno ENTRIX

Site 3 Tracer Gravel Study Results

Figure 33





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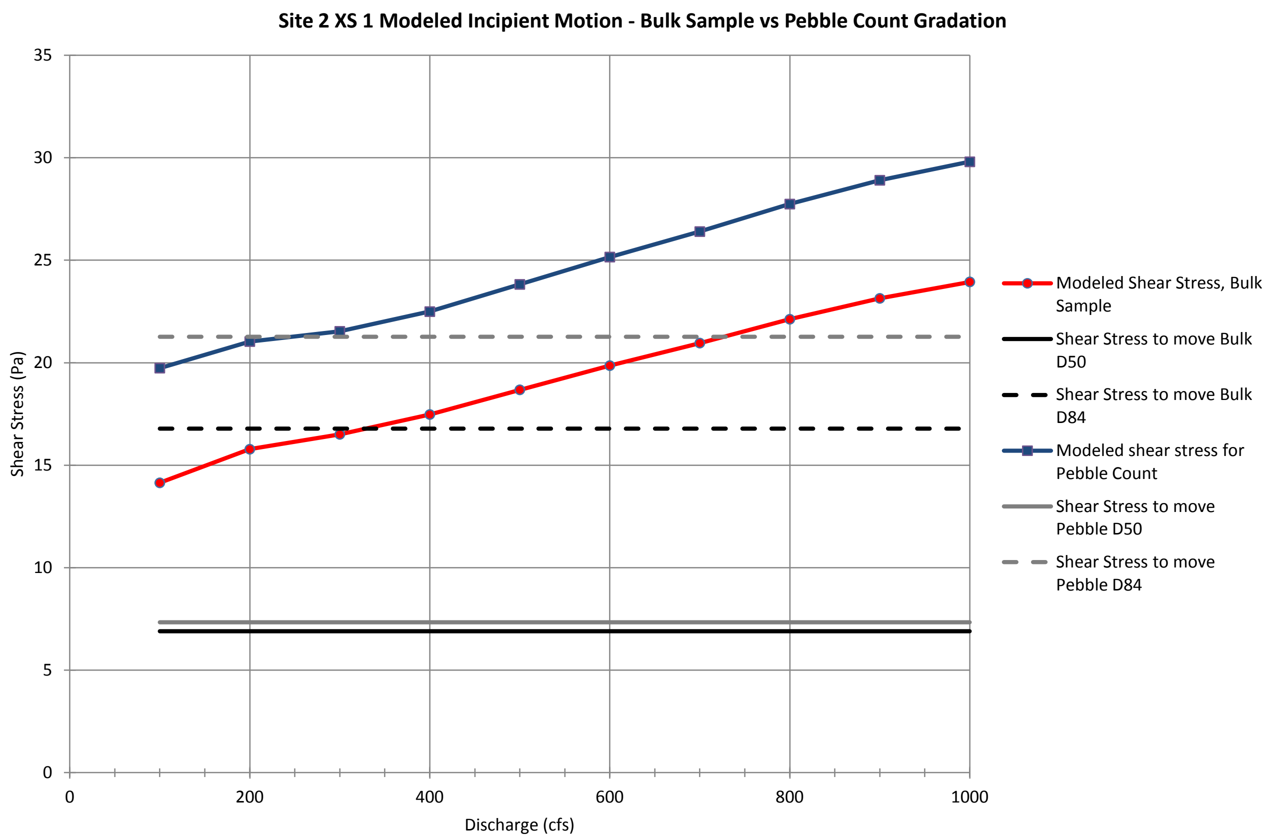
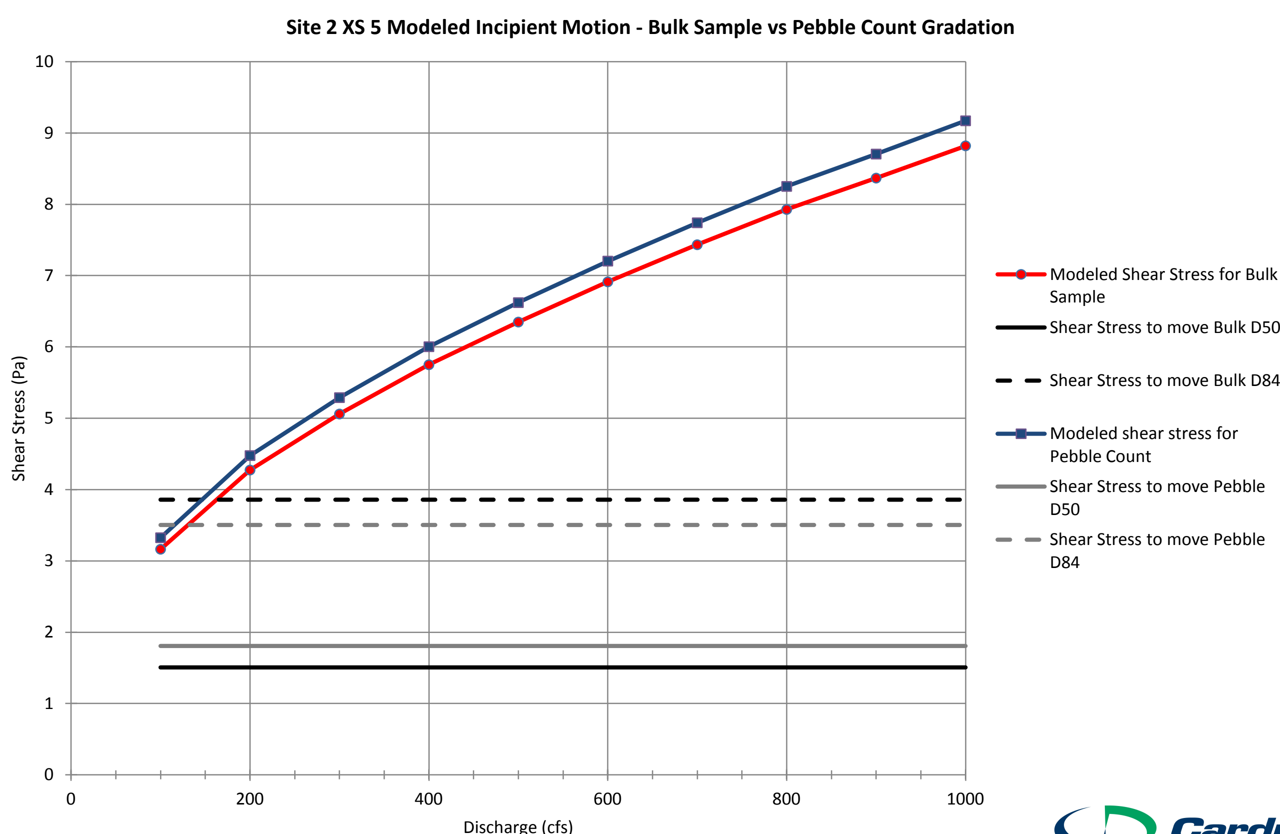
Site 1 Critical Shear Stress Graphs for Bulk Sample Locations

Piru Creek Geomorphology Study Report

Figure 34





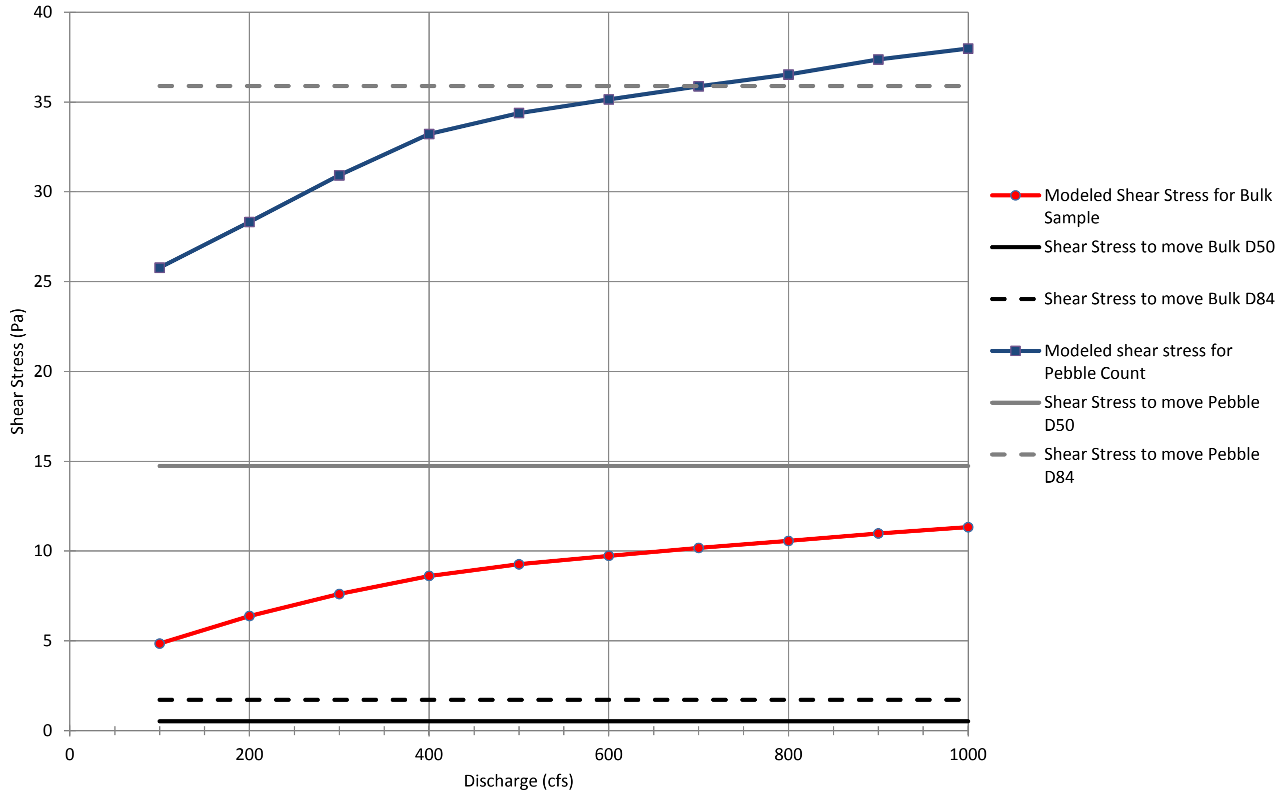
Cardno ENTRIX

Site 2 Critical Shear Stress Graphs for Bulk Sample Locations

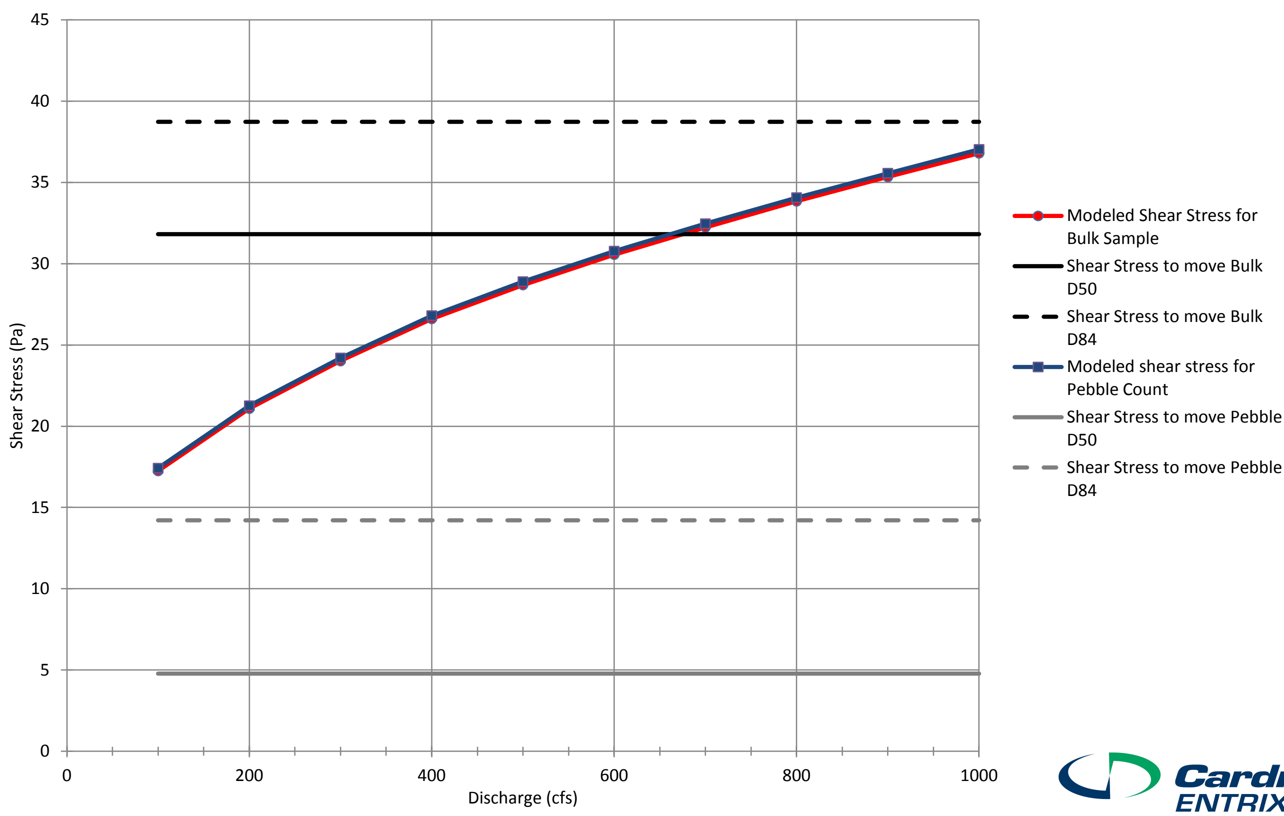
Piru Creek Geomorphology Study Report

Figure 35

Site 3 XS 3 Modeled Incipient Motion - Bulk Sample vs Pebble Count Gradation



Site 3 XS 6 Modeled Incipient Motion - Bulk Sample vs Pebble Count Gradation



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Site 3 Critical Shear Stress Graphs for Bulk Sample Locations

Piru Creek Geomorphology Study Report

Figure 36

Tables

TABLE 1
Study Site 1- Change in Cross-Sectional Area Following Flow Release Events
Piru Creek Geomorphology Study Report
United Water Conservation District

Cross-Section	Cross-Sectional Area (ft^2)			Change in Cross-Sectional Area (ft^2)		Percent Change in Cross-Sectional Area (%)	
	Pre-425 cfs Release	Post-425 cfs Release	Post-591 cfs Release	Pre-425 cfs minus Post-425 cfs Area	Post-425 cfs minus Post-591 cfs Area	Pre-425 cfs vs. Post-425 cfs Area	Post-425 cfs vs. Post-591 cfs Area
XS-1	163.1	162.7	163.0	0.4	-0.3	0.2%	-0.2%
XS-2	207.6	195.4	200.1	12.2	-4.7	5.9%	-2.4%
XS-3	166.3	170.7	171.1	-4.3	-0.4	-2.6%	-0.2%
XS-4	121.2	122.6	125.6	-1.3	-3.0	-1.1%	-2.5%
XS-5	107.3	109.7	111.2	-2.4	-1.5	-2.3%	-1.3%
XS-6	193.5	201.2	202.7	-7.7	-1.5	-4.0%	-0.7%
XS-7	165.1	168.2	163.4	-3.1	4.8	-1.9%	2.9%

Note:
Negative values indicate channel scour and positive values indicate sediment deposition
ft = feet
ft^2 = square feet
cfs = cubic feet per second
XS = Cross-Section

TABLE 2

Study Site 2 - Change in Cross-Sectional Area Following Flow Release Events

Piru Creek Geomorphology Study Report

United Water Conservation District

Cross-Section	Cross-Sectional Area (ft^2)			Change in Cross-Sectional Area (ft^2)		Percent Change in Cross-Sectional Area (%)	
	Pre-425 cfs Release	Post-425 cfs Release	Post-591 cfs Release	Pre-425 cfs minus Post-425 cfs Area	Post-425 cfs minus Post-591 cfs Area	Pre-425 cfs vs. Post-425 cfs Area	Post-425 cfs vs. Post-591 cfs Area
XS-1	206.3	212.2	209.9	-5.9	2.3	-2.8%	1.1%
XS-2	148.0	137.8	134.4	10.1	3.4	6.9%	2.5%
XS-3	280.2	286.9	262.4	-6.7	24.5	-2.4%	8.5%
XS-4	280.7	269.2	263.6	11.5	5.6	4.1%	2.1%
XS-5	420.7	407.7	428.0	12.9	-20.3	3.1%	-5.0%

Note:

Negative values indicate channel scour and positive values indicate sediment deposition

ft = feet

ft^2 = square feet

cfs = cubic feet per second

XS = Cross-Section

TABLE 3

Study Site 3 - Change in Cross-Sectional Area Following Flow Release Events

Piru Creek Geomorphology Study Report

United Water Conservation District

Cross-Section	Cross-Sectional Area (ft^2)			Change in Cross-Sectional Area (ft^2)		Percent Change in Cross-Sectional Area (%)	
	Pre-425 cfs Release	Post-425 cfs Release	Post-591 cfs Release	Pre-425 cfs minus Post-425 cfs Area	Post-425 cfs minus Post-591 cfs Area	Pre-425 cfs vs. Post-425 cfs Area	Post-425 cfs vs. Post-591 cfs Area
XS-1	213.1	208.4	204.7	4.8	3.6	2.2%	1.7%
XS-2	205.5	200.7	200.4	4.9	0.3	2.4%	0.1%
XS-3	185.9	190.5	182.9	-4.6	7.5	-2.5%	3.9%
XS-4	175.6	185.7	185.6	-10.1	0.1	-5.7%	0.1%
XS-5	174.7	192.2	194.2	-17.6	-2.0	-10.1%	-1.0%
XS-6	196.9	203.6	195.8	-6.8	7.9	-3.4%	3.9%

Note:

Negative values indicate channel scour and positive values indicate sediment deposition

ft = feet

ft^2 = square feet

cfs = cubic feet per second

XS = Cross-Section

TABLE 4

Study Site 4 - Change in Cross-Sectional Area Following Flow Release Events

Piru Creek Geomorphology Study Report

United Water Conservation District

Cross-Section	Cross-Sectional Area (ft^2)			Change in Cross-Sectional Area (ft^2)		Percent Change in Cross-Sectional Area (%)	
	Pre-425 cfs Release	Post-425 cfs Release	Post-591 cfs Release	Pre-425 cfs minus Post-425 cfs Area	Post-425 cfs minus Post-591 cfs Area	Pre-425 cfs vs. Post-425 cfs Area	Post-425 cfs vs. Post-591 cfs Area
XS-1	132.8	145.9	143.0	-13.1	2.9	-9.9%	2.0%

Note:

Negative values indicate channel scour and positive values indicate sediment deposition

ft = feet

ft^2 = square feet

cfs = cubic feet per second

XS = Cross-Section

TABLE 5

Summary of the Change in Pool Volumes at Sites 1 and 2

Piru Creek Geomorphology Study Report

United Water Conservation District

Study Site No.	Pool Number	Pool Volume Calculations			Percent Change in Pool Volume	
		Pre-425 cfs Release (Acre Feet)	Post-425 cfs Relase (Cubic Feet)	Post-591 cfs Release (Cubic Feet)	Between Pre- and Post-425 cfs Release	Between Pre- and Post-591 cfs Release
1	1	0.2103	0.2057	0.2168	-2.2%	5.4%
1	2	0.2937	0.2829	0.3356	-2.2%	18.6%
2	1	1.3567	1.5301	1.4355	-2.2%	18.6%

Note:

cfs = cubic feet per second

TABLE 6
Wentworth Particle Size Scale
Piru Creek Geomorphology Study Report
United Water Conservation District

Particle Size Range	Description
>256 mm	boulder
64–256 mm	cobble
32–64 mm	very coarse gravel
16–32 mm	coarse gravel
8–16 mm	medium gravel
4–8 mm	fine gravel
2–4 mm	very fine gravel
1–2 mm	very coarse sand
0.5–1 mm	coarse sand
0.25–0.5 mm	medium sand
0.125–0.25 mm	fine sand
0.063–0.125 mm	very fine sand
0.0039–0.063 mm	silt
0.00024–0.0039 mm	clay

Note:
mm = millimeter

TABLE 7

Study Site 1 - Pebble Count Results

Piru Creek Geomorphology Study Report

United Water Conservation District

Cross Section	D_{10}	D_{16}	D_{50}	D_{84}	D_{90}	Geometric Mean (mm)	Percent Sand or Finer (%)	D_{50} Size Class	Dominant Size Class
Pre-425 cfs Release									
XS-1	6.5	11	31.4	81.4	95.4	29.9	4	Coarse gravel	Coarse gravel
XS-2	2	2	2	53.7	75.9	10.4	51	Sand or Finer	Sand or Finer
XS-3	0.45	0.7	17.1	38.2	46.4	5.2	31	Coarse gravel	Sand or Finer
XS-4	2	2	30.9	85.1	104.4	13	23	Coarse gravel	Sand or Finer
XS-5	2	2	14.6	93.2	115.2	13.7	40	Medium gravel	Sand or Finer
XS-6	2	2	12.1	60	76.3	11	31	Medium gravel	Sand or Finer
XS-7	2	2	20.4	48.2	65.3	9.8	20	Coarse gravel	Sand or Finer
Post-425 cfs Release									
XS-1	0.96	3.4	36.2	69.4	86	15.4	15	Coarse gravel	Very coarse gravel
XS-2	0.06	0.07	0.21	58.8	76.2	2	60	Sand or Finer	Sand or Finer
XS-3	0.06	0.11	16	53.3	73.4	2.4	36	Medium gravel	Sand or Finer
XS-4	0.12	0.21	32.6	77.5	91.9	4	24	Very coarse gravel	Very coarse gravel
XS-5	0.06	0.06	23.8	82.9	106.9	2.3	33	Coarse gravel	Sand or Finer
XS-6	0.06	0.08	17.8	80	98	2.6	40	Coarse gravel	Sand or Finer
XS-7	0.06	0.06	12.4	47.2	59.8	1.7	49	Medium gravel	Sand or Finer
Post-591 cfs Release									
XS-1	0.22	0.65	27.8	79	106.1	7.2	23	Coarse gravel	Coarse gravel
XS-2	0.06	0.06	0.23	50.7	64	1.8	52	Sand or Finer	Sand or Finer
XS-3	0.06	0.06	16.3	46.7	68.8	1.7	39	Coarse gravel	Sand or Finer
XS-4	0.2	1.1	31.2	74.4	89.1	9.2	18	Coarse gravel	Very coarse gravel
XS-5	2	9.6	35.9	103.2	116.1	31.5	10	Very coarse gravel	Small cobble
XS-6	0.11	0.49	21.4	81.6	102.3	6.3	19	Coarse gravel	Medium/Coarse gravel
XS-7	0.06	0.06	23.1	56.4	63.6	1.9	38	Coarse gravel	Sand or Finer

Note:

mm = millimeter

cfs = cubic feet per second

XS = Cross-Section

TABLE 8
Study Site 2 - Pebble Count Results
Piru Creek Geomorphology Study Report
United Water Conservation District

Cross Section	D_{10}	D_{16}	D_{50}	D_{84}	D_{90}	Geometric Mean (mm)	Percent Sand or Finer (%)	D_{50} Size Class	Dominant Size Class
Pre-425 cfs Release									
XS-1	2	4.2	17.8	101.2	214.7	20.5	10	Coarse gravel	Fine gravel
XS-2	4.9	9.9	86.2	196.8	237.2	44	8	Small cobble	Small cobble
XS-3	0.06	0.06	0.06	1.1	3.6	0.26	86	Sand or Finer	Sand or Finer
XS-4	0.06	0.06	0.06	0.06	0.06	0.06	100	Sand or Finer	Sand or Finer
XS-5	0.06	0.06	3.3	29	35.9	1.3	47	Very fine gravel	Sand or Finer
Post-425 cfs Release									
XS-1	0.44	4	25.5	118	160.9	21.8	13	Coarse gravel	Coarse gravel
XS-2	11.9	17.4	55.6	146.7	180	50.6	5	Very coarse gravel	Very coarse gravel/ Small cobble
XS-3	0.06	0.06	9.9	75.9	99.1	2.2	47	Medium gravel	Sand or Finer
XS-4	0.06	0.07	16.6	46.8	59.2	1.9	33	Coarse gravel	Sand or Finer
XS-5	0.06	0.06	12	32	37.9	1.4	29	Medium gravel	Medium gravel
Post-591 cfs Release									
XS-1	6.8	10.8	37.9	168.7	272.5	42.8	2	Very coarse gravel	Medium gravel
XS-2	14.1	21.1	49.5	111.2	139.4	48.4	0	Very coarse gravel	Very coarse gravel/ Small cobble
XS-3	0.06	0.06	13.9	107.1	127	2.6	44	Medium gravel	Sand or Finer
XS-4	0.06	0.11	24.5	53.7	67.2	2.5	26	Coarse gravel	Coarse gravel
XS-5	0.42	12.3	27.8	44.1	55.1	23.3	10	Coarse gravel	Very coarse gravel

Note:
mm = millimeter
cfs = cubic feet per second
XS = Cross-Section

TABLE 9
Study Site 3 - Pebble Count Results
Piru Creek Geomorphology Study Report
United Water Conservation District

Cross Section	D_{10}	D_{16}	D_{50}	D_{84}	D_{90}	Geometric Mean (mm)	Percent Sand or Finer (%)	D_{50} Size Class	Dominant Size Class
Pre-425 cfs Release									
XS-1	0.06	0.06	16	223.8	411.3	3.7	46	Medium/ Coarse gravel	Sand or Finer
XS-2	0.06	0.06	122.5	246.7	359.5	3.9	30	Small cobble	Sand or Finer
XS-3	0.06	0.06	11	220.7	254.8	3.7	36	Medium gravel	Sand or Finer
XS-4	0.06	0.06	117.2	254.1	357.9	4	28	Small cobble	Sand or Finer
XS-5	0.06	0.06	0.1	6.5	61.3	0.64	69	Sand or Finer	Sand or Finer
XS-6	0.06	0.06	0.06	148.2	212.2	3	80	Sand or Finer	Sand or Finer
Post-425 cfs Release									
XS-1	0.06	0.06	12.9	122.2	192.5	2.8	43	Medium gravel	Sand or Finer
XS-2	2.1	12.2	132.7	245.8	325.3	54.6	10	Large cobble	Large cobble
XS-3	5.6	7.6	49.5	167.3	196.6	35.7	6	Very coarse gravel	Large cobble
XS-4	2.8	29.9	143.1	239.3	281.4	84.5	10	Large cobble	Large cobble
XS-5	0.06	0.06	48.3	201.5	226.3	3.5	36	Very coarse gravel	Sand or Finer
XS-6	0.09	0.17	28.4	140.8	186.5	4.8	29	Coarse gravel	Sand or Finer
Post-591 cfs Release									
XS-1	0.06	0.06	24.3	166.3	210.6	3.2	32	Coarse gravel	Sand or Finer
XS-2	3.9	7.7	57.6	198.2	236.7	39.2	6	Very coarse gravel	Small cobble/ Large cobble
XS-3	13.3	25.4	109.7	225.2	298.6	75.6	5	Small cobble	Large cobble
XS-4	0.2	1	55.6	189.9	231.1	13.8	19	Very coarse gravel	Small cobble
XS-5	0.06	0.1	64	222.4	256	4.7	25	Very coarse gravel/ Small cobble	Large cobble
XS-6	0.06	0.11	32.6	194.4	229.1	4.7	27	Very coarse gravel	Large cobble

Note:
mm = millimeter
cfs = cubic feet per second
XS = Cross-Section

TABLE 10
Study Site 4 - Pebble Count Results
Piru Creek Geomorphology Study Report
United Water Conservation District

Cross Section	D_{10}	D_{16}	D_{50}	D_{84}	D_{90}	Geometric Mean (mm)	Percent Sand or Finer (%)	D_{50} Size Class	Dominant Size Class
Pre-425 cfs Release									
XS-1	0.06	0.06	0.07	2.1	33.5	0.36	83	Sand or Finer	Sand or Finer
Post-425 cfs Release									
XS-1	0.06	0.06	28.4	140.8	186.5	3	62	Coarse gravel	Sand or Finer
Post-591 cfs Release									
XS-1	0.06	0.09	4.4	46.2	63	2	48	Fine gravel	Sand or Finer

Note:
mm = millimeter
cfs = cubic feet per second
XS = Cross-Section

TABLE 11

Study Site 1 - Bulk Sediment Sample Results

Piru Creek Geomorphology Study Report

United Water Conservation District

Cross Section	D_{10}	D_{16}	D_{50}	D_{84}	D_{90}	Geometric Mean of D_{16} and D_{85} (mm)	% Cobble	% Gravel	% Sand	% Silt/Clay	D_{50} Size Class	Dominant Size Class
Pre-425 cfs Release												
XS-1	0.62	1.4	26.5	63.3	82	9.41	13.4	61.4	22	3.2	Coarse gravel	Coarse/ Very coarse gravel
XS-7	1.2	3.4	23.3	69.1	82.6	15.33	13.9	67.3	15.1	3.7	Coarse gravel	Small cobble
Post-425 cfs Release												
XS-1	0.67	1.2	19.4	47.9	65.8	7.58	4.2	67.9	25.5	2.4	Coarse gravel	Coarse/ Very coarse gravel
XS-7	0.58	1.2	15.1	49.9	63.3	7.74	9.9	60.1	26.9	3.1	Medium gravel	Coarse/ Very coarse gravel
Post-591 cfs Release												
XS-1	1.3	3.4	35.2	61.6	72.2	14.47	8.6	73.6	17.6	0.2	Very coarse gravel	Very coarse gravel
XS-7	0.91	4.8	28.2	57.8	61.5	16.66	4.8	79.3	8.5	7.4	Coarse gravel	Very coarse gravel

Note:

mm = millimeter

cfs = cubic feet per second

XS = Cross-Section

TABLE 12

Study Site 2 - Bulk Sediment Sample Results

Piru Creek Geomorphology Study Report

United Water Conservation District

Cross Section	D_{10}	D_{16}	D_{50}	D_{84}	D_{90}	% Cobble	% Gravel	% Sand	% Silt/Clay	D_{50} Size Class	Dominant Size Class
Pre-425 cfs Release											
XS-1	0.82	1.6	22.3	47.3	52.4	0	72.9	26.2	0.9	Coarse gravel	Very coarse gravel
XS-5	0.09	0.12	1.1	29	36.8	0	39.4	53.6	7	Very coarse sand	Fine/Medium sand
Post-425 cfs Release											
XS-1	2.5	3.5	23.4	77.9	86	17.3	60.8	18.6	3.3	Coarse gravel	Coarse/ Very coarse gravel
XS-5	0.1	0.18	8.2	29.1	34.8	0	57.8	35	7.2	Medium gravel	Coarse/ Very coarse gravel
Post-591 cfs Release											
XS-1	1.1	2.1	21.9	66.3	74	8.4	67.7	23.1	0.8	Coarse gravel	Coarse/ Very coarse gravel
XS-5	0.38	0.51	6.4	26.2	32.2	0	55.1	43.5	1.4	Fine gravel	Coarse/ Very coarse sand

Note:

mm = millimeter

cfs = cubic feet per second

XS = Cross-Section

TABLE 13

Study Site 3 - Bulk Sediment Sample Results

Piru Creek Geomorphology Study Report

United Water Conservation District

Cross Section	D_{10}	D_{16}	D_{50}	D_{84}	D_{90}	% Cobble	% Gravel	% Sand	% Silt/Clay	D_{50} Size Class	Dominant Size Class
Pre-425 cfs Release											
XS-3	0.2	0.29	1.7	10.2	12.7	0	38.1	60	1.9	Very coarse sand	Fine/Medium gravel
XS-5	0.11	0.16	0.33	2	3.5	0	6.6	89.6	3.8	Medium sand	Fine/Medium sand
Post-425 cfs Release											
XS-6	10.8	23.4	104	139.2	144	61.8	32.3	5.9	0	Small cobble	Large cobble
Post-591 cfs Release											
XS-6	7.1	17.8	119.6	190.3	195	57.4	34.7	7.7	0.2	Small cobble	Large cobble

Note:

The 400 cfs flow scoured the spawning gravel from XS-3 and XS-5, leaving a coarse cobble and bed substrate. Thus, the sampling location was moved to a remaining area of pocket gravel on XS-6

mm = millimeter

cfs = cubic feet per second

XS = Cross-Section

TABLE 14

Summary of Spawning Gravel Inventory Results

Piru Creek Geomorphology Study Report

United Water Conservation District

Site	Total Spawning Gravels (sq. ft.)			Average Embeddedness (%)			Gravels Wetted at Time of Survey		
	Pre-425 cfs Release	Post-425 cfs Release	Post-591 cfs Release	Pre-425 cfs Release	Post-425 cfs Release	Post-591 cfs Release	Pre-425 cfs Release	Post-425 cfs Release	Post-591 cfs Release
Site 1	4,734	9,968	10,012	36	15	23	63	22	90
Site 2	2,702	11,703	13,324	24	27	28	80	89	78
Site 3	17,805	17,939	18,455	0	26	24	91	52	51

Note:

sq ft = square feet

cfs = cubic feet per second

TABLE 15
Study Site 1 - Spawning Gravel Inventory Results
Piru Creek Geomorphology Study Report
United Water Conservation District

Pre-425 cfs							Post-425 cfs							Post-591 cfs						
Location	Area (sq ft)	Wet/Dry	Gravel Size Range	Fines Present	Embeddedness	Habitat	Location	Area (sq ft)	Wet/Dry	Gravel Size Range	Fines Present	Embeddedness	Habitat	Location	Area (sq ft)	Wet/Dry	Gravel Size Range	Fines Present	Embeddedness	Habitat
1-2 riffle 1	770	w	sm-med	Yes	80-90	riffle	3	130	w	sm-med	Yes	25	riffle	1	737	w	sm-med-lrg	Yes	25	run
1-3 bar 1	1,100	d	med-lrg	Yes	20-50	dry	4	330	w	sm-med	Yes	10-15	pool	2	667	w	sm-lrg	Yes	25	run
1-4 riffle 2	64	w	med-lrg	Yes	20-50	riffle	5	196	d	sm-lrg	Yes	10-15	dry	3	109	w	med-lrg	Yes	<20	run
1-5 riffle 2 tail	40	w	med-lrg	Yes	20-50	riffle tail	6	480	d	sm-med	Yes	10-15	dry	4	154	w	med-lrg	Yes	<20	run
1-6	429	w	lrg	Yes	20-50	pool tail/riffle	7	195	w	med-lrg	Yes	15-20	run	5	126	w	med-lrg	Yes	20	riffle
1-7	304	d	md-lrg	Yes	20-50	dry	8	693	50/50	med-lrg	Yes	15-20	run/riffle	6	123	50/50	med-lrg	Yes	20	pool tail
1-8	42	d	sm-med	Yes	20-50	dry	9	1,370	50/50				pool/riffle	1	250	w	med-lrg	Yes	<20	pool
1-9	120	d	med-lrg	Yes	40-50	dry	10	1,160	d	sm-med	Yes	10-15	dry	2	32	w	med-lrg	Yes	<20	pool
1-10	375	50/50	sm-med	Yes	20-30	pool tail/riffle	11	1,400	d	sm-med	Yes	10-15	dry	3-4-5	3,078	75/25	med			run/riffle
1-11	150	w	sm-med	Yes	30-40	riffle	11-12	1,000	d	sm-med	Yes	10-15	dry	5-6	663	w	sm-lrg	Yes	30	pool
1-12	12	d	sm-med	Yes	30-40	dry	13-14	2,100	w	sm-med-lrg	Yes	15-20	pool/riffle	6-7-8	1,888	w	sm-lrg	Yes	30	
1-13	9	w	sm-med	Yes	20-30	run	15-16	224	50/50	sm-med	Yes	15-20	pool/riffle	8-11	1,085	w				
1-14	1,040	w	sm-med	Yes	20-50	riffle/run	17	690	50/50	sm-med	Yes	15-20	run/riffle	12-13	651	w	sm-med-lrg	Yes	<20	pool
1-16	75	w	sm-med	Yes	20-50	run								14	450	70/30	sm-med-lrg	Yes	<20	riffle/run
1-17	204	w	med-lrg	Yes	10-20	riffle														
Total	**4,734**						**Total**	**9,968**						**Total**	**10,012**					

Note:
sq ft = square feet
cfs = cubic feet per second
sm = small
med = medium
lrg = large

TABLE 16
Study Site 2 - Spawning Gravel Inventory Results
Piru Creek Geomorphology Study Report
United Water Conservation District

Pre-425 cfs							Post-425 cfs							Post-591 cfs						
Location	**Area (sq ft)**	**Wet/Dry**	**Gravel Size Range**	**Fines Present**	**Embeddedness**	**Habitat**	**Location**	**Area (sq ft)**	**Wet/Dry**	**Gravel Size Range**	**Fines Present**	**Embeddedness**	**Habitat**	**Location**	**Area (sq ft)**	**Wet/Dry**	**Gravel Size Range**	**Fines Present**	**Embeddedness**	**Habitat**
2-1	90	w	med-lrg	No	<20	riffle	1	2,299	w	med-lrg	Yes	25	riffle	1	48	w	sm-med	Yes	<20	riffle
2-2 to 2-3	665	w	med-lrg	No	<20	riffle	2	980	w	sm-lrg	Yes	25	pool tail	1	2,299	w	sm-lrg	Yes	25	riffle
2-4	72	w	sm-med	Yes	30	riffle	3	658	w	med-lrg	Yes	40	riffle	2	980	w	med-lrg	Yes	25	pool tail
2-5	600	10/90	sm-med	Yes	30	riffle	4	426	w	med-lrg	Yes	15	riffle	3	658	w	med-lrg	Yes	40	riffle
2-6 to 2-7	1,275	w	med-lrg	Yes	20	run	5	4,313	95/5	sm-lrg	Yes	40	pool tail/riffle	4	426	w	sm-lrg	Yes	15	riffle
							6	302	w	med-lrg	Yes	30-40	run	5	4,313	95/5	sm-lrg	Yes	40	pool tail/riffle
							14	32	w	sm-med-lrg	Yes	<20	run	2	1,605	w	sm-med-lrg	Yes	30-40	pool/run
							7	651	d	sm-lrg	Yes	<20	dry	6	302	w	med-lrg	Yes	30-40	run
							8	2,042	80/20	sm-med-lrg	Yes	20	riffle	7	651	d	sm-lrg	Yes	<20	dry
														8	2,042	d	sm-med-lrg	Yes	20	riffle
Total	**2,703**						**Total**	**11,703**						**Total**	**13,324**					

Note:
sq ft = square feet
cfs = cubic feet per second
sm = small
med = medium
lrg = large

TABLE 17

Study Site 3 - Spawning Gravel Inventory Results
Piru Creek Geomorphology Study Report
United Water Conservation District

Pre-425 cfs							Post-425 cfs							Post-591 cfs						
Location	**Area (sq ft)**	**Wet/Dry**	**Gravel Size Range**	**Fines Present**	**Embeddedness**	**Habitat**	**Location**	**Area (sq ft)**	**Wet/Dry**	**Gravel Size Range**	**Fines Present**	**Embeddedness**	**Habitat**	**Location**	**Area (sq ft)**	**Wet/Dry**	**Gravel Size Range**	**Fines Present**	**Embeddedness**	**Habitat**
Bar 3-1	1,231	d	sm-lrg	Yes	0	dry	1	1,068	d	sm-med-lrg		<20	dry	1	364	d	sm-med-lrg	Yes	<20	dry
Bar 3-2	438	d	sm-lrg	Yes	0	dry	2	569	w	med-lrg	Yes (low)	<20	run	2	152	w	sm-med	Yes	<10	run
Poly 3-1	784	w	sm-med	Yes	0	run/riffle	3	1,118	d	sm-med-lrg	Yes	<20	dry	1	1,068	d	sm-med-lrg		<20	dry
grav 3 track	15,352	w	sm-med	Yes	0-10	pool tail/run	4	895	w	med-lrg	Yes	<20	run	2	569	w	med-lrg	Yes (low)	<20	run
							5	1,015	d	sm-med	Yes	<20	dry	3	1,118	d	sm-med-lrg	Yes	<20	dry
							6	1,947	d	sm-med-lrg	Yes	30	dry	4	895	w	med-lrg	Yes	<20	run
							7	2,753	70/30		Yes (low)	36	riffle	5	1,015	d	sm-med	Yes	<20	dry
							8	2,675	80/20	sm-med-lrg	Yes (low)	30-40	run	6	1,947	d	sm-med-lrg	Yes	30	dry
							9	4,675	60/40	med-lrg	Yes (low)	30	riffle/run	7	2,753	70/30		Yes (low)	36	riffle
							10	1,224	80/20	med-lrg	Yes (low)	25	Pool tail/run	8	2,675	80/20	sm-med-lrg	Yes (low)	30-40	run
														9	4,675	60/40	med-lrg	Yes (low)	30	riffle/run
														10	1,224	80/20	med-lrg	Yes (low)	25	Pool tail/run
Total	**17,805**						**Total**	**17,939**						**Total**	**18,455**					

Note:
sq ft = square feet
cfs = cubic feet per second
sm = small
med = medium
lrg = large

TABLE 18
Study Site 1 - Tracer Gravel Study Results
Piru Creek Geomorphology Study Report
United Water Conservation District

Cross Section	Size (mm)						Description
	19	27	38	54	76	Total	
425 cfs							
XS-1	10	10	10	10	10	50	Total No. Tracers
	1	3	4	5	3	16	No. That Did Not Move
	0	1	4	4	7	16	No. That Moved
	0	26.3	6.9	6.3	131		Max Distance Downstream of XS (ft)
	0	6.6	2.3	6.4	16.4		Mean Distance Downstream of XS (ft)
	9	6	2	1	0	18	No. Missing
	90%	70%	60%	50%	70%	68%	Percentage Moved and Missing
XS-4	10	10	10	10	10	50	Total No. Tracers
	0	1	1	3	6	11	No. That Did Not Move
	2	2	1	6	3	14	No. That Moved
	10.8	10.5	33.5	21	6.5		Max Distance Downstream of XS (ft)
	8.4	4.2	16.8	4.1	1.4		Mean Distance Downstream of XS (ft)
	8	7	8	1	1	25	No. Missing
	100%	90%	90%	70%	40%	78%	Percentage Moved and Missing
591 cfs							
XS-1	10	10	10	10	10	50	Total No. Tracers
	1	1	6	4	1	13	No. That Did Not Move
	6	9	4	5	7	31	No. That Moved
	60	18.6	11	6.6	4.7		Max Distance Downstream of XS (ft)
	11	5.2	2.1	1.9	2		Mean Distance Downstream of XS (ft)
	3	0	0	1	2	6	No. Missing
	90%	90%	40%	60%	90%	74%	Percentage Moved and Missing
XS-4	10	10	10	10	10	50	Total No. Tracers
	2	4	1	2	3	12	No. That Did Not Move
	6	5	9	6	7	33	No. That Moved
	104	14.7	9.9	2.8	16.4		Max Distance Downstream of XS (ft)
	35.6	3.7	4.1	1.6	3.5		Mean Distance Downstream of XS (ft)
	2	1	0	2	0	5	No. Missing
	80%	60%	90%	80%	70%	76%	Percentage Moved and Missing

Note:
mm = millimeter
cfs = cubic feet per second
No. = Number
XS = Cross-Section
ft = feet

TABLE 19
Study Site 2 - Tracer Gravel Study Results
Piru Creek Geomorphology Study Report
United Water Conservation District

Cross Section	Size (mm)						Description
	19	27	38	54	76	Total	
425 cfs							
XS-1	10	10	10	10	10	50	Total No. Tracers
	0	0	3	2	5	10	No. That Did Not Move
	0	0	6	2	4	12	No. That Moved
			4.8	1.7	2.4		Max Distance Downstream of XS (ft)
			1.8	0.9	0.9		Mean Distance Downstream of XS (ft)
	10	10	1	6	1	28	No. Missing
	100%	100%	70%	80%	50%	80%	Percentage Moved and Missing
XS-5	10	10	10	10	10	50	Total No. Tracers
	0	0	0	1	4	5	No. That Did Not Move
	7	4	7	9	6	33	No. That Moved
	27.6	5.6	25	4.2	3		Max Distance Downstream of XS (ft)
	9.3	3.4	4.9	2.8	1.2		Mean Distance Downstream of XS (ft)
	3	6	3	0	0	12	No. Missing
	100%	100%	100%	90%	60%	90%	Percentage Moved and Missing
591 cfs							
XS-1	10	10	10	10	10	50	Total No. Tracers
	0	3	6	4	9	22	No. That Did Not Move
	3	2	2	6	1	14	No. That Moved
	105	93	1.6	17.2	0.7		Max Distance Downstream of XS (ft)
	36.8	19.6	0.2	2.3	0.1		Mean Distance Downstream of XS (ft)
	7	5	2	0	0	14	No. Missing
	100%	70%	40%	60%	10%	56%	Percentage Moved and Missing
XS-5	10	10	10	10	10	50	Total No. Tracers
	0	1	0	0	4	5	No. That Did Not Move
	3	3	5	4	3	18	No. That Moved
	43	41	61	22	13		Max Distance Downstream of XS (ft)
	30.7	28.5	26.4	10.4	3.2		Mean Distance Downstream of XS (ft)
	7	6	5	6	3	27	No. Missing
	100%	90%	100%	100%	60%	90%	Percentage Moved and Missing

Note:
mm = millimeter
cfs = cubic feet per second
No. = Number
XS = Cross-Section
ft = feet

TABLE 20
Study Site 3 - Tracer Gravel Study Results
Piru Creek Geomorphology Study Report
United Water Conservation District

Cross Section	Size (mm)						Description
	19	27	38	54	76	Total	
425 cfs							
XS-1	10	10	10	10	10	50	Total No. Tracers
	0	2	5	5	2	14	No. That Did Not Move
	1	2	0	3	4	10	No. That Moved
	2	7	0	3.5	3		Max Distance Downstream of XS (ft)
	2	2.1	0	0.9	1.4		Mean Distance Downstream of XS (ft)
	9	6	5	2	4	26	No. Missing
	100%	80%	50%	50%	80%	72%	Percentage Moved and Missing
XS-5	10	10	10	10	10	50	Total No. Tracers
	0	0	1	2	8	11	No. That Did Not Move
	0	0	0	0	0	0	No. That Moved
			4	5	0		Max Distance Downstream of XS (ft)
			2	2	0		Mean Distance Downstream of XS (ft)
	10	10	9	8	2	39	No. Missing
	100%	100%	90%	80%	20%	78%	Percentage Moved and Missing
591 cfs							
XS-1	10	10	10	10	10	50	Total No. Tracers
	2	5	6	7	8	28	No. That Did Not Move
	5	4	4	3	2	18	No. That Moved
	2.3	4.4	1.2	1.9	0.9		Max Distance Downstream of XS (ft)
	1.4	0.6	0.4	0.3	0.2		Mean Distance Downstream of XS (ft)
	3	1	0	0	0	4	No. Missing
	80%	50%	40%	30%	20%	44%	Percentage Moved and Missing
XS-6	10	10	10	10	10	50	Total No. Tracers
	0	2	1	4	2	9	No. That Did Not Move
	5	4	4	3	2	18	No. That Moved
	5.3	2.2	4.8	1.2	1.9		Max Distance Downstream of XS (ft)
	2.1	0.9	1.1	0.5	1		Mean Distance Downstream of XS (ft)
	5	4	5	3	6	23	No. Missing
	100%	80%	90%	60%	80%	82%	Percentage Moved and Missing

Note:
mm = millimeter
cfs = cubic feet per second
No. = Number
XS = Cross-Section
ft = feet

TABLE 21
Study Site 1 - Flows Required to Overtop Banks
Piru Creek Geomorphology Study Report
United Water Conservation District

Cross-Section	Flow (cfs)	Feature	Flow (cfs)	Feature
XS-1	>3,500	Overtop left bank	3,500	Overtop right bank
XS-2	1,500	Overtop left bank	2,500	Overtop right bank
XS-3	1,750	Overtop left bank	2,000	Overtop right bank
XS-4	1,250	Overtop left bank	1,750	Overtop right bank
XS-5	2,000	Overtop left bank	2,000	Overtop right bank
XS-6	2,000	Overtop left bank	2,500	Overtop right bank
XS-7	1,000	Overtop left bank	2,000	Overtop right bank

Note:
cfs = cubic feet per second

TABLE 22

Study Site 2 - Flows Required to Overtop Banks
Piru Creek Geomorphology Study Report
United Water Conservation District

Cross-Section	Flow (cfs)	Feature	Flow (cfs)	Feature
XS-1	2,000	Overtop left bank	1,500	Overtop right bank
XS-2	1,000	Overtop left bank	1,500	Overtop right bank
XS-3	1,000	Overtop left bank	2,500	Overtop right bank
XS-4	1,100	Overtop left bank	2,200	Overtop right bank
XS-5	1,500	Overtop left bank	2,000	Overtop right bank

Note:
cfs = cubic feet per second

TABLE 23
Study Site 3 - Flows Required to Overtop Banks
Piru Creek Geomorphology Study Report
United Water Conservation District

Cross-Section	Flow (cfs)	Feature	Flow (cfs)	Feature
XS-1	2,000	Overtop left bank	7,500	Overtop right bank
XS-2	2,100	Overtop left bank	5,000	Overtop right bank
XS-3	2,200	Overtop left bank	7,500	Overtop right bank
XS-4	>2,000	Overtop left bank	10,000	Overtop right bank
XS-5	2,000	Overtop left bank	7,500	Overtop right bank
XS-6	2,200	Overtop left bank	5,000	Overtop right bank

Note:
cfs = cubic feet per second

TABLE 24

Study Site 1 - Modeled Flows Required to Mobilize D_{50} and D_{84} Particle Sizes

Piru Creek Geomorphology Study Report

United Water Conservation District

Cross Section	Habitat Type	Bulk Sediment Size Gradation				Pebble Count Size Gradation			
		Particle Size (mm)		Flow (cfs)		Particle Size (mm)		Flow (cfs)	
		D_{50}	D_{84}	D_{50}	D_{84}	D_{50}	D_{84}	D_{50}	D_{84}
XS 1	Riffle	19.4	47.9	<50	<50	36.2	69.4	<50	<50
XS 2	Riffle	NA	NA	NA	NA	0.21	58.8	<50	250
XS 3	Pool	NA	NA	NA	NA	16	53.3	100	225
XS 4	Riffle	NA	NA	NA	NA	32.6	77.5	<50	<50
XS 5	Riffle	NA	NA	NA	NA	23.8	82.9	<50	50
XS 6	Pool	NA	NA	NA	NA	17.8	80	150	380
XS 7	Riffle	15.1	49.9	<50	185	12.4	47.2	<50	50

Note:

NA = not analyzed

mm = millimeter

cfs = cubic feet per second

XS = Cross-Section

TABLE 25

Study Site 2 - Modeled Flows Required to Mobilize D_{50} and D_{84} Particle Sizes

Piru Creek Geomorphology Study Report

United Water Conservation District

Cross Section	Habitat Type	Bulk Sediment Size Gradation				Pebble Count Size Gradation			
		Particle Size (mm)		Flow (cfs)		Particle Size (mm)		Flow (cfs)	
		D_{50}	D_{84}	D_{50}	D_{84}	D_{50}	D_{84}	D_{50}	D_{84}
XS 1	Riffle	23.4	77.9	<50	320	25.5	118	<50	240
XS 2	Riffle	NA	NA	NA	NA	55.6	146.7	<50	<50
XS 3	Pool	NA	NA	NA	NA	9.9	75.9	70	375
XS 4	Pool	NA	NA	NA	NA	16.6	46.8	75	160
XS 5	Riffle	8.2	29.1	<50	170	12	32	<50	120

Note:

NA = not analyzed

mm = millimeter

cfs = cubic feet per second

XS = Cross-Section

TABLE 26

Study Site 3 - Modeled Flows Required to Mobilize D_{50} and D_{84} Particle Sizes

Piru Creek Geomorphology Study Report

United Water Conservation District

Cross Section	Habitat Type	Bulk Sediment Size Gradation				Pebble Count Size Gradation			
		Particle Size (mm)		Flow (cfs)		Particle Size (mm)		Flow (cfs)	
		D_{50}	D_{84}	D_{50}	D_{84}	D_{50}	D_{84}	D_{50}	D_{84}
XS 1	Riffle	NA	NA	NA	NA	12.9	122.2	<50	250
XS 2	Riffle	NA	NA	NA	NA	132.7	245.8	450	>1,000
XS 3[1]	Riffle	1.7	10.2	<50	<50	11	220.7	<50	1,025
XS 3[2]	Riffle	NA	NA	NA	NA	49.5	167.3	<50	700
XS 4	Riffle	NA	NA	NA	NA	143.1	239.3	525	>1,000
XS 5[1]	Riffle	0.33	2	<50	<50	0.1	6.5	<50	<50
XS 5[2]	Run	NA	NA	NA	NA	48.3	201.5	<50	<50
XS 6	Run	104	139.2	700	1,200	28.4	140.8	<50	50

Note:

1 - Particle sizes and shear stress calculations based on the pre-400 cfs sediment samples.

2 - Particle sizes and shear stress calculations based on the post-400 cfs sediment samples.

NA = not analyzed

mm = millimeter

cfs = cubic feet per second

XS = Cross-Section

TABLE 27

Maximum Recorded Flow Data for Lower Piru Creek During Spill Events at Santa Felicia Dam
Piru Creek Geomorphology Study Report
United Water Conservation District

Date	Maximum Mean Daily Flow Recorded During Spill Event (cfs)	Maximum Instaneous Peak Flow Recorded During Spill Event* (cfs)
02/25/69	7,700	--
03/05/78	4,686	--
04/07/79	506	--
02/22/80	2,000	--
03/03/83	3,048	--
03/31/92	220	--
02/08/93	2,588	--
03/11/95	1,077	--
02/24/98	6,199	--
01/10/05	8,760	Estimated at 14,404 cfs

Note:

* Instantaneous peak flow data only available for the 2005 spill event.

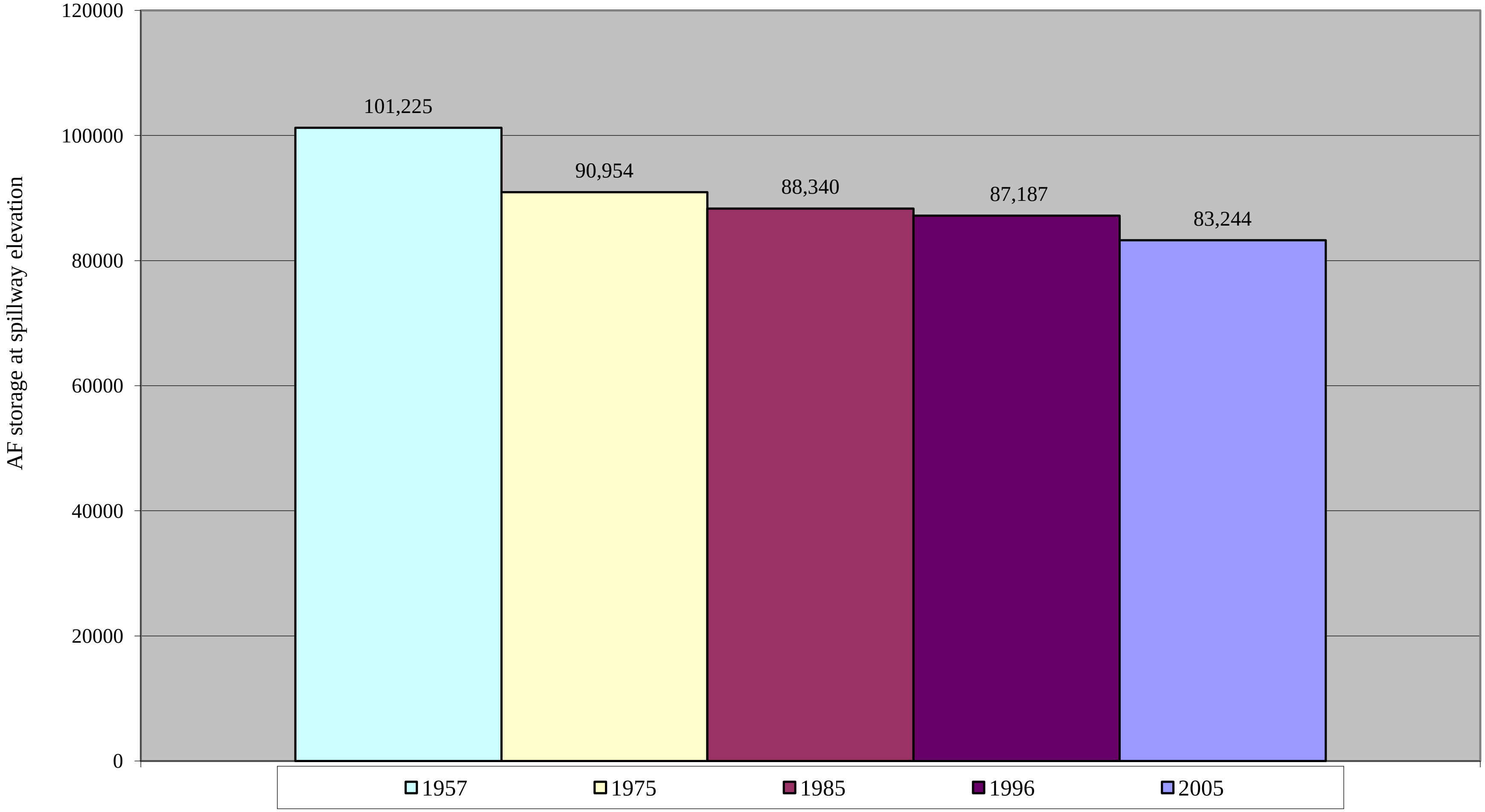
cfs = cubic feet per second

Appendix A

Lake Piru – Available Storage Capacity Data

Appendix A

Available Water Storage (Capacity) in Lake Piru Based on Historical Siltation Surveys



Available water storage in Lake Piru based on previous and current (Dec. 2005) siltation survey

Appendix B

Provisional Flow Data Collected During Release Events

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)

Piru Creek 2011 Controlled Flow Release Geomorphology Study

United Water Conservation District

DATE	TIME	Flow (cfs)
9/10/2011	0:00:00	9.5
9/10/2011	0:15:00	9.5
9/10/2011	0:30:00	9.5
9/10/2011	0:45:00	9.5
9/10/2011	1:00:00	9.5
9/10/2011	1:15:00	9.5
9/10/2011	1:30:00	9.5
9/10/2011	1:45:00	9.5
9/10/2011	2:00:00	9.5
9/10/2011	2:15:00	9.5
9/10/2011	2:30:00	9.5
9/10/2011	2:45:00	9.5
9/10/2011	3:00:00	9.5
9/10/2011	3:15:00	9.5
9/10/2011	3:30:00	9.5
9/10/2011	3:45:00	9.5
9/10/2011	4:00:00	9.5
9/10/2011	4:15:00	9.5
9/10/2011	4:30:00	9.5
9/10/2011	4:45:00	9.5
9/10/2011	5:00:00	9.5
9/10/2011	5:15:00	9.5
9/10/2011	5:30:00	9.5
9/10/2011	5:45:00	9.5
9/10/2011	6:00:00	9.5
9/10/2011	6:15:00	9.5
9/10/2011	6:30:00	9.5
9/10/2011	6:45:00	9.5
9/10/2011	7:00:00	9.5
9/10/2011	7:15:00	9.5
9/10/2011	7:30:00	9.5
9/10/2011	7:45:00	9.5
9/10/2011	8:00:00	9.5
9/10/2011	8:15:00	9.5
9/10/2011	8:30:00	9.5
9/10/2011	8:45:00	9.5
9/10/2011	9:00:00	9.5
9/10/2011	9:15:00	9.5
9/10/2011	9:30:00	9.5
9/10/2011	9:45:00	9.5
9/10/2011	10:00:00	9.5
9/10/2011	10:15:00	9.5
9/10/2011	10:30:00	9.5
9/10/2011	10:45:00	9.5
9/10/2011	11:00:00	9.5
9/10/2011	11:15:00	9.5
9/10/2011	11:30:00	9.5
9/10/2011	11:45:00	9.5
9/10/2011	12:00:00	9.5
9/10/2011	12:15:00	9.5
9/10/2011	12:30:00	9.5
9/10/2011	12:45:00	9.5
9/10/2011	13:00:00	9.5
9/10/2011	13:15:00	9.5
9/10/2011	13:30:00	9.5
9/10/2011	13:45:00	9.5
9/10/2011	14:00:00	9.5
9/10/2011	14:15:00	9.5
9/10/2011	14:30:00	9.5
9/10/2011	14:45:00	9.5
9/10/2011	15:00:00	9.5
9/10/2011	15:15:00	9.5
9/10/2011	15:30:00	9.5
9/10/2011	15:45:00	9.5
9/10/2011	16:00:00	9.5
9/10/2011	16:15:00	9.5
9/10/2011	16:30:00	9.5
9/10/2011	16:45:00	9.5
9/10/2011	17:00:00	9.5
9/10/2011	17:15:00	9.5
9/10/2011	17:30:00	9.5
9/10/2011	17:45:00	9.5
9/10/2011	18:00:00	9.5
9/10/2011	18:15:00	9.5
9/10/2011	18:30:00	9.5
9/10/2011	18:45:00	9.5
9/10/2011	19:00:00	9.5
9/10/2011	19:15:00	9.5
9/10/2011	19:30:00	9.5

APPENDIX B
Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
9/10/2011	19:45:00	9.5
9/10/2011	20:00:00	9.5
9/10/2011	20:15:00	9.5
9/10/2011	20:30:00	9.5
9/10/2011	20:45:00	9.5
9/10/2011	21:00:00	9.5
9/10/2011	21:15:00	9.5
9/10/2011	21:30:00	9.5
9/10/2011	21:45:00	9.5
9/10/2011	22:00:00	9.5
9/10/2011	22:15:00	9.5
9/10/2011	22:30:00	9.5
9/10/2011	22:45:00	9.5
9/10/2011	23:00:00	9.5
9/10/2011	23:15:00	9.5
9/10/2011	23:30:00	9.5
9/10/2011	23:45:00	9.5
9/11/2011	0:00:00	9.5
9/11/2011	0:15:00	9.5
9/11/2011	0:30:00	9.5
9/11/2011	0:45:00	9.5
9/11/2011	1:00:00	9.5
9/11/2011	1:30:00	9.5
9/11/2011	1:45:00	9.5
9/11/2011	2:00:00	9.5
9/11/2011	2:15:00	9.5
9/11/2011	2:30:00	9.5
9/11/2011	2:45:00	9.5
9/11/2011	3:00:00	9.5
9/11/2011	3:15:00	9.8
9/11/2011	3:30:00	9.8
9/11/2011	3:45:00	9.8
9/11/2011	4:00:00	9.8
9/11/2011	4:15:00	9.8
9/11/2011	4:30:00	9.8
9/11/2011	4:45:00	9.8
9/11/2011	5:00:00	9.8
9/11/2011	5:15:00	9.8
9/11/2011	5:30:00	9.8
9/11/2011	5:45:00	9.8
9/11/2011	6:00:00	9.8
9/11/2011	6:15:00	9.8
9/11/2011	6:30:00	9.8
9/11/2011	6:45:00	9.8
9/11/2011	7:00:00	9.8
9/11/2011	7:15:00	9.8
9/11/2011	7:30:00	9.8
9/11/2011	7:45:00	9.8
9/11/2011	8:00:00	9.8
9/11/2011	8:15:00	9.8
9/11/2011	8:30:00	9.8
9/11/2011	8:45:00	9.8
9/11/2011	9:00:00	9.8
9/11/2011	9:15:00	9.8
9/11/2011	9:30:00	9.8
9/11/2011	9:45:00	9.8
9/11/2011	10:00:00	9.8
9/11/2011	10:15:00	9.8
9/11/2011	10:30:00	9.8
9/11/2011	10:45:00	9.8
9/11/2011	11:00:00	9.8
9/11/2011	11:15:00	9.8
9/11/2011	11:30:00	9.8
9/11/2011	11:45:00	9.8
9/11/2011	12:00:00	9.8
9/11/2011	12:15:00	9.8
9/11/2011	12:30:00	9.8
9/11/2011	12:45:00	9.8
9/11/2011	13:00:00	9.8
9/11/2011	13:15:00	9.8
9/11/2011	13:30:00	9.8
9/11/2011	13:45:00	9.8
9/11/2011	14:00:00	9.8
9/11/2011	14:15:00	9.8
9/11/2011	14:30:00	9.8
9/11/2011	14:45:00	9.8
9/11/2011	15:00:00	9.8
9/11/2011	15:15:00	9.8
9/11/2011	15:30:00	9.8

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
9/11/2011	15:45:00	9.8
9/11/2011	16:00:00	9.8
9/11/2011	16:15:00	9.8
9/11/2011	16:30:00	9.8
9/11/2011	16:45:00	9.8
9/11/2011	17:00:00	9.8
9/11/2011	17:15:00	9.8
9/11/2011	17:30:00	9.8
9/11/2011	17:45:00	9.8
9/11/2011	18:00:00	9.8
9/11/2011	18:15:00	9.8
9/11/2011	18:30:00	9.8
9/11/2011	18:45:00	9.8
9/11/2011	19:00:00	9.8
9/11/2011	19:15:00	9.8
9/11/2011	19:30:00	9.8
9/11/2011	19:45:00	9.8
9/11/2011	20:00:00	9.8
9/11/2011	20:15:00	9.8
9/11/2011	20:30:00	9.8
9/11/2011	20:45:00	9.8
9/11/2011	21:00:00	9.8
9/11/2011	21:15:00	9.8
9/11/2011	21:30:00	9.8
9/11/2011	21:45:00	9.8
9/11/2011	22:00:00	9.8
9/11/2011	22:15:00	9.8
9/11/2011	22:30:00	9.8
9/11/2011	22:45:00	9.8
9/11/2011	23:00:00	9.8
9/11/2011	23:15:00	9.8
9/11/2011	23:30:00	9.8
9/11/2011	23:45:00	9.8
9/12/2011	0:00:00	9.8
9/12/2011	0:15:00	9.8
9/12/2011	0:30:00	9.8
9/12/2011	0:45:00	9.8
9/12/2011	1:00:00	9.8
9/12/2011	1:15:00	9.8
9/12/2011	1:30:00	9.8
9/12/2011	1:45:00	9.8
9/12/2011	2:00:00	9.8
9/12/2011	2:15:00	9.8
9/12/2011	2:30:00	9.8
9/12/2011	2:45:00	9.8
9/12/2011	3:00:00	9.8
9/12/2011	3:15:00	9.8
9/12/2011	3:30:00	9.8
9/12/2011	3:45:00	9.8
9/12/2011	4:00:00	9.8
9/12/2011	4:15:00	9.8
9/12/2011	4:30:00	9.8
9/12/2011	4:45:00	9.8
9/12/2011	5:00:00	9.8
9/12/2011	5:15:00	9.8
9/12/2011	5:30:00	9.8
9/12/2011	5:45:00	9.8
9/12/2011	6:00:00	9.8
9/12/2011	6:15:00	9.8
9/12/2011	6:30:00	9.8
9/12/2011	6:45:00	9.8
9/12/2011	7:00:00	10
9/12/2011	7:15:00	10
9/12/2011	7:30:00	10
9/12/2011	7:45:00	10
9/12/2011	8:00:00	10
9/12/2011	8:15:00	12
9/12/2011	8:30:00	18
9/12/2011	9:15:00	20
9/12/2011	9:30:00	20
9/12/2011	9:45:00	20
9/12/2011	10:00:00	20
9/12/2011	10:15:00	38
9/12/2011	10:30:00	38
9/12/2011	10:45:00	38
9/12/2011	11:00:00	38
9/12/2011	11:15:00	39
9/12/2011	11:30:00	39
9/12/2011	11:45:00	39

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
9/12/2011	12:00:00	39
9/12/2011	12:15:00	76
9/12/2011	12:30:00	76
9/12/2011	12:45:00	76
9/12/2011	13:00:00	76
9/12/2011	13:15:00	77
9/12/2011	13:30:00	77
9/12/2011	13:45:00	77
9/12/2011	14:00:00	145
9/12/2011	14:15:00	155
9/12/2011	14:30:00	155
9/12/2011	14:45:00	155
9/12/2011	15:00:00	152
9/12/2011	15:15:00	152
9/12/2011	15:30:00	152
9/12/2011	15:45:00	152
9/12/2011	16:00:00	152
9/12/2011	16:15:00	185
9/12/2011	16:30:00	214
9/12/2011	16:45:00	239
9/12/2011	17:00:00	273
9/12/2011	17:15:00	287
9/12/2011	17:30:00	302
9/12/2011	17:45:00	302
9/12/2011	18:00:00	302
9/12/2011	18:15:00	302
9/12/2011	18:30:00	302
9/12/2011	18:45:00	302
9/12/2011	19:00:00	302
9/12/2011	19:15:00	302
9/12/2011	19:30:00	302
9/12/2011	19:45:00	302
9/12/2011	20:00:00	302
9/12/2011	20:15:00	298
9/12/2011	20:30:00	302
9/12/2011	20:45:00	302
9/12/2011	21:00:00	302
9/12/2011	21:15:00	298
9/12/2011	21:30:00	298
9/12/2011	21:45:00	298
9/12/2011	22:00:00	302
9/12/2011	22:15:00	302
9/12/2011	22:30:00	302
9/12/2011	22:45:00	298
9/12/2011	23:00:00	302
9/12/2011	23:15:00	298
9/12/2011	23:30:00	298
9/12/2011	23:45:00	298
9/13/2011	0:00:00	302
9/13/2011	0:15:00	302
9/13/2011	0:30:00	298
9/13/2011	0:45:00	302
9/13/2011	1:00:00	302
9/13/2011	1:15:00	302
9/13/2011	1:30:00	298
9/13/2011	1:45:00	298
9/13/2011	2:00:00	298
9/13/2011	2:15:00	298
9/13/2011	2:30:00	302
9/13/2011	2:45:00	298
9/13/2011	3:00:00	302
9/13/2011	3:15:00	298
9/13/2011	3:30:00	298
9/13/2011	3:45:00	298
9/13/2011	4:00:00	298
9/13/2011	4:15:00	298
9/13/2011	4:30:00	298
9/13/2011	4:45:00	298
9/13/2011	5:00:00	298
9/13/2011	5:15:00	298
9/13/2011	5:30:00	298
9/13/2011	5:45:00	298
9/13/2011	6:00:00	298
9/13/2011	6:15:00	298
9/13/2011	6:30:00	298
9/13/2011	6:45:00	298
9/13/2011	7:00:00	298
9/13/2011	7:15:00	302
9/13/2011	7:30:00	399

APPENDIX B
Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
9/13/2011	7:45:00	410
9/13/2011	8:00:00	404
9/13/2011	8:15:00	399
9/13/2011	8:30:00	399
9/13/2011	8:45:00	399
9/13/2011	9:00:00	399
9/13/2011	9:15:00	399
9/13/2011	9:30:00	399
9/13/2011	9:45:00	399
9/13/2011	10:00:00	399
9/13/2011	10:15:00	399
9/13/2011	10:30:00	404
9/13/2011	10:45:00	404
9/13/2011	11:00:00	399
9/13/2011	11:15:00	404
9/13/2011	11:30:00	404
9/13/2011	11:45:00	404
9/13/2011	12:00:00	404
9/13/2011	12:15:00	404
9/13/2011	12:30:00	404
9/13/2011	12:45:00	404
9/13/2011	13:00:00	410
9/13/2011	13:15:00	410
9/13/2011	13:30:00	410
9/13/2011	13:45:00	410
9/13/2011	14:00:00	404
9/13/2011	14:15:00	404
9/13/2011	14:30:00	404
9/13/2011	14:45:00	404
9/13/2011	15:00:00	404
9/13/2011	15:15:00	404
9/13/2011	15:30:00	410
9/13/2011	15:45:00	404
9/13/2011	16:00:00	404
9/13/2011	16:15:00	404
9/13/2011	16:30:00	404
9/13/2011	16:45:00	404
9/13/2011	17:00:00	404
9/13/2011	17:15:00	404
9/13/2011	17:30:00	404
9/13/2011	17:45:00	404
9/13/2011	18:00:00	404
9/13/2011	18:15:00	399
9/13/2011	18:30:00	399
9/13/2011	18:45:00	399
9/13/2011	19:00:00	404
9/13/2011	19:15:00	399
9/13/2011	19:30:00	404
9/13/2011	19:45:00	399
9/13/2011	20:00:00	399
9/13/2011	20:15:00	399
9/13/2011	20:30:00	399
9/13/2011	20:45:00	399
9/13/2011	21:00:00	399
9/13/2011	21:15:00	399
9/13/2011	21:30:00	399
9/13/2011	21:45:00	399
9/13/2011	22:00:00	399
9/13/2011	22:15:00	399
9/13/2011	22:30:00	399
9/13/2011	22:45:00	399
9/13/2011	23:00:00	399
9/13/2011	23:15:00	399
9/13/2011	23:30:00	399
9/13/2011	23:45:00	399
9/14/2011	0:00:00	399
9/14/2011	0:15:00	399
9/14/2011	0:30:00	399
9/14/2011	0:45:00	399
9/14/2011	1:00:00	399
9/14/2011	1:15:00	399
9/14/2011	1:30:00	394
9/14/2011	1:45:00	394
9/14/2011	2:00:00	399
9/14/2011	2:15:00	399
9/14/2011	2:30:00	399
9/14/2011	2:45:00	394
9/14/2011	3:00:00	399
9/14/2011	3:15:00	399

DATE	TIME	Flow (cfs)
9/14/2011	3:30:00	394
9/14/2011	3:45:00	399
9/14/2011	4:00:00	399
9/14/2011	4:15:00	399
9/14/2011	4:30:00	394
9/14/2011	4:45:00	399
9/14/2011	5:00:00	399
9/14/2011	5:15:00	399
9/14/2011	5:30:00	399
9/14/2011	5:45:00	399
9/14/2011	6:00:00	394
9/14/2011	6:15:00	399
9/14/2011	6:30:00	399
9/14/2011	6:45:00	399
9/14/2011	7:00:00	399
9/14/2011	7:15:00	399
9/14/2011	7:45:00	399
9/14/2011	8:00:00	399
9/14/2011	8:15:00	399
9/14/2011	8:30:00	399
9/14/2011	8:45:00	399
9/14/2011	9:00:00	399
9/14/2011	9:15:00	399
9/14/2011	9:30:00	399
9/14/2011	9:45:00	399
9/14/2011	10:00:00	399
9/14/2011	10:15:00	399
9/14/2011	10:30:00	404
9/14/2011	11:00:00	399
9/14/2011	11:15:00	399
9/14/2011	11:30:00	399
9/14/2011	11:45:00	399
9/14/2011	12:00:00	404
9/14/2011	12:15:00	404
9/14/2011	12:30:00	404
9/14/2011	12:45:00	404
9/14/2011	13:00:00	399
9/14/2011	13:15:00	404
9/14/2011	13:30:00	404
9/14/2011	13:45:00	404
9/14/2011	14:00:00	404
9/14/2011	14:15:00	404
9/14/2011	14:30:00	404
9/14/2011	14:45:00	404
9/14/2011	15:00:00	410
9/14/2011	15:15:00	404
9/14/2011	15:30:00	404
9/14/2011	15:45:00	404
9/14/2011	16:00:00	404
9/14/2011	16:15:00	404
9/14/2011	16:30:00	404
9/14/2011	16:45:00	404
9/14/2011	17:00:00	404
9/14/2011	17:15:00	404
9/14/2011	17:30:00	399
9/14/2011	17:45:00	404
9/14/2011	18:00:00	404
9/14/2011	18:15:00	399
9/14/2011	18:30:00	399
9/14/2011	18:45:00	404
9/14/2011	19:00:00	399
9/14/2011	19:15:00	404
9/14/2011	19:30:00	404
9/14/2011	19:45:00	404
9/14/2011	20:00:00	399
9/14/2011	20:15:00	399
9/14/2011	20:30:00	399
9/14/2011	20:45:00	399
9/14/2011	21:00:00	399
9/14/2011	21:15:00	399
9/14/2011	21:30:00	399
9/14/2011	21:45:00	399
9/14/2011	22:00:00	399
9/14/2011	22:15:00	399
9/14/2011	22:30:00	399
9/14/2011	22:45:00	399
9/14/2011	23:00:00	399
9/14/2011	23:15:00	399
9/14/2011	23:30:00	399

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
9/14/2011	23:45:00	399
9/15/2011	0:00:00	399
9/15/2011	0:15:00	399
9/15/2011	0:30:00	399
9/15/2011	0:45:00	399
9/15/2011	1:00:00	399
9/15/2011	1:15:00	399
9/15/2011	1:30:00	399
9/15/2011	1:45:00	399
9/15/2011	2:00:00	399
9/15/2011	2:15:00	399
9/15/2011	2:30:00	399
9/15/2011	2:45:00	394
9/15/2011	3:00:00	399
9/15/2011	3:15:00	399
9/15/2011	3:30:00	399
9/15/2011	3:45:00	399
9/15/2011	4:00:00	399
9/15/2011	4:15:00	399
9/15/2011	4:30:00	399
9/15/2011	4:45:00	394
9/15/2011	5:00:00	399
9/15/2011	5:15:00	399
9/15/2011	5:30:00	399
9/15/2011	5:45:00	399
9/15/2011	6:00:00	399
9/15/2011	6:15:00	394
9/15/2011	6:30:00	399
9/15/2011	6:45:00	399
9/15/2011	7:00:00	399
9/15/2011	7:15:00	399
9/15/2011	7:30:00	394
9/15/2011	7:45:00	399
9/15/2011	8:00:00	399
9/15/2011	8:15:00	399
9/15/2011	8:30:00	399
9/15/2011	8:45:00	399
9/15/2011	9:00:00	394
9/15/2011	9:15:00	399
9/15/2011	9:30:00	399
9/15/2011	9:45:00	394
9/15/2011	10:00:00	399
9/15/2011	10:15:00	399
9/15/2011	10:30:00	399
9/15/2011	10:45:00	399
9/15/2011	11:00:00	399
9/15/2011	11:15:00	399
9/15/2011	11:30:00	399
9/15/2011	11:45:00	399
9/15/2011	12:00:00	399
9/15/2011	12:15:00	399
9/15/2011	12:30:00	399
9/15/2011	12:45:00	404
9/15/2011	13:00:00	399
9/15/2011	13:15:00	404
9/15/2011	13:30:00	404
9/15/2011	13:45:00	404
9/15/2011	14:00:00	404
9/15/2011	14:15:00	404
9/15/2011	14:30:00	399
9/15/2011	14:45:00	404
9/15/2011	15:00:00	404
9/15/2011	15:15:00	404
9/15/2011	15:30:00	404
9/15/2011	15:45:00	399
9/15/2011	16:00:00	404
9/15/2011	16:15:00	404
9/15/2011	16:30:00	404
9/15/2011	16:45:00	399
9/15/2011	17:00:00	404
9/15/2011	17:15:00	399
9/15/2011	17:30:00	399
9/15/2011	17:45:00	399
9/15/2011	18:00:00	404
9/15/2011	18:15:00	399
9/15/2011	18:30:00	404
9/15/2011	18:45:00	399
9/15/2011	19:00:00	399
9/15/2011	19:15:00	399

APPENDIX B
Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
9/15/2011	19:30:00	399
9/15/2011	19:45:00	399
9/15/2011	20:00:00	399
9/15/2011	20:15:00	394
9/15/2011	20:30:00	399
9/15/2011	20:45:00	399
9/15/2011	21:00:00	399
9/15/2011	21:15:00	399
9/15/2011	21:30:00	399
9/15/2011	21:45:00	399
9/15/2011	22:00:00	399
9/15/2011	22:15:00	399
9/15/2011	22:30:00	399
9/15/2011	22:45:00	399
9/15/2011	23:00:00	399
9/15/2011	23:15:00	399
9/15/2011	23:30:00	394
9/15/2011	23:45:00	394
9/16/2011	0:00:00	399
9/16/2011	0:15:00	399
9/16/2011	0:30:00	394
9/16/2011	0:45:00	399
9/16/2011	1:00:00	394
9/16/2011	1:15:00	399
9/16/2011	1:30:00	399
9/16/2011	1:45:00	399
9/16/2011	2:00:00	399
9/16/2011	2:15:00	399
9/16/2011	2:30:00	399
9/16/2011	2:45:00	399
9/16/2011	3:00:00	399
9/16/2011	3:15:00	399
9/16/2011	3:30:00	394
9/16/2011	3:45:00	399
9/16/2011	4:00:00	399
9/16/2011	4:15:00	394
9/16/2011	4:30:00	399
9/16/2011	4:45:00	394
9/16/2011	5:00:00	394
9/16/2011	5:15:00	394
9/16/2011	5:30:00	399
9/16/2011	5:45:00	399
9/16/2011	6:00:00	399
9/16/2011	6:15:00	399
9/16/2011	6:30:00	394
9/16/2011	6:45:00	399
9/16/2011	7:00:00	394
9/16/2011	7:15:00	394
9/16/2011	7:30:00	394
9/16/2011	7:45:00	394
9/16/2011	8:00:00	399
9/16/2011	8:15:00	394
9/16/2011	8:45:00	394
9/16/2011	9:00:00	394
9/16/2011	9:15:00	399
9/16/2011	9:30:00	394
9/16/2011	9:45:00	399
9/16/2011	10:00:00	399
9/16/2011	10:15:00	399
9/16/2011	10:30:00	399
9/16/2011	10:45:00	399
9/16/2011	11:00:00	399
9/16/2011	11:15:00	394
9/16/2011	11:30:00	399
9/16/2011	11:45:00	399
9/16/2011	12:00:00	399
9/16/2011	12:15:00	399
9/16/2011	12:30:00	399
9/16/2011	12:45:00	399
9/16/2011	13:00:00	399
9/16/2011	13:15:00	399
9/16/2011	13:30:00	404
9/16/2011	13:45:00	399
9/16/2011	14:00:00	399
9/16/2011	14:15:00	399
9/16/2011	14:30:00	404
9/16/2011	14:45:00	399
9/16/2011	15:00:00	399
9/16/2011	15:15:00	399

APPENDIX B
Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
9/16/2011	15:30:00	399
9/16/2011	15:45:00	399
9/16/2011	16:00:00	399
9/16/2011	16:15:00	399
9/16/2011	16:30:00	399
9/16/2011	16:45:00	399
9/16/2011	17:00:00	399
9/16/2011	17:15:00	399
9/16/2011	17:30:00	399
9/16/2011	17:45:00	399
9/16/2011	18:00:00	399
9/16/2011	18:15:00	399
9/16/2011	18:30:00	399
9/16/2011	18:45:00	399
9/16/2011	19:00:00	394
9/16/2011	19:15:00	399
9/16/2011	19:30:00	399
9/16/2011	19:45:00	399
9/16/2011	20:00:00	399
9/16/2011	20:15:00	399
9/16/2011	20:30:00	394
9/16/2011	20:45:00	394
9/16/2011	21:00:00	399
9/16/2011	21:15:00	394
9/16/2011	21:30:00	399
9/16/2011	21:45:00	394
9/16/2011	22:00:00	399
9/16/2011	22:15:00	399
9/16/2011	22:30:00	394
9/16/2011	22:45:00	394
9/16/2011	23:00:00	394
9/16/2011	23:15:00	394
9/16/2011	23:30:00	394
9/16/2011	23:45:00	399
9/17/2011	0:00:00	394
9/17/2011	0:15:00	399
9/17/2011	0:30:00	394
9/17/2011	0:45:00	399
9/17/2011	1:00:00	399
9/17/2011	1:15:00	394
9/17/2011	1:30:00	394
9/17/2011	1:45:00	399
9/17/2011	2:00:00	394
9/17/2011	2:15:00	394
9/17/2011	2:30:00	399
9/17/2011	2:45:00	394
9/17/2011	3:00:00	399
9/17/2011	3:15:00	394
9/17/2011	3:30:00	394
9/17/2011	3:45:00	394
9/17/2011	4:00:00	394
9/17/2011	4:15:00	399
9/17/2011	4:30:00	399
9/17/2011	4:45:00	394
9/17/2011	5:00:00	399
9/17/2011	5:15:00	394
9/17/2011	5:30:00	399
9/17/2011	5:45:00	394
9/17/2011	6:00:00	399
9/17/2011	6:15:00	399
9/17/2011	6:30:00	394
9/17/2011	6:45:00	394
9/17/2011	7:00:00	394
9/17/2011	7:15:00	394
9/17/2011	7:30:00	394
9/17/2011	7:45:00	399
9/17/2011	8:00:00	399
9/17/2011	8:15:00	394
9/17/2011	8:30:00	399
9/17/2011	8:45:00	394
9/17/2011	9:00:00	394
9/17/2011	9:15:00	399
9/17/2011	9:30:00	399
9/17/2011	9:45:00	399
9/17/2011	10:00:00	394
9/17/2011	10:15:00	399
9/17/2011	10:30:00	394
9/17/2011	10:45:00	399
9/17/2011	11:00:00	394

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Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
9/17/2011	11:15:00	399
9/17/2011	11:30:00	399
9/17/2011	11:45:00	399
9/17/2011	12:00:00	399
9/17/2011	12:15:00	399
9/17/2011	12:30:00	399
9/17/2011	12:45:00	404
9/17/2011	13:00:00	399
9/17/2011	13:15:00	399
9/17/2011	13:30:00	399
9/17/2011	13:45:00	399
9/17/2011	14:00:00	399
9/17/2011	14:15:00	399
9/17/2011	14:30:00	399
9/17/2011	14:45:00	399
9/17/2011	15:00:00	399
9/17/2011	15:15:00	399
9/17/2011	15:30:00	399
9/17/2011	15:45:00	399
9/17/2011	16:00:00	399
9/17/2011	16:15:00	394
9/17/2011	16:30:00	399
9/17/2011	16:45:00	399
9/17/2011	17:00:00	399
9/17/2011	17:15:00	399
9/17/2011	17:30:00	399
9/17/2011	17:45:00	399
9/17/2011	18:00:00	399
9/17/2011	18:15:00	399
9/17/2011	18:30:00	394
9/17/2011	18:45:00	394
9/17/2011	19:00:00	399
9/17/2011	19:15:00	399
9/17/2011	19:30:00	399
9/17/2011	20:00:00	394
9/17/2011	20:15:00	399
9/17/2011	20:30:00	399
9/17/2011	20:45:00	399
9/17/2011	21:00:00	394
9/17/2011	21:15:00	394
9/17/2011	21:30:00	394
9/17/2011	21:45:00	394
9/17/2011	22:00:00	390
9/17/2011	22:15:00	394
9/17/2011	22:30:00	394
9/17/2011	22:45:00	399
9/17/2011	23:00:00	390
9/17/2011	23:15:00	394
9/17/2011	23:30:00	394
9/17/2011	23:45:00	394
9/18/2011	0:00:00	394
9/18/2011	0:15:00	394
9/18/2011	0:30:00	394
9/18/2011	0:45:00	394
9/18/2011	1:00:00	399
9/18/2011	1:15:00	394
9/18/2011	1:30:00	394
9/18/2011	1:45:00	394
9/18/2011	2:00:00	394
9/18/2011	2:15:00	390
9/18/2011	2:30:00	394
9/18/2011	2:45:00	394
9/18/2011	3:00:00	394
9/18/2011	3:15:00	394
9/18/2011	3:30:00	394
9/18/2011	3:45:00	399
9/18/2011	4:00:00	394
9/18/2011	4:15:00	394
9/18/2011	4:30:00	394
9/18/2011	4:45:00	399
9/18/2011	5:00:00	394
9/18/2011	5:15:00	394
9/18/2011	5:30:00	394
9/18/2011	5:45:00	399
9/18/2011	6:00:00	394
9/18/2011	6:15:00	394
9/18/2011	6:30:00	399
9/18/2011	6:45:00	394
9/18/2011	7:00:00	394

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Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
9/18/2011	7:15:00	394
9/18/2011	7:30:00	394
9/18/2011	7:45:00	394
9/18/2011	8:00:00	394
9/18/2011	8:15:00	399
9/18/2011	8:30:00	394
9/18/2011	8:45:00	394
9/18/2011	9:00:00	394
9/18/2011	9:15:00	394
9/18/2011	9:30:00	399
9/18/2011	9:45:00	399
9/18/2011	10:00:00	399
9/18/2011	10:15:00	394
9/18/2011	10:30:00	399
9/18/2011	10:45:00	399
9/18/2011	11:00:00	399
9/18/2011	11:15:00	399
9/18/2011	11:30:00	399
9/18/2011	11:45:00	399
9/18/2011	12:00:00	399
9/18/2011	12:15:00	399
9/18/2011	12:30:00	399
9/18/2011	12:45:00	399
9/18/2011	13:00:00	399
9/18/2011	13:15:00	399
9/18/2011	13:30:00	399
9/18/2011	13:45:00	399
9/18/2011	14:00:00	399
9/18/2011	14:15:00	399
9/18/2011	14:30:00	404
9/18/2011	14:45:00	404
9/18/2011	15:00:00	399
9/18/2011	15:15:00	404
9/18/2011	15:30:00	404
9/18/2011	15:45:00	399
9/18/2011	16:00:00	404
9/18/2011	16:15:00	399
9/18/2011	16:30:00	399
9/18/2011	16:45:00	399
9/18/2011	17:00:00	399
9/18/2011	17:15:00	399
9/18/2011	17:30:00	399
9/18/2011	17:45:00	399
9/18/2011	18:00:00	394
9/18/2011	18:15:00	399
9/18/2011	18:30:00	399
9/18/2011	18:45:00	399
9/18/2011	19:00:00	399
9/18/2011	19:15:00	399
9/18/2011	19:30:00	399
9/18/2011	19:45:00	394
9/18/2011	20:00:00	394
9/18/2011	20:15:00	394
9/18/2011	20:30:00	399
9/18/2011	20:45:00	394
9/18/2011	21:00:00	399
9/18/2011	21:15:00	399
9/18/2011	21:30:00	394
9/18/2011	21:45:00	399
9/18/2011	22:00:00	399
9/18/2011	22:15:00	394
9/18/2011	22:30:00	394
9/18/2011	22:45:00	399
9/18/2011	23:00:00	394
9/18/2011	23:15:00	399
9/18/2011	23:30:00	399
9/18/2011	23:45:00	399
9/19/2011	0:00:00	394
9/19/2011	0:15:00	399
9/19/2011	0:30:00	399
9/19/2011	0:45:00	394
9/19/2011	1:00:00	394
9/19/2011	1:15:00	394
9/19/2011	1:30:00	399
9/19/2011	1:45:00	399
9/19/2011	2:00:00	394
9/19/2011	2:15:00	399
9/19/2011	2:30:00	394
9/19/2011	2:45:00	394

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Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)

Piru Creek 2011 Controlled Flow Release Geomorphology Study

United Water Conservation District

DATE	TIME	Flow (cfs)
9/19/2011	3:00:00	399
9/19/2011	3:15:00	394
9/19/2011	3:30:00	399
9/19/2011	3:45:00	394
9/19/2011	4:00:00	399
9/19/2011	4:15:00	394
9/19/2011	4:30:00	399
9/19/2011	4:45:00	394
9/19/2011	5:00:00	399
9/19/2011	5:15:00	394
9/19/2011	5:30:00	394
9/19/2011	5:45:00	394
9/19/2011	6:00:00	394
9/19/2011	6:15:00	394
9/19/2011	6:30:00	394
9/19/2011	6:45:00	394
9/19/2011	7:00:00	394
9/19/2011	7:15:00	394
9/19/2011	7:30:00	394
9/19/2011	7:45:00	399
9/19/2011	8:00:00	394
9/19/2011	8:15:00	394
9/19/2011	8:30:00	394
9/19/2011	8:45:00	399
9/19/2011	9:00:00	394
9/19/2011	9:15:00	394
9/19/2011	9:30:00	399
9/19/2011	9:45:00	394
9/19/2011	10:00:00	394
9/19/2011	10:15:00	399
9/19/2011	10:30:00	399
9/19/2011	10:45:00	399
9/19/2011	11:00:00	399
9/19/2011	11:15:00	399
9/19/2011	11:30:00	404
9/19/2011	11:45:00	399
9/19/2011	12:00:00	399
9/19/2011	12:15:00	399
9/19/2011	12:30:00	399
9/19/2011	12:45:00	404
9/19/2011	13:00:00	399
9/19/2011	13:15:00	404
9/19/2011	13:30:00	404
9/19/2011	13:45:00	404
9/19/2011	14:00:00	399
9/19/2011	14:15:00	399
9/19/2011	14:30:00	399
9/19/2011	14:45:00	399
9/19/2011	15:00:00	399
9/19/2011	15:15:00	399
9/19/2011	15:30:00	399
9/19/2011	15:45:00	404
9/19/2011	16:00:00	399
9/19/2011	16:15:00	399
9/19/2011	16:30:00	404
9/19/2011	16:45:00	399
9/19/2011	17:00:00	404
9/19/2011	17:15:00	399
9/19/2011	17:30:00	399
9/19/2011	17:45:00	399
9/19/2011	18:00:00	399
9/19/2011	18:15:00	404
9/19/2011	18:30:00	399
9/19/2011	18:45:00	399
9/19/2011	19:00:00	399
9/19/2011	19:15:00	394
9/19/2011	19:30:00	394
9/19/2011	19:45:00	399
9/19/2011	20:00:00	399
9/19/2011	20:15:00	399
9/19/2011	20:30:00	394
9/19/2011	20:45:00	394
9/19/2011	21:00:00	394
9/19/2011	21:15:00	399
9/19/2011	21:30:00	399
9/19/2011	21:45:00	399
9/19/2011	22:00:00	394
9/19/2011	22:15:00	394
9/19/2011	22:30:00	399

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
9/19/2011	22:45:00	399
9/19/2011	23:00:00	399
9/19/2011	23:15:00	394
9/19/2011	23:30:00	399
9/19/2011	23:45:00	394
9/20/2011	0:00:00	394
9/20/2011	0:15:00	394
9/20/2011	0:30:00	399
9/20/2011	0:45:00	399
9/20/2011	1:00:00	394
9/20/2011	1:15:00	394
9/20/2011	1:30:00	394
9/20/2011	1:45:00	394
9/20/2011	2:00:00	394
9/20/2011	2:15:00	390
9/20/2011	2:30:00	394
9/20/2011	2:45:00	399
9/20/2011	3:00:00	394
9/20/2011	3:15:00	394
9/20/2011	3:30:00	394
9/20/2011	3:45:00	394
9/20/2011	4:00:00	394
9/20/2011	4:15:00	394
9/20/2011	4:30:00	394
9/20/2011	4:45:00	390
9/20/2011	5:00:00	394
9/20/2011	5:15:00	399
9/20/2011	5:30:00	394
9/20/2011	5:45:00	394
9/20/2011	6:00:00	394
9/20/2011	6:15:00	394
9/20/2011	6:30:00	390
9/20/2011	6:45:00	394
9/20/2011	7:00:00	394
9/20/2011	7:15:00	394
9/20/2011	7:30:00	399
9/20/2011	7:45:00	399
9/20/2011	8:00:00	399
9/20/2011	8:15:00	399
9/20/2011	8:30:00	399
9/20/2011	9:00:00	420
9/20/2011	9:15:00	420
9/20/2011	9:30:00	420
9/20/2011	9:45:00	420
9/20/2011	10:00:00	420
9/20/2011	10:15:00	420
9/20/2011	10:30:00	420
9/20/2011	10:45:00	420
9/20/2011	11:00:00	420
9/20/2011	11:15:00	425
9/20/2011	11:30:00	420
9/20/2011	11:45:00	415
9/20/2011	12:00:00	425
9/20/2011	12:15:00	420
9/20/2011	12:30:00	425
9/20/2011	12:45:00	420
9/20/2011	13:00:00	425
9/20/2011	13:15:00	425
9/20/2011	13:30:00	420
9/20/2011	13:45:00	420
9/20/2011	14:00:00	425
9/20/2011	14:15:00	425
9/20/2011	14:30:00	425
9/20/2011	14:45:00	425
9/20/2011	15:15:00	420
9/20/2011	15:30:00	415
9/20/2011	15:45:00	415
9/20/2011	16:00:00	415
9/20/2011	16:15:00	420
9/20/2011	16:30:00	415
9/20/2011	16:45:00	410
9/20/2011	17:00:00	415
9/20/2011	17:15:00	415
9/20/2011	17:30:00	415
9/20/2011	17:45:00	415
9/20/2011	18:00:00	415
9/20/2011	18:15:00	415
9/20/2011	18:30:00	415
9/20/2011	18:45:00	410

DATE	TIME	Flow (cfs)
9/20/2011	19:00:00	415
9/20/2011	19:15:00	415
9/20/2011	19:30:00	415
9/20/2011	19:45:00	415
9/20/2011	20:00:00	410
9/20/2011	20:15:00	410
9/20/2011	20:30:00	415
9/20/2011	20:45:00	410
9/20/2011	21:00:00	410
9/20/2011	21:15:00	410
9/20/2011	21:30:00	410
9/20/2011	21:45:00	410
9/20/2011	22:00:00	410
9/20/2011	22:15:00	410
9/20/2011	22:30:00	410
9/20/2011	22:45:00	410
9/20/2011	23:00:00	410
9/20/2011	23:15:00	410
9/20/2011	23:30:00	410
9/20/2011	23:45:00	410
9/21/2011	0:00:00	410
9/21/2011	0:15:00	410
9/21/2011	0:30:00	410
9/21/2011	0:45:00	415
9/21/2011	1:00:00	410
9/21/2011	1:15:00	410
9/21/2011	1:30:00	410
9/21/2011	1:45:00	410
9/21/2011	2:00:00	410
9/21/2011	2:15:00	410
9/21/2011	2:30:00	410
9/21/2011	2:45:00	410
9/21/2011	3:00:00	410
9/21/2011	3:15:00	410
9/21/2011	3:30:00	410
9/21/2011	3:45:00	415
9/21/2011	4:00:00	410
9/21/2011	4:15:00	410
9/21/2011	4:30:00	410
9/21/2011	4:45:00	415
9/21/2011	5:00:00	410
9/21/2011	5:15:00	410
9/21/2011	5:30:00	410
9/21/2011	5:45:00	410
9/21/2011	6:00:00	410
9/21/2011	6:15:00	410
9/21/2011	6:30:00	410
9/21/2011	6:45:00	410
9/21/2011	7:00:00	410
9/21/2011	7:15:00	410
9/21/2011	7:30:00	415
9/21/2011	7:45:00	410
9/21/2011	8:00:00	410
9/21/2011	8:15:00	410
9/21/2011	8:30:00	410
9/21/2011	8:45:00	410
9/21/2011	9:00:00	410
9/21/2011	9:15:00	415
9/21/2011	9:30:00	410
9/21/2011	9:45:00	410
9/21/2011	10:00:00	415
9/21/2011	10:15:00	410
9/21/2011	10:30:00	415
9/21/2011	10:45:00	415
9/21/2011	11:00:00	410
9/21/2011	11:15:00	415
9/21/2011	11:30:00	415
9/21/2011	11:45:00	415
9/21/2011	12:00:00	415
9/21/2011	12:15:00	415
9/21/2011	12:30:00	415
9/21/2011	12:45:00	415
9/21/2011	13:00:00	420
9/21/2011	13:15:00	415
9/21/2011	13:30:00	415
9/21/2011	13:45:00	415
9/21/2011	14:00:00	420
9/21/2011	14:15:00	415
9/21/2011	14:30:00	415

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)

Piru Creek 2011 Controlled Flow Release Geomorphology Study

United Water Conservation District

DATE	TIME	Flow (cfs)
9/21/2011	14:45:00	415
9/21/2011	15:00:00	415
9/21/2011	15:15:00	415
9/21/2011	15:30:00	415
9/21/2011	15:45:00	415
9/21/2011	16:00:00	415
9/21/2011	16:15:00	420
9/21/2011	16:30:00	415
9/21/2011	16:45:00	415
9/21/2011	17:00:00	415
9/21/2011	17:15:00	415
9/21/2011	17:30:00	415
9/21/2011	17:45:00	415
9/21/2011	18:00:00	415
9/21/2011	18:15:00	410
9/21/2011	18:30:00	415
9/21/2011	18:45:00	415
9/21/2011	19:00:00	415
9/21/2011	19:15:00	415
9/21/2011	19:30:00	415
9/21/2011	19:45:00	415
9/21/2011	20:00:00	415
9/21/2011	20:15:00	410
9/21/2011	20:30:00	410
9/21/2011	20:45:00	415
9/21/2011	21:00:00	410
9/21/2011	21:15:00	415
9/21/2011	21:30:00	410
9/21/2011	21:45:00	410
9/21/2011	22:00:00	410
9/21/2011	22:15:00	410
9/21/2011	22:30:00	410
9/21/2011	22:45:00	410
9/21/2011	23:00:00	410
9/21/2011	23:15:00	410
9/21/2011	23:30:00	410
9/21/2011	23:45:00	410
9/22/2011	0:00:00	410
9/22/2011	0:15:00	410
9/22/2011	0:30:00	410
9/22/2011	0:45:00	410
9/22/2011	1:00:00	410
9/22/2011	1:15:00	410
9/22/2011	1:30:00	410
9/22/2011	1:45:00	410
9/22/2011	2:00:00	410
9/22/2011	2:15:00	410
9/22/2011	2:30:00	410
9/22/2011	2:45:00	410
9/22/2011	3:00:00	410
9/22/2011	3:15:00	410
9/22/2011	3:30:00	410
9/22/2011	3:45:00	410
9/22/2011	4:00:00	410
9/22/2011	4:15:00	410
9/22/2011	4:30:00	410
9/22/2011	4:45:00	410
9/22/2011	5:00:00	410
9/22/2011	5:15:00	410
9/22/2011	5:30:00	410
9/22/2011	5:45:00	410
9/22/2011	6:00:00	410
9/22/2011	6:15:00	410
9/22/2011	6:30:00	410
9/22/2011	6:45:00	410
9/22/2011	7:00:00	410
9/22/2011	7:15:00	410
9/22/2011	7:30:00	410
9/22/2011	7:45:00	410
9/22/2011	8:00:00	410
9/22/2011	8:15:00	410
9/22/2011	8:30:00	410
9/22/2011	8:45:00	410
9/22/2011	9:00:00	410
9/22/2011	9:15:00	410
9/22/2011	9:30:00	410
9/22/2011	9:45:00	410
9/22/2011	10:00:00	415
9/22/2011	10:15:00	410

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
9/22/2011	10:30:00	410
9/22/2011	10:45:00	410
9/22/2011	11:00:00	410
9/22/2011	11:15:00	410
9/22/2011	11:30:00	415
9/22/2011	11:45:00	415
9/22/2011	12:00:00	415
9/22/2011	12:15:00	410
9/22/2011	12:30:00	410
9/22/2011	12:45:00	415
9/22/2011	13:00:00	415
9/22/2011	13:15:00	415
9/22/2011	13:30:00	415
9/22/2011	13:45:00	415
9/22/2011	14:00:00	415
9/22/2011	14:15:00	415
9/22/2011	14:30:00	415
9/22/2011	14:45:00	415
9/22/2011	15:00:00	415
9/22/2011	15:15:00	415
9/22/2011	15:30:00	415
9/22/2011	15:45:00	415
9/22/2011	16:00:00	415
9/22/2011	16:15:00	415
9/22/2011	16:30:00	415
9/22/2011	16:45:00	415
9/22/2011	17:00:00	415
9/22/2011	17:15:00	415
9/22/2011	17:30:00	415
9/22/2011	17:45:00	415
9/22/2011	18:00:00	415
9/22/2011	18:15:00	415
9/22/2011	18:30:00	415
9/22/2011	18:45:00	410
9/22/2011	19:00:00	410
9/22/2011	19:15:00	410
9/22/2011	19:30:00	410
9/22/2011	19:45:00	410
9/22/2011	20:00:00	410
9/22/2011	20:15:00	410
9/22/2011	20:30:00	410
9/22/2011	20:45:00	410
9/22/2011	21:00:00	410
9/22/2011	21:15:00	410
9/22/2011	21:30:00	410
9/22/2011	21:45:00	410
9/22/2011	22:00:00	410
9/22/2011	22:15:00	410
9/22/2011	22:30:00	410
9/22/2011	22:45:00	410
9/22/2011	23:00:00	410
9/22/2011	23:15:00	410
9/22/2011	23:30:00	410
9/22/2011	23:45:00	410
9/23/2011	0:00:00	410
9/23/2011	0:15:00	410
9/23/2011	0:30:00	410
9/23/2011	0:45:00	410
9/23/2011	1:00:00	410
9/23/2011	1:15:00	410
9/23/2011	1:30:00	410
9/23/2011	1:45:00	410
9/23/2011	2:00:00	410
9/23/2011	2:15:00	410
9/23/2011	2:30:00	410
9/23/2011	2:45:00	410
9/23/2011	3:00:00	410
9/23/2011	3:15:00	410
9/23/2011	3:30:00	410
9/23/2011	3:45:00	410
9/23/2011	4:00:00	410
9/23/2011	4:15:00	410
9/23/2011	4:30:00	410
9/23/2011	4:45:00	404
9/23/2011	5:00:00	410
9/23/2011	5:15:00	410
9/23/2011	5:30:00	410
9/23/2011	5:45:00	410
9/23/2011	6:00:00	410

APPENDIX B
Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
9/23/2011	6:15:00	410
9/23/2011	6:30:00	410
9/23/2011	6:45:00	410
9/23/2011	7:00:00	410
9/23/2011	7:30:00	410
9/23/2011	7:45:00	410
9/23/2011	8:00:00	404
9/23/2011	8:15:00	410
9/23/2011	8:30:00	404
9/23/2011	9:00:00	410
9/23/2011	9:15:00	410
9/23/2011	9:30:00	404
9/23/2011	9:45:00	410
9/23/2011	10:00:00	410
9/23/2011	10:15:00	410
9/23/2011	10:30:00	410
9/23/2011	10:45:00	410
9/23/2011	11:00:00	410
9/23/2011	11:15:00	415
9/23/2011	11:30:00	410
9/23/2011	11:45:00	410
9/23/2011	12:00:00	410
9/23/2011	12:15:00	410
9/23/2011	12:30:00	415
9/23/2011	12:45:00	415
9/23/2011	13:00:00	410
9/23/2011	13:15:00	415
9/23/2011	13:30:00	415
9/23/2011	13:45:00	415
9/23/2011	14:00:00	410
9/23/2011	14:15:00	415
9/23/2011	14:30:00	415
9/23/2011	14:45:00	415
9/23/2011	15:00:00	415
9/23/2011	15:15:00	410
9/23/2011	15:30:00	410
9/23/2011	15:45:00	415
9/23/2011	16:00:00	410
9/23/2011	16:15:00	415
9/23/2011	16:30:00	410
9/23/2011	16:45:00	410
9/23/2011	17:00:00	410
9/23/2011	17:15:00	410
9/23/2011	17:30:00	415
9/23/2011	17:45:00	410
9/23/2011	18:00:00	410
9/23/2011	18:15:00	410
9/23/2011	18:30:00	410
9/23/2011	18:45:00	410
9/23/2011	19:00:00	410
9/23/2011	19:15:00	410
9/23/2011	19:30:00	410
9/23/2011	19:45:00	410
9/23/2011	20:00:00	410
9/23/2011	20:15:00	410
9/23/2011	20:30:00	404
9/23/2011	20:45:00	410
9/23/2011	21:00:00	410
9/23/2011	21:15:00	410
9/23/2011	21:30:00	410
9/23/2011	21:45:00	410
9/23/2011	22:00:00	410
9/23/2011	22:15:00	410
9/23/2011	22:30:00	410
9/23/2011	22:45:00	410
9/23/2011	23:00:00	404
9/23/2011	23:15:00	410
9/23/2011	23:30:00	404
9/23/2011	23:45:00	404
9/24/2011	0:00:00	404
9/24/2011	0:15:00	410
9/24/2011	0:30:00	404
9/24/2011	0:45:00	404
9/24/2011	1:00:00	404
9/24/2011	1:15:00	410
9/24/2011	1:30:00	410
9/24/2011	1:45:00	410
9/24/2011	2:00:00	410
9/24/2011	2:15:00	410

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
9/24/2011	2:30:00	404
9/24/2011	2:45:00	404
9/24/2011	3:00:00	410
9/24/2011	3:15:00	404
9/24/2011	3:30:00	410
9/24/2011	3:45:00	404
9/24/2011	4:00:00	410
9/24/2011	4:15:00	410
9/24/2011	4:30:00	404
9/24/2011	4:45:00	410
9/24/2011	5:00:00	410
9/24/2011	5:15:00	404
9/24/2011	5:30:00	410
9/24/2011	5:45:00	410
9/24/2011	6:00:00	404
9/24/2011	6:15:00	404
9/24/2011	6:30:00	404
9/24/2011	6:45:00	410
9/24/2011	7:00:00	404
9/24/2011	7:15:00	410
9/24/2011	7:30:00	404
9/24/2011	7:45:00	404
9/24/2011	8:00:00	410
9/24/2011	8:15:00	404
9/24/2011	8:30:00	404
9/24/2011	8:45:00	404
9/24/2011	9:00:00	410
9/24/2011	9:15:00	404
9/24/2011	9:30:00	404
9/24/2011	9:45:00	404
9/24/2011	10:00:00	404
9/24/2011	10:15:00	410
9/24/2011	10:30:00	404
9/24/2011	10:45:00	410
9/24/2011	11:00:00	410
9/24/2011	11:15:00	410
9/24/2011	11:30:00	410
9/24/2011	11:45:00	410
9/24/2011	12:00:00	410
9/24/2011	12:15:00	410
9/24/2011	12:30:00	410
9/24/2011	12:45:00	410
9/24/2011	13:00:00	410
9/24/2011	13:15:00	410
9/24/2011	13:30:00	410
9/24/2011	13:45:00	410
9/24/2011	14:00:00	410
9/24/2011	14:15:00	410
9/24/2011	14:30:00	410
9/24/2011	14:45:00	410
9/24/2011	15:00:00	410
9/24/2011	15:15:00	410
9/24/2011	15:30:00	410
9/24/2011	15:45:00	410
9/24/2011	16:00:00	410
9/24/2011	16:15:00	410
9/24/2011	16:30:00	410
9/24/2011	16:45:00	410
9/24/2011	17:00:00	404
9/24/2011	17:15:00	410
9/24/2011	17:30:00	410
9/24/2011	17:45:00	410
9/24/2011	18:00:00	410
9/24/2011	18:15:00	410
9/24/2011	18:30:00	404
9/24/2011	18:45:00	410
9/24/2011	19:00:00	410
9/24/2011	19:15:00	404
9/24/2011	19:30:00	404
9/24/2011	19:45:00	410
9/24/2011	20:00:00	410
9/24/2011	20:15:00	410
9/24/2011	20:30:00	410
9/24/2011	20:45:00	410
9/24/2011	21:00:00	404
9/24/2011	21:15:00	410
9/24/2011	21:30:00	410
9/24/2011	21:45:00	404
9/24/2011	22:00:00	404

DATE	TIME	Flow (cfs)
9/24/2011	22:15:00	404
9/24/2011	22:30:00	410
9/24/2011	22:45:00	404
9/24/2011	23:00:00	410
9/24/2011	23:15:00	404
9/24/2011	23:30:00	410
9/24/2011	23:45:00	410
9/25/2011	0:00:00	404
9/25/2011	0:15:00	404
9/25/2011	0:30:00	404
9/25/2011	0:45:00	404
9/25/2011	1:00:00	410
9/25/2011	1:15:00	404
9/25/2011	1:30:00	404
9/25/2011	1:45:00	404
9/25/2011	2:00:00	410
9/25/2011	2:15:00	404
9/25/2011	2:30:00	404
9/25/2011	2:45:00	404
9/25/2011	3:00:00	404
9/25/2011	3:15:00	404
9/25/2011	3:30:00	404
9/25/2011	3:45:00	404
9/25/2011	4:00:00	404
9/25/2011	4:15:00	404
9/25/2011	4:30:00	404
9/25/2011	4:45:00	404
9/25/2011	5:00:00	404
9/25/2011	5:15:00	404
9/25/2011	5:30:00	404
9/25/2011	5:45:00	404
9/25/2011	6:00:00	404
9/25/2011	6:15:00	410
9/25/2011	6:30:00	404
9/25/2011	6:45:00	404
9/25/2011	7:00:00	404
9/25/2011	7:15:00	404
9/25/2011	7:30:00	404
9/25/2011	7:45:00	404
9/25/2011	8:00:00	404
9/25/2011	8:15:00	404
9/25/2011	8:30:00	404
9/25/2011	8:45:00	404
9/25/2011	9:00:00	404
9/25/2011	9:15:00	404
9/25/2011	9:30:00	404
9/25/2011	9:45:00	404
9/25/2011	10:00:00	404
9/25/2011	10:15:00	404
9/25/2011	10:30:00	404
9/25/2011	10:45:00	404
9/25/2011	11:00:00	404
9/25/2011	11:15:00	410
9/25/2011	11:30:00	404
9/25/2011	11:45:00	404
9/25/2011	12:00:00	404
9/25/2011	12:15:00	410
9/25/2011	12:30:00	404
9/25/2011	12:45:00	410
9/25/2011	13:00:00	410
9/25/2011	13:15:00	410
9/25/2011	13:30:00	410
9/25/2011	13:45:00	410
9/25/2011	14:00:00	410
9/25/2011	14:15:00	410
9/25/2011	14:30:00	410
9/25/2011	14:45:00	410
9/25/2011	15:00:00	410
9/25/2011	15:15:00	404
9/25/2011	15:30:00	410
9/25/2011	15:45:00	410
9/25/2011	16:00:00	404
9/25/2011	16:15:00	410
9/25/2011	16:30:00	404
9/25/2011	16:45:00	410
9/25/2011	17:00:00	410
9/25/2011	17:15:00	404
9/25/2011	17:30:00	404
9/25/2011	17:45:00	404

DATE	TIME	Flow (cfs)
9/25/2011	18:00:00	404
9/25/2011	18:15:00	404
9/25/2011	18:30:00	404
9/25/2011	18:45:00	410
9/25/2011	19:00:00	404
9/25/2011	19:15:00	410
9/25/2011	19:30:00	404
9/25/2011	19:45:00	404
9/25/2011	20:00:00	404
9/25/2011	20:15:00	404
9/25/2011	20:30:00	404
9/25/2011	20:45:00	404
9/25/2011	21:00:00	410
9/25/2011	21:15:00	404
9/25/2011	21:30:00	404
9/25/2011	21:45:00	404
9/25/2011	22:00:00	404
9/25/2011	22:15:00	404
9/25/2011	22:30:00	404
9/25/2011	22:45:00	404
9/25/2011	23:00:00	404
9/25/2011	23:15:00	404
9/25/2011	23:30:00	404
9/25/2011	23:45:00	404
9/26/2011	0:00:00	404
9/26/2011	0:15:00	404
9/26/2011	0:30:00	404
9/26/2011	0:45:00	404
9/26/2011	1:00:00	399
9/26/2011	1:15:00	404
9/26/2011	1:30:00	399
9/26/2011	1:45:00	404
9/26/2011	2:00:00	404
9/26/2011	2:15:00	404
9/26/2011	2:30:00	404
9/26/2011	2:45:00	404
9/26/2011	3:00:00	404
9/26/2011	3:15:00	404
9/26/2011	3:30:00	404
9/26/2011	3:45:00	404
9/26/2011	4:00:00	404
9/26/2011	4:15:00	404
9/26/2011	4:30:00	404
9/26/2011	4:45:00	404
9/26/2011	5:00:00	404
9/26/2011	5:15:00	404
9/26/2011	5:30:00	404
9/26/2011	5:45:00	399
9/26/2011	6:00:00	404
9/26/2011	6:15:00	404
9/26/2011	6:30:00	404
9/26/2011	6:45:00	404
9/26/2011	7:00:00	404
9/26/2011	7:15:00	404
9/26/2011	7:30:00	399
9/26/2011	7:45:00	404
9/26/2011	8:00:00	404
9/26/2011	8:15:00	404
9/26/2011	8:30:00	404
9/26/2011	8:45:00	404
9/26/2011	9:00:00	404
9/26/2011	9:15:00	404
9/26/2011	9:30:00	404
9/26/2011	9:45:00	404
9/26/2011	10:00:00	404
9/26/2011	10:15:00	404
9/26/2011	10:30:00	404
9/26/2011	10:45:00	404
9/26/2011	11:00:00	404
9/26/2011	11:15:00	404
9/26/2011	11:30:00	404
9/26/2011	11:45:00	404
9/26/2011	12:00:00	410
9/26/2011	12:15:00	410
9/26/2011	12:30:00	404
9/26/2011	12:45:00	404
9/26/2011	13:00:00	404
9/26/2011	13:15:00	404
9/26/2011	13:30:00	410

APPENDIX B
Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
9/26/2011	13:45:00	404
9/26/2011	14:00:00	410
9/26/2011	14:15:00	410
9/26/2011	14:30:00	410
9/26/2011	14:45:00	410
9/26/2011	15:00:00	404
9/26/2011	15:15:00	404
9/26/2011	15:30:00	404
9/26/2011	15:45:00	404
9/26/2011	16:00:00	404
9/26/2011	16:15:00	404
9/26/2011	16:30:00	410
9/26/2011	16:45:00	404
9/26/2011	17:00:00	404
9/26/2011	17:15:00	410
9/26/2011	17:30:00	404
9/26/2011	17:45:00	404
9/26/2011	18:00:00	404
9/26/2011	18:15:00	404
9/26/2011	18:30:00	404
9/26/2011	18:45:00	404
9/26/2011	19:00:00	404
9/26/2011	19:15:00	404
9/26/2011	19:30:00	404
9/26/2011	19:45:00	404
9/26/2011	20:00:00	404
9/26/2011	20:15:00	404
9/26/2011	20:30:00	404
9/26/2011	20:45:00	404
9/26/2011	21:00:00	399
9/26/2011	21:15:00	399
9/26/2011	21:30:00	404
9/26/2011	21:45:00	404
9/26/2011	22:00:00	404
9/26/2011	22:15:00	404
9/26/2011	22:30:00	404
9/26/2011	22:45:00	404
9/26/2011	23:00:00	404
9/26/2011	23:15:00	404
9/26/2011	23:30:00	404
9/26/2011	23:45:00	404
9/27/2011	0:00:00	399
9/27/2011	0:15:00	404
9/27/2011	0:30:00	404
9/27/2011	0:45:00	404
9/27/2011	1:00:00	404
9/27/2011	1:15:00	404
9/27/2011	1:30:00	404
9/27/2011	1:45:00	404
9/27/2011	2:00:00	404
9/27/2011	2:15:00	404
9/27/2011	2:30:00	404
9/27/2011	2:45:00	399
9/27/2011	3:00:00	404
9/27/2011	3:15:00	404
9/27/2011	3:30:00	404
9/27/2011	3:45:00	404
9/27/2011	4:00:00	404
9/27/2011	4:15:00	404
9/27/2011	4:30:00	399
9/27/2011	4:45:00	404
9/27/2011	5:00:00	399
9/27/2011	5:15:00	404
9/27/2011	5:30:00	404
9/27/2011	5:45:00	404
9/27/2011	6:00:00	404
9/27/2011	6:15:00	404
9/27/2011	6:30:00	404
9/27/2011	6:45:00	404
9/27/2011	7:00:00	404
9/27/2011	7:15:00	404
9/27/2011	7:30:00	404
9/27/2011	7:45:00	399
9/27/2011	8:00:00	404
9/27/2011	8:15:00	404
9/27/2011	8:30:00	404
9/27/2011	8:45:00	404
9/27/2011	9:00:00	404
9/27/2011	9:15:00	399

DATE	TIME	Flow (cfs)
9/27/2011	9:30:00	404
9/27/2011	9:45:00	404
9/27/2011	10:00:00	404
9/27/2011	10:15:00	404
9/27/2011	10:30:00	404
9/27/2011	10:45:00	404
9/27/2011	11:00:00	404
9/27/2011	11:15:00	404
9/27/2011	11:30:00	404
9/27/2011	11:45:00	410
9/27/2011	12:00:00	404
9/27/2011	12:15:00	404
9/27/2011	12:30:00	404
9/27/2011	12:45:00	410
9/27/2011	13:00:00	410
9/27/2011	13:15:00	410
9/27/2011	13:30:00	410
9/27/2011	13:45:00	410
9/27/2011	14:00:00	410
9/27/2011	14:15:00	410
9/27/2011	14:30:00	410
9/27/2011	14:45:00	410
9/27/2011	15:00:00	410
9/27/2011	15:15:00	410
9/27/2011	15:30:00	399
9/27/2011	15:45:00	380
9/27/2011	16:00:00	375
9/27/2011	16:15:00	375
9/27/2011	16:30:00	375
9/27/2011	16:45:00	375
9/27/2011	17:00:00	375
9/27/2011	17:15:00	380
9/27/2011	17:30:00	375
9/27/2011	17:45:00	375
9/27/2011	18:00:00	375
9/27/2011	18:15:00	375
9/27/2011	18:30:00	375
9/27/2011	18:45:00	375
9/27/2011	19:00:00	375
9/27/2011	19:15:00	375
9/27/2011	19:30:00	375
9/27/2011	19:45:00	375
9/27/2011	20:00:00	371
9/27/2011	20:15:00	371
9/27/2011	20:30:00	375
9/27/2011	20:45:00	371
9/27/2011	21:00:00	375
9/27/2011	21:15:00	375
9/27/2011	21:30:00	375
9/27/2011	21:45:00	371
9/27/2011	22:00:00	375
9/27/2011	22:15:00	371
9/27/2011	22:30:00	375
9/27/2011	22:45:00	375
9/27/2011	23:00:00	371
9/27/2011	23:15:00	371
9/27/2011	23:30:00	371
9/27/2011	23:45:00	371
9/28/2011	0:00:00	375
9/28/2011	0:15:00	371
9/28/2011	0:30:00	375
9/28/2011	0:45:00	371
9/28/2011	1:00:00	375
9/28/2011	1:15:00	371
9/28/2011	1:30:00	371
9/28/2011	1:45:00	375
9/28/2011	2:00:00	371
9/28/2011	2:15:00	371
9/28/2011	2:30:00	375
9/28/2011	2:45:00	371
9/28/2011	3:00:00	371
9/28/2011	3:15:00	371
9/28/2011	3:30:00	371
9/28/2011	3:45:00	375
9/28/2011	4:00:00	375
9/28/2011	4:15:00	375
9/28/2011	4:30:00	371
9/28/2011	4:45:00	371
9/28/2011	5:00:00	371

DATE	TIME	Flow (cfs)
9/28/2011	5:15:00	371
9/28/2011	5:30:00	371
9/28/2011	5:45:00	371
9/28/2011	6:00:00	371
9/28/2011	6:15:00	371
9/28/2011	6:30:00	371
9/28/2011	6:45:00	371
9/28/2011	7:00:00	375
9/28/2011	7:15:00	362
9/28/2011	7:30:00	354
9/28/2011	7:45:00	354
9/28/2011	8:00:00	354
9/28/2011	8:15:00	354
9/28/2011	8:30:00	354
9/28/2011	8:45:00	354
9/28/2011	9:00:00	358
9/28/2011	9:15:00	354
9/28/2011	9:30:00	354
9/28/2011	9:45:00	354
9/28/2011	10:00:00	354
9/28/2011	10:15:00	358
9/28/2011	10:30:00	358
9/28/2011	10:45:00	358
9/28/2011	11:00:00	358
9/28/2011	11:15:00	358
9/28/2011	11:30:00	358
9/28/2011	11:45:00	358
9/28/2011	12:00:00	358
9/28/2011	12:15:00	358
9/28/2011	12:30:00	358
9/28/2011	12:45:00	358
9/28/2011	13:00:00	358
9/28/2011	13:15:00	358
9/28/2011	13:30:00	358
9/28/2011	13:45:00	362
9/28/2011	14:00:00	362
9/28/2011	14:15:00	358
9/28/2011	14:30:00	358
9/28/2011	14:45:00	358
9/28/2011	15:00:00	358
9/28/2011	15:15:00	358
9/28/2011	15:30:00	358
9/28/2011	15:45:00	358
9/28/2011	16:00:00	358
9/28/2011	16:15:00	358
9/28/2011	16:30:00	358
9/28/2011	16:45:00	358
9/28/2011	17:00:00	358
9/28/2011	17:15:00	358
9/28/2011	17:30:00	358
9/28/2011	17:45:00	358
9/28/2011	18:00:00	358
9/28/2011	18:15:00	358
9/28/2011	18:30:00	358
9/28/2011	18:45:00	358
9/28/2011	19:00:00	358
9/28/2011	19:15:00	354
9/28/2011	19:30:00	358
9/28/2011	19:45:00	358
9/28/2011	20:00:00	354
9/28/2011	20:15:00	358
9/28/2011	20:30:00	358
9/28/2011	20:45:00	354
9/28/2011	21:00:00	358
9/28/2011	21:15:00	358
9/28/2011	21:30:00	358
9/28/2011	21:45:00	354
9/28/2011	22:00:00	358
9/28/2011	22:15:00	358
9/28/2011	22:30:00	354
9/28/2011	22:45:00	358
9/28/2011	23:00:00	354
9/28/2011	23:15:00	354
9/28/2011	23:30:00	358
9/28/2011	23:45:00	354
9/29/2011	0:00:00	358
9/29/2011	0:15:00	354
9/29/2011	0:30:00	354
9/29/2011	0:45:00	354

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
9/29/2011	1:00:00	354
9/29/2011	1:15:00	354
9/29/2011	1:30:00	354
9/29/2011	1:45:00	354
9/29/2011	2:00:00	354
9/29/2011	2:15:00	354
9/29/2011	2:30:00	354
9/29/2011	2:45:00	358
9/29/2011	3:00:00	358
9/29/2011	3:15:00	354
9/29/2011	3:30:00	354
9/29/2011	3:45:00	354
9/29/2011	4:00:00	358
9/29/2011	4:15:00	354
9/29/2011	4:30:00	354
9/29/2011	4:45:00	354
9/29/2011	5:00:00	354
9/29/2011	5:15:00	354
9/29/2011	5:30:00	354
9/29/2011	5:45:00	358
9/29/2011	6:00:00	358
9/29/2011	6:15:00	354
9/29/2011	6:30:00	354
9/29/2011	6:45:00	354
9/29/2011	7:00:00	354
9/29/2011	7:15:00	354
9/29/2011	7:30:00	358
9/29/2011	7:45:00	354
9/29/2011	8:00:00	354
9/29/2011	8:15:00	354
9/29/2011	8:30:00	354
9/29/2011	8:45:00	354
9/29/2011	9:00:00	358
9/29/2011	9:15:00	354
9/29/2011	9:30:00	354
9/29/2011	9:45:00	354
9/29/2011	10:00:00	354
9/29/2011	10:15:00	358
9/29/2011	10:30:00	358
9/29/2011	10:45:00	358
9/29/2011	11:00:00	358
9/29/2011	11:15:00	358
9/29/2011	11:30:00	358
9/29/2011	11:45:00	358
9/29/2011	12:00:00	354
9/29/2011	12:15:00	358
9/29/2011	12:30:00	358
9/29/2011	12:45:00	358
9/29/2011	13:00:00	358
9/29/2011	13:15:00	358
9/29/2011	13:30:00	358
9/29/2011	13:45:00	358
9/29/2011	14:00:00	358
9/29/2011	14:15:00	362
9/29/2011	14:30:00	358
9/29/2011	14:45:00	358
9/29/2011	15:00:00	358
9/29/2011	15:15:00	358
9/29/2011	15:30:00	358
9/29/2011	15:45:00	358
9/29/2011	16:00:00	358
9/29/2011	16:15:00	358
9/29/2011	16:30:00	358
9/29/2011	16:45:00	358
9/29/2011	17:00:00	362
9/29/2011	17:15:00	358
9/29/2011	17:30:00	358
9/29/2011	17:45:00	358
9/29/2011	18:00:00	358
9/29/2011	18:15:00	358
9/29/2011	18:30:00	358
9/29/2011	18:45:00	358
9/29/2011	19:00:00	358
9/29/2011	19:15:00	354
9/29/2011	19:30:00	354
9/29/2011	19:45:00	354
9/29/2011	20:00:00	354
9/29/2011	20:15:00	354
9/29/2011	20:30:00	354

APPENDIX B
Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
9/29/2011	20:45:00	354
9/29/2011	21:00:00	354
9/29/2011	21:15:00	354
9/29/2011	21:30:00	354
9/29/2011	21:45:00	354
9/29/2011	22:00:00	358
9/29/2011	22:15:00	354
9/29/2011	22:30:00	354
9/29/2011	22:45:00	354
9/29/2011	23:00:00	354
9/29/2011	23:15:00	354
9/29/2011	23:30:00	354
9/29/2011	23:45:00	354
9/30/2011	0:00:00	354
9/30/2011	0:15:00	354
9/30/2011	0:30:00	354
9/30/2011	0:45:00	354
9/30/2011	1:00:00	354
9/30/2011	1:15:00	354
9/30/2011	1:30:00	354
9/30/2011	1:45:00	354
9/30/2011	2:00:00	354
9/30/2011	2:15:00	354
9/30/2011	2:30:00	354
9/30/2011	2:45:00	354
9/30/2011	3:00:00	354
9/30/2011	3:15:00	354
9/30/2011	3:30:00	354
9/30/2011	3:45:00	354
9/30/2011	4:00:00	354
9/30/2011	4:15:00	354
9/30/2011	4:30:00	354
9/30/2011	4:45:00	354
9/30/2011	5:00:00	354
9/30/2011	5:15:00	354
9/30/2011	5:30:00	354
9/30/2011	5:45:00	354
9/30/2011	6:00:00	354
9/30/2011	6:15:00	354
9/30/2011	6:30:00	354
9/30/2011	6:45:00	354
9/30/2011	7:00:00	354
9/30/2011	7:15:00	354
9/30/2011	7:30:00	354
9/30/2011	7:45:00	354
9/30/2011	8:00:00	354
9/30/2011	8:15:00	354
9/30/2011	8:30:00	354
9/30/2011	8:45:00	354
9/30/2011	9:00:00	354
9/30/2011	9:15:00	354
9/30/2011	9:30:00	354
9/30/2011	9:45:00	354
9/30/2011	10:00:00	354
9/30/2011	10:15:00	354
9/30/2011	10:30:00	354
9/30/2011	10:45:00	354
9/30/2011	11:00:00	354
9/30/2011	11:15:00	354
9/30/2011	11:30:00	354
9/30/2011	11:45:00	354
9/30/2011	12:00:00	358
9/30/2011	12:15:00	358
9/30/2011	12:30:00	354
9/30/2011	12:45:00	354
9/30/2011	13:00:00	354
9/30/2011	13:15:00	354
9/30/2011	13:30:00	354
9/30/2011	13:45:00	358
9/30/2011	14:00:00	358
9/30/2011	14:15:00	358
9/30/2011	14:30:00	358
9/30/2011	14:45:00	354
9/30/2011	15:00:00	358
9/30/2011	15:15:00	358
9/30/2011	15:30:00	358
9/30/2011	15:45:00	358
9/30/2011	16:00:00	354
9/30/2011	16:15:00	358

DATE	TIME	Flow (cfs)
9/30/2011	16:30:00	358
9/30/2011	16:45:00	358
9/30/2011	17:00:00	354
9/30/2011	17:15:00	358
9/30/2011	17:30:00	358
9/30/2011	17:45:00	358
9/30/2011	18:00:00	354
9/30/2011	18:15:00	358
9/30/2011	18:30:00	358
9/30/2011	18:45:00	358
9/30/2011	19:00:00	358
9/30/2011	19:15:00	358
9/30/2011	19:30:00	358
9/30/2011	19:45:00	354
9/30/2011	20:00:00	358
9/30/2011	20:15:00	354
9/30/2011	20:30:00	354
9/30/2011	20:45:00	354
9/30/2011	21:00:00	354
9/30/2011	21:15:00	354
9/30/2011	21:30:00	354
9/30/2011	21:45:00	354
9/30/2011	22:00:00	354
9/30/2011	22:15:00	354
9/30/2011	22:30:00	354
9/30/2011	22:45:00	354
9/30/2011	23:00:00	354
9/30/2011	23:15:00	354
9/30/2011	23:30:00	354
9/30/2011	23:45:00	354
10/1/2011	0:00:00	354
10/1/2011	0:15:00	354
10/1/2011	0:30:00	354
10/1/2011	0:45:00	354
10/1/2011	1:00:00	354
10/1/2011	1:15:00	354
10/1/2011	1:30:00	354
10/1/2011	1:45:00	354
10/1/2011	2:00:00	354
10/1/2011	2:15:00	354
10/1/2011	2:30:00	354
10/1/2011	2:45:00	354
10/1/2011	3:00:00	354
10/1/2011	3:15:00	354
10/1/2011	3:30:00	354
10/1/2011	3:45:00	354
10/1/2011	4:00:00	354
10/1/2011	4:15:00	354
10/1/2011	4:30:00	354
10/1/2011	4:45:00	354
10/1/2011	5:00:00	354
10/1/2011	5:15:00	354
10/1/2011	5:30:00	354
10/1/2011	5:45:00	354
10/1/2011	6:00:00	354
10/1/2011	6:15:00	354
10/1/2011	6:30:00	354
10/1/2011	6:45:00	354
10/1/2011	7:00:00	354
10/1/2011	7:15:00	354
10/1/2011	7:30:00	354
10/1/2011	7:45:00	354
10/1/2011	8:00:00	354
10/1/2011	8:15:00	354
10/1/2011	8:30:00	354
10/1/2011	8:45:00	354
10/1/2011	9:00:00	354
10/1/2011	9:15:00	354
10/1/2011	9:30:00	354
10/1/2011	9:45:00	354
10/1/2011	10:00:00	354
10/1/2011	10:15:00	354
10/1/2011	10:30:00	354
10/1/2011	10:45:00	354
10/1/2011	11:00:00	354
10/1/2011	11:15:00	354
10/1/2011	11:30:00	354
10/1/2011	11:45:00	358
10/1/2011	12:00:00	358

APPENDIX B
Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/1/2011	12:15:00	358
10/1/2011	12:30:00	358
10/1/2011	12:45:00	358
10/1/2011	13:00:00	358
10/1/2011	13:15:00	358
10/1/2011	13:30:00	358
10/1/2011	13:45:00	358
10/1/2011	14:00:00	358
10/1/2011	14:15:00	358
10/1/2011	14:30:00	358
10/1/2011	14:45:00	358
10/1/2011	15:00:00	358
10/1/2011	15:15:00	358
10/1/2011	15:30:00	358
10/1/2011	15:45:00	358
10/1/2011	16:00:00	354
10/1/2011	16:15:00	354
10/1/2011	16:30:00	358
10/1/2011	16:45:00	358
10/1/2011	17:00:00	358
10/1/2011	17:15:00	358
10/1/2011	17:30:00	358
10/1/2011	17:45:00	358
10/1/2011	18:00:00	354
10/1/2011	18:15:00	358
10/1/2011	18:30:00	354
10/1/2011	18:45:00	358
10/1/2011	19:00:00	354
10/1/2011	19:15:00	354
10/1/2011	19:30:00	358
10/1/2011	19:45:00	354
10/1/2011	20:00:00	354
10/1/2011	20:15:00	354
10/1/2011	20:30:00	354
10/1/2011	20:45:00	354
10/1/2011	21:00:00	354
10/1/2011	21:15:00	354
10/1/2011	21:30:00	354
10/1/2011	21:45:00	354
10/1/2011	22:00:00	354
10/1/2011	22:15:00	354
10/1/2011	22:30:00	354
10/1/2011	22:45:00	354
10/1/2011	23:00:00	354
10/1/2011	23:15:00	354
10/1/2011	23:30:00	354
10/1/2011	23:45:00	354
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10/2/2011	0:15:00	354
10/2/2011	0:30:00	354
10/2/2011	0:45:00	354
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10/2/2011	1:15:00	354
10/2/2011	1:30:00	354
10/2/2011	1:45:00	354
10/2/2011	2:00:00	354
10/2/2011	2:15:00	354
10/2/2011	2:30:00	354
10/2/2011	2:45:00	354
10/2/2011	3:00:00	354
10/2/2011	3:15:00	354
10/2/2011	3:30:00	354
10/2/2011	3:45:00	354
10/2/2011	4:00:00	354
10/2/2011	4:15:00	354
10/2/2011	4:30:00	354
10/2/2011	4:45:00	354
10/2/2011	5:00:00	354
10/2/2011	5:15:00	354
10/2/2011	5:30:00	354
10/2/2011	5:45:00	354
10/2/2011	6:00:00	354
10/2/2011	6:15:00	354
10/2/2011	6:30:00	354
10/2/2011	6:45:00	354
10/2/2011	7:00:00	354
10/2/2011	7:15:00	354
10/2/2011	7:30:00	354
10/2/2011	7:45:00	354

DATE	TIME	Flow (cfs)
10/2/2011	8:00:00	354
10/2/2011	8:15:00	354
10/2/2011	8:30:00	354
10/2/2011	8:45:00	354
10/2/2011	9:00:00	354
10/2/2011	9:15:00	354
10/2/2011	9:30:00	354
10/2/2011	9:45:00	354
10/2/2011	10:00:00	354
10/2/2011	10:15:00	354
10/2/2011	10:30:00	354
10/2/2011	10:45:00	354
10/2/2011	11:00:00	358
10/2/2011	11:15:00	354
10/2/2011	11:30:00	358
10/2/2011	11:45:00	358
10/2/2011	12:00:00	358
10/2/2011	12:15:00	358
10/2/2011	12:30:00	358
10/2/2011	12:45:00	358
10/2/2011	13:00:00	358
10/2/2011	13:15:00	358
10/2/2011	13:30:00	358
10/2/2011	13:45:00	362
10/2/2011	14:00:00	358
10/2/2011	14:15:00	358
10/2/2011	14:30:00	358
10/2/2011	14:45:00	358
10/2/2011	15:00:00	358
10/2/2011	15:15:00	358
10/2/2011	15:30:00	358
10/2/2011	15:45:00	358
10/2/2011	16:00:00	358
10/2/2011	16:15:00	358
10/2/2011	16:30:00	358
10/2/2011	16:45:00	358
10/2/2011	17:00:00	358
10/2/2011	17:15:00	358
10/2/2011	17:30:00	358
10/2/2011	17:45:00	358
10/2/2011	18:00:00	358
10/2/2011	18:15:00	358
10/2/2011	18:30:00	354
10/2/2011	18:45:00	354
10/2/2011	19:00:00	358
10/2/2011	19:15:00	354
10/2/2011	19:30:00	354
10/2/2011	19:45:00	354
10/2/2011	20:00:00	354
10/2/2011	20:15:00	354
10/2/2011	20:30:00	354
10/2/2011	20:45:00	354
10/2/2011	21:00:00	354
10/2/2011	21:15:00	354
10/2/2011	21:30:00	354
10/2/2011	21:45:00	354
10/2/2011	22:00:00	354
10/2/2011	22:15:00	354
10/2/2011	22:30:00	354
10/2/2011	22:45:00	354
10/2/2011	23:00:00	354
10/2/2011	23:15:00	354
10/2/2011	23:30:00	354
10/2/2011	23:45:00	354
10/3/2011	0:00:00	354
10/3/2011	0:15:00	354
10/3/2011	0:30:00	354
10/3/2011	0:45:00	354
10/3/2011	1:00:00	354
10/3/2011	1:15:00	354
10/3/2011	1:30:00	354
10/3/2011	1:45:00	354
10/3/2011	2:00:00	354
10/3/2011	2:15:00	354
10/3/2011	2:30:00	354
10/3/2011	2:45:00	354
10/3/2011	3:00:00	354
10/3/2011	3:15:00	354
10/3/2011	3:30:00	354

APPENDIX B
Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/3/2011	3:45:00	354
10/3/2011	4:00:00	354
10/3/2011	4:15:00	354
10/3/2011	4:30:00	354
10/3/2011	4:45:00	354
10/3/2011	5:00:00	354
10/3/2011	5:15:00	354
10/3/2011	5:30:00	354
10/3/2011	5:45:00	354
10/3/2011	6:00:00	354
10/3/2011	6:15:00	354
10/3/2011	6:30:00	354
10/3/2011	6:45:00	354
10/3/2011	7:00:00	354
10/3/2011	7:15:00	354
10/3/2011	7:30:00	354
10/3/2011	7:45:00	354
10/3/2011	8:00:00	354
10/3/2011	8:15:00	354
10/3/2011	8:30:00	354
10/3/2011	8:45:00	354
10/3/2011	9:00:00	354
10/3/2011	9:15:00	354
10/3/2011	9:30:00	354
10/3/2011	9:45:00	354
10/3/2011	10:00:00	354
10/3/2011	10:15:00	358
10/3/2011	10:30:00	354
10/3/2011	10:45:00	358
10/3/2011	11:00:00	354
10/3/2011	11:15:00	358
10/3/2011	11:30:00	354
10/3/2011	11:45:00	354
10/3/2011	12:00:00	345
10/3/2011	12:15:00	329
10/3/2011	12:30:00	321
10/3/2011	12:45:00	321
10/3/2011	13:00:00	321
10/3/2011	13:15:00	321
10/3/2011	13:30:00	321
10/3/2011	13:45:00	321
10/3/2011	14:00:00	321
10/3/2011	14:15:00	313
10/3/2011	14:30:00	302
10/3/2011	14:45:00	302
10/3/2011	15:00:00	302
10/3/2011	15:15:00	302
10/3/2011	15:30:00	302
10/3/2011	15:45:00	302
10/3/2011	16:00:00	302
10/3/2011	16:15:00	302
10/3/2011	16:30:00	302
10/3/2011	16:45:00	302
10/3/2011	17:00:00	302
10/3/2011	17:15:00	302
10/3/2011	17:30:00	302
10/3/2011	17:45:00	302
10/3/2011	18:00:00	302
10/3/2011	18:15:00	302
10/3/2011	18:30:00	302
10/3/2011	18:45:00	298
10/3/2011	19:00:00	302
10/3/2011	19:15:00	298
10/3/2011	19:30:00	298
10/3/2011	19:45:00	298
10/3/2011	20:00:00	298
10/3/2011	20:15:00	298
10/3/2011	20:30:00	298
10/3/2011	20:45:00	298
10/3/2011	21:00:00	298
10/3/2011	21:15:00	298
10/3/2011	21:30:00	298
10/3/2011	21:45:00	298
10/3/2011	22:00:00	298
10/3/2011	22:15:00	298
10/3/2011	22:30:00	298
10/3/2011	22:45:00	298
10/3/2011	23:00:00	298
10/3/2011	23:15:00	298

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Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/3/2011	23:30:00	298
10/3/2011	23:45:00	298
10/4/2011	0:00:00	298
10/4/2011	0:15:00	298
10/4/2011	0:30:00	298
10/4/2011	0:45:00	298
10/4/2011	1:00:00	298
10/4/2011	1:15:00	298
10/4/2011	1:30:00	298
10/4/2011	1:45:00	298
10/4/2011	2:00:00	298
10/4/2011	2:15:00	298
10/4/2011	2:30:00	298
10/4/2011	2:45:00	298
10/4/2011	3:00:00	298
10/4/2011	3:15:00	298
10/4/2011	3:30:00	298
10/4/2011	3:45:00	298
10/4/2011	4:00:00	298
10/4/2011	4:15:00	298
10/4/2011	4:30:00	298
10/4/2011	4:45:00	298
10/4/2011	5:00:00	298
10/4/2011	5:15:00	298
10/4/2011	5:30:00	298
10/4/2011	5:45:00	298
10/4/2011	6:00:00	298
10/4/2011	6:15:00	298
10/4/2011	6:30:00	298
10/4/2011	6:45:00	298
10/4/2011	7:00:00	298
10/4/2011	7:15:00	298
10/4/2011	7:30:00	298
10/4/2011	7:45:00	298
10/4/2011	8:00:00	298
10/4/2011	8:15:00	291
10/4/2011	8:30:00	280
10/4/2011	8:45:00	280
10/4/2011	9:00:00	280
10/4/2011	9:15:00	280
10/4/2011	9:30:00	280
10/4/2011	9:45:00	280
10/4/2011	10:00:00	280
10/4/2011	10:15:00	259
10/4/2011	10:30:00	259
10/4/2011	10:45:00	259
10/4/2011	11:00:00	252
10/4/2011	11:15:00	252
10/4/2011	11:30:00	252
10/4/2011	11:45:00	252
10/4/2011	12:00:00	252
10/4/2011	12:15:00	252
10/4/2011	12:30:00	252
10/4/2011	12:45:00	246
10/4/2011	13:00:00	236
10/4/2011	13:15:00	230
10/4/2011	13:30:00	230
10/4/2011	13:45:00	227
10/4/2011	14:00:00	227
10/4/2011	14:15:00	227
10/4/2011	14:30:00	227
10/4/2011	14:45:00	227
10/4/2011	15:00:00	227
10/4/2011	15:15:00	227
10/4/2011	15:30:00	227
10/4/2011	15:45:00	227
10/4/2011	16:00:00	227
10/4/2011	16:15:00	227
10/4/2011	16:30:00	227
10/4/2011	16:45:00	227
10/4/2011	17:00:00	227
10/4/2011	17:15:00	227
10/4/2011	17:30:00	227
10/4/2011	17:45:00	227
10/4/2011	18:00:00	227
10/4/2011	18:15:00	227
10/4/2011	18:30:00	227
10/4/2011	18:45:00	227
10/4/2011	19:00:00	227

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Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/4/2011	19:15:00	227
10/4/2011	19:30:00	227
10/4/2011	19:45:00	227
10/4/2011	20:00:00	227
10/4/2011	20:15:00	227
10/4/2011	20:30:00	227
10/4/2011	20:45:00	227
10/4/2011	21:00:00	227
10/4/2011	21:15:00	227
10/4/2011	21:30:00	227
10/4/2011	21:45:00	227
10/4/2011	22:00:00	227
10/4/2011	22:15:00	227
10/4/2011	22:30:00	227
10/4/2011	22:45:00	227
10/4/2011	23:00:00	227
10/4/2011	23:15:00	227
10/4/2011	23:30:00	227
10/4/2011	23:45:00	227
10/5/2011	0:00:00	227
10/5/2011	0:15:00	227
10/5/2011	0:30:00	227
10/5/2011	0:45:00	227
10/5/2011	1:00:00	227
10/5/2011	1:15:00	227
10/5/2011	1:30:00	227
10/5/2011	1:45:00	227
10/5/2011	2:00:00	227
10/5/2011	2:15:00	227
10/5/2011	2:30:00	227
10/5/2011	2:45:00	227
10/5/2011	3:00:00	227
10/5/2011	3:15:00	227
10/5/2011	3:30:00	227
10/5/2011	3:45:00	227
10/5/2011	4:00:00	227
10/5/2011	4:15:00	227
10/5/2011	4:30:00	227
10/5/2011	4:45:00	227
10/5/2011	5:00:00	227
10/5/2011	5:15:00	227
10/5/2011	5:30:00	227
10/5/2011	5:45:00	227
10/5/2011	6:00:00	227
10/5/2011	6:15:00	227
10/5/2011	6:30:00	227
10/5/2011	6:45:00	227
10/5/2011	7:00:00	227
10/5/2011	7:15:00	227
10/5/2011	7:30:00	227
10/5/2011	7:45:00	227
10/5/2011	8:00:00	227
10/5/2011	8:15:00	227
10/5/2011	8:30:00	227
10/5/2011	8:45:00	227
10/5/2011	9:00:00	227
10/5/2011	9:15:00	227
10/5/2011	9:30:00	227
10/5/2011	9:45:00	227
10/5/2011	10:00:00	227
10/5/2011	10:15:00	227
10/5/2011	10:30:00	227
10/5/2011	10:45:00	227
10/5/2011	11:00:00	227
10/5/2011	11:15:00	227
10/5/2011	11:30:00	227
10/5/2011	11:45:00	214
10/5/2011	12:00:00	214
10/5/2011	12:15:00	211
10/5/2011	12:30:00	211
10/5/2011	12:45:00	211
10/5/2011	13:00:00	211
10/5/2011	13:15:00	211
10/5/2011	13:30:00	211
10/5/2011	13:45:00	203
10/5/2011	14:00:00	185
10/5/2011	14:15:00	185
10/5/2011	14:30:00	185
10/5/2011	14:45:00	185

DATE	TIME	Flow (cfs)
10/5/2011	15:00:00	185
10/5/2011	15:15:00	185
10/5/2011	15:30:00	185
10/5/2011	15:45:00	179
10/5/2011	16:00:00	177
10/5/2011	16:15:00	177
10/5/2011	16:30:00	177
10/5/2011	16:45:00	177
10/5/2011	17:00:00	177
10/5/2011	17:15:00	177
10/5/2011	17:30:00	177
10/5/2011	17:45:00	177
10/5/2011	18:00:00	177
10/5/2011	18:15:00	177
10/5/2011	18:30:00	177
10/5/2011	18:45:00	177
10/5/2011	19:00:00	177
10/5/2011	19:15:00	177
10/5/2011	19:30:00	177
10/5/2011	19:45:00	177
10/5/2011	20:00:00	177
10/5/2011	20:15:00	177
10/5/2011	20:30:00	177
10/5/2011	20:45:00	177
10/5/2011	21:00:00	174
10/5/2011	21:15:00	174
10/5/2011	21:30:00	174
10/5/2011	21:45:00	174
10/5/2011	22:00:00	174
10/5/2011	22:15:00	174
10/5/2011	22:30:00	174
10/5/2011	22:45:00	174
10/5/2011	23:00:00	174
10/5/2011	23:15:00	174
10/5/2011	23:30:00	174
10/5/2011	23:45:00	174
10/6/2011	0:00:00	174
10/6/2011	0:15:00	174
10/6/2011	0:30:00	174
10/6/2011	0:45:00	174
10/6/2011	1:00:00	174
10/6/2011	1:15:00	174
10/6/2011	1:30:00	174
10/6/2011	1:45:00	174
10/6/2011	2:00:00	174
10/6/2011	2:15:00	174
10/6/2011	2:30:00	174
10/6/2011	2:45:00	174
10/6/2011	3:00:00	174
10/6/2011	3:15:00	174
10/6/2011	3:30:00	174
10/6/2011	3:45:00	174
10/6/2011	4:00:00	174
10/6/2011	4:15:00	174
10/6/2011	4:30:00	174
10/6/2011	4:45:00	174
10/6/2011	5:00:00	174
10/6/2011	5:15:00	174
10/6/2011	5:30:00	174
10/6/2011	5:45:00	174
10/6/2011	6:00:00	174
10/6/2011	6:15:00	174
10/6/2011	6:30:00	174
10/6/2011	6:45:00	174
10/6/2011	7:00:00	174
10/6/2011	7:15:00	174
10/6/2011	7:30:00	174
10/6/2011	7:45:00	174
10/6/2011	8:00:00	171
10/6/2011	8:15:00	171
10/6/2011	8:30:00	171
10/6/2011	8:45:00	171
10/6/2011	9:00:00	185
10/6/2011	9:15:00	197
10/6/2011	9:30:00	209
10/6/2011	9:45:00	209
10/6/2011	10:00:00	233
10/6/2011	10:15:00	236
10/6/2011	10:30:00	246

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Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/6/2011	10:45:00	246
10/6/2011	11:00:00	252
10/6/2011	11:15:00	252
10/6/2011	11:30:00	256
10/6/2011	11:45:00	256
10/6/2011	12:00:00	256
10/6/2011	12:15:00	256
10/6/2011	12:30:00	256
10/6/2011	12:45:00	256
10/6/2011	13:00:00	256
10/6/2011	13:15:00	256
10/6/2011	13:30:00	256
10/6/2011	13:45:00	256
10/6/2011	14:00:00	256
10/6/2011	14:15:00	256
10/6/2011	14:30:00	256
10/6/2011	14:45:00	256
10/6/2011	15:00:00	256
10/6/2011	15:15:00	256
10/6/2011	15:30:00	256
10/6/2011	15:45:00	256
10/6/2011	16:00:00	256
10/6/2011	16:15:00	256
10/6/2011	16:30:00	256
10/6/2011	16:45:00	256
10/6/2011	17:00:00	256
10/6/2011	17:15:00	256
10/6/2011	17:30:00	256
10/6/2011	17:45:00	256
10/6/2011	18:00:00	256
10/6/2011	18:15:00	256
10/6/2011	18:30:00	256
10/6/2011	18:45:00	256
10/6/2011	19:00:00	256
10/6/2011	19:15:00	256
10/6/2011	19:30:00	256
10/6/2011	19:45:00	256
10/6/2011	20:00:00	256
10/6/2011	20:15:00	256
10/6/2011	20:30:00	256
10/6/2011	20:45:00	256
10/6/2011	21:00:00	256
10/6/2011	21:15:00	256
10/6/2011	21:30:00	256
10/6/2011	21:45:00	256
10/6/2011	22:00:00	256
10/6/2011	22:15:00	256
10/6/2011	22:30:00	256
10/6/2011	22:45:00	256
10/6/2011	23:00:00	256
10/6/2011	23:15:00	256
10/6/2011	23:30:00	256
10/6/2011	23:45:00	256
10/7/2011	0:00:00	256
10/7/2011	0:15:00	256
10/7/2011	0:30:00	256
10/7/2011	0:45:00	256
10/7/2011	1:00:00	256
10/7/2011	1:15:00	256
10/7/2011	1:30:00	256
10/7/2011	1:45:00	256
10/7/2011	2:00:00	256
10/7/2011	2:15:00	256
10/7/2011	2:30:00	256
10/7/2011	2:45:00	256
10/7/2011	3:00:00	256
10/7/2011	3:15:00	256
10/7/2011	3:30:00	256
10/7/2011	3:45:00	256
10/7/2011	4:00:00	256
10/7/2011	4:15:00	256
10/7/2011	4:30:00	256
10/7/2011	4:45:00	256
10/7/2011	5:00:00	256
10/7/2011	5:15:00	256
10/7/2011	5:30:00	256
10/7/2011	5:45:00	256
10/7/2011	6:00:00	256
10/7/2011	6:15:00	256

APPENDIX B
Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/7/2011	6:30:00	256
10/7/2011	6:45:00	256
10/7/2011	7:00:00	256
10/7/2011	7:15:00	256
10/7/2011	7:30:00	256
10/7/2011	7:45:00	256
10/7/2011	8:00:00	256
10/7/2011	8:15:00	256
10/7/2011	8:30:00	256
10/7/2011	8:45:00	256
10/7/2011	9:00:00	256
10/7/2011	9:15:00	256
10/7/2011	9:30:00	266
10/7/2011	9:45:00	287
10/7/2011	10:00:00	302
10/7/2011	10:15:00	306
10/7/2011	10:30:00	306
10/7/2011	10:45:00	306
10/7/2011	11:00:00	306
10/7/2011	11:15:00	306
10/7/2011	11:30:00	306
10/7/2011	11:45:00	306
10/7/2011	12:00:00	306
10/7/2011	12:15:00	306
10/7/2011	12:30:00	306
10/7/2011	12:45:00	306
10/7/2011	13:00:00	306
10/7/2011	13:15:00	306
10/7/2011	13:30:00	306
10/7/2011	13:45:00	306
10/7/2011	14:00:00	306
10/7/2011	14:15:00	306
10/7/2011	14:30:00	306
10/7/2011	14:45:00	306
10/7/2011	15:00:00	306
10/7/2011	15:15:00	306
10/7/2011	15:30:00	306
10/7/2011	15:45:00	306
10/7/2011	16:00:00	306
10/7/2011	16:15:00	306
10/7/2011	16:30:00	306
10/7/2011	16:45:00	306
10/7/2011	17:00:00	306
10/7/2011	17:15:00	306
10/7/2011	17:30:00	306
10/7/2011	17:45:00	306
10/7/2011	18:00:00	306
10/7/2011	18:15:00	306
10/7/2011	18:30:00	306
10/7/2011	18:45:00	306
10/7/2011	19:00:00	306
10/7/2011	19:15:00	306
10/7/2011	19:30:00	306
10/7/2011	19:45:00	306
10/7/2011	20:00:00	306
10/7/2011	20:15:00	306
10/7/2011	20:30:00	306
10/7/2011	20:45:00	306
10/7/2011	21:00:00	306
10/7/2011	21:15:00	306
10/7/2011	21:30:00	306
10/7/2011	21:45:00	306
10/7/2011	22:00:00	306
10/7/2011	22:15:00	306
10/7/2011	22:30:00	306
10/7/2011	22:45:00	306
10/7/2011	23:00:00	306
10/7/2011	23:15:00	306
10/7/2011	23:30:00	306
10/7/2011	23:45:00	306
10/8/2011	0:00:00	306
10/8/2011	0:15:00	306
10/8/2011	0:30:00	306
10/8/2011	0:45:00	306
10/8/2011	1:00:00	306
10/8/2011	1:15:00	306
10/8/2011	1:30:00	306
10/8/2011	1:45:00	306
10/8/2011	2:00:00	306

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/8/2011	2:15:00	306
10/8/2011	2:30:00	306
10/8/2011	2:45:00	306
10/8/2011	3:00:00	306
10/8/2011	3:15:00	306
10/8/2011	3:30:00	306
10/8/2011	3:45:00	306
10/8/2011	4:00:00	306
10/8/2011	4:15:00	306
10/8/2011	4:30:00	306
10/8/2011	4:45:00	306
10/8/2011	5:00:00	306
10/8/2011	5:15:00	306
10/8/2011	5:30:00	306
10/8/2011	5:45:00	306
10/8/2011	6:00:00	306
10/8/2011	6:15:00	306
10/8/2011	6:30:00	306
10/8/2011	6:45:00	306
10/8/2011	7:00:00	306
10/8/2011	7:15:00	306
10/8/2011	7:30:00	306
10/8/2011	7:45:00	306
10/8/2011	8:00:00	306
10/8/2011	8:15:00	306
10/8/2011	8:30:00	306
10/8/2011	8:45:00	306
10/8/2011	9:00:00	306
10/8/2011	9:15:00	306
10/8/2011	9:30:00	306
10/8/2011	9:45:00	306
10/8/2011	10:00:00	306
10/8/2011	10:15:00	306
10/8/2011	10:30:00	306
10/8/2011	10:45:00	306
10/8/2011	11:00:00	306
10/8/2011	11:15:00	306
10/8/2011	11:30:00	306
10/8/2011	11:45:00	306
10/8/2011	12:00:00	306
10/8/2011	12:15:00	306
10/8/2011	12:30:00	306
10/8/2011	12:45:00	306
10/8/2011	13:00:00	306
10/8/2011	13:15:00	306
10/8/2011	13:30:00	306
10/8/2011	13:45:00	309
10/8/2011	14:00:00	309
10/8/2011	14:15:00	309
10/8/2011	14:30:00	309
10/8/2011	14:45:00	309
10/8/2011	15:00:00	309
10/8/2011	15:15:00	309
10/8/2011	15:30:00	309
10/8/2011	15:45:00	309
10/8/2011	16:00:00	309
10/8/2011	16:15:00	309
10/8/2011	16:30:00	309
10/8/2011	16:45:00	309
10/8/2011	17:00:00	309
10/8/2011	17:15:00	309
10/8/2011	17:30:00	309
10/8/2011	17:45:00	309
10/8/2011	18:00:00	309
10/8/2011	18:15:00	309
10/8/2011	18:30:00	309
10/8/2011	18:45:00	309
10/8/2011	19:00:00	309
10/8/2011	19:15:00	309
10/8/2011	19:30:00	309
10/8/2011	19:45:00	309
10/8/2011	20:00:00	309
10/8/2011	20:15:00	309
10/8/2011	20:30:00	309
10/8/2011	20:45:00	309
10/8/2011	21:00:00	309
10/8/2011	21:15:00	309
10/8/2011	21:30:00	309
10/8/2011	21:45:00	309

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)

Piru Creek 2011 Controlled Flow Release Geomorphology Study

United Water Conservation District

DATE	TIME	Flow (cfs)
10/8/2011	22:00:00	306
10/8/2011	22:15:00	306
10/8/2011	22:30:00	306
10/8/2011	22:45:00	306
10/8/2011	23:00:00	306
10/8/2011	23:15:00	306
10/8/2011	23:30:00	306
10/8/2011	23:45:00	306
10/9/2011	0:00:00	306
10/9/2011	0:15:00	306
10/9/2011	0:30:00	306
10/9/2011	0:45:00	306
10/9/2011	1:00:00	306
10/9/2011	1:15:00	309
10/9/2011	1:30:00	306
10/9/2011	1:45:00	306
10/9/2011	2:00:00	306
10/9/2011	2:15:00	306
10/9/2011	2:30:00	306
10/9/2011	2:45:00	306
10/9/2011	3:00:00	306
10/9/2011	3:15:00	306
10/9/2011	3:30:00	306
10/9/2011	3:45:00	306
10/9/2011	4:00:00	306
10/9/2011	4:15:00	306
10/9/2011	4:30:00	306
10/9/2011	4:45:00	306
10/9/2011	5:00:00	306
10/9/2011	5:15:00	306
10/9/2011	5:30:00	306
10/9/2011	5:45:00	306
10/9/2011	6:00:00	306
10/9/2011	6:15:00	306
10/9/2011	6:30:00	306
10/9/2011	6:45:00	306
10/9/2011	7:00:00	306
10/9/2011	7:15:00	306
10/9/2011	7:30:00	306
10/9/2011	7:45:00	306
10/9/2011	8:00:00	306
10/9/2011	8:15:00	306
10/9/2011	8:30:00	306
10/9/2011	8:45:00	306
10/9/2011	9:00:00	306
10/9/2011	9:15:00	306
10/9/2011	9:30:00	306
10/9/2011	9:45:00	306
10/9/2011	10:00:00	306
10/9/2011	10:15:00	306
10/9/2011	10:30:00	306
10/9/2011	10:45:00	306
10/9/2011	11:00:00	306
10/9/2011	11:15:00	306
10/9/2011	11:30:00	306
10/9/2011	11:45:00	306
10/9/2011	12:00:00	306
10/9/2011	12:15:00	306
10/9/2011	12:30:00	306
10/9/2011	12:45:00	306
10/9/2011	13:00:00	309
10/9/2011	13:15:00	309
10/9/2011	13:30:00	309
10/9/2011	13:45:00	309
10/9/2011	14:00:00	309
10/9/2011	14:15:00	309
10/9/2011	14:30:00	309
10/9/2011	14:45:00	309
10/9/2011	15:00:00	309
10/9/2011	15:15:00	309
10/9/2011	15:30:00	309
10/9/2011	15:45:00	309
10/9/2011	16:00:00	309
10/9/2011	16:15:00	309
10/9/2011	16:30:00	309
10/9/2011	16:45:00	309
10/9/2011	17:00:00	309
10/9/2011	17:15:00	309
10/9/2011	17:30:00	309

APPENDIX B
Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/9/2011	17:45:00	309
10/9/2011	18:00:00	309
10/9/2011	18:15:00	309
10/9/2011	18:30:00	309
10/9/2011	18:45:00	309
10/9/2011	19:00:00	309
10/9/2011	19:15:00	309
10/9/2011	19:30:00	309
10/9/2011	19:45:00	309
10/9/2011	20:00:00	309
10/9/2011	20:15:00	309
10/9/2011	20:30:00	309
10/9/2011	20:45:00	309
10/9/2011	21:00:00	306
10/9/2011	21:15:00	306
10/9/2011	21:30:00	306
10/9/2011	21:45:00	306
10/9/2011	22:00:00	306
10/9/2011	22:15:00	306
10/9/2011	22:30:00	306
10/9/2011	22:45:00	306
10/9/2011	23:00:00	306
10/9/2011	23:15:00	306
10/9/2011	23:30:00	306
10/9/2011	23:45:00	306
10/10/2011	0:00:00	306
10/10/2011	0:15:00	306
10/10/2011	0:30:00	306
10/10/2011	0:45:00	306
10/10/2011	1:00:00	306
10/10/2011	1:15:00	306
10/10/2011	1:30:00	306
10/10/2011	1:45:00	306
10/10/2011	2:00:00	306
10/10/2011	2:15:00	306
10/10/2011	2:30:00	306
10/10/2011	2:45:00	306
10/10/2011	3:00:00	306
10/10/2011	3:15:00	306
10/10/2011	3:30:00	306
10/10/2011	3:45:00	306
10/10/2011	4:00:00	306
10/10/2011	4:15:00	306
10/10/2011	4:30:00	306
10/10/2011	4:45:00	306
10/10/2011	5:00:00	306
10/10/2011	5:15:00	306
10/10/2011	5:30:00	306
10/10/2011	5:45:00	306
10/10/2011	6:00:00	306
10/10/2011	6:15:00	306
10/10/2011	6:30:00	306
10/10/2011	6:45:00	306
10/10/2011	7:00:00	306
10/10/2011	7:15:00	306
10/10/2011	7:30:00	306
10/10/2011	7:45:00	306
10/10/2011	8:00:00	306
10/10/2011	8:15:00	306
10/10/2011	8:30:00	306
10/10/2011	8:45:00	306
10/10/2011	9:00:00	306
10/10/2011	9:15:00	306
10/10/2011	9:30:00	306
10/10/2011	9:45:00	306
10/10/2011	10:00:00	306
10/10/2011	10:15:00	306
10/10/2011	10:30:00	306
10/10/2011	10:45:00	306
10/10/2011	11:00:00	306
10/10/2011	11:15:00	306
10/10/2011	11:30:00	306
10/10/2011	11:45:00	306
10/10/2011	12:00:00	306
10/10/2011	12:15:00	306
10/10/2011	12:30:00	306
10/10/2011	12:45:00	306
10/10/2011	13:00:00	306
10/10/2011	13:15:00	309

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/10/2011	13:30:00	309
10/10/2011	13:45:00	309
10/10/2011	14:00:00	309
10/10/2011	14:15:00	309
10/10/2011	14:30:00	309
10/10/2011	14:45:00	309
10/10/2011	15:00:00	309
10/10/2011	15:15:00	309
10/10/2011	15:30:00	309
10/10/2011	15:45:00	309
10/10/2011	16:00:00	309
10/10/2011	16:15:00	309
10/10/2011	16:30:00	309
10/10/2011	16:45:00	309
10/10/2011	17:00:00	309
10/10/2011	17:15:00	309
10/10/2011	17:30:00	309
10/10/2011	17:45:00	309
10/10/2011	18:00:00	309
10/10/2011	18:15:00	309
10/10/2011	18:30:00	309
10/10/2011	18:45:00	309
10/10/2011	19:00:00	309
10/10/2011	19:15:00	309
10/10/2011	19:30:00	309
10/10/2011	19:45:00	309
10/10/2011	20:00:00	309
10/10/2011	20:15:00	309
10/10/2011	20:30:00	309
10/10/2011	20:45:00	309
10/10/2011	21:00:00	309
10/10/2011	21:15:00	306
10/10/2011	21:30:00	306
10/10/2011	21:45:00	306
10/10/2011	22:00:00	306
10/10/2011	22:15:00	306
10/10/2011	22:30:00	306
10/10/2011	22:45:00	306
10/10/2011	23:00:00	306
10/10/2011	23:15:00	306
10/10/2011	23:30:00	306
10/10/2011	23:45:00	306
10/11/2011	0:00:00	306
10/11/2011	0:15:00	306
10/11/2011	0:30:00	306
10/11/2011	0:45:00	306
10/11/2011	1:00:00	306
10/11/2011	1:15:00	306
10/11/2011	1:30:00	306
10/11/2011	1:45:00	306
10/11/2011	2:00:00	306
10/11/2011	2:15:00	306
10/11/2011	2:30:00	306
10/11/2011	2:45:00	306
10/11/2011	3:00:00	306
10/11/2011	3:15:00	306
10/11/2011	3:30:00	306
10/11/2011	3:45:00	306
10/11/2011	4:00:00	306
10/11/2011	4:15:00	306
10/11/2011	4:30:00	306
10/11/2011	4:45:00	306
10/11/2011	5:00:00	306
10/11/2011	5:15:00	306
10/11/2011	5:30:00	306
10/11/2011	5:45:00	306
10/11/2011	6:00:00	306
10/11/2011	6:15:00	306
10/11/2011	6:30:00	306
10/11/2011	6:45:00	306
10/11/2011	7:00:00	306
10/11/2011	7:15:00	306
10/11/2011	7:30:00	306
10/11/2011	7:45:00	306
10/11/2011	8:00:00	306
10/11/2011	8:15:00	306
10/11/2011	8:30:00	306
10/11/2011	8:45:00	306
10/11/2011	9:00:00	306

DATE	TIME	Flow (cfs)
10/11/2011	9:15:00	306
10/11/2011	9:30:00	306
10/11/2011	9:45:00	306
10/11/2011	10:00:00	306
10/11/2011	10:15:00	306
10/11/2011	10:30:00	306
10/11/2011	10:45:00	306
10/11/2011	11:00:00	306
10/11/2011	11:15:00	306
10/11/2011	11:30:00	306
10/11/2011	11:45:00	306
10/11/2011	12:00:00	306
10/11/2011	12:15:00	306
10/11/2011	12:30:00	306
10/11/2011	12:45:00	306
10/11/2011	13:00:00	306
10/11/2011	13:15:00	306
10/11/2011	13:30:00	309
10/11/2011	13:45:00	309
10/11/2011	14:00:00	309
10/11/2011	14:15:00	309
10/11/2011	14:30:00	309
10/11/2011	14:45:00	309
10/11/2011	15:00:00	309
10/11/2011	15:15:00	309
10/11/2011	15:30:00	309
10/11/2011	15:45:00	309
10/11/2011	16:00:00	309
10/11/2011	16:15:00	309
10/11/2011	16:30:00	309
10/11/2011	16:45:00	309
10/11/2011	17:00:00	309
10/11/2011	17:15:00	309
10/11/2011	17:30:00	309
10/11/2011	17:45:00	309
10/11/2011	18:00:00	309
10/11/2011	18:15:00	309
10/11/2011	18:30:00	309
10/11/2011	18:45:00	309
10/11/2011	19:00:00	309
10/11/2011	19:15:00	309
10/11/2011	19:30:00	309
10/11/2011	19:45:00	309
10/11/2011	20:00:00	309
10/11/2011	20:15:00	309
10/11/2011	20:30:00	309
10/11/2011	20:45:00	309
10/11/2011	21:00:00	309
10/11/2011	21:15:00	309
10/11/2011	21:30:00	309
10/11/2011	21:45:00	306
10/11/2011	22:00:00	306
10/11/2011	22:15:00	306
10/11/2011	22:30:00	306
10/11/2011	22:45:00	306
10/11/2011	23:00:00	306
10/11/2011	23:15:00	306
10/11/2011	23:30:00	306
10/11/2011	23:45:00	306
10/12/2011	0:00:00	306
10/12/2011	0:15:00	306
10/12/2011	0:30:00	306
10/12/2011	0:45:00	306
10/12/2011	1:00:00	306
10/12/2011	1:15:00	306
10/12/2011	1:30:00	306
10/12/2011	1:45:00	306
10/12/2011	2:00:00	306
10/12/2011	2:15:00	306
10/12/2011	2:30:00	306
10/12/2011	2:45:00	306
10/12/2011	3:00:00	306
10/12/2011	3:15:00	306
10/12/2011	3:30:00	306
10/12/2011	3:45:00	306
10/12/2011	4:00:00	306
10/12/2011	4:15:00	306
10/12/2011	4:30:00	306
10/12/2011	4:45:00	306

DATE	TIME	Flow (cfs)
10/12/2011	5:00:00	306
10/12/2011	5:15:00	306
10/12/2011	5:30:00	306
10/12/2011	5:45:00	306
10/12/2011	6:00:00	306
10/12/2011	6:15:00	306
10/12/2011	6:30:00	306
10/12/2011	6:45:00	306
10/12/2011	7:00:00	306
10/12/2011	7:30:00	306
10/12/2011	7:45:00	306
10/12/2011	8:00:00	306
10/12/2011	8:15:00	306
10/12/2011	8:30:00	306
10/12/2011	8:45:00	306
10/12/2011	11:00:00	306
10/12/2011	11:15:00	306
10/12/2011	11:30:00	306
10/12/2011	11:45:00	306
10/12/2011	12:00:00	306
10/12/2011	12:15:00	306
10/12/2011	12:30:00	306
10/12/2011	12:45:00	306
10/12/2011	13:00:00	306
10/12/2011	13:15:00	306
10/12/2011	13:30:00	306
10/12/2011	13:45:00	306
10/12/2011	14:00:00	306
10/12/2011	14:15:00	306
10/12/2011	14:30:00	306
10/12/2011	14:45:00	306
10/12/2011	15:00:00	306
10/12/2011	15:15:00	306
10/12/2011	15:30:00	306
10/12/2011	15:45:00	306
10/12/2011	16:00:00	306
10/12/2011	16:15:00	306
10/12/2011	16:30:00	306
10/12/2011	16:45:00	306
10/12/2011	17:00:00	306
10/12/2011	17:15:00	306
10/12/2011	17:30:00	306
10/12/2011	17:45:00	306
10/12/2011	18:00:00	306
10/12/2011	18:15:00	306
10/12/2011	18:30:00	306
10/12/2011	18:45:00	306
10/12/2011	19:00:00	306
10/12/2011	19:15:00	306
10/12/2011	19:30:00	306
10/12/2011	19:45:00	306
10/12/2011	20:00:00	306
10/12/2011	20:15:00	306
10/12/2011	20:30:00	306
10/12/2011	20:45:00	306
10/12/2011	21:00:00	306
10/12/2011	21:15:00	306
10/12/2011	21:30:00	306
10/12/2011	21:45:00	306
10/12/2011	22:00:00	306
10/12/2011	22:15:00	306
10/12/2011	22:30:00	306
10/12/2011	22:45:00	306
10/12/2011	23:00:00	306
10/12/2011	23:15:00	306
10/12/2011	23:30:00	306
10/12/2011	23:45:00	306
10/13/2011	0:00:00	306
10/13/2011	0:15:00	306
10/13/2011	0:30:00	306
10/13/2011	0:45:00	306
10/13/2011	1:00:00	306
10/13/2011	1:15:00	306
10/13/2011	1:30:00	306
10/13/2011	1:45:00	306
10/13/2011	2:00:00	306
10/13/2011	2:15:00	306
10/13/2011	2:30:00	306
10/13/2011	2:45:00	306

APPENDIX B
Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/13/2011	3:00:00	306
10/13/2011	3:15:00	306
10/13/2011	3:30:00	306
10/13/2011	3:45:00	306
10/13/2011	4:00:00	306
10/13/2011	4:15:00	306
10/13/2011	4:30:00	306
10/13/2011	4:45:00	306
10/13/2011	5:00:00	306
10/13/2011	5:15:00	306
10/13/2011	5:30:00	306
10/13/2011	5:45:00	306
10/13/2011	6:00:00	306
10/13/2011	6:15:00	306
10/13/2011	6:30:00	306
10/13/2011	6:45:00	306
10/13/2011	7:00:00	306
10/13/2011	7:15:00	306
10/13/2011	7:30:00	306
10/13/2011	7:45:00	306
10/13/2011	8:00:00	306
10/13/2011	8:15:00	306
10/13/2011	8:30:00	306
10/13/2011	8:45:00	306
10/13/2011	9:00:00	306
10/13/2011	9:15:00	306
10/13/2011	9:30:00	306
10/13/2011	9:45:00	306
10/13/2011	10:00:00	306
10/13/2011	10:15:00	306
10/13/2011	10:30:00	306
10/13/2011	10:45:00	306
10/13/2011	11:00:00	306
10/13/2011	11:15:00	306
10/13/2011	11:30:00	306
10/13/2011	11:45:00	306
10/13/2011	12:00:00	306
10/13/2011	12:15:00	306
10/13/2011	12:30:00	306
10/13/2011	12:45:00	306
10/13/2011	13:00:00	306
10/13/2011	13:15:00	306
10/13/2011	13:30:00	306
10/13/2011	13:45:00	306
10/13/2011	14:00:00	306
10/13/2011	14:15:00	306
10/13/2011	14:30:00	306
10/13/2011	14:45:00	306
10/13/2011	15:00:00	306
10/13/2011	15:15:00	306
10/13/2011	15:30:00	306
10/13/2011	15:45:00	306
10/13/2011	16:00:00	306
10/13/2011	16:15:00	306
10/13/2011	16:30:00	306
10/13/2011	16:45:00	306
10/13/2011	17:00:00	306
10/13/2011	17:15:00	306
10/13/2011	17:30:00	306
10/13/2011	17:45:00	306
10/13/2011	18:00:00	306
10/13/2011	18:15:00	306
10/13/2011	18:30:00	306
10/13/2011	18:45:00	306
10/13/2011	19:00:00	306
10/13/2011	19:15:00	306
10/13/2011	19:30:00	306
10/13/2011	19:45:00	306
10/13/2011	20:00:00	306
10/13/2011	20:15:00	306
10/13/2011	20:30:00	306
10/13/2011	20:45:00	306
10/13/2011	21:00:00	306
10/13/2011	21:15:00	306
10/13/2011	21:30:00	306
10/13/2011	21:45:00	306
10/13/2011	22:00:00	306
10/13/2011	22:15:00	306
10/13/2011	22:30:00	306

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)

Piru Creek 2011 Controlled Flow Release Geomorphology Study

United Water Conservation District

DATE	TIME	Flow (cfs)
10/13/2011	22:45:00	306
10/13/2011	23:00:00	306
10/13/2011	23:15:00	306
10/13/2011	23:30:00	306
10/13/2011	23:45:00	306
10/14/2011	0:00:00	306
10/14/2011	0:15:00	306
10/14/2011	0:30:00	306
10/14/2011	0:45:00	306
10/14/2011	1:00:00	306
10/14/2011	1:15:00	306
10/14/2011	1:30:00	306
10/14/2011	1:45:00	306
10/14/2011	2:00:00	306
10/14/2011	2:15:00	306
10/14/2011	2:30:00	306
10/14/2011	2:45:00	306
10/14/2011	3:00:00	306
10/14/2011	3:15:00	306
10/14/2011	3:30:00	306
10/14/2011	3:45:00	306
10/14/2011	4:00:00	306
10/14/2011	4:15:00	306
10/14/2011	4:30:00	306
10/14/2011	4:45:00	306
10/14/2011	5:00:00	306
10/14/2011	5:15:00	306
10/14/2011	5:30:00	306
10/14/2011	5:45:00	306
10/14/2011	6:00:00	306
10/14/2011	6:15:00	306
10/14/2011	6:30:00	306
10/14/2011	6:45:00	306
10/14/2011	7:00:00	306
10/14/2011	7:15:00	306
10/14/2011	7:30:00	306
10/14/2011	7:45:00	306
10/14/2011	8:00:00	306
10/14/2011	8:15:00	306
10/14/2011	8:30:00	306
10/14/2011	8:45:00	306
10/14/2011	9:00:00	306
10/14/2011	9:15:00	306
10/14/2011	9:30:00	306
10/14/2011	9:45:00	306
10/14/2011	10:00:00	306
10/14/2011	10:15:00	306
10/14/2011	10:30:00	306
10/14/2011	10:45:00	306
10/14/2011	11:00:00	306
10/14/2011	11:15:00	306
10/14/2011	11:30:00	306
10/14/2011	11:45:00	306
10/14/2011	12:00:00	306
10/14/2011	12:15:00	306
10/14/2011	12:30:00	306
10/14/2011	12:45:00	306
10/14/2011	13:00:00	306
10/14/2011	13:15:00	306
10/14/2011	13:30:00	306
10/14/2011	13:45:00	306
10/14/2011	14:00:00	306
10/14/2011	14:15:00	306
10/14/2011	14:30:00	306
10/14/2011	14:45:00	306
10/14/2011	15:00:00	306
10/14/2011	15:15:00	306
10/14/2011	15:30:00	306
10/14/2011	15:45:00	306
10/14/2011	16:00:00	306
10/14/2011	16:15:00	306
10/14/2011	16:30:00	306
10/14/2011	16:45:00	306
10/14/2011	17:00:00	306
10/14/2011	17:15:00	306
10/14/2011	17:30:00	306
10/14/2011	17:45:00	306
10/14/2011	18:00:00	306
10/14/2011	18:15:00	306

DATE	TIME	Flow (cfs)
10/14/2011	18:30:00	306
10/14/2011	18:45:00	306
10/14/2011	19:00:00	306
10/14/2011	19:15:00	306
10/14/2011	19:30:00	306
10/14/2011	19:45:00	306
10/14/2011	20:00:00	306
10/14/2011	20:15:00	306
10/14/2011	20:30:00	306
10/14/2011	20:45:00	306
10/14/2011	21:00:00	306
10/14/2011	21:15:00	306
10/14/2011	21:30:00	306
10/14/2011	21:45:00	306
10/14/2011	22:00:00	306
10/14/2011	22:15:00	306
10/14/2011	22:30:00	306
10/14/2011	22:45:00	306
10/14/2011	23:00:00	306
10/14/2011	23:15:00	306
10/14/2011	23:30:00	306
10/14/2011	23:45:00	306
10/15/2011	0:00:00	306
10/15/2011	0:15:00	306
10/15/2011	0:30:00	306
10/15/2011	0:45:00	306
10/15/2011	1:00:00	306
10/15/2011	1:15:00	306
10/15/2011	1:30:00	306
10/15/2011	1:45:00	306
10/15/2011	2:00:00	306
10/15/2011	2:15:00	306
10/15/2011	2:30:00	306
10/15/2011	2:45:00	306
10/15/2011	3:00:00	306
10/15/2011	3:15:00	306
10/15/2011	3:30:00	306
10/15/2011	3:45:00	306
10/15/2011	4:00:00	306
10/15/2011	4:15:00	306
10/15/2011	4:30:00	306
10/15/2011	4:45:00	302
10/15/2011	5:00:00	302
10/15/2011	5:15:00	302
10/15/2011	5:30:00	302
10/15/2011	5:45:00	302
10/15/2011	6:00:00	302
10/15/2011	6:15:00	302
10/15/2011	6:30:00	302
10/15/2011	6:45:00	302
10/15/2011	7:00:00	302
10/15/2011	7:15:00	302
10/15/2011	7:30:00	302
10/15/2011	7:45:00	302
10/15/2011	8:00:00	302
10/15/2011	8:15:00	302
10/15/2011	8:30:00	302
10/15/2011	8:45:00	302
10/15/2011	9:00:00	302
10/15/2011	9:15:00	302
10/15/2011	9:30:00	302
10/15/2011	9:45:00	302
10/15/2011	10:00:00	302
10/15/2011	10:15:00	302
10/15/2011	10:30:00	302
10/15/2011	10:45:00	302
10/15/2011	11:00:00	302
10/15/2011	11:15:00	302
10/15/2011	11:30:00	302
10/15/2011	11:45:00	302
10/15/2011	12:00:00	302
10/15/2011	12:15:00	302
10/15/2011	12:30:00	302
10/15/2011	12:45:00	306
10/15/2011	13:00:00	306
10/15/2011	13:15:00	306
10/15/2011	13:30:00	306
10/15/2011	13:45:00	306
10/15/2011	14:00:00	306

DATE	TIME	Flow (cfs)
10/15/2011	14:15:00	306
10/15/2011	14:30:00	306
10/15/2011	14:45:00	306
10/15/2011	15:00:00	306
10/15/2011	15:15:00	306
10/15/2011	15:30:00	306
10/15/2011	15:45:00	306
10/15/2011	16:00:00	306
10/15/2011	16:15:00	306
10/15/2011	16:30:00	306
10/15/2011	16:45:00	306
10/15/2011	17:00:00	306
10/15/2011	17:15:00	306
10/15/2011	17:30:00	306
10/15/2011	17:45:00	306
10/15/2011	18:00:00	306
10/15/2011	18:15:00	306
10/15/2011	18:30:00	306
10/15/2011	18:45:00	306
10/15/2011	19:00:00	306
10/15/2011	19:15:00	306
10/15/2011	19:30:00	306
10/15/2011	19:45:00	306
10/15/2011	20:00:00	306
10/15/2011	20:15:00	306
10/15/2011	20:30:00	306
10/15/2011	20:45:00	306
10/15/2011	21:00:00	306
10/15/2011	21:15:00	306
10/15/2011	21:30:00	306
10/15/2011	21:45:00	306
10/15/2011	22:00:00	306
10/15/2011	22:15:00	306
10/15/2011	22:30:00	302
10/15/2011	22:45:00	302
10/15/2011	23:00:00	302
10/15/2011	23:15:00	302
10/15/2011	23:30:00	302
10/15/2011	23:45:00	302
10/16/2011	0:00:00	302
10/16/2011	0:15:00	302
10/16/2011	0:30:00	302
10/16/2011	0:45:00	302
10/16/2011	1:00:00	302
10/16/2011	1:15:00	302
10/16/2011	1:30:00	302
10/16/2011	1:45:00	302
10/16/2011	2:00:00	302
10/16/2011	2:15:00	302
10/16/2011	2:30:00	302
10/16/2011	2:45:00	302
10/16/2011	3:00:00	302
10/16/2011	3:15:00	302
10/16/2011	3:30:00	302
10/16/2011	3:45:00	302
10/16/2011	4:00:00	302
10/16/2011	4:15:00	302
10/16/2011	4:30:00	302
10/16/2011	4:45:00	302
10/16/2011	5:00:00	302
10/16/2011	5:15:00	302
10/16/2011	5:30:00	302
10/16/2011	5:45:00	302
10/16/2011	6:00:00	302
10/16/2011	6:15:00	302
10/16/2011	6:30:00	302
10/16/2011	6:45:00	302
10/16/2011	7:00:00	302
10/16/2011	7:15:00	302
10/16/2011	7:30:00	302
10/16/2011	7:45:00	302
10/16/2011	8:00:00	302
10/16/2011	8:15:00	302
10/16/2011	8:30:00	302
10/16/2011	8:45:00	302
10/16/2011	9:00:00	302
10/16/2011	9:15:00	302
10/16/2011	9:30:00	302
10/16/2011	9:45:00	302

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/16/2011	10:00:00	302
10/16/2011	10:15:00	302
10/16/2011	10:30:00	302
10/16/2011	10:45:00	302
10/16/2011	11:00:00	302
10/16/2011	11:15:00	302
10/16/2011	11:30:00	302
10/16/2011	11:45:00	302
10/16/2011	12:00:00	302
10/16/2011	12:15:00	302
10/16/2011	12:45:00	302
10/16/2011	13:00:00	302
10/16/2011	13:15:00	302
10/16/2011	13:30:00	302
10/16/2011	13:45:00	302
10/16/2011	14:00:00	302
10/16/2011	14:15:00	302
10/16/2011	14:30:00	306
10/16/2011	14:45:00	306
10/16/2011	15:00:00	306
10/16/2011	15:15:00	306
10/16/2011	15:30:00	306
10/16/2011	15:45:00	306
10/16/2011	16:00:00	306
10/16/2011	16:15:00	306
10/16/2011	16:30:00	306
10/16/2011	16:45:00	306
10/16/2011	17:00:00	306
10/16/2011	17:15:00	306
10/16/2011	17:30:00	306
10/16/2011	17:45:00	306
10/16/2011	18:00:00	306
10/16/2011	18:15:00	306
10/16/2011	18:30:00	306
10/16/2011	18:45:00	306
10/16/2011	19:00:00	306
10/16/2011	19:15:00	306
10/16/2011	19:30:00	306
10/16/2011	19:45:00	306
10/16/2011	20:00:00	306
10/16/2011	20:15:00	302
10/16/2011	20:30:00	302
10/16/2011	20:45:00	302
10/16/2011	21:00:00	302
10/16/2011	21:15:00	302
10/16/2011	21:30:00	302
10/16/2011	21:45:00	302
10/16/2011	22:00:00	302
10/16/2011	22:15:00	302
10/16/2011	22:30:00	302
10/16/2011	22:45:00	302
10/16/2011	23:00:00	302
10/16/2011	23:15:00	302
10/16/2011	23:30:00	302
10/16/2011	23:45:00	302
10/17/2011	0:00:00	302
10/17/2011	0:15:00	302
10/17/2011	0:30:00	302
10/17/2011	0:45:00	302
10/17/2011	1:00:00	302
10/17/2011	1:15:00	302
10/17/2011	1:30:00	302
10/17/2011	1:45:00	302
10/17/2011	2:00:00	302
10/17/2011	2:15:00	302
10/17/2011	2:30:00	302
10/17/2011	2:45:00	302
10/17/2011	3:00:00	302
10/17/2011	3:15:00	302
10/17/2011	3:30:00	302
10/17/2011	3:45:00	302
10/17/2011	4:00:00	302
10/17/2011	4:15:00	302
10/17/2011	4:30:00	302
10/17/2011	4:45:00	302
10/17/2011	5:00:00	302
10/17/2011	5:15:00	302
10/17/2011	5:30:00	302
10/17/2011	5:45:00	302

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/17/2011	6:00:00	302
10/17/2011	6:15:00	302
10/17/2011	6:30:00	302
10/17/2011	6:45:00	302
10/17/2011	7:00:00	302
10/17/2011	7:15:00	302
10/17/2011	7:30:00	302
10/17/2011	7:45:00	302
10/17/2011	8:00:00	302
10/17/2011	8:15:00	302
10/17/2011	8:30:00	302
10/17/2011	8:45:00	302
10/17/2011	9:00:00	302
10/17/2011	9:15:00	302
10/17/2011	9:30:00	302
10/17/2011	9:45:00	302
10/17/2011	10:00:00	302
10/17/2011	10:15:00	302
10/17/2011	10:30:00	302
10/17/2011	10:45:00	302
10/17/2011	11:00:00	302
10/17/2011	11:15:00	302
10/17/2011	11:30:00	302
10/17/2011	11:45:00	302
10/17/2011	12:00:00	302
10/17/2011	12:15:00	302
10/17/2011	12:30:00	302
10/17/2011	12:45:00	302
10/17/2011	13:00:00	302
10/17/2011	13:15:00	302
10/17/2011	13:30:00	302
10/17/2011	13:45:00	302
10/17/2011	14:00:00	302
10/17/2011	14:15:00	302
10/17/2011	14:30:00	302
10/17/2011	14:45:00	306
10/17/2011	15:00:00	306
10/17/2011	15:15:00	306
10/17/2011	15:30:00	306
10/17/2011	15:45:00	306
10/17/2011	16:00:00	306
10/17/2011	16:15:00	306
10/17/2011	16:30:00	306
10/17/2011	16:45:00	306
10/17/2011	17:00:00	306
10/17/2011	17:15:00	306
10/17/2011	17:30:00	306
10/17/2011	17:45:00	306
10/17/2011	18:00:00	306
10/17/2011	18:15:00	306
10/17/2011	18:30:00	306
10/17/2011	18:45:00	306
10/17/2011	19:00:00	306
10/17/2011	19:15:00	302
10/17/2011	19:30:00	302
10/17/2011	19:45:00	302
10/17/2011	20:00:00	302
10/17/2011	20:15:00	302
10/17/2011	20:30:00	302
10/17/2011	20:45:00	302
10/17/2011	21:00:00	302
10/17/2011	21:15:00	302
10/17/2011	21:30:00	302
10/17/2011	21:45:00	302
10/17/2011	22:00:00	302
10/17/2011	22:15:00	302
10/17/2011	22:30:00	302
10/17/2011	22:45:00	302
10/17/2011	23:00:00	302
10/17/2011	23:15:00	302
10/17/2011	23:30:00	302
10/17/2011	23:45:00	302
10/18/2011	0:00:00	302
10/18/2011	0:15:00	302
10/18/2011	0:30:00	302
10/18/2011	0:45:00	302
10/18/2011	1:00:00	302
10/18/2011	1:15:00	302
10/18/2011	1:30:00	302

APPENDIX B
Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/18/2011	1:45:00	302
10/18/2011	2:00:00	302
10/18/2011	2:15:00	302
10/18/2011	2:30:00	302
10/18/2011	2:45:00	302
10/18/2011	3:00:00	302
10/18/2011	3:15:00	302
10/18/2011	3:30:00	302
10/18/2011	3:45:00	302
10/18/2011	4:00:00	302
10/18/2011	4:15:00	302
10/18/2011	4:30:00	302
10/18/2011	4:45:00	302
10/18/2011	5:00:00	302
10/18/2011	5:15:00	302
10/18/2011	5:30:00	302
10/18/2011	5:45:00	302
10/18/2011	6:00:00	302
10/18/2011	6:15:00	302
10/18/2011	6:30:00	302
10/18/2011	6:45:00	302
10/18/2011	7:30:00	298
10/18/2011	7:45:00	298
10/18/2011	8:00:00	298
10/18/2011	8:15:00	298
10/18/2011	8:30:00	298
10/18/2011	8:45:00	298
10/18/2011	9:00:00	298
10/18/2011	9:15:00	298
10/18/2011	9:30:00	298
10/18/2011	9:45:00	298
10/18/2011	10:00:00	298
10/18/2011	10:15:00	298
10/18/2011	10:30:00	298
10/18/2011	10:45:00	298
10/18/2011	11:00:00	298
10/18/2011	11:15:00	298
10/18/2011	11:30:00	298
10/18/2011	11:45:00	298
10/18/2011	12:00:00	298
10/18/2011	12:15:00	298
10/18/2011	12:30:00	298
10/18/2011	12:45:00	298
10/18/2011	13:00:00	298
10/18/2011	13:15:00	298
10/18/2011	13:30:00	298
10/18/2011	13:45:00	302
10/18/2011	14:00:00	302
10/18/2011	14:15:00	302
10/18/2011	14:30:00	302
10/18/2011	14:45:00	302
10/18/2011	15:00:00	302
10/18/2011	15:15:00	302
10/18/2011	15:30:00	302
10/18/2011	15:45:00	302
10/18/2011	16:00:00	302
10/18/2011	16:15:00	302
10/18/2011	16:30:00	302
10/18/2011	16:45:00	302
10/18/2011	17:00:00	302
10/18/2011	17:15:00	302
10/18/2011	17:30:00	302
10/18/2011	17:45:00	302
10/18/2011	18:00:00	302
10/18/2011	18:15:00	302
10/18/2011	18:30:00	302
10/18/2011	18:45:00	302
10/18/2011	19:00:00	302
10/18/2011	19:15:00	302
10/18/2011	19:30:00	302
10/18/2011	19:45:00	302
10/18/2011	20:00:00	302
10/18/2011	20:15:00	302
10/18/2011	20:30:00	302
10/18/2011	20:45:00	302
10/18/2011	21:00:00	302
10/18/2011	21:15:00	302
10/18/2011	21:30:00	302
10/18/2011	21:45:00	298

APPENDIX B
Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/18/2011	22:00:00	298
10/18/2011	22:15:00	298
10/18/2011	22:30:00	298
10/18/2011	22:45:00	298
10/18/2011	23:00:00	298
10/18/2011	23:15:00	298
10/18/2011	23:30:00	298
10/18/2011	23:45:00	298
10/19/2011	0:00:00	298
10/19/2011	0:15:00	298
10/19/2011	0:30:00	298
10/19/2011	0:45:00	298
10/19/2011	1:00:00	298
10/19/2011	1:15:00	298
10/19/2011	1:30:00	298
10/19/2011	1:45:00	298
10/19/2011	2:00:00	298
10/19/2011	2:15:00	298
10/19/2011	2:30:00	298
10/19/2011	2:45:00	298
10/19/2011	3:00:00	298
10/19/2011	3:15:00	298
10/19/2011	3:30:00	298
10/19/2011	3:45:00	298
10/19/2011	4:00:00	298
10/19/2011	4:15:00	298
10/19/2011	4:30:00	298
10/19/2011	4:45:00	298
10/19/2011	5:00:00	298
10/19/2011	5:15:00	298
10/19/2011	5:30:00	298
10/19/2011	5:45:00	298
10/19/2011	6:00:00	298
10/19/2011	6:15:00	298
10/19/2011	6:30:00	298
10/19/2011	6:45:00	298
10/19/2011	7:00:00	298
10/19/2011	7:15:00	298
10/19/2011	7:30:00	298
10/19/2011	7:45:00	298
10/19/2011	8:00:00	209
10/19/2011	8:45:00	302
10/19/2011	9:00:00	302
10/19/2011	9:15:00	302
10/19/2011	9:30:00	302
10/19/2011	9:45:00	306
10/19/2011	10:00:00	306
10/19/2011	10:15:00	306
10/19/2011	10:30:00	306
10/19/2011	10:45:00	306
10/19/2011	11:00:00	306
10/19/2011	11:15:00	306
10/19/2011	11:30:00	306
10/19/2011	11:45:00	306
10/19/2011	12:00:00	306
10/19/2011	12:15:00	306
10/19/2011	12:30:00	306
10/19/2011	12:45:00	306
10/19/2011	13:00:00	309
10/19/2011	13:15:00	309
10/19/2011	13:30:00	309
10/19/2011	13:45:00	309
10/19/2011	14:00:00	309
10/19/2011	14:15:00	309
10/19/2011	14:30:00	309
10/19/2011	14:45:00	309
10/19/2011	15:00:00	309
10/19/2011	15:15:00	309
10/19/2011	15:30:00	309
10/19/2011	15:45:00	309
10/19/2011	16:00:00	309
10/19/2011	16:15:00	309
10/19/2011	16:30:00	309
10/19/2011	16:45:00	309
10/19/2011	17:00:00	309
10/19/2011	17:15:00	309
10/19/2011	17:30:00	309
10/19/2011	17:45:00	309
10/19/2011	18:00:00	309

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/19/2011	18:15:00	309
10/19/2011	18:30:00	309
10/19/2011	18:45:00	309
10/19/2011	19:00:00	309
10/19/2011	19:15:00	309
10/19/2011	19:30:00	309
10/19/2011	19:45:00	309
10/19/2011	20:00:00	309
10/19/2011	20:15:00	309
10/19/2011	20:30:00	309
10/19/2011	20:45:00	309
10/19/2011	21:00:00	309
10/19/2011	21:15:00	309
10/19/2011	21:30:00	309
10/19/2011	21:45:00	309
10/19/2011	22:00:00	309
10/19/2011	22:15:00	309
10/19/2011	22:30:00	309
10/19/2011	22:45:00	309
10/19/2011	23:00:00	309
10/19/2011	23:15:00	309
10/19/2011	23:30:00	309
10/19/2011	23:45:00	309
10/20/2011	0:00:00	309
10/20/2011	0:15:00	309
10/20/2011	0:30:00	306
10/20/2011	0:45:00	306
10/20/2011	1:00:00	306
10/20/2011	1:15:00	306
10/20/2011	1:30:00	306
10/20/2011	1:45:00	306
10/20/2011	2:00:00	306
10/20/2011	2:15:00	306
10/20/2011	2:30:00	306
10/20/2011	2:45:00	306
10/20/2011	3:00:00	306
10/20/2011	3:15:00	306
10/20/2011	3:30:00	306
10/20/2011	3:45:00	306
10/20/2011	4:00:00	306
10/20/2011	4:15:00	306
10/20/2011	4:30:00	306
10/20/2011	4:45:00	306
10/20/2011	5:00:00	306
10/20/2011	5:15:00	306
10/20/2011	5:30:00	306
10/20/2011	5:45:00	306
10/20/2011	6:00:00	306
10/20/2011	6:15:00	306
10/20/2011	6:30:00	306
10/20/2011	6:45:00	306
10/20/2011	7:00:00	306
10/20/2011	7:15:00	306
10/20/2011	7:30:00	306
10/20/2011	7:45:00	306
10/20/2011	8:00:00	306
10/20/2011	8:15:00	306
10/20/2011	8:30:00	306
10/20/2011	8:45:00	306
10/20/2011	9:00:00	306
10/20/2011	9:15:00	306
10/20/2011	9:30:00	306
10/20/2011	9:45:00	306
10/20/2011	10:00:00	306
10/20/2011	10:15:00	306
10/20/2011	10:30:00	306
10/20/2011	10:45:00	306
10/20/2011	11:00:00	306
10/20/2011	11:15:00	306
10/20/2011	11:30:00	306
10/20/2011	11:45:00	306
10/20/2011	12:00:00	306
10/20/2011	12:15:00	306
10/20/2011	12:30:00	306
10/20/2011	12:45:00	306
10/20/2011	13:00:00	306
10/20/2011	13:15:00	306
10/20/2011	13:30:00	306
10/20/2011	13:45:00	306

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/20/2011	14:00:00	306
10/20/2011	14:15:00	306
10/20/2011	14:30:00	306
10/20/2011	14:45:00	306
10/20/2011	15:00:00	306
10/20/2011	15:15:00	306
10/20/2011	15:30:00	306
10/20/2011	15:45:00	306
10/20/2011	16:00:00	306
10/20/2011	16:15:00	306
10/20/2011	16:30:00	306
10/20/2011	16:45:00	306
10/20/2011	17:00:00	306
10/20/2011	17:15:00	306
10/20/2011	17:30:00	306
10/20/2011	17:45:00	306
10/20/2011	18:00:00	306
10/20/2011	18:15:00	306
10/20/2011	18:30:00	306
10/20/2011	18:45:00	306
10/20/2011	19:00:00	306
10/20/2011	19:15:00	306
10/20/2011	19:30:00	306
10/20/2011	19:45:00	306
10/20/2011	20:00:00	306
10/20/2011	20:15:00	306
10/20/2011	20:30:00	306
10/20/2011	20:45:00	306
10/20/2011	21:15:00	306
10/20/2011	21:30:00	306
10/20/2011	21:45:00	306
10/20/2011	22:15:00	306
10/20/2011	22:30:00	306
10/20/2011	22:45:00	306
10/20/2011	23:00:00	306
10/20/2011	23:15:00	306
10/20/2011	23:30:00	306
10/20/2011	23:45:00	306
10/21/2011	0:00:00	306
10/21/2011	0:15:00	306
10/21/2011	0:30:00	306
10/21/2011	0:45:00	306
10/21/2011	1:00:00	306
10/21/2011	1:15:00	306
10/21/2011	1:30:00	306
10/21/2011	1:45:00	306
10/21/2011	2:00:00	306
10/21/2011	2:15:00	306
10/21/2011	2:30:00	306
10/21/2011	2:45:00	306
10/21/2011	3:00:00	306
10/21/2011	3:15:00	306
10/21/2011	3:30:00	306
10/21/2011	3:45:00	306
10/21/2011	4:00:00	306
10/21/2011	4:15:00	306
10/21/2011	4:30:00	306
10/21/2011	4:45:00	306
10/21/2011	5:00:00	306
10/21/2011	5:15:00	306
10/21/2011	5:30:00	306
10/21/2011	5:45:00	306
10/21/2011	6:00:00	306
10/21/2011	6:15:00	306
10/21/2011	6:30:00	306
10/21/2011	6:45:00	306
10/21/2011	7:00:00	306
10/21/2011	7:15:00	306
10/21/2011	7:30:00	306
10/21/2011	7:45:00	306
10/21/2011	8:00:00	306
10/21/2011	8:15:00	306
10/21/2011	8:30:00	306
10/21/2011	8:45:00	306
10/21/2011	9:00:00	306
10/21/2011	9:15:00	306
10/21/2011	9:30:00	306
10/21/2011	9:45:00	306
10/21/2011	10:00:00	306

DATE	TIME	Flow (cfs)
10/21/2011	10:15:00	306
10/21/2011	10:30:00	306
10/21/2011	10:45:00	306
10/21/2011	11:00:00	306
10/21/2011	11:15:00	306
10/21/2011	11:30:00	306
10/21/2011	11:45:00	306
10/21/2011	12:00:00	306
10/21/2011	12:15:00	306
10/21/2011	12:30:00	306
10/21/2011	12:45:00	306
10/21/2011	13:00:00	306
10/21/2011	13:15:00	306
10/21/2011	13:30:00	306
10/21/2011	13:45:00	306
10/21/2011	14:00:00	306
10/21/2011	14:15:00	306
10/21/2011	14:30:00	306
10/21/2011	14:45:00	306
10/21/2011	15:00:00	306
10/21/2011	15:15:00	306
10/21/2011	15:30:00	306
10/21/2011	15:45:00	306
10/21/2011	16:00:00	306
10/21/2011	16:15:00	306
10/21/2011	16:30:00	306
10/21/2011	16:45:00	306
10/21/2011	17:00:00	306
10/21/2011	17:15:00	306
10/21/2011	17:30:00	306
10/21/2011	17:45:00	306
10/21/2011	18:00:00	306
10/21/2011	18:15:00	306
10/21/2011	18:30:00	306
10/21/2011	18:45:00	306
10/21/2011	19:00:00	306
10/21/2011	19:15:00	306
10/21/2011	19:30:00	306
10/21/2011	19:45:00	306
10/21/2011	20:00:00	306
10/21/2011	20:15:00	306
10/21/2011	20:30:00	306
10/21/2011	20:45:00	306
10/21/2011	21:00:00	306
10/21/2011	21:15:00	306
10/21/2011	21:30:00	306
10/21/2011	21:45:00	306
10/21/2011	22:00:00	306
10/21/2011	22:15:00	306
10/21/2011	22:30:00	306
10/21/2011	22:45:00	306
10/21/2011	23:00:00	306
10/21/2011	23:15:00	306
10/21/2011	23:30:00	306
10/21/2011	23:45:00	306
10/22/2011	0:00:00	306
10/22/2011	0:15:00	306
10/22/2011	0:30:00	306
10/22/2011	0:45:00	306
10/22/2011	1:00:00	306
10/22/2011	1:15:00	306
10/22/2011	1:30:00	306
10/22/2011	1:45:00	306
10/22/2011	2:00:00	306
10/22/2011	2:15:00	306
10/22/2011	2:30:00	306
10/22/2011	2:45:00	306
10/22/2011	3:00:00	306
10/22/2011	3:15:00	306
10/22/2011	3:30:00	306
10/22/2011	3:45:00	306
10/22/2011	4:00:00	306
10/22/2011	4:15:00	306
10/22/2011	4:30:00	306
10/22/2011	4:45:00	306
10/22/2011	5:00:00	306
10/22/2011	5:15:00	306
10/22/2011	5:30:00	306
10/22/2011	5:45:00	306

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)

Piru Creek 2011 Controlled Flow Release Geomorphology Study

United Water Conservation District

DATE	TIME	Flow (cfs)
10/22/2011	6:00:00	306
10/22/2011	6:15:00	306
10/22/2011	6:30:00	306
10/22/2011	6:45:00	306
10/22/2011	7:00:00	306
10/22/2011	7:15:00	306
10/22/2011	7:30:00	306
10/22/2011	7:45:00	306
10/22/2011	8:00:00	306
10/22/2011	8:15:00	306
10/22/2011	8:30:00	306
10/22/2011	8:45:00	306
10/22/2011	9:00:00	306
10/22/2011	9:15:00	306
10/22/2011	9:30:00	306
10/22/2011	9:45:00	306
10/22/2011	10:00:00	306
10/22/2011	10:15:00	306
10/22/2011	10:30:00	306
10/22/2011	10:45:00	306
10/22/2011	11:00:00	306
10/22/2011	11:15:00	306
10/22/2011	11:30:00	306
10/22/2011	11:45:00	306
10/22/2011	12:00:00	306
10/22/2011	12:15:00	306
10/22/2011	12:30:00	306
10/22/2011	12:45:00	306
10/22/2011	13:00:00	306
10/22/2011	13:15:00	306
10/22/2011	13:30:00	306
10/22/2011	13:45:00	306
10/22/2011	14:00:00	306
10/22/2011	14:15:00	306
10/22/2011	14:30:00	306
10/22/2011	14:45:00	306
10/22/2011	15:00:00	306
10/22/2011	15:15:00	306
10/22/2011	15:30:00	306
10/22/2011	15:45:00	306
10/22/2011	16:00:00	306
10/22/2011	16:15:00	306
10/22/2011	16:30:00	306
10/22/2011	16:45:00	306
10/22/2011	17:00:00	306
10/22/2011	17:15:00	306
10/22/2011	17:30:00	306
10/22/2011	18:00:00	306
10/22/2011	18:15:00	306
10/22/2011	18:30:00	306
10/22/2011	18:45:00	306
10/22/2011	19:00:00	306
10/22/2011	19:15:00	306
10/22/2011	19:30:00	306
10/22/2011	19:45:00	306
10/22/2011	20:00:00	306
10/22/2011	20:15:00	306
10/22/2011	20:30:00	306
10/22/2011	20:45:00	306
10/22/2011	21:00:00	306
10/22/2011	21:15:00	306
10/22/2011	21:30:00	306
10/22/2011	21:45:00	306
10/22/2011	22:00:00	306
10/22/2011	22:15:00	306
10/22/2011	22:30:00	306
10/22/2011	22:45:00	306
10/22/2011	23:00:00	306
10/22/2011	23:15:00	306
10/22/2011	23:30:00	306
10/22/2011	23:45:00	306
10/23/2011	0:00:00	306
10/23/2011	0:15:00	306
10/23/2011	0:30:00	306
10/23/2011	0:45:00	306
10/23/2011	1:00:00	306
10/23/2011	1:15:00	306
10/23/2011	1:30:00	306
10/23/2011	1:45:00	306

APPENDIX B
Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/23/2011	2:00:00	306
10/23/2011	2:15:00	306
10/23/2011	2:30:00	306
10/23/2011	2:45:00	306
10/23/2011	3:00:00	306
10/23/2011	3:15:00	306
10/23/2011	3:30:00	306
10/23/2011	3:45:00	306
10/23/2011	4:00:00	306
10/23/2011	4:15:00	306
10/23/2011	4:30:00	306
10/23/2011	4:45:00	306
10/23/2011	5:00:00	306
10/23/2011	5:15:00	306
10/23/2011	5:30:00	306
10/23/2011	5:45:00	306
10/23/2011	6:00:00	306
10/23/2011	6:15:00	306
10/23/2011	6:30:00	306
10/23/2011	6:45:00	306
10/23/2011	7:00:00	306
10/23/2011	7:15:00	306
10/23/2011	7:30:00	306
10/23/2011	8:00:00	306
10/23/2011	8:15:00	306
10/23/2011	8:30:00	306
10/23/2011	8:45:00	306
10/23/2011	9:00:00	306
10/23/2011	9:15:00	306
10/23/2011	9:30:00	306
10/23/2011	9:45:00	306
10/23/2011	10:00:00	306
10/23/2011	10:15:00	306
10/23/2011	10:30:00	306
10/23/2011	10:45:00	306
10/23/2011	11:00:00	306
10/23/2011	11:15:00	306
10/23/2011	11:30:00	306
10/23/2011	11:45:00	306
10/23/2011	12:00:00	306
10/23/2011	12:15:00	306
10/23/2011	12:30:00	306
10/23/2011	12:45:00	306
10/23/2011	13:00:00	306
10/23/2011	13:15:00	306
10/23/2011	13:30:00	306
10/23/2011	13:45:00	306
10/23/2011	14:00:00	306
10/23/2011	14:15:00	306
10/23/2011	14:30:00	306
10/23/2011	14:45:00	306
10/23/2011	15:00:00	306
10/23/2011	15:15:00	306
10/23/2011	15:30:00	306
10/23/2011	15:45:00	306
10/23/2011	16:00:00	306
10/23/2011	16:15:00	306
10/23/2011	16:30:00	306
10/23/2011	16:45:00	306
10/23/2011	17:00:00	306
10/23/2011	17:15:00	306
10/23/2011	17:30:00	306
10/23/2011	17:45:00	306
10/23/2011	18:00:00	306
10/23/2011	18:15:00	306
10/23/2011	18:30:00	306
10/23/2011	18:45:00	306
10/23/2011	19:00:00	306
10/23/2011	19:15:00	306
10/23/2011	19:30:00	306
10/23/2011	19:45:00	306
10/23/2011	20:00:00	306
10/23/2011	20:15:00	306
10/23/2011	20:30:00	306
10/23/2011	20:45:00	306
10/23/2011	21:00:00	306
10/23/2011	21:15:00	306
10/23/2011	21:30:00	306
10/23/2011	21:45:00	306

DATE	TIME	Flow (cfs)
10/23/2011	22:00:00	306
10/23/2011	22:15:00	306
10/23/2011	22:30:00	306
10/23/2011	22:45:00	306
10/23/2011	23:00:00	306
10/23/2011	23:15:00	306
10/23/2011	23:30:00	306
10/23/2011	23:45:00	306
10/24/2011	0:00:00	306
10/24/2011	0:15:00	306
10/24/2011	0:30:00	306
10/24/2011	0:45:00	306
10/24/2011	1:00:00	306
10/24/2011	1:15:00	306
10/24/2011	1:30:00	306
10/24/2011	1:45:00	306
10/24/2011	2:00:00	306
10/24/2011	2:15:00	306
10/24/2011	2:30:00	306
10/24/2011	2:45:00	306
10/24/2011	3:00:00	306
10/24/2011	3:15:00	306
10/24/2011	3:30:00	306
10/24/2011	3:45:00	306
10/24/2011	4:00:00	306
10/24/2011	4:15:00	306
10/24/2011	4:30:00	306
10/24/2011	4:45:00	306
10/24/2011	5:00:00	306
10/24/2011	5:15:00	306
10/24/2011	5:30:00	306
10/24/2011	5:45:00	306
10/24/2011	6:00:00	306
10/24/2011	6:15:00	306
10/24/2011	6:30:00	306
10/24/2011	6:45:00	306
10/24/2011	7:15:00	306
10/24/2011	7:30:00	306
10/24/2011	7:45:00	306
10/24/2011	8:00:00	306
10/24/2011	8:15:00	306
10/24/2011	8:30:00	306
10/24/2011	8:45:00	306
10/24/2011	9:00:00	306
10/24/2011	9:15:00	306
10/24/2011	9:30:00	306
10/24/2011	9:45:00	306
10/24/2011	10:00:00	306
10/24/2011	10:15:00	306
10/24/2011	10:30:00	306
10/24/2011	10:45:00	306
10/24/2011	11:00:00	306
10/24/2011	11:15:00	306
10/24/2011	11:30:00	306
10/24/2011	11:45:00	306
10/24/2011	12:00:00	306
10/24/2011	12:15:00	306
10/24/2011	12:30:00	306
10/24/2011	12:45:00	306
10/24/2011	13:00:00	306
10/24/2011	13:15:00	306
10/24/2011	13:30:00	306
10/24/2011	13:45:00	306
10/24/2011	14:00:00	306
10/24/2011	14:15:00	306
10/24/2011	14:30:00	306
10/24/2011	14:45:00	306
10/24/2011	15:00:00	306
10/24/2011	15:15:00	306
10/24/2011	15:30:00	306
10/24/2011	15:45:00	306
10/24/2011	16:00:00	306
10/24/2011	16:15:00	306
10/24/2011	16:30:00	306
10/24/2011	16:45:00	306
10/24/2011	17:00:00	306
10/24/2011	17:15:00	306
10/24/2011	17:30:00	306
10/24/2011	17:45:00	306

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/24/2011	18:00:00	306
10/24/2011	18:15:00	306
10/24/2011	18:30:00	306
10/24/2011	18:45:00	306
10/24/2011	19:00:00	306
10/24/2011	19:15:00	306
10/24/2011	19:30:00	306
10/24/2011	19:45:00	306
10/24/2011	20:00:00	306
10/24/2011	20:15:00	306
10/24/2011	20:30:00	306
10/24/2011	20:45:00	306
10/24/2011	21:00:00	306
10/24/2011	21:15:00	306
10/24/2011	21:30:00	306
10/24/2011	21:45:00	306
10/24/2011	22:00:00	306
10/24/2011	22:15:00	306
10/24/2011	22:30:00	306
10/24/2011	22:45:00	306
10/24/2011	23:00:00	306
10/24/2011	23:15:00	306
10/24/2011	23:30:00	306
10/24/2011	23:45:00	306
10/25/2011	0:00:00	306
10/25/2011	0:15:00	306
10/25/2011	0:30:00	306
10/25/2011	0:45:00	306
10/25/2011	1:00:00	306
10/25/2011	1:15:00	306
10/25/2011	1:30:00	306
10/25/2011	1:45:00	306
10/25/2011	2:00:00	306
10/25/2011	2:15:00	306
10/25/2011	2:30:00	306
10/25/2011	2:45:00	306
10/25/2011	3:00:00	306
10/25/2011	3:15:00	306
10/25/2011	3:30:00	306
10/25/2011	3:45:00	306
10/25/2011	4:00:00	306
10/25/2011	4:15:00	306
10/25/2011	4:30:00	306
10/25/2011	4:45:00	306
10/25/2011	5:00:00	306
10/25/2011	5:15:00	306
10/25/2011	5:30:00	306
10/25/2011	5:45:00	306
10/25/2011	6:00:00	306
10/25/2011	6:15:00	306
10/25/2011	6:30:00	306
10/25/2011	6:45:00	306
10/25/2011	7:00:00	306
10/25/2011	7:30:00	306
10/25/2011	7:45:00	294
10/25/2011	8:00:00	287
10/25/2011	8:30:00	269
10/25/2011	8:45:00	259
10/25/2011	9:00:00	249
10/25/2011	9:15:00	239
10/25/2011	9:45:00	220
10/25/2011	10:00:00	214
10/25/2011	11:00:00	236
10/25/2011	11:15:00	230
10/25/2011	11:30:00	224
10/25/2011	11:45:00	220
10/25/2011	12:00:00	217
10/25/2011	12:15:00	211
10/25/2011	12:30:00	209
10/25/2011	12:45:00	206
10/25/2011	13:00:00	203
10/25/2011	13:15:00	197
10/25/2011	13:30:00	194
10/25/2011	13:45:00	191
10/25/2011	14:00:00	185
10/25/2011	14:15:00	182
10/25/2011	14:30:00	179
10/25/2011	14:45:00	177
10/25/2011	15:00:00	174

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/25/2011	15:15:00	171
10/25/2011	15:30:00	171
10/25/2011	15:45:00	168
10/25/2011	16:00:00	168
10/25/2011	16:15:00	166
10/25/2011	16:30:00	166
10/25/2011	16:45:00	166
10/25/2011	17:00:00	163
10/25/2011	17:15:00	163
10/25/2011	17:30:00	163
10/25/2011	17:45:00	160
10/25/2011	18:00:00	160
10/25/2011	18:15:00	160
10/25/2011	18:30:00	160
10/25/2011	18:45:00	160
10/25/2011	19:00:00	160
10/25/2011	19:15:00	160
10/25/2011	19:30:00	160
10/25/2011	19:45:00	160
10/25/2011	20:00:00	157
10/25/2011	20:15:00	157
10/25/2011	20:30:00	157
10/25/2011	20:45:00	157
10/25/2011	21:00:00	157
10/25/2011	21:15:00	157
10/25/2011	21:30:00	157
10/25/2011	21:45:00	157
10/25/2011	22:00:00	157
10/25/2011	22:15:00	157
10/25/2011	22:30:00	157
10/25/2011	22:45:00	157
10/25/2011	23:00:00	157
10/25/2011	23:15:00	157
10/25/2011	23:30:00	157
10/25/2011	23:45:00	157
10/26/2011	0:00:00	157
10/26/2011	0:15:00	157
10/26/2011	0:30:00	157
10/26/2011	0:45:00	157
10/26/2011	1:00:00	157
10/26/2011	1:15:00	155
10/26/2011	1:30:00	155
10/26/2011	1:45:00	155
10/26/2011	2:00:00	155
10/26/2011	2:15:00	155
10/26/2011	2:30:00	155
10/26/2011	2:45:00	155
10/26/2011	3:00:00	155
10/26/2011	3:15:00	155
10/26/2011	3:30:00	155
10/26/2011	3:45:00	155
10/26/2011	4:00:00	155
10/26/2011	4:15:00	155
10/26/2011	4:30:00	155
10/26/2011	4:45:00	155
10/26/2011	5:00:00	155
10/26/2011	5:15:00	155
10/26/2011	5:30:00	155
10/26/2011	5:45:00	155
10/26/2011	6:00:00	155
10/26/2011	6:15:00	155
10/26/2011	6:30:00	155
10/26/2011	6:45:00	155
10/26/2011	7:00:00	155
10/26/2011	7:30:00	152
10/26/2011	7:45:00	150
10/26/2011	8:00:00	147
10/26/2011	8:15:00	145
10/26/2011	8:30:00	140
10/26/2011	8:45:00	137
10/26/2011	9:00:00	135
10/26/2011	9:15:00	133
10/26/2011	9:30:00	131
10/26/2011	9:45:00	126
10/26/2011	10:00:00	124
10/26/2011	10:15:00	120
10/26/2011	10:30:00	116
10/26/2011	10:45:00	114
10/26/2011	11:00:00	110

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Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/26/2011	11:15:00	108
10/26/2011	11:30:00	106
10/26/2011	11:45:00	102
10/26/2011	12:00:00	100
10/26/2011	12:15:00	98
10/26/2011	12:30:00	95
10/26/2011	12:45:00	93
10/26/2011	13:00:00	91
10/26/2011	13:15:00	89
10/26/2011	13:30:00	88
10/26/2011	13:45:00	88
10/26/2011	14:00:00	86
10/26/2011	14:15:00	86
10/26/2011	14:30:00	85
10/26/2011	14:45:00	85
10/26/2011	15:00:00	85
10/26/2011	15:15:00	83
10/26/2011	15:30:00	83
10/26/2011	15:45:00	82
10/26/2011	16:00:00	82
10/26/2011	16:15:00	82
10/26/2011	16:30:00	82
10/26/2011	16:45:00	82
10/26/2011	17:00:00	82
10/26/2011	17:15:00	80
10/26/2011	17:30:00	80
10/26/2011	17:45:00	80
10/26/2011	18:00:00	80
10/26/2011	18:15:00	80
10/26/2011	18:30:00	79
10/26/2011	18:45:00	79
10/26/2011	19:00:00	79
10/26/2011	19:15:00	79
10/26/2011	19:30:00	79
10/26/2011	19:45:00	79
10/26/2011	20:00:00	79
10/26/2011	20:15:00	77
10/26/2011	20:30:00	77
10/26/2011	20:45:00	77
10/26/2011	21:00:00	77
10/26/2011	21:15:00	77
10/26/2011	21:30:00	77
10/26/2011	21:45:00	77
10/26/2011	22:00:00	77
10/26/2011	22:15:00	77
10/26/2011	22:30:00	77
10/26/2011	22:45:00	77
10/26/2011	23:00:00	76
10/26/2011	23:15:00	76
10/26/2011	23:30:00	76
10/26/2011	23:45:00	76
10/27/2011	0:00:00	76
10/27/2011	0:15:00	76
10/27/2011	0:30:00	76
10/27/2011	0:45:00	76
10/27/2011	1:00:00	76
10/27/2011	1:15:00	76
10/27/2011	1:30:00	76
10/27/2011	1:45:00	76
10/27/2011	2:00:00	76
10/27/2011	2:15:00	76
10/27/2011	2:30:00	76
10/27/2011	2:45:00	76
10/27/2011	3:00:00	76
10/27/2011	3:15:00	76
10/27/2011	3:30:00	76
10/27/2011	3:45:00	76
10/27/2011	4:00:00	76
10/27/2011	4:15:00	76
10/27/2011	4:30:00	76
10/27/2011	4:45:00	76
10/27/2011	5:00:00	76
10/27/2011	5:15:00	76
10/27/2011	5:30:00	76
10/27/2011	5:45:00	76
10/27/2011	6:00:00	76
10/27/2011	6:15:00	76
10/27/2011	6:30:00	76
10/27/2011	6:45:00	76

DATE	TIME	Flow (cfs)
10/27/2011	7:00:00	76
10/27/2011	7:15:00	75
10/27/2011	7:30:00	75
10/27/2011	7:45:00	73
10/27/2011	8:00:00	73
10/27/2011	8:15:00	73
10/27/2011	8:30:00	72
10/27/2011	8:45:00	71
10/27/2011	9:00:00	69
10/27/2011	9:15:00	68
10/27/2011	9:30:00	67
10/27/2011	9:45:00	65
10/27/2011	10:00:00	64
10/27/2011	10:15:00	63
10/27/2011	10:30:00	63
10/27/2011	10:45:00	60
10/27/2011	11:00:00	59
10/27/2011	11:15:00	58
10/27/2011	11:30:00	56
10/27/2011	11:45:00	54
10/27/2011	12:00:00	53
10/27/2011	12:15:00	53
10/27/2011	12:30:00	52
10/27/2011	12:45:00	51
10/27/2011	13:00:00	51
10/27/2011	13:15:00	49
10/27/2011	13:30:00	48
10/27/2011	13:45:00	48
10/27/2011	14:00:00	48
10/27/2011	14:15:00	48
10/27/2011	14:30:00	47
10/27/2011	14:45:00	47
10/27/2011	15:00:00	47
10/27/2011	15:15:00	46
10/27/2011	15:30:00	46
10/27/2011	15:45:00	46
10/27/2011	16:00:00	46
10/27/2011	16:15:00	46
10/27/2011	16:30:00	45
10/27/2011	16:45:00	45
10/27/2011	17:00:00	45
10/27/2011	17:15:00	45
10/27/2011	17:30:00	45
10/27/2011	17:45:00	45
10/27/2011	18:00:00	45
10/27/2011	18:15:00	44
10/27/2011	18:30:00	44
10/27/2011	18:45:00	44
10/27/2011	19:00:00	44
10/27/2011	19:15:00	44
10/27/2011	19:30:00	44
10/27/2011	19:45:00	44
10/27/2011	20:00:00	44
10/27/2011	20:15:00	44
10/27/2011	20:30:00	44
10/27/2011	20:45:00	44
10/27/2011	21:00:00	43
10/27/2011	21:15:00	43
10/27/2011	21:30:00	43
10/27/2011	21:45:00	43
10/27/2011	22:00:00	43
10/27/2011	22:15:00	43
10/27/2011	22:30:00	43
10/27/2011	22:45:00	43
10/27/2011	23:00:00	43
10/27/2011	23:15:00	42
10/27/2011	23:30:00	42
10/27/2011	23:45:00	42
10/28/2011	0:00:00	42
10/28/2011	0:15:00	42
10/28/2011	0:30:00	42
10/28/2011	0:45:00	42
10/28/2011	1:00:00	42
10/28/2011	1:15:00	42
10/28/2011	1:30:00	42
10/28/2011	1:45:00	42
10/28/2011	2:00:00	42
10/28/2011	2:15:00	42
10/28/2011	2:30:00	42

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Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/28/2011	2:45:00	42
10/28/2011	3:00:00	42
10/28/2011	3:15:00	42
10/28/2011	3:30:00	42
10/28/2011	3:45:00	42
10/28/2011	4:00:00	42
10/28/2011	4:15:00	42
10/28/2011	4:30:00	42
10/28/2011	4:45:00	42
10/28/2011	5:00:00	42
10/28/2011	5:15:00	42
10/28/2011	5:30:00	42
10/28/2011	5:45:00	42
10/28/2011	6:00:00	42
10/28/2011	6:15:00	41
10/28/2011	6:30:00	41
10/28/2011	6:45:00	41
10/28/2011	7:00:00	41
10/28/2011	7:15:00	41
10/28/2011	7:30:00	40
10/28/2011	7:45:00	40
10/28/2011	8:00:00	39
10/28/2011	8:15:00	38
10/28/2011	8:30:00	37
10/28/2011	8:45:00	36
10/28/2011	9:15:00	35
10/28/2011	9:30:00	33
10/28/2011	9:45:00	33
10/28/2011	10:00:00	31
10/28/2011	10:15:00	30
10/28/2011	10:30:00	29
10/28/2011	10:45:00	28
10/28/2011	11:00:00	28
10/28/2011	11:15:00	27
10/28/2011	11:30:00	26
10/28/2011	11:45:00	25
10/28/2011	12:00:00	23
10/28/2011	12:15:00	22
10/28/2011	12:30:00	21
10/28/2011	12:45:00	20
10/28/2011	13:00:00	20
10/28/2011	13:15:00	19
10/28/2011	13:30:00	18
10/28/2011	13:45:00	18
10/28/2011	14:00:00	17
10/28/2011	14:15:00	17
10/28/2011	14:30:00	16
10/28/2011	14:45:00	16
10/28/2011	15:00:00	15
10/28/2011	15:15:00	15
10/28/2011	15:30:00	15
10/28/2011	15:45:00	15
10/28/2011	16:00:00	15
10/28/2011	16:15:00	14
10/28/2011	16:30:00	14
10/28/2011	16:45:00	14
10/28/2011	17:00:00	14
10/28/2011	17:15:00	14
10/28/2011	17:30:00	14
10/28/2011	17:45:00	14
10/28/2011	18:00:00	14
10/28/2011	18:15:00	14
10/28/2011	18:30:00	14
10/28/2011	18:45:00	14
10/28/2011	19:00:00	14
10/28/2011	19:15:00	14
10/28/2011	19:30:00	14
10/28/2011	19:45:00	13
10/28/2011	20:00:00	13
10/28/2011	20:15:00	13
10/28/2011	20:30:00	13
10/28/2011	20:45:00	13
10/28/2011	21:00:00	13
10/28/2011	21:15:00	13
10/28/2011	21:30:00	13
10/28/2011	21:45:00	13
10/28/2011	22:00:00	13
10/28/2011	22:15:00	13
10/28/2011	22:30:00	13

APPENDIX B
Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/28/2011	22:45:00	13
10/28/2011	23:00:00	13
10/28/2011	23:15:00	13
10/28/2011	23:30:00	13
10/28/2011	23:45:00	13
10/29/2011	0:00:00	13
10/29/2011	0:15:00	13
10/29/2011	0:30:00	13
10/29/2011	0:45:00	13
10/29/2011	1:00:00	13
10/29/2011	1:15:00	13
10/29/2011	1:30:00	13
10/29/2011	1:45:00	13
10/29/2011	2:00:00	13
10/29/2011	2:15:00	13
10/29/2011	2:30:00	13
10/29/2011	2:45:00	13
10/29/2011	3:00:00	13
10/29/2011	3:15:00	13
10/29/2011	3:30:00	13
10/29/2011	3:45:00	13
10/29/2011	4:00:00	13
10/29/2011	4:15:00	13
10/29/2011	4:30:00	13
10/29/2011	4:45:00	13
10/29/2011	5:00:00	13
10/29/2011	5:15:00	13
10/29/2011	5:30:00	13
10/29/2011	5:45:00	13
10/29/2011	6:00:00	13
10/29/2011	6:15:00	13
10/29/2011	6:30:00	13
10/29/2011	6:45:00	13
10/29/2011	7:00:00	13
10/29/2011	7:15:00	13
10/29/2011	7:30:00	13
10/29/2011	7:45:00	13
10/29/2011	8:00:00	13
10/29/2011	8:15:00	13
10/29/2011	8:30:00	13
10/29/2011	8:45:00	13
10/29/2011	9:00:00	13
10/29/2011	9:15:00	13
10/29/2011	9:30:00	13
10/29/2011	9:45:00	13
10/29/2011	10:00:00	13
10/29/2011	10:15:00	13
10/29/2011	10:30:00	13
10/29/2011	10:45:00	13
10/29/2011	11:00:00	13
10/29/2011	11:15:00	13
10/29/2011	11:30:00	13
10/29/2011	11:45:00	13
10/29/2011	12:00:00	13
10/29/2011	12:15:00	13
10/29/2011	12:30:00	13
10/29/2011	12:45:00	13
10/29/2011	13:00:00	13
10/29/2011	13:15:00	13
10/29/2011	13:30:00	13
10/29/2011	13:45:00	13
10/29/2011	14:00:00	13
10/29/2011	14:15:00	13
10/29/2011	14:45:00	13
10/29/2011	15:00:00	13
10/29/2011	15:15:00	13
10/29/2011	15:30:00	13
10/29/2011	15:45:00	13
10/29/2011	16:00:00	13
10/29/2011	16:15:00	13
10/29/2011	16:30:00	13
10/29/2011	16:45:00	13
10/29/2011	17:00:00	13
10/29/2011	17:15:00	13
10/29/2011	17:30:00	13
10/29/2011	17:45:00	13
10/29/2011	18:00:00	13
10/29/2011	18:15:00	13
10/29/2011	18:30:00	13

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)

Piru Creek 2011 Controlled Flow Release Geomorphology Study

United Water Conservation District

DATE	TIME	Flow (cfs)
10/29/2011	18:45:00	13
10/29/2011	19:00:00	13
10/29/2011	19:15:00	13
10/29/2011	19:30:00	13
10/29/2011	19:45:00	13
10/29/2011	20:00:00	13
10/29/2011	20:15:00	13
10/29/2011	20:30:00	13
10/29/2011	20:45:00	13
10/29/2011	21:00:00	13
10/29/2011	21:15:00	12
10/29/2011	21:30:00	12
10/29/2011	21:45:00	12
10/29/2011	22:00:00	12
10/29/2011	22:15:00	12
10/29/2011	22:30:00	12
10/29/2011	22:45:00	12
10/29/2011	23:00:00	12
10/29/2011	23:15:00	12
10/29/2011	23:30:00	12
10/29/2011	23:45:00	12
10/30/2011	0:00:00	12
10/30/2011	0:15:00	12
10/30/2011	0:30:00	12
10/30/2011	0:45:00	12
10/30/2011	1:00:00	12
10/30/2011	1:15:00	12
10/30/2011	1:30:00	12
10/30/2011	1:45:00	12
10/30/2011	2:00:00	12
10/30/2011	2:15:00	12
10/30/2011	2:30:00	12
10/30/2011	2:45:00	12
10/30/2011	3:00:00	12
10/30/2011	3:15:00	12
10/30/2011	3:30:00	12
10/30/2011	3:45:00	12
10/30/2011	4:00:00	12
10/30/2011	4:15:00	12
10/30/2011	4:30:00	12
10/30/2011	4:45:00	12
10/30/2011	5:00:00	12
10/30/2011	5:15:00	12
10/30/2011	5:30:00	12
10/30/2011	5:45:00	12
10/30/2011	6:00:00	12
10/30/2011	6:15:00	12
10/30/2011	6:30:00	12
10/30/2011	6:45:00	12
10/30/2011	7:00:00	12
10/30/2011	7:15:00	12
10/30/2011	7:30:00	12
10/30/2011	7:45:00	12
10/30/2011	8:00:00	12
10/30/2011	8:15:00	12
10/30/2011	8:30:00	12
10/30/2011	8:45:00	12
10/30/2011	9:00:00	12
10/30/2011	9:15:00	12
10/30/2011	9:30:00	12
10/30/2011	9:45:00	12
10/30/2011	10:00:00	12
10/30/2011	10:15:00	12
10/30/2011	10:30:00	12
10/30/2011	10:45:00	12
10/30/2011	11:00:00	12
10/30/2011	11:15:00	12
10/30/2011	11:30:00	12
10/30/2011	11:45:00	12
10/30/2011	12:00:00	12
10/30/2011	12:15:00	12
10/30/2011	12:30:00	12
10/30/2011	12:45:00	12
10/30/2011	13:00:00	12
10/30/2011	13:15:00	12
10/30/2011	13:30:00	12
10/30/2011	13:45:00	12
10/30/2011	14:00:00	12
10/30/2011	14:15:00	12

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
10/30/2011	14:30:00	12
10/30/2011	14:45:00	12
10/30/2011	15:00:00	12
10/30/2011	15:15:00	12
10/30/2011	15:30:00	12
10/30/2011	15:45:00	12
10/30/2011	16:00:00	12
10/30/2011	16:15:00	12
10/30/2011	16:30:00	12
10/30/2011	16:45:00	12
10/30/2011	17:00:00	12
10/30/2011	17:15:00	12
10/30/2011	17:30:00	12
10/30/2011	17:45:00	12
10/30/2011	18:00:00	12
10/30/2011	18:15:00	12
10/30/2011	18:30:00	12
10/30/2011	18:45:00	12
10/30/2011	19:00:00	12
10/30/2011	19:15:00	12
10/30/2011	19:30:00	12
10/30/2011	19:45:00	12
10/30/2011	20:00:00	12
10/30/2011	20:15:00	12
10/30/2011	20:30:00	12
10/30/2011	20:45:00	12
10/30/2011	21:00:00	12
10/30/2011	21:15:00	12
10/30/2011	21:30:00	12
10/30/2011	21:45:00	12
10/30/2011	22:00:00	12
10/30/2011	22:15:00	12
10/30/2011	22:30:00	12
10/30/2011	22:45:00	12
10/30/2011	23:00:00	12
10/30/2011	23:15:00	12
10/30/2011	23:30:00	12
10/30/2011	23:45:00	12
10/31/2011	0:00:00	12
10/31/2011	0:15:00	12
10/31/2011	0:30:00	12
10/31/2011	0:45:00	12
10/31/2011	1:00:00	12
10/31/2011	1:15:00	12
10/31/2011	1:30:00	12
10/31/2011	1:45:00	12
10/31/2011	2:00:00	12
10/31/2011	2:15:00	12
10/31/2011	2:30:00	12
10/31/2011	2:45:00	12
10/31/2011	3:00:00	12
10/31/2011	3:15:00	12
10/31/2011	3:30:00	12
10/31/2011	3:45:00	12
10/31/2011	4:00:00	12
10/31/2011	4:15:00	12
10/31/2011	4:30:00	12
10/31/2011	4:45:00	12
10/31/2011	5:00:00	12
10/31/2011	5:15:00	12
10/31/2011	5:30:00	12
10/31/2011	5:45:00	12
10/31/2011	6:00:00	12
10/31/2011	6:15:00	12
10/31/2011	6:30:00	12
10/31/2011	6:45:00	12
10/31/2011	7:00:00	12
10/31/2011	7:30:00	12
10/31/2011	7:45:00	12
10/31/2011	8:00:00	12
10/31/2011	8:15:00	12
10/31/2011	8:30:00	12
10/31/2011	8:45:00	12
10/31/2011	9:00:00	12
10/31/2011	9:15:00	12
10/31/2011	9:30:00	12
10/31/2011	9:45:00	12
10/31/2011	10:00:00	12
10/31/2011	10:15:00	12

DATE	TIME	Flow (cfs)
10/31/2011	10:30:00	12
10/31/2011	10:45:00	12
10/31/2011	11:00:00	12
10/31/2011	11:15:00	12
10/31/2011	11:30:00	12
10/31/2011	11:45:00	12
10/31/2011	12:00:00	12
10/31/2011	12:15:00	12
10/31/2011	12:30:00	12
10/31/2011	12:45:00	12
10/31/2011	13:00:00	12
10/31/2011	13:15:00	12
10/31/2011	13:30:00	12
10/31/2011	13:45:00	12
10/31/2011	14:00:00	12
10/31/2011	14:15:00	12
10/31/2011	14:30:00	12
10/31/2011	14:45:00	12
10/31/2011	15:00:00	12
10/31/2011	15:15:00	12
10/31/2011	15:30:00	12
10/31/2011	15:45:00	12
10/31/2011	16:00:00	12
10/31/2011	16:15:00	12
10/31/2011	16:30:00	12
10/31/2011	16:45:00	12
10/31/2011	17:00:00	12
10/31/2011	17:15:00	12
10/31/2011	17:30:00	12
10/31/2011	17:45:00	12
10/31/2011	18:00:00	12
10/31/2011	18:15:00	12
10/31/2011	18:30:00	12
10/31/2011	18:45:00	12
10/31/2011	19:00:00	12
10/31/2011	19:15:00	12
10/31/2011	19:30:00	12
10/31/2011	19:45:00	12
10/31/2011	20:00:00	12
10/31/2011	20:15:00	12
10/31/2011	20:30:00	12
10/31/2011	20:45:00	12
10/31/2011	21:00:00	12
10/31/2011	21:15:00	12
10/31/2011	21:30:00	12
10/31/2011	21:45:00	12
10/31/2011	22:00:00	12
10/31/2011	22:15:00	12
10/31/2011	22:30:00	12
10/31/2011	22:45:00	12
10/31/2011	23:00:00	12
10/31/2011	23:15:00	12
10/31/2011	23:30:00	12
10/31/2011	23:45:00	12
11/1/2011	0:00:00	12
11/1/2011	0:15:00	12
11/1/2011	0:30:00	12
11/1/2011	0:45:00	12
11/1/2011	1:00:00	12
11/1/2011	1:15:00	12
11/1/2011	1:30:00	12
11/1/2011	1:45:00	12
11/1/2011	2:00:00	12
11/1/2011	2:15:00	12
11/1/2011	2:30:00	12
11/1/2011	2:45:00	12
11/1/2011	3:00:00	12
11/1/2011	3:15:00	12
11/1/2011	3:30:00	12
11/1/2011	3:45:00	12
11/1/2011	4:00:00	12
11/1/2011	4:15:00	12
11/1/2011	4:30:00	12
11/1/2011	4:45:00	12
11/1/2011	5:00:00	12
11/1/2011	5:15:00	12
11/1/2011	5:30:00	12
11/1/2011	5:45:00	12
11/1/2011	6:00:00	12

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
11/1/2011	6:15:00	12
11/1/2011	6:30:00	12
11/1/2011	6:45:00	12
11/1/2011	7:00:00	12
11/1/2011	7:15:00	12
11/1/2011	7:30:00	12
11/1/2011	7:45:00	12
11/1/2011	8:00:00	12
11/1/2011	8:15:00	12
11/1/2011	8:30:00	12
11/1/2011	8:45:00	12
11/1/2011	9:00:00	12
11/1/2011	9:15:00	12
11/1/2011	9:30:00	12
11/1/2011	9:45:00	12
11/1/2011	10:00:00	12
11/1/2011	10:15:00	12
11/1/2011	10:30:00	12
11/1/2011	10:45:00	12
11/1/2011	11:00:00	12
11/1/2011	11:15:00	12
11/1/2011	11:30:00	12
11/1/2011	11:45:00	12
11/1/2011	12:00:00	12
11/1/2011	12:15:00	12
11/1/2011	12:30:00	12
11/1/2011	12:45:00	12
11/1/2011	13:00:00	12
11/1/2011	13:15:00	12
11/1/2011	13:30:00	12
11/1/2011	13:45:00	12
11/1/2011	14:00:00	12
11/1/2011	14:15:00	12
11/1/2011	14:30:00	12
11/1/2011	14:45:00	12
11/1/2011	15:15:00	12
11/1/2011	15:30:00	12
11/1/2011	15:45:00	12
11/1/2011	16:00:00	12
11/1/2011	16:15:00	12
11/1/2011	16:30:00	12
11/1/2011	16:45:00	12
11/1/2011	17:00:00	12
11/1/2011	17:15:00	12
11/1/2011	17:30:00	12
11/1/2011	17:45:00	12
11/1/2011	18:00:00	12
11/1/2011	18:15:00	12
11/1/2011	18:30:00	12
11/1/2011	18:45:00	12
11/1/2011	19:00:00	12
11/1/2011	19:15:00	12
11/1/2011	19:30:00	12
11/1/2011	19:45:00	12
11/1/2011	20:00:00	12
11/1/2011	20:15:00	12
11/1/2011	20:30:00	12
11/1/2011	20:45:00	12
11/1/2011	21:00:00	12
11/1/2011	21:15:00	12
11/1/2011	21:30:00	12
11/1/2011	21:45:00	12
11/1/2011	22:00:00	12
11/1/2011	22:15:00	12
11/1/2011	22:30:00	12
11/1/2011	22:45:00	12
11/1/2011	23:00:00	12
11/1/2011	23:15:00	12
11/1/2011	23:30:00	12
11/1/2011	23:45:00	12
11/2/2011	0:00:00	12
11/2/2011	0:15:00	12
11/2/2011	0:30:00	12
11/2/2011	0:45:00	12
11/2/2011	1:00:00	12
11/2/2011	1:15:00	12
11/2/2011	1:30:00	12
11/2/2011	1:45:00	12
11/2/2011	2:00:00	12

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
11/2/2011	2:15:00	12
11/2/2011	2:30:00	12
11/2/2011	2:45:00	12
11/2/2011	3:00:00	12
11/2/2011	3:15:00	12
11/2/2011	3:30:00	12
11/2/2011	3:45:00	12
11/2/2011	4:00:00	12
11/2/2011	4:15:00	12
11/2/2011	4:30:00	12
11/2/2011	4:45:00	12
11/2/2011	5:00:00	12
11/2/2011	5:15:00	12
11/2/2011	5:30:00	12
11/2/2011	5:45:00	12
11/2/2011	6:00:00	12
11/2/2011	6:15:00	12
11/2/2011	6:30:00	12
11/2/2011	6:45:00	12
11/2/2011	7:00:00	12
11/2/2011	7:15:00	12
11/2/2011	7:30:00	12
11/2/2011	7:45:00	12
11/2/2011	8:00:00	12
11/2/2011	8:15:00	12
11/2/2011	8:30:00	13
11/2/2011	8:45:00	14
11/2/2011	9:00:00	15
11/2/2011	9:15:00	16
11/2/2011	9:30:00	17
11/2/2011	9:45:00	18
11/2/2011	10:15:00	20
11/2/2011	10:30:00	22
11/2/2011	10:45:00	23
11/2/2011	11:00:00	25
11/2/2011	11:15:00	26
11/2/2011	11:30:00	28
11/2/2011	11:45:00	29
11/2/2011	12:00:00	31
11/2/2011	12:15:00	114
11/2/2011	12:30:00	116
11/2/2011	13:00:00	120
11/2/2011	13:15:00	120
11/2/2011	13:30:00	120
11/2/2011	13:45:00	120
11/2/2011	14:00:00	120
11/2/2011	14:15:00	200
11/2/2011	14:45:00	239
11/2/2011	15:00:00	236
11/2/2011	15:15:00	236
11/2/2011	15:30:00	239
11/2/2011	15:45:00	239
11/2/2011	16:00:00	236
11/2/2011	16:15:00	262
11/2/2011	16:30:00	283
11/2/2011	16:45:00	283
11/2/2011	17:00:00	283
11/2/2011	17:15:00	283
11/2/2011	17:30:00	283
11/2/2011	17:45:00	283
11/2/2011	18:00:00	283
11/2/2011	18:15:00	283
11/2/2011	18:30:00	283
11/2/2011	18:45:00	283
11/2/2011	19:00:00	283
11/2/2011	19:15:00	283
11/2/2011	19:30:00	283
11/2/2011	19:45:00	283
11/2/2011	20:00:00	283
11/2/2011	20:15:00	283
11/2/2011	20:30:00	283
11/2/2011	20:45:00	283
11/2/2011	21:00:00	283
11/2/2011	21:15:00	283
11/2/2011	21:30:00	283
11/2/2011	21:45:00	283
11/2/2011	22:00:00	283
11/2/2011	22:15:00	283
11/2/2011	22:30:00	283

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
11/2/2011	22:45:00	283
11/2/2011	23:00:00	283
11/2/2011	23:15:00	283
11/2/2011	23:30:00	283
11/2/2011	23:45:00	283
11/3/2011	0:00:00	283
11/3/2011	0:15:00	283
11/3/2011	0:30:00	283
11/3/2011	0:45:00	283
11/3/2011	1:00:00	283
11/3/2011	1:15:00	283
11/3/2011	1:30:00	283
11/3/2011	1:45:00	283
11/3/2011	2:00:00	283
11/3/2011	2:15:00	283
11/3/2011	2:30:00	283
11/3/2011	2:45:00	283
11/3/2011	3:00:00	283
11/3/2011	3:15:00	283
11/3/2011	3:30:00	283
11/3/2011	3:45:00	283
11/3/2011	4:00:00	283
11/3/2011	4:15:00	283
11/3/2011	4:30:00	283
11/3/2011	4:45:00	283
11/3/2011	5:00:00	283
11/3/2011	5:15:00	283
11/3/2011	5:30:00	283
11/3/2011	5:45:00	283
11/3/2011	6:00:00	283
11/3/2011	6:15:00	291
11/3/2011	6:30:00	371
11/3/2011	6:45:00	375
11/3/2011	7:00:00	375
11/3/2011	7:15:00	394
11/3/2011	7:30:00	468
11/3/2011	8:00:00	474
11/3/2011	8:15:00	483
11/3/2011	8:45:00	499
11/3/2011	9:00:00	504
11/3/2011	9:30:00	504
11/3/2011	9:45:00	504
11/3/2011	10:00:00	504
11/3/2011	10:15:00	504
11/3/2011	10:30:00	509
11/3/2011	10:45:00	509
11/3/2011	11:00:00	509
11/3/2011	12:00:00	591
11/3/2011	12:15:00	591
11/3/2011	12:30:00	591
11/3/2011	12:45:00	591
11/3/2011	13:15:00	579
11/3/2011	13:30:00	579
11/3/2011	13:45:00	573
11/3/2011	14:00:00	573
11/3/2011	14:15:00	568
11/3/2011	14:30:00	579
11/3/2011	14:45:00	573
11/3/2011	15:00:00	568
11/3/2011	15:15:00	562
11/3/2011	15:30:00	562
11/3/2011	15:45:00	551
11/3/2011	16:00:00	551
11/3/2011	16:15:00	546
11/3/2011	16:30:00	546
11/3/2011	16:45:00	535
11/3/2011	17:00:00	519
11/3/2011	17:15:00	504
11/3/2011	17:30:00	494
11/3/2011	17:45:00	483
11/3/2011	18:00:00	474
11/3/2011	18:15:00	468
11/3/2011	18:30:00	457
11/3/2011	18:45:00	457
11/3/2011	19:00:00	451
11/3/2011	19:15:00	446
11/3/2011	19:45:00	446
11/3/2011	20:00:00	446
11/3/2011	20:15:00	441

APPENDIX B
Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
11/3/2011	20:30:00	435
11/3/2011	20:45:00	420
11/3/2011	21:00:00	415
11/3/2011	21:15:00	410
11/3/2011	21:30:00	399
11/3/2011	21:45:00	394
11/3/2011	22:00:00	390
11/3/2011	22:15:00	390
11/3/2011	22:30:00	385
11/3/2011	22:45:00	385
11/3/2011	23:00:00	380
11/3/2011	23:15:00	380
11/3/2011	23:30:00	380
11/3/2011	23:45:00	375
11/4/2011	0:00:00	375
11/4/2011	0:15:00	375
11/4/2011	0:30:00	375
11/4/2011	0:45:00	375
11/4/2011	1:00:00	375
11/4/2011	1:15:00	375
11/4/2011	1:30:00	371
11/4/2011	1:45:00	371
11/4/2011	2:00:00	371
11/4/2011	2:15:00	371
11/4/2011	2:30:00	371
11/4/2011	2:45:00	371
11/4/2011	3:00:00	371
11/4/2011	3:15:00	371
11/4/2011	3:30:00	371
11/4/2011	3:45:00	371
11/4/2011	4:00:00	371
11/4/2011	4:15:00	371
11/4/2011	4:30:00	371
11/4/2011	4:45:00	371
11/4/2011	5:00:00	371
11/4/2011	5:15:00	371
11/4/2011	5:30:00	371
11/4/2011	5:45:00	371
11/4/2011	6:00:00	371
11/4/2011	6:15:00	371
11/4/2011	6:30:00	371
11/4/2011	6:45:00	371
11/4/2011	7:00:00	371
11/4/2011	7:15:00	371
11/4/2011	7:30:00	371
11/4/2011	7:45:00	371
11/4/2011	8:00:00	371
11/4/2011	8:15:00	430
11/4/2011	8:30:00	420
11/4/2011	8:45:00	410
11/4/2011	9:00:00	410
11/4/2011	9:15:00	399
11/4/2011	9:30:00	390
11/4/2011	9:45:00	380
11/4/2011	10:00:00	375
11/4/2011	10:15:00	371
11/4/2011	10:30:00	362
11/4/2011	10:45:00	358
11/4/2011	11:00:00	349
11/4/2011	11:15:00	345
11/4/2011	11:30:00	337
11/4/2011	11:45:00	329
11/4/2011	12:00:00	321
11/4/2011	12:15:00	317
11/4/2011	12:30:00	309
11/4/2011	12:45:00	306
11/4/2011	13:00:00	298
11/4/2011	13:15:00	294
11/4/2011	13:30:00	291
11/4/2011	13:45:00	287
11/4/2011	14:00:00	283
11/4/2011	14:15:00	276
11/4/2011	14:30:00	276
11/4/2011	14:45:00	269
11/4/2011	15:00:00	266
11/4/2011	15:15:00	262
11/4/2011	15:30:00	256
11/4/2011	15:45:00	252
11/4/2011	16:00:00	249

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Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)

Piru Creek 2011 Controlled Flow Release Geomorphology Study

United Water Conservation District

DATE	TIME	Flow (cfs)
11/4/2011	16:15:00	242
11/4/2011	16:30:00	239
11/4/2011	16:45:00	233
11/4/2011	17:00:00	230
11/4/2011	17:30:00	230
11/4/2011	17:45:00	224
11/4/2011	18:00:00	220
11/4/2011	18:15:00	217
11/4/2011	18:30:00	211
11/4/2011	18:45:00	211
11/4/2011	19:00:00	209
11/4/2011	19:15:00	206
11/4/2011	19:30:00	206
11/4/2011	19:45:00	203
11/4/2011	20:00:00	203
11/4/2011	20:15:00	200
11/4/2011	20:30:00	200
11/4/2011	20:45:00	200
11/4/2011	21:00:00	197
11/4/2011	21:15:00	197
11/4/2011	21:30:00	197
11/4/2011	21:45:00	194
11/4/2011	22:00:00	194
11/4/2011	22:15:00	194
11/4/2011	22:30:00	194
11/4/2011	22:45:00	194
11/4/2011	23:00:00	194
11/4/2011	23:15:00	194
11/4/2011	23:30:00	194
11/4/2011	23:45:00	194
11/5/2011	0:00:00	191
11/5/2011	0:15:00	191
11/5/2011	0:30:00	191
11/5/2011	0:45:00	191
11/5/2011	1:00:00	191
11/5/2011	1:15:00	191
11/5/2011	1:30:00	191
11/5/2011	1:45:00	191
11/5/2011	2:00:00	191
11/5/2011	2:15:00	191
11/5/2011	2:30:00	191
11/5/2011	2:45:00	191
11/5/2011	3:00:00	191
11/5/2011	3:15:00	191
11/5/2011	3:30:00	191
11/5/2011	3:45:00	191
11/5/2011	4:00:00	191
11/5/2011	4:15:00	191
11/5/2011	4:30:00	191
11/5/2011	4:45:00	191
11/5/2011	5:00:00	191
11/5/2011	5:15:00	191
11/5/2011	5:30:00	191
11/5/2011	5:45:00	191
11/5/2011	6:00:00	191
11/5/2011	6:15:00	191
11/5/2011	6:30:00	191
11/5/2011	6:45:00	191
11/5/2011	7:00:00	191
11/5/2011	7:15:00	191
11/5/2011	7:30:00	188
11/5/2011	7:45:00	188
11/5/2011	8:00:00	185
11/5/2011	8:15:00	182
11/5/2011	8:30:00	182
11/5/2011	8:45:00	179
11/5/2011	9:00:00	179
11/5/2011	9:15:00	177
11/5/2011	9:30:00	177
11/5/2011	9:45:00	174
11/5/2011	10:00:00	171
11/5/2011	10:15:00	171
11/5/2011	10:30:00	168
11/5/2011	10:45:00	168
11/5/2011	11:15:00	163
11/5/2011	11:30:00	157
11/5/2011	11:45:00	155
11/5/2011	12:00:00	150
11/5/2011	12:15:00	147

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Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)

Piru Creek 2011 Controlled Flow Release Geomorphology Study

United Water Conservation District

DATE	TIME	Flow (cfs)
11/5/2011	12:30:00	145
11/5/2011	12:45:00	142
11/5/2011	13:00:00	137
11/5/2011	13:15:00	135
11/5/2011	13:30:00	131
11/5/2011	13:45:00	128
11/5/2011	14:00:00	126
11/5/2011	14:15:00	122
11/5/2011	14:30:00	120
11/5/2011	14:45:00	116
11/5/2011	15:00:00	114
11/5/2011	15:15:00	112
11/5/2011	15:30:00	110
11/5/2011	15:45:00	108
11/5/2011	16:00:00	108
11/5/2011	16:15:00	106
11/5/2011	16:30:00	106
11/5/2011	16:45:00	104
11/5/2011	17:00:00	104
11/5/2011	17:15:00	102
11/5/2011	17:30:00	102
11/5/2011	17:45:00	102
11/5/2011	18:00:00	102
11/5/2011	18:15:00	100
11/5/2011	18:30:00	100
11/5/2011	18:45:00	100
11/5/2011	19:00:00	100
11/5/2011	19:15:00	100
11/5/2011	19:30:00	98
11/5/2011	19:45:00	98
11/5/2011	20:00:00	98
11/5/2011	20:15:00	98
11/5/2011	20:30:00	98
11/5/2011	20:45:00	98
11/5/2011	21:00:00	98
11/5/2011	21:15:00	98
11/5/2011	21:30:00	98
11/5/2011	22:00:00	96
11/5/2011	22:15:00	96
11/5/2011	22:30:00	96
11/5/2011	22:45:00	96
11/5/2011	23:00:00	96
11/5/2011	23:15:00	96
11/5/2011	23:30:00	96
11/5/2011	23:45:00	96
11/6/2011	0:00:00	96
11/6/2011	0:15:00	96
11/6/2011	0:30:00	96
11/6/2011	0:45:00	96
11/6/2011	1:00:00	96
11/6/2011	1:15:00	96
11/6/2011	1:30:00	96
11/6/2011	1:45:00	96
11/6/2011	1:00:00	95
11/6/2011	1:15:00	95
11/6/2011	1:30:00	95
11/6/2011	1:45:00	95
11/6/2011	2:00:00	95
11/6/2011	2:15:00	95
11/6/2011	2:30:00	95
11/6/2011	2:45:00	95
11/6/2011	3:00:00	95
11/6/2011	3:15:00	95
11/6/2011	3:30:00	95
11/6/2011	3:45:00	95
11/6/2011	4:00:00	95
11/6/2011	4:15:00	95
11/6/2011	4:30:00	95
11/6/2011	4:45:00	95
11/6/2011	5:00:00	95
11/6/2011	5:15:00	95
11/6/2011	5:30:00	95
11/6/2011	5:45:00	95
11/6/2011	6:00:00	95
11/6/2011	6:15:00	95
11/6/2011	6:30:00	95
11/6/2011	6:45:00	95
11/6/2011	7:00:00	95
11/6/2011	7:15:00	95

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Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
11/6/2011	7:30:00	95
11/6/2011	7:45:00	93
11/6/2011	8:00:00	93
11/6/2011	8:15:00	93
11/6/2011	8:45:00	89
11/6/2011	9:00:00	88
11/6/2011	9:15:00	86
11/6/2011	9:30:00	86
11/6/2011	9:45:00	85
11/6/2011	10:00:00	82
11/6/2011	10:15:00	80
11/6/2011	10:30:00	77
11/6/2011	10:45:00	76
11/6/2011	11:00:00	73
11/6/2011	11:15:00	72
11/6/2011	11:30:00	69
11/6/2011	11:45:00	68
11/6/2011	12:00:00	67
11/6/2011	12:15:00	65
11/6/2011	12:30:00	64
11/6/2011	12:45:00	63
11/6/2011	13:00:00	60
11/6/2011	13:15:00	59
11/6/2011	13:30:00	58
11/6/2011	13:45:00	56
11/6/2011	14:00:00	55
11/6/2011	14:15:00	54
11/6/2011	14:30:00	53
11/6/2011	14:45:00	53
11/6/2011	15:00:00	52
11/6/2011	15:15:00	52
11/6/2011	15:30:00	51
11/6/2011	15:45:00	51
11/6/2011	16:00:00	49
11/6/2011	16:15:00	49
11/6/2011	16:30:00	49
11/6/2011	16:45:00	48
11/6/2011	17:00:00	48
11/6/2011	17:15:00	48
11/6/2011	17:30:00	48
11/6/2011	17:45:00	48
11/6/2011	18:00:00	47
11/6/2011	18:15:00	47
11/6/2011	18:30:00	47
11/6/2011	18:45:00	47
11/6/2011	19:00:00	47
11/6/2011	19:15:00	47
11/6/2011	19:30:00	46
11/6/2011	19:45:00	46
11/6/2011	20:00:00	46
11/6/2011	20:15:00	46
11/6/2011	20:30:00	46
11/6/2011	20:45:00	46
11/6/2011	21:00:00	46
11/6/2011	21:15:00	46
11/6/2011	21:30:00	46
11/6/2011	21:45:00	46
11/6/2011	22:00:00	46
11/6/2011	22:15:00	46
11/6/2011	22:30:00	46
11/6/2011	22:45:00	46
11/6/2011	23:00:00	45
11/6/2011	23:15:00	45
11/6/2011	23:30:00	45
11/6/2011	23:45:00	45
11/7/2011	0:00:00	45
11/7/2011	0:15:00	45
11/7/2011	0:30:00	45
11/7/2011	0:45:00	45
11/7/2011	1:00:00	45
11/7/2011	1:15:00	45
11/7/2011	1:30:00	45
11/7/2011	1:45:00	45
11/7/2011	2:00:00	45
11/7/2011	2:15:00	45
11/7/2011	2:30:00	45
11/7/2011	2:45:00	45
11/7/2011	3:00:00	45
11/7/2011	3:30:00	45

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Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
11/7/2011	3:45:00	45
11/7/2011	4:00:00	44
11/7/2011	4:15:00	44
11/7/2011	4:30:00	44
11/7/2011	4:45:00	44
11/7/2011	5:00:00	44
11/7/2011	5:15:00	44
11/7/2011	5:30:00	44
11/7/2011	5:45:00	44
11/7/2011	6:00:00	44
11/7/2011	6:15:00	44
11/7/2011	6:30:00	43
11/7/2011	6:45:00	43
11/7/2011	7:00:00	42
11/7/2011	7:15:00	42
11/7/2011	7:30:00	41
11/7/2011	7:45:00	40
11/7/2011	8:00:00	39
11/7/2011	8:15:00	38
11/7/2011	8:30:00	37
11/7/2011	8:45:00	37
11/7/2011	9:00:00	35
11/7/2011	9:15:00	31
11/7/2011	9:30:00	20
11/7/2011	10:00:00	20
11/7/2011	10:15:00	20
11/7/2011	10:30:00	20
11/7/2011	10:45:00	20
11/7/2011	11:00:00	20
11/7/2011	11:15:00	20
11/7/2011	11:30:00	20
11/7/2011	11:45:00	20
11/7/2011	12:00:00	20
11/7/2011	12:15:00	20
11/7/2011	12:30:00	20
11/7/2011	12:45:00	20
11/7/2011	13:00:00	20
11/7/2011	13:15:00	20
11/7/2011	13:30:00	20
11/7/2011	13:45:00	20
11/7/2011	14:00:00	20
11/7/2011	14:15:00	20
11/7/2011	14:30:00	20
11/7/2011	14:45:00	20
11/7/2011	15:00:00	20
11/7/2011	15:15:00	20
11/7/2011	15:30:00	20
11/7/2011	15:45:00	20
11/7/2011	16:00:00	20
11/7/2011	16:15:00	20
11/7/2011	16:30:00	20
11/7/2011	16:45:00	20
11/7/2011	17:00:00	20
11/7/2011	17:15:00	20
11/7/2011	17:30:00	20
11/7/2011	17:45:00	20
11/7/2011	18:00:00	20
11/7/2011	18:15:00	20
11/7/2011	18:30:00	20
11/7/2011	18:45:00	20
11/7/2011	19:00:00	20
11/7/2011	19:15:00	20
11/7/2011	19:30:00	20
11/7/2011	19:45:00	20
11/7/2011	20:00:00	20
11/7/2011	20:15:00	20
11/7/2011	20:30:00	20
11/7/2011	20:45:00	20
11/7/2011	21:00:00	20
11/7/2011	21:15:00	20
11/7/2011	21:30:00	20
11/7/2011	21:45:00	20
11/7/2011	22:00:00	20
11/7/2011	22:15:00	20
11/7/2011	22:30:00	20
11/7/2011	22:45:00	20
11/7/2011	23:00:00	20
11/7/2011	23:15:00	20
11/7/2011	23:30:00	20

DATE	TIME	Flow (cfs)
11/7/2011	23:45:00	20
11/8/2011	0:00:00	20
11/8/2011	0:15:00	20
11/8/2011	0:30:00	20
11/8/2011	0:45:00	20
11/8/2011	1:00:00	20
11/8/2011	1:15:00	20
11/8/2011	1:30:00	20
11/8/2011	1:45:00	20
11/8/2011	2:00:00	20
11/8/2011	2:15:00	20
11/8/2011	2:30:00	20
11/8/2011	2:45:00	20
11/8/2011	3:00:00	20
11/8/2011	3:15:00	20
11/8/2011	3:30:00	20
11/8/2011	3:45:00	20
11/8/2011	4:00:00	20
11/8/2011	4:15:00	20
11/8/2011	4:30:00	20
11/8/2011	4:45:00	20
11/8/2011	5:00:00	20
11/8/2011	5:15:00	20
11/8/2011	5:30:00	20
11/8/2011	5:45:00	20
11/8/2011	6:00:00	20
11/8/2011	6:15:00	20
11/8/2011	6:30:00	20
11/8/2011	6:45:00	20
11/8/2011	7:00:00	20
11/8/2011	7:15:00	20
11/8/2011	7:30:00	15
11/8/2011	7:45:00	15
11/8/2011	8:00:00	15
11/8/2011	8:15:00	15
11/8/2011	8:30:00	15
11/8/2011	8:45:00	15
11/8/2011	9:00:00	15
11/8/2011	9:15:00	15
11/8/2011	9:30:00	15
11/8/2011	9:45:00	15
11/8/2011	10:00:00	15
11/8/2011	10:15:00	15
11/8/2011	10:30:00	15
11/8/2011	10:45:00	15
11/8/2011	11:00:00	15
11/8/2011	11:15:00	15
11/8/2011	11:30:00	15
11/8/2011	11:45:00	15
11/8/2011	12:00:00	15
11/8/2011	12:15:00	15
11/8/2011	12:30:00	15
11/8/2011	12:45:00	15
11/8/2011	13:00:00	15
11/8/2011	13:15:00	15
11/8/2011	13:30:00	15
11/8/2011	13:45:00	15
11/8/2011	14:00:00	15
11/8/2011	14:15:00	15
11/8/2011	14:30:00	15
11/8/2011	14:45:00	15
11/8/2011	15:00:00	15
11/8/2011	15:15:00	15
11/8/2011	15:30:00	15
11/8/2011	15:45:00	15
11/8/2011	16:00:00	15
11/8/2011	16:15:00	15
11/8/2011	16:30:00	15
11/8/2011	16:45:00	15
11/8/2011	17:00:00	15
11/8/2011	17:15:00	15
11/8/2011	17:30:00	15
11/8/2011	17:45:00	15
11/8/2011	18:00:00	15
11/8/2011	18:15:00	15
11/8/2011	18:30:00	15
11/8/2011	18:45:00	15
11/8/2011	19:00:00	15
11/8/2011	19:15:00	15

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Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
11/8/2011	19:30:00	15
11/8/2011	19:45:00	15
11/8/2011	20:00:00	15
11/8/2011	20:15:00	15
11/8/2011	20:30:00	15
11/8/2011	20:45:00	15
11/8/2011	21:00:00	15
11/8/2011	21:15:00	15
11/8/2011	21:30:00	15
11/8/2011	21:45:00	15
11/8/2011	22:00:00	15
11/8/2011	22:15:00	15
11/8/2011	22:30:00	15
11/8/2011	22:45:00	15
11/8/2011	23:00:00	15
11/8/2011	23:15:00	15
11/8/2011	23:30:00	15
11/8/2011	23:45:00	15
11/9/2011	0:00:00	15
11/9/2011	0:15:00	15
11/9/2011	0:30:00	15
11/9/2011	0:45:00	15
11/9/2011	1:00:00	15
11/9/2011	1:15:00	15
11/9/2011	1:30:00	15
11/9/2011	1:45:00	15
11/9/2011	2:00:00	15
11/9/2011	2:15:00	15
11/9/2011	2:30:00	15
11/9/2011	2:45:00	15
11/9/2011	3:00:00	15
11/9/2011	3:15:00	15
11/9/2011	3:30:00	15
11/9/2011	3:45:00	15
11/9/2011	4:00:00	15
11/9/2011	4:15:00	15
11/9/2011	4:30:00	15
11/9/2011	4:45:00	15
11/9/2011	5:00:00	15
11/9/2011	5:15:00	15
11/9/2011	5:30:00	15
11/9/2011	5:45:00	15
11/9/2011	6:00:00	15
11/9/2011	6:15:00	15
11/9/2011	6:30:00	15
11/9/2011	6:45:00	15
11/9/2011	7:00:00	15
11/9/2011	7:15:00	15
11/9/2011	7:30:00	15
11/9/2011	7:45:00	15
11/9/2011	8:00:00	15
11/9/2011	8:45:00	4.8
11/9/2011	9:00:00	4.3
11/9/2011	9:15:00	4.1
11/9/2011	9:30:00	4.1
11/9/2011	9:45:00	4.1
11/9/2011	10:00:00	4.1
11/9/2011	10:15:00	4.1
11/9/2011	10:30:00	4.1
11/9/2011	10:45:00	4.1
11/9/2011	11:00:00	4.1
11/9/2011	11:15:00	4.1
11/9/2011	11:30:00	4.1
11/9/2011	11:45:00	4.1
11/9/2011	12:00:00	4.1
11/9/2011	12:15:00	4.1
11/9/2011	12:30:00	4.1
11/9/2011	12:45:00	4.1
11/9/2011	13:00:00	4.1
11/9/2011	13:15:00	4.1
11/9/2011	13:30:00	4.1
11/9/2011	13:45:00	4.1
11/9/2011	14:00:00	4.1
11/9/2011	14:15:00	4.1
11/9/2011	14:30:00	4.1
11/9/2011	14:45:00	4.1
11/9/2011	15:00:00	4.1
11/9/2011	15:15:00	4.1
11/9/2011	15:30:00	4.1

APPENDIX B
Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
11/9/2011	15:45:00	4.1
11/9/2011	16:00:00	4.1
11/9/2011	16:15:00	4.1
11/9/2011	16:30:00	4.1
11/9/2011	16:45:00	4.1
11/9/2011	17:00:00	4.1
11/9/2011	17:15:00	4.1
11/9/2011	17:30:00	4.1
11/9/2011	17:45:00	4.1
11/9/2011	18:00:00	4.1
11/9/2011	18:15:00	4.1
11/9/2011	18:30:00	4.1
11/9/2011	18:45:00	4.1
11/9/2011	19:00:00	4.1
11/9/2011	19:15:00	4.1
11/9/2011	19:30:00	4.1
11/9/2011	19:45:00	4.1
11/9/2011	20:00:00	4.1
11/9/2011	20:15:00	4.1
11/9/2011	20:30:00	4.1
11/9/2011	20:45:00	4.1
11/9/2011	21:00:00	4.1
11/9/2011	21:15:00	4.1
11/9/2011	21:30:00	4.1
11/9/2011	21:45:00	4.1
11/9/2011	22:00:00	4.1
11/9/2011	22:15:00	4.1
11/9/2011	22:30:00	4.1
11/9/2011	22:45:00	4.1
11/9/2011	23:00:00	4.1
11/9/2011	23:15:00	4.1
11/9/2011	23:30:00	4.1
11/9/2011	23:45:00	4.1
11/10/2011	0:00:00	4.1
11/10/2011	0:15:00	4.1
11/10/2011	0:30:00	4.1
11/10/2011	0:45:00	4.1
11/10/2011	1:00:00	4.1
11/10/2011	1:15:00	4.1
11/10/2011	1:30:00	4.1
11/10/2011	1:45:00	4.1
11/10/2011	2:00:00	4.1
11/10/2011	2:15:00	4.1
11/10/2011	2:30:00	4.1
11/10/2011	2:45:00	4.1
11/10/2011	3:00:00	4.1
11/10/2011	3:15:00	4.1
11/10/2011	3:30:00	4.1
11/10/2011	3:45:00	4.1
11/10/2011	4:00:00	4.1
11/10/2011	4:15:00	4.1
11/10/2011	4:30:00	4.1
11/10/2011	4:45:00	4.1
11/10/2011	5:00:00	4.1
11/10/2011	5:15:00	4.1
11/10/2011	5:30:00	4.1
11/10/2011	5:45:00	4.1
11/10/2011	6:00:00	4.1
11/10/2011	6:15:00	4.1
11/10/2011	6:30:00	4.1
11/10/2011	6:45:00	4.1
11/10/2011	7:00:00	4.1
11/10/2011	7:15:00	4.1
11/10/2011	7:30:00	6.3
11/10/2011	7:45:00	7.5
11/10/2011	8:00:00	7.5
11/10/2011	8:15:00	7.5
11/10/2011	8:30:00	7.5
11/10/2011	8:45:00	7.5
11/10/2011	9:00:00	7.5
11/10/2011	9:15:00	7.5
11/10/2011	9:30:00	7.8
11/10/2011	9:45:00	7.8
11/10/2011	10:00:00	7.8
11/10/2011	10:15:00	7.8
11/10/2011	10:30:00	7.8
11/10/2011	10:45:00	7.8
11/10/2011	11:00:00	7.8
11/10/2011	11:15:00	7.8

DATE	TIME	Flow (cfs)
11/10/2011	11:30:00	7.8
11/10/2011	11:45:00	7.8
11/10/2011	12:00:00	7.8
11/10/2011	12:15:00	7.8
11/10/2011	12:30:00	7.8
11/10/2011	12:45:00	7.8
11/10/2011	13:00:00	7.8
11/10/2011	13:15:00	7.8
11/10/2011	13:30:00	7.8
11/10/2011	13:45:00	7.8
11/10/2011	14:00:00	7.8
11/10/2011	14:15:00	7.8
11/10/2011	14:30:00	7.8
11/10/2011	14:45:00	7.8
11/10/2011	15:00:00	7.8
11/10/2011	15:15:00	7.8
11/10/2011	15:30:00	7.8
11/10/2011	15:45:00	7.8
11/10/2011	16:00:00	7.8
11/10/2011	16:15:00	7.8
11/10/2011	16:30:00	7.8
11/10/2011	16:45:00	7.8
11/10/2011	17:00:00	7.8
11/10/2011	17:15:00	7.8
11/10/2011	17:30:00	7.8
11/10/2011	17:45:00	7.8
11/10/2011	18:00:00	7.8
11/10/2011	18:15:00	7.8
11/10/2011	18:30:00	7.8
11/10/2011	18:45:00	7.8
11/10/2011	19:00:00	7.8
11/10/2011	19:15:00	7.8
11/10/2011	19:30:00	7.8
11/10/2011	19:45:00	7.8
11/10/2011	20:00:00	7.8
11/10/2011	20:15:00	7.8
11/10/2011	20:30:00	7.8
11/10/2011	20:45:00	7.8
11/10/2011	21:00:00	7.8
11/10/2011	21:15:00	7.8
11/10/2011	21:30:00	7.8
11/10/2011	21:45:00	7.8
11/10/2011	22:00:00	7.8
11/10/2011	22:15:00	7.8
11/10/2011	22:30:00	7.8
11/10/2011	22:45:00	7.8
11/10/2011	23:00:00	7.8
11/10/2011	23:15:00	7.8
11/10/2011	23:30:00	7.8
11/10/2011	23:45:00	7.8
11/11/2011	0:00:00	7.8
11/11/2011	0:15:00	7.8
11/11/2011	0:30:00	7.8
11/11/2011	0:45:00	7.8
11/11/2011	1:00:00	7.8
11/11/2011	1:15:00	7.8
11/11/2011	1:30:00	7.8
11/11/2011	1:45:00	7.8
11/11/2011	2:00:00	7.8
11/11/2011	2:15:00	7.8
11/11/2011	2:30:00	7.8
11/11/2011	2:45:00	7.8
11/11/2011	3:00:00	7.8
11/11/2011	3:15:00	7.8
11/11/2011	3:30:00	7.8
11/11/2011	3:45:00	7.8
11/11/2011	4:00:00	7.8
11/11/2011	4:15:00	7.8
11/11/2011	4:30:00	7.8
11/11/2011	4:45:00	7.8
11/11/2011	5:00:00	7.8
11/11/2011	5:15:00	7.8
11/11/2011	5:30:00	7.8
11/11/2011	5:45:00	7.8
11/11/2011	6:00:00	7.8
11/11/2011	6:15:00	7.8
11/11/2011	6:30:00	7.8
11/11/2011	6:45:00	7.8
11/11/2011	7:00:00	7.8

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
11/11/2011	7:15:00	7.8
11/11/2011	7:30:00	7.8
11/11/2011	7:45:00	7.8
11/11/2011	8:00:00	7.8
11/11/2011	8:15:00	7.8
11/11/2011	8:30:00	7.8
11/11/2011	8:45:00	7.8
11/11/2011	9:00:00	7.8
11/11/2011	9:15:00	7.8
11/11/2011	9:30:00	7.8
11/11/2011	9:45:00	7.8
11/11/2011	10:00:00	7.8
11/11/2011	10:15:00	7.8
11/11/2011	10:30:00	7.8
11/11/2011	10:45:00	7.8
11/11/2011	11:00:00	7.8
11/11/2011	11:15:00	7.8
11/11/2011	11:30:00	7.8
11/11/2011	11:45:00	7.8
11/11/2011	12:00:00	7.8
11/11/2011	12:15:00	7.8
11/11/2011	12:30:00	7.8
11/11/2011	12:45:00	7.8
11/11/2011	13:00:00	7.8
11/11/2011	13:15:00	7.8
11/11/2011	13:30:00	7.8
11/11/2011	13:45:00	7.8
11/11/2011	14:00:00	7.8
11/11/2011	14:15:00	7.8
11/11/2011	14:30:00	7.8
11/11/2011	14:45:00	7.8
11/11/2011	15:00:00	7.8
11/11/2011	15:15:00	7.8
11/11/2011	15:30:00	7.8
11/11/2011	15:45:00	7.8
11/11/2011	16:00:00	7.8
11/11/2011	16:15:00	7.8
11/11/2011	16:30:00	7.8
11/11/2011	16:45:00	7.8
11/11/2011	17:00:00	7.8
11/11/2011	17:15:00	7.8
11/11/2011	17:30:00	7.8
11/11/2011	17:45:00	7.8
11/11/2011	18:00:00	7.8
11/11/2011	18:15:00	7.8
11/11/2011	18:30:00	7.8
11/11/2011	18:45:00	7.8
11/11/2011	19:00:00	7.8
11/11/2011	19:15:00	7.8
11/11/2011	19:30:00	7.8
11/11/2011	19:45:00	7.8
11/11/2011	20:00:00	7.8
11/11/2011	20:15:00	7.8
11/11/2011	20:30:00	7.8
11/11/2011	20:45:00	7.8
11/11/2011	21:00:00	7.8
11/11/2011	21:15:00	7.8
11/11/2011	21:30:00	7.8
11/11/2011	21:45:00	7.8
11/11/2011	22:00:00	7.8
11/11/2011	22:15:00	7.8
11/11/2011	22:30:00	7.8
11/11/2011	22:45:00	7.8
11/11/2011	23:00:00	7.8
11/11/2011	23:15:00	7.8
11/11/2011	23:30:00	7.8
11/11/2011	23:45:00	7.8
11/12/2011	0:00:00	8.1
11/12/2011	0:15:00	8.1
11/12/2011	0:30:00	8.1
11/12/2011	0:45:00	7.8
11/12/2011	1:00:00	7.8
11/12/2011	1:15:00	7.8
11/12/2011	1:30:00	7.8
11/12/2011	1:45:00	7.8
11/12/2011	2:00:00	8.1
11/12/2011	2:15:00	8.1
11/12/2011	2:30:00	8.4
11/12/2011	2:45:00	8.4

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
11/12/2011	3:00:00	8.4
11/12/2011	3:15:00	8.1
11/12/2011	3:30:00	7.8
11/12/2011	3:45:00	7.8
11/12/2011	4:00:00	7.8
11/12/2011	4:15:00	7.8
11/12/2011	4:30:00	7.8
11/12/2011	4:45:00	7.8
11/12/2011	5:00:00	7.8
11/12/2011	5:15:00	7.8
11/12/2011	5:30:00	7.8
11/12/2011	5:45:00	7.8
11/12/2011	6:00:00	7.8
11/12/2011	6:15:00	7.8
11/12/2011	6:30:00	7.8
11/12/2011	6:45:00	7.8
11/12/2011	7:00:00	7.8
11/12/2011	7:15:00	7.8
11/12/2011	7:30:00	7.8
11/12/2011	7:45:00	7.8
11/12/2011	8:00:00	7.8
11/12/2011	8:15:00	7.8
11/12/2011	8:30:00	7.8
11/12/2011	8:45:00	7.8
11/12/2011	9:00:00	7.8
11/12/2011	9:15:00	7.8
11/12/2011	9:30:00	7.8
11/12/2011	9:45:00	7.8
11/12/2011	10:00:00	7.8
11/12/2011	10:15:00	7.8
11/12/2011	10:30:00	7.8
11/12/2011	10:45:00	7.8
11/12/2011	11:00:00	7.8
11/12/2011	11:15:00	7.8
11/12/2011	11:30:00	7.8
11/12/2011	11:45:00	7.8
11/12/2011	12:00:00	7.8
11/12/2011	12:15:00	7.8
11/12/2011	12:30:00	7.8
11/12/2011	12:45:00	7.8
11/12/2011	13:00:00	7.8
11/12/2011	13:15:00	7.8
11/12/2011	13:30:00	7.8
11/12/2011	13:45:00	7.8
11/12/2011	14:00:00	7.8
11/12/2011	14:15:00	7.8
11/12/2011	14:30:00	7.8
11/12/2011	14:45:00	7.8
11/12/2011	15:00:00	7.8
11/12/2011	15:15:00	7.8
11/12/2011	15:30:00	7.8
11/12/2011	15:45:00	7.8
11/12/2011	16:00:00	7.8
11/12/2011	16:15:00	7.8
11/12/2011	16:30:00	7.8
11/12/2011	16:45:00	7.8
11/12/2011	17:00:00	7.8
11/12/2011	17:15:00	7.8
11/12/2011	17:30:00	7.8
11/12/2011	17:45:00	7.8
11/12/2011	18:00:00	7.8
11/12/2011	18:15:00	7.8
11/12/2011	18:30:00	7.8
11/12/2011	18:45:00	7.8
11/12/2011	19:00:00	7.8
11/12/2011	19:15:00	7.8
11/12/2011	19:30:00	7.8
11/12/2011	19:45:00	7.8
11/12/2011	20:00:00	7.8
11/12/2011	20:15:00	7.8
11/12/2011	20:30:00	7.8
11/12/2011	20:45:00	7.8
11/12/2011	21:00:00	7.8
11/12/2011	21:15:00	7.8
11/12/2011	21:30:00	7.8
11/12/2011	21:45:00	7.8
11/12/2011	22:00:00	7.8
11/12/2011	22:15:00	7.8
11/12/2011	22:30:00	7.8

APPENDIX B

Provisonal Flow Data Collected During Release Events (USGS Gage No. 11109800)
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

DATE	TIME	Flow (cfs)
11/12/2011	22:45:00	7.8
11/12/2011	23:00:00	7.8
11/12/2011	23:15:00	7.8
11/12/2011	23:30:00	7.8
11/12/2011	23:45:00	7.8

Appendix C

Site Photos

Site 1 Photos

Photo #1 - Site 1
Survey: Pre 400 cfs
Cross-section: 1
View: Towards Right Bank
9/1/2011

Photo #2 - Site 1
Survey: Pre 400 cfs
Cross-section: 1
View: Downstream
9/1/2011

Photo #3 - Site 1
Survey: Pre 400 cfs
Cross-section: 1
View: Towards Left Bank
9/1/2011

Photo #4 - Site 1
Survey: Post 400 cfs
Cross-section: 1
View: Towards Right Bank
11/1/2011

Photo #5 - Site 1
Survey: Post 400 cfs
Cross-section: 1
View: Downstream
11/1/2011

Photo #6 - Site 1
Survey: Post 400 cfs
Cross-section: 1
View: Towards Left Bank
11/1/2011

Photo #7 - Site 1
Survey: Post 600 cfs
Cross-section: 1
View: Towards Right Bank
11/9/2011

Photo #8 - Site 1
Survey: Post 600 cfs
Cross-section: 1
View: Upstream
11/9/2011

Photo #9 - Site 1
Survey: Post 600 cfs
Cross-section: 1
View: Towards Left Bank
11/9/2011

Photo #10 - Site 1
Survey: Pre 400 cfs
Cross-section: 2
View: Towards Right Bank
9/1/2011

Photo #11 - Site 1
Survey: Pre 400 cfs
Cross-section: 2
View: Upstream
9/1/2011

Photo #12 - Site 1
Survey: Pre 400 cfs
Cross-section: 2
View: Towards Left Bank
9/1/2011

Photo #13 - Site 1
Survey: Post 400 cfs
Cross-section: 2
View: Towards Right Bank
11/1/2011

Photo #14 - Site 1
Survey: Post 400 cfs
Cross-section: 2
View: Upstream
11/1/2011

Photo #15 - Site 1
Survey: Post 400 cfs
Cross-section: 2
View: Towards Left Bank
11/1/2011

Photo #16 - Site 1
Survey: Post 600 cfs
Cross-section: 2
View: Towards Right Bank
11/9/2011

Photo #17 - Site 1
Survey: Post 600 cfs
Cross-section: 2
View: Upstream
11/9/2011

Photo #18 - Site 1
Survey: Post 600 cfs
Cross-section: 2
View: Towards Left Bank
11/9/2011

Photo #19 - Site 1
Survey: Pre 400 cfs
Cross-section: 3
View: Towards Right Bank
9/1/2011

Photo #20 - Site 1
Survey: Pre 400 cfs
Cross-section: 3
View: Upstream
9/1/2011

Photo #21 - Site 1
Survey: Pre 400 cfs
Cross-section: 3
View: Towards Left Bank
9/1/2011

Photo #22 - Site 1
Survey: Post 400 cfs
Cross-section: 3
View: Towards Right Bank
11/1/2011

Photo #23 - Site 1
Survey: Post 400 cfs
Cross-section: 3
View: Downstream
11/1/2011

Photo #24 - Site 1
Survey: Post 400 cfs
Cross-section: 3
View: Towards Left Bank
11/1/2011

Photo #25 - Site 1
Survey: Post 600 cfs
Cross-section: 3
View: Towards Right Bank
11/9/2011

Photo #26 - Site 1
Survey: Post 600 cfs
Cross-section: 3
View: Downstream
11/9/2011

Photo #27 - Site 1
Survey: Post 600 cfs
Cross-section: 3
View: Towards Left Bank
11/9/2011

Photo #28 - Site 1
Survey: Pre 400 cfs
Cross-section: 4
View: Towards Right Bank
9/1/2011

Photo #29 - Site 1
Survey: Pre 400 cfs
Cross-section: 4
View: Downstream with Tracer Gravels
9/1/2011

Photo #30 - Site 1
Survey: Pre 400 cfs
Cross-section: 4
View: Towards Left Bank
9/1/2011

Photo #31 - Site 1
Survey: Post 400 cfs
Cross-section: 4
View: Towards Right Bank
11/1/2011

Photo #32 - Site 1
Survey: Post 400 cfs
Cross-section: 4
View: Downstream
11/1/2011

Photo #33 - Site 1
Survey: Post 400 cfs
Cross-section: 4
View: Towards Left Bank
11/1/2011

Photo #34 - Site 1
Survey: Post 600 cfs
Cross-section: 4
View: Towards Right Bank
11/9/2011

Photo #35 - Site 1
Survey: Post 600 cfs
Cross-section: 4
View: Upstream
11/9/2011

Photo #36 - Site 1
Survey: Post 600 cfs
Cross-section: 4
View: Towards Left Bank
11/9/2011

Photo #37 - Site 1
Survey: Pre 400 cfs
Cross-section: 5
View: Towards Right Bank
9/1/2011

Photo #38 - Site 1
Survey: Pre 400 cfs
Cross-section: 5
View: Upstream
9/1/2011

Photo #39 - Site 1
Survey: Pre 400 cfs
Cross-section: 5
View: Towards Left Bank
9/1/2011

Photo #40 - Site 1
Survey: Post 400 cfs
Cross-section: 5
View: Towards Right Bank
11/1/2011

Photo #41 - Site 1
Survey: Post 400 cfs
Cross-section: 5
View: Upstream
11/1/2011

Photo #42 - Site 1
Survey: Post 400 cfs
Cross-section: 5
View: Towards Left Bank
11/1/2011

Photo #43 - Site 1
Survey: Post 600 cfs
Cross-section: 5
View: Towards Right Bank
11/9/2011

Photo #44 - Site 1
Survey: Post 600 cfs
Cross-section: 5
View: Downstream
11/9/2011

Photo #45 - Site 1
Survey: Post 600 cfs
Cross-section: 5
View: Towards Left Bank
11/9/2011

Photo #46 - Site 1
Survey: Pre 400 cfs
Cross-section: 6
View: Towards Right Bank
9/1/2011

Photo #47 - Site 1
Survey: Pre 400 cfs
Cross-section: 6
View: Upstream
9/1/2011

Photo #48 - Site 1
Survey: Pre 400 cfs
Cross-section: 6
View: Towards Left Bank
9/1/2011

Photo #49 - Site 1
Survey: Post 400 cfs
Cross-section: 6
View: Towards Right Bank
11/1/2011

Photo #50 - Site 1
Survey: Post 400 cfs
Cross-section: 6
View: Downstream
11/1/2011

Photo #51 - Site 1
Survey: Post 400 cfs
Cross-section: 6
View: Towards Left Bank
11/1/2011

Photo #52 - Site 1
Survey: Post 600 cfs
Cross-section: 6
View: Towards Right Bank
11/9/2011

Photo #53 - Site 1
Survey: Post 600 cfs
Cross-section: 6
View: Downstream
11/9/2011

Photo #54 - Site 1
Survey: Post 600 cfs
Cross-section: 6
View: Towards Left Bank
11/9/2011

Photo #55 - Site 1
Survey: Pre 400 cfs
Cross-section: 7
View: Towards Right Bank with Staff gauge
9/1/2011

Photo #56 - Site 1
Survey: Pre 400 cfs
Cross-section: 7
View: Downstream
9/1/2011

Photo #57 - Site 1
Survey: Pre 400 cfs
Cross-section: 7
View: Towards Left Bank
9/1/2011

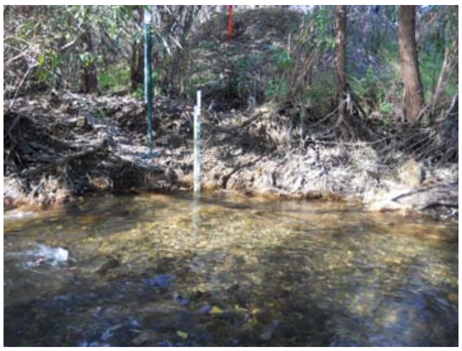


Photo #58 - Site 1
Survey: Post 400 cfs
Cross-section: 7
View: Towards Right Bank with Staff gauge
11/1/2011

Photo #59 - Site 1
Survey: Post 400 cfs
Cross-section: 7
View: Downstream
11/1/2011

Photo #60 - Site 1
Survey: Post 400 cfs
Cross-section: 7
View: Towards Left Bank
11/1/2011

Photo #61 - Site 1
Survey: Post 600 cfs
Cross-section: 7
View: Towards Right Bank with Staff gauge
11/9/2011

Photo #62 - Site 1
Survey: Post 600 cfs
Cross-section: 7
View: Downstream
11/9/2011

Photo #63 - Site 1
Survey: Post 600 cfs
Cross-section: 7
View: Towards Left Bank
11/9/2011

Photo #64 - Site 1
Survey: Pre 400 cfs
Cross-section: 1 - Tracer Gravels
View: Towards Left Bank
9/1/2011

Photo #65 - Site 1
Survey: Pre 400 cfs
Cross-section: 1 - Tracer Gravels
View: Downstream
9/1/2011

Photo #66 - Site 1
Survey: Pre 400 cfs
Cross-section: 4 - Tracer Gravels
View: Towards Right Bank
9/1/2011

Photo #67 - Site 1
Survey: Post 400 cfs
Cross-section: NA
View:
11/1/2011

Photo #68 - Site 1
Survey: Post 400 cfs
Cross-section: 1 - Tracer Gravels
View: Towards Left Bank
11/1/2011

Photo #69 - Site 1
Survey: Post 400 cfs
Cross-section: 4 - Tracer Gravels
View: Towards Right Bank
11/1/2011

No Tracer Gravel photos Available at Site 1 following the 600 cfs Release

Site 2 Photos

Photo #70 - Site 2
Survey: Pre 400 cfs
Cross-section: 1
View: Towards Right Bank
8/31/2011

Photo #71 - Site 2
Survey: Pre 400 cfs
Cross-section: 1
View: Downstream
8/31/2011

Photo #72 - Site 2
Survey: Pre 400 cfs
Cross-section: 1
View: Towards Left Bank
8/31/2011

Photo #73 - Site 2
Survey: Post 400 cfs
Cross-section: 1
View: Towards Right Bank
11/1/2011

Photo #74 - Site 2
Survey: Post 400 cfs
Cross-section: 1
View: Upstream
11/1/2011

Photo #75 - Site 2
Survey: Post 400 cfs
Cross-section: 1
View: Towards Left Bank
11/1/2011

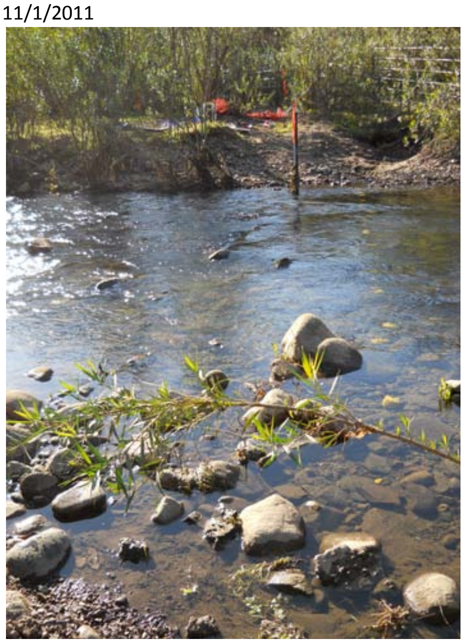


Photo #76 - Site 2
Survey: Post 600 cfs
Cross-section: 1
View: Towards Right Bank
11/9/2011

Photo #77 - Site 2
Survey: Post 600 cfs
Cross-section: 1
View: Upstream
11/9/2011

Photo #78 - Site 2
Survey: Post 600 cfs
Cross-section: 1
View: Towards Left Bank
11/9/2011

Photo #79 - Site 2
Survey: Pre 400 cfs
Cross-section: 2
View: Towards Right Bank
9/1/2011

Photo #80 - Site 2
Survey: Pre 400 cfs
Cross-section: 2
View: Downstream
8/31/2011

Photo #81 - Site 2
Survey: Pre 400 cfs
Cross-section: 2
View: Towards Left Bank
8/31/2011

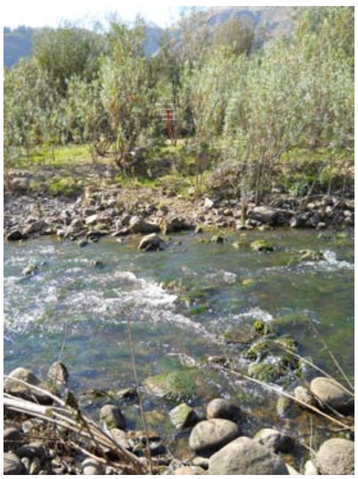


Photo #82 - Site 2
Survey: Post 400 cfs
Cross-section: 2
View: Towards Right Bank
11/1/2011

Photo #83 - Site 2
Survey: Post 400 cfs
Cross-section: 2
View: Upstream
11/1/2011

Photo #84 - Site 2
Survey: Post 400 cfs
Cross-section: 2
View: Towards Left Bank
11/1/2011

Photo #85 - Site 2
Survey: Post 600 cfs
Cross-section: 2
View: Towards Right Bank
11/9/2011

Photo #86 - Site 2
Survey: Post 600 cfs
Cross-section: 2
View: Upstream
11/9/2011

Photo #87 - Site 2
Survey: Post 600 cfs
Cross-section: 2
View: Towards Left Bank
11/9/2011

Photo #88 - Site 2
Survey: Pre 400 cfs
Cross-section: 3
View: Towards Right Bank
8/31/2011

Photo #89 - Site 2
Survey: Pre 400 cfs
Cross-section: 3
View: Downstream
8/31/2011

Photo #90 - Site 2
Survey: Pre 400 cfs
Cross-section: 3
View: Towards Left Bank
8/31/2011

Photo #91 - Site 2
Survey: Post 400 cfs
Cross-section: 3
View: Towards Right Bank
11/1/2011

Photo #92 - Site 2
Survey: Post 400 cfs
Cross-section: 3
View: Downstream
11/1/2011

Photo #93 - Site 2
Survey: Post 400 cfs
Cross-section: 3
View: Towards Left Bank
11/1/2011

Photo #94 - Site 2
Survey: Post 600 cfs
Cross-section: 3
View: Towards Right Bank
11/9/2011

Photo #95 - Site 2
Survey: Post 600 cfs
Cross-section: 3
View: Downstream
11/9/2011

Photo #96 - Site 2
Survey: Post 600 cfs
Cross-section: 3
View: Towards Left Bank
11/9/2011

Photo #97 - Site 2
Survey: Pre 400 cfs
Cross-section: 4
View: Towards Right Bank
8/31/2011

Photo #98 - Site 2
Survey: Pre 400 cfs
Cross-section: 4
View: Upstream
8/31/2011

Photo #99 - Site 2
Survey: Pre 400 cfs
Cross-section: 4
View: Towards Left Bank
8/31/2011

Photo #100 - Site 2
Survey: Post 400 cfs
Cross-section: 4
View: Towards Right Bank
11/1/2011

Photo #101 - Site 2
Survey: Post 400 cfs
Cross-section: 4
View: Upstream
11/1/2011

Photo #102 - Site 2
Survey: Post 400 cfs
Cross-section: 4
View: Towards Left Bank
11/1/2011

Photo #103 - Site 2
Survey: Post 600 cfs
Cross-section: 4
View: Towards Right Bank
11/9/2011

Photo #104 - Site 2
Survey: Post 600 cfs
Cross-section: 4
View: Upstream
11/9/2011

Photo #105 - Site 2
Survey: Post 600 cfs
Cross-section: 4
View: Towards Left Bank
11/9/2011

Photo #106 - Site 2
Survey: Pre 400 cfs
Cross-section: 5
View: Towards Right Bank
8/31/2011

Photo #107 - Site 2
Survey: Pre 400 cfs
Cross-section: 5
View: Upstream
8/31/2011

Photo #108 - Site 2
Survey: Pre 400 cfs
Cross-section: 5
View: Towards Left Bank
8/31/2011

Photo #109 - Site 2
Survey: Post 400 cfs
Cross-section: 5
View: Towards Right Bank
11/1/2011

Photo #110 - Site 2
Survey: Post 400 cfs
Cross-section: 5
View: Upstream
11/1/2011

Photo #111 - Site 2
Survey: Post 400 cfs
Cross-section: 5
View: Towards Left Bank
11/1/2011

Photo #112 - Site 2
Survey: Post 600 cfs
Cross-section: 5
View: Towards Right Bank
11/9/2011

Photo #113 - Site 2
Survey: Post 600 cfs
Cross-section: 5
View: Upstream
11/9/2011

Photo #114 - Site 2
Survey: Post 600 cfs
Cross-section: 5
View: Towards Left Bank
11/9/2011

Photo #115 - Site 2
Survey: Pre 400 cfs
Cross-section: 1 - Tracer Gravels
View: Towards Left Bank
8/31/2011

Photo #116 - Site 2
Survey: Pre 400 cfs
Cross-section: 5 - Tracer Gravels
View: Towards Left Bank
8/31/2011

Photo #117 - Site 2
Survey: Pre 400 cfs
Cross-section: 5 - Tracer Gravels
View: Towards Left Bank
8/31/2011

Photo #118 - Site 2
Survey: Post 400 cfs
Cross-section: 1 - Recovered Tracer Gravels from 400 cfs Flows
View: NA
11/1/2011

Photo #119 - Site 2
Survey: Post 400 cfs
Cross-section: 1 - Tracer Gravels
View: Towards Left Bank
11/1/2011

Photo #120 - Site 2
Survey: Post 400 cfs
Cross-section: 5 - Tracer Gravels
View: Towards Right Bank
11/1/2011

Photo #121 - Site 2
Survey: Post 600 cfs
Cross-section: 1 - Tracer Gravels
View: Towards Left Bank
11/9/2011

Photo #122 - Site 2
Survey: Post 600 cfs
Cross-section: 5 - Tracer Gravels
View: Towards Left Bank
11/9/2011

Site 3 Photos

a

Photo #123 - Site 3
Survey: Pre 400 cfs
Cross-section: 1
View: Towards Right Bank
9/1/2011

Photo #124 - Site 3
Survey: Pre 400 cfs
Cross-section: 1
View: Downstream
9/1/2011

Photo #125 - Site 3
Survey: Pre 400 cfs
Cross-section: 1
View: Towards Left Bank
9/1/2011

Photo #126 - Site 3
Survey: Post 400 cfs
Cross-section: 1
View: Towards Right Bank
11/1/2011

Photo #127 - Site 3
Survey: Post 400 cfs
Cross-section: 1
View: Upstream
11/1/2011

No Photo Available

Photo #128 - Site 3
Survey: Post 400 cfs
Cross-section: 1
View: Towards Left Bank
11/1/2011

Photo #129 - Site 3
Survey: Post 600 cfs
Cross-section: 1
View: Towards Right Bank
11/9/2011

Photo #130 - Site 3
Survey: Post 600 cfs
Cross-section: 1
View: Upstream
11/9/2011

Photo #131 - Site 3
Survey: Post 600 cfs
Cross-section: 1
View: Towards Left Bank
11/9/2011

Photo #132 - Site 3
Survey: Pre 400 cfs
Cross-section: 2
View: Towards Right Bank
9/1/2011

Photo #133 - Site 3
Survey: Pre 400 cfs
Cross-section: 2
View: Upstream
9/1/2011

Photo #134 - Site 3
Survey: Pre 400 cfs
Cross-section: 2
View: Towards Left Bank
9/1/2011

Photo #135 - Site 3
Survey: Post 400 cfs
Cross-section: 2
View: Towards Right Bank
11/1/2011

Photo #136 - Site 3
Survey: Post 400 cfs
Cross-section: 2
View: Downstream
11/1/2011

No Photo Available

Photo #137 - Site 3
Survey: Post 400 cfs
Cross-section: 2
View: Towards Left Bank
11/1/2011

Photo #138 - Site 3
Survey: Post 600 cfs
Cross-section: 2
View: Towards Right Bank
11/9/2011

Photo #139 - Site 3
Survey: Post 600 cfs
Cross-section: 2
View: Upstream
11/9/2011

Photo #140 - Site 3
Survey: Post 600 cfs
Cross-section: 2
View: Towards Left Bank
11/9/2011

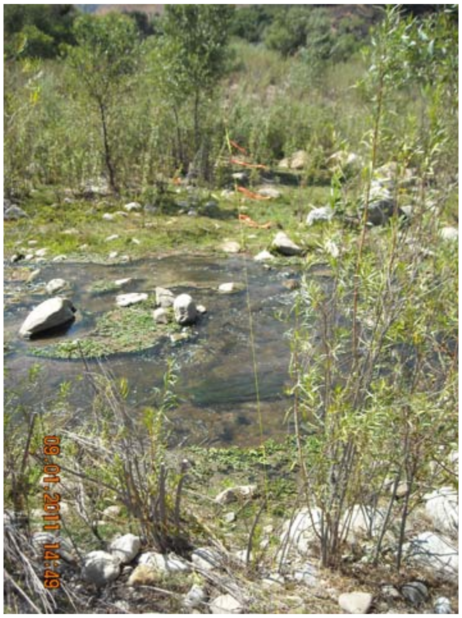


Photo #141 - Site 3
Survey: Pre 400 cfs
Cross-section: 3
View: Towards Right Bank
9/1/2011

Photo #142 - Site 3
Survey: Pre 400 cfs
Cross-section: 3
View: Upstream
9/1/2011

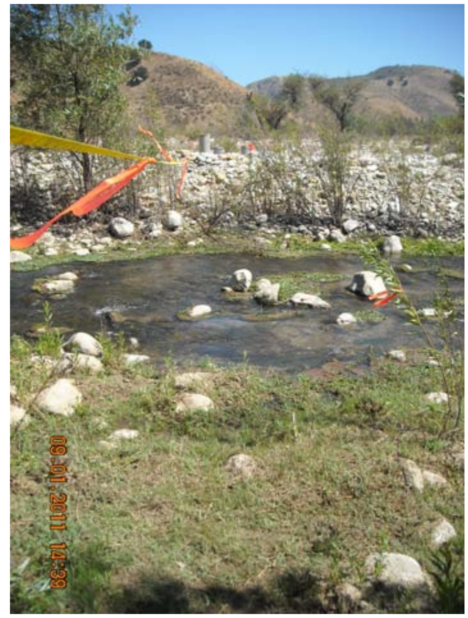


Photo #143 - Site 3
Survey: Pre 400 cfs
Cross-section: 3
View: Towards Left Bank
9/1/2011

Photo #144 - Site 3
Survey: Post 400 cfs
Cross-section: 3
View: Towards Right Bank
11/1/2011

Photo #145 - Site 3
Survey: Post 400 cfs
Cross-section: 3
View: Downstream
11/1/2011

No Photo Available

Photo #146 - Site 3
Survey: Post 400 cfs
Cross-section: 3
View: Towards Left Bank
11/1/2011

Photo #147 - Site 3
Survey: Post 600 cfs
Cross-section: 3
View: Towards Right Bank
11/9/2011

Photo #148 - Site 3
Survey: Post 600 cfs
Cross-section: 3
View: Upstream
11/9/2011

Photo #149 - Site 3
Survey: Post 600 cfs
Cross-section: 3
View: Towards Right Bank
11/9/2011

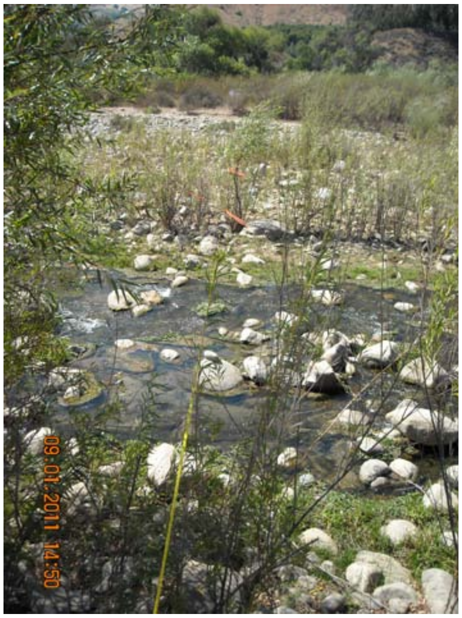


Photo #150 - Site 3
Survey: Pre 400 cfs
Cross-section: 4
View: Towards Right Bank
9/1/2011

Photo #151 - Site 3
Survey: Pre 400 cfs
Cross-section: 4
View: Downstream
9/1/2011

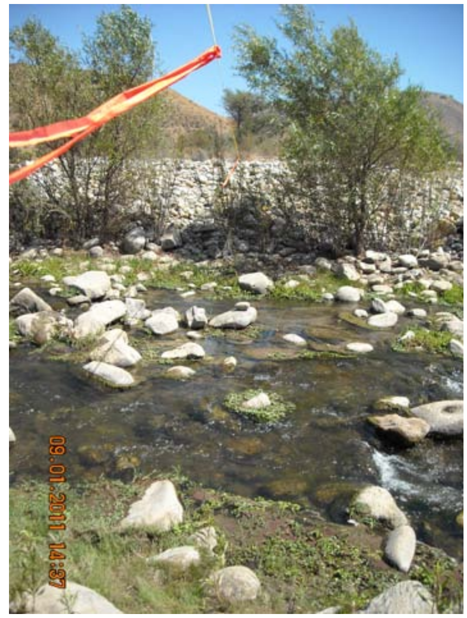


Photo #152 - Site 3
Survey: Pre 400 cfs
Cross-section: 4
View: Towards Left Bank
9/1/2011

Photo #153 - Site 3
Survey: Post 400 cfs
Cross-section: 4
View: Towards Right Bank
11/1/2011

Photo #154 - Site 3
Survey: Post 400 cfs
Cross-section: 4
View: Upstream
11/1/2011

No Photo Available

Photo #155 - Site 3
Survey: Post 400 cfs
Cross-section: 4
View: Towards Left Bank
11/1/2011

Photo #156 - Site 3
Survey: Post 600 cfs
Cross-section: 4
View: Towards Right Bank
11/9/2011

Photo #157 - Site 3
Survey: Post 600 cfs
Cross-section: 4
View: Upstream
11/9/2011

Photo #158 - Site 3
Survey: Post 600 cfs
Cross-section: 4
View: Towards Left Bank
11/9/2011

Photo #159 - Site 3
Survey: Pre 400 cfs
Cross-section: 5
View: Towards Right Bank
9/1/2011

Photo #160 - Site 3
Survey: Pre 400 cfs
Cross-section: 5
View: Upstream
9/1/2011

Photo #161 - Site 3
Survey: Pre 400 cfs
Cross-section: 5
View: Towards Left Bank
9/1/2011

Photo #162 - Site 3
Survey: Post 400 cfs
Cross-section: 5
View: Towards Right Bank
11/1/2011

Photo #163 - Site 3
Survey: Post 400 cfs
Cross-section: 5
View: Upstream
11/1/2011

No Photo Available

Photo #164 - Site 3
Survey: Post 400 cfs
Cross-section: 5
View: Towards Left Bank
11/1/2011

Photo #165 - Site 3
Survey: Post 600 cfs
Cross-section: 5
View: Towards Right Bank
11/9/2011

Photo #166 - Site 3
Survey: Post 600 cfs
Cross-section: 5
View: Upstream
11/9/2011

Photo #167 - Site 3
Survey: Post 600 cfs
Cross-section: 5
View: Towards Right Bank
11/9/2011

Photo #168 - Site 3
Survey: Pre 400 cfs
Cross-section: 6
View: Towards Right Bank
9/1/2011

Photo #169 - Site 3
Survey: Pre 400 cfs
Cross-section: 6
View: Upstream
9/1/2011

Photo #170 - Site 3
Survey: Pre 400 cfs
Cross-section: 6
View: Towards Left Bank
9/1/2011

Photo #171 - Site 3
Survey: Post 400 cfs
Cross-section: 6
View: Towards Right Bank
11/1/2011

Photo #172 - Site 3
Survey: Post 400 cfs
Cross-section: 6
View: Upstream
11/1/2011

No Photo Available

Photo #173 - Site 3
Survey: Post 400 cfs
Cross-section: 6
View: Towards Left Bank
11/1/2011

Photo #174 - Site 3
Survey: Post 600 cfs
Cross-section: 6
View: Towards Right Bank
11/9/2011

Photo #175 - Site 3
Survey: Post 600 cfs
Cross-section: 6
View: Upstream
11/9/2011

Photo #176 - Site 3
Survey: Post 600 cfs
Cross-section: 6
View: Towards Right Bank
11/9/2011

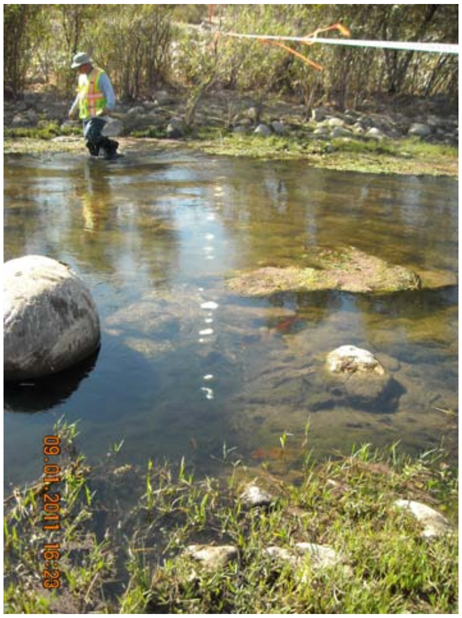


Photo #177 - Site 3
Survey: Pre 400 cfs
Cross-section: 1 - Tracer Gravels
View: Towards Left Bank
9/1/2011

Photo #178 - Site 3
Survey: Pre 400 cfs
Cross-section: 5 - Tracer Gravels
View: Downstream
9/1/2011

Photo #179 - Site 3
Survey: Pre 400 cfs
Cross-section: 5 - Tracer Gravels
View: Upstream
9/1/2011

Photo #180 - Site 3
Survey: Post 400 cfs
Cross-section: 1 - Tracer Gravel
View: NA
11/1/2011

Photo #181 - Site 3
Survey: Post 400 cfs
Cross-section: 1 - Tracer Gravels Setup
View: Downstream
11/1/2011

Photo #182 - Site 3
Survey: Post 400 cfs
Cross-section: 5 - Staff Gauge - high water marks
View: Towards Right Bank
11/1/2011

Photo #183 - Site 3
Survey: Post 600 cfs
Cross-section: 1 - Staff Gauge - high water marks
View: NA
11/9/2011

Site 4 Photos

Photo #183 - Site 4
Survey: Pre 400 cfs
Cross-section: 1
View: Towards Right Bank
9/1/2011

Photo #184 - Site 4
Survey: Pre 400 cfs
Cross-section: 1
View: Downstream
9/1/2011

Photo #185 - Site 4
Survey: Pre 400 cfs
Cross-section: 1
View: Towards Left Bank
9/1/2011


Photo #186 - Site 4
Survey: Post 400 cfs
Cross-section: 1
View: Towards Right Bank
11/1/2011


Photo #187 - Site 4
Survey: Post 400 cfs
Cross-section: 1
View: Upstream
11/1/2011


Photo #188 - Site 4
Survey: Post 400 cfs
Cross-section: 1
View: Towards Left Bank
11/1/2011


Photo #189 - Site 4
Survey: Post 600 cfs
Cross-section: 1
View: Towards Left Bank
11/9/2011


Photo #190 - Site 4
Survey: Post 600 cfs
Cross-section: 1
View: Downstream
11/9/2011


Photo #191 - Site 4
Survey: Post 600 cfs
Cross-section: 1
View: Towards Right Bank
11/9/2011

Appendix D

Study Sites 1 and 2 – Pool Scour Calculations

APPENDIX D

Sites 1 & 2 Pool Scour Calculations
Piru Creek 2011 Controlled Flow Release Geomorphology Study
United Water Conservation District

Water Surface Height (Averaged Survey Elevation)	**Elevation** (ft, msl)	**Pre 425 Flow** (Cubic Feet)	**Pre 425 Flow** (Acre Feet)	**Post 425 Flow** (Cubic Feet)	**Post 425 Flow** (Acre Feet)	**Post 591 Flow** (Cubic Feet)	**Post 591 Flow** (Acre Feet)
Site 1 - Pool 1							
95.4	860.4	9,163	0.210	8,962	0.206	9,445	0.217
Site 1 - Pool 2							
94.6	859.6	12,795	0.294	12,324	0.283	14,618	0.336
Site 2 - Pool 1							
98.5	840.5	59,097	1.357	66,650	1.530	62,530	1.436

Cardno ENTRIX

0 15 30 Feet

N

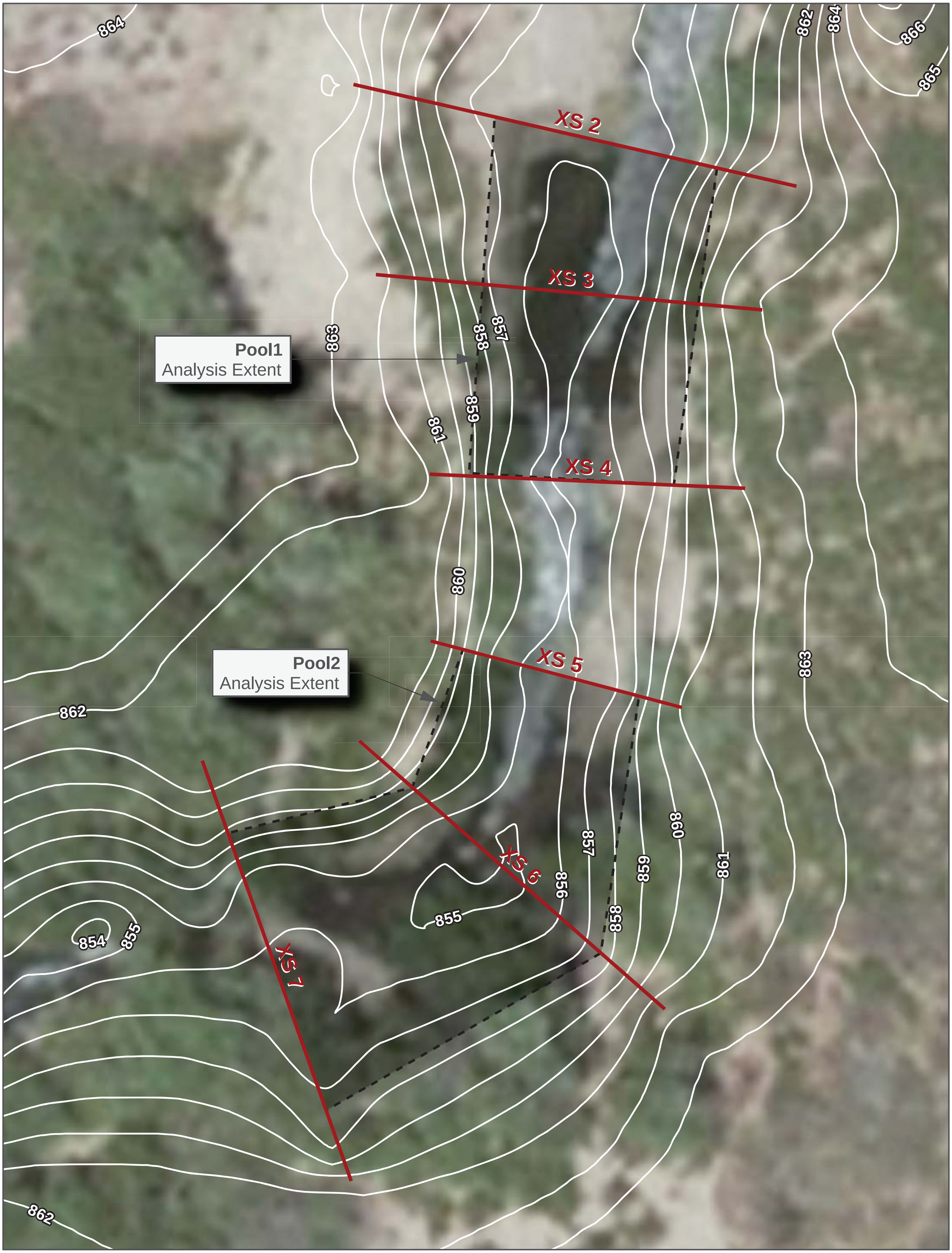
1 inch = 25 feet

Date: 5/11/2012

PIRU CREEK

Site 01

Pre 425 Flows



Cardno ENTRIX

0 15 30 Feet

N

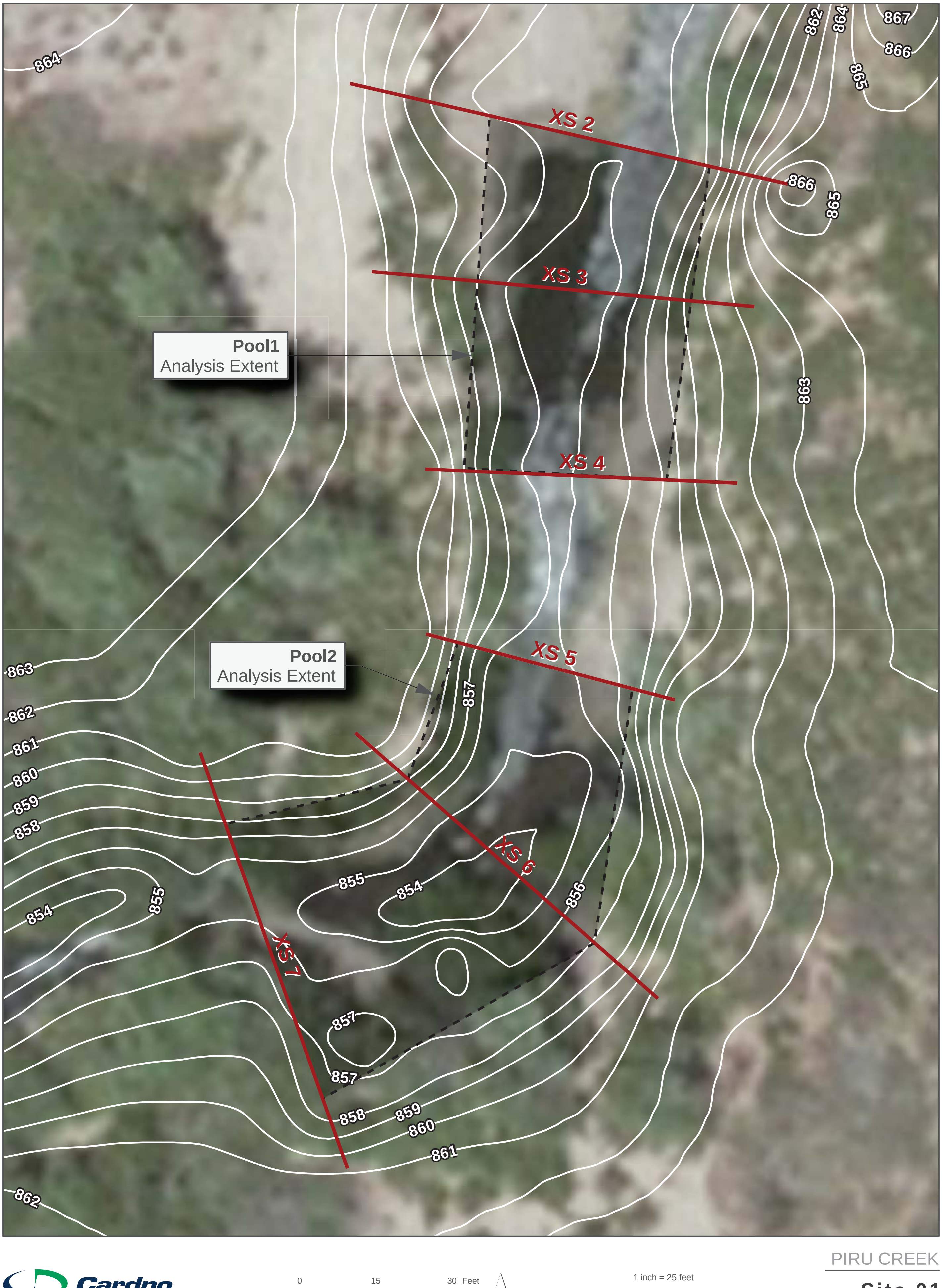
1 inch = 25 feet

Date: 5/11/2012

PIRU CREEK

Site 01

Post 425 Flows



Cardno ENTRIX

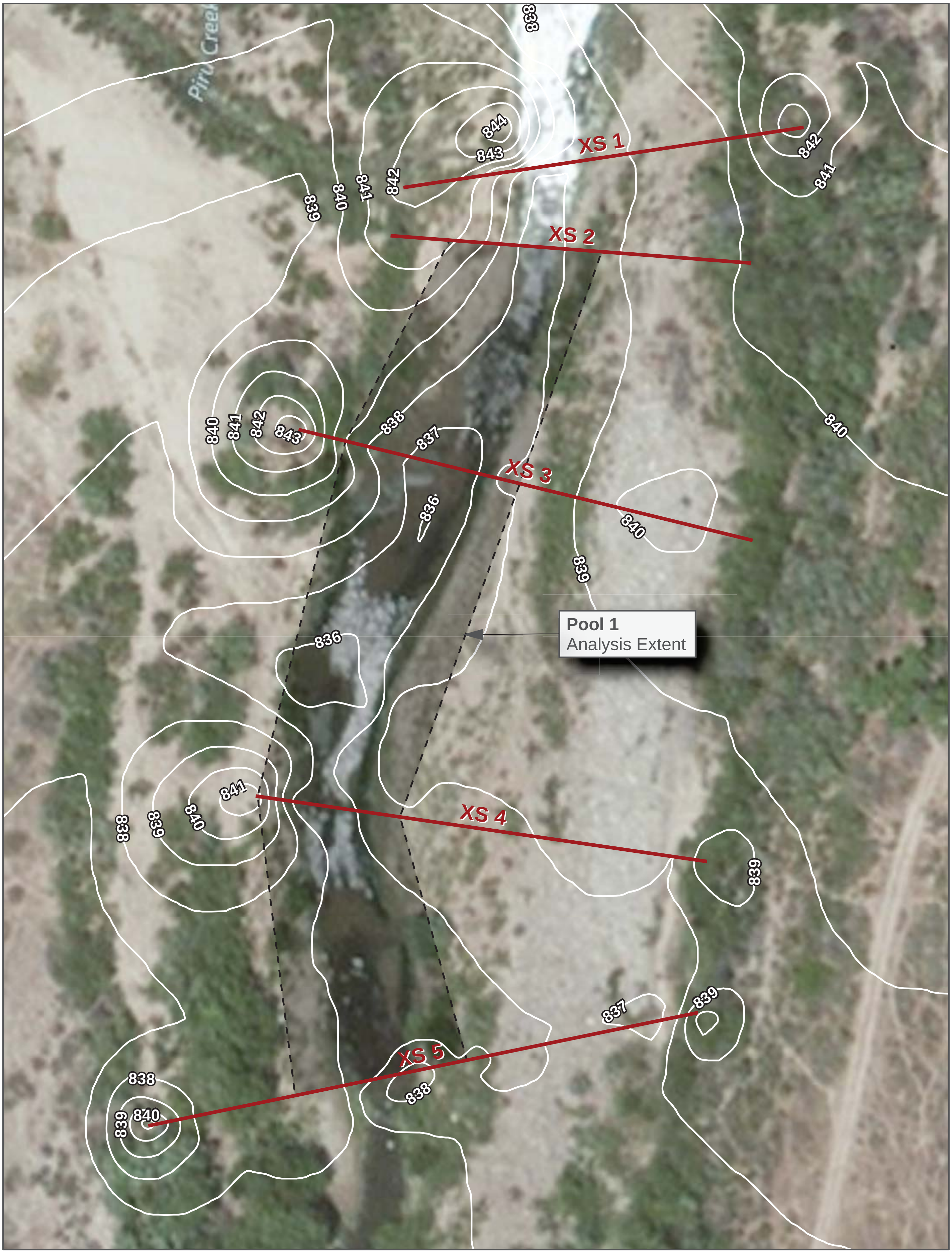
1 inch = 25 feet

Date: 5/11/2012

PIRU CREEK

Site 01

Post 591 Flows



Cardno ENTRIX

0 30 60 Feet

N

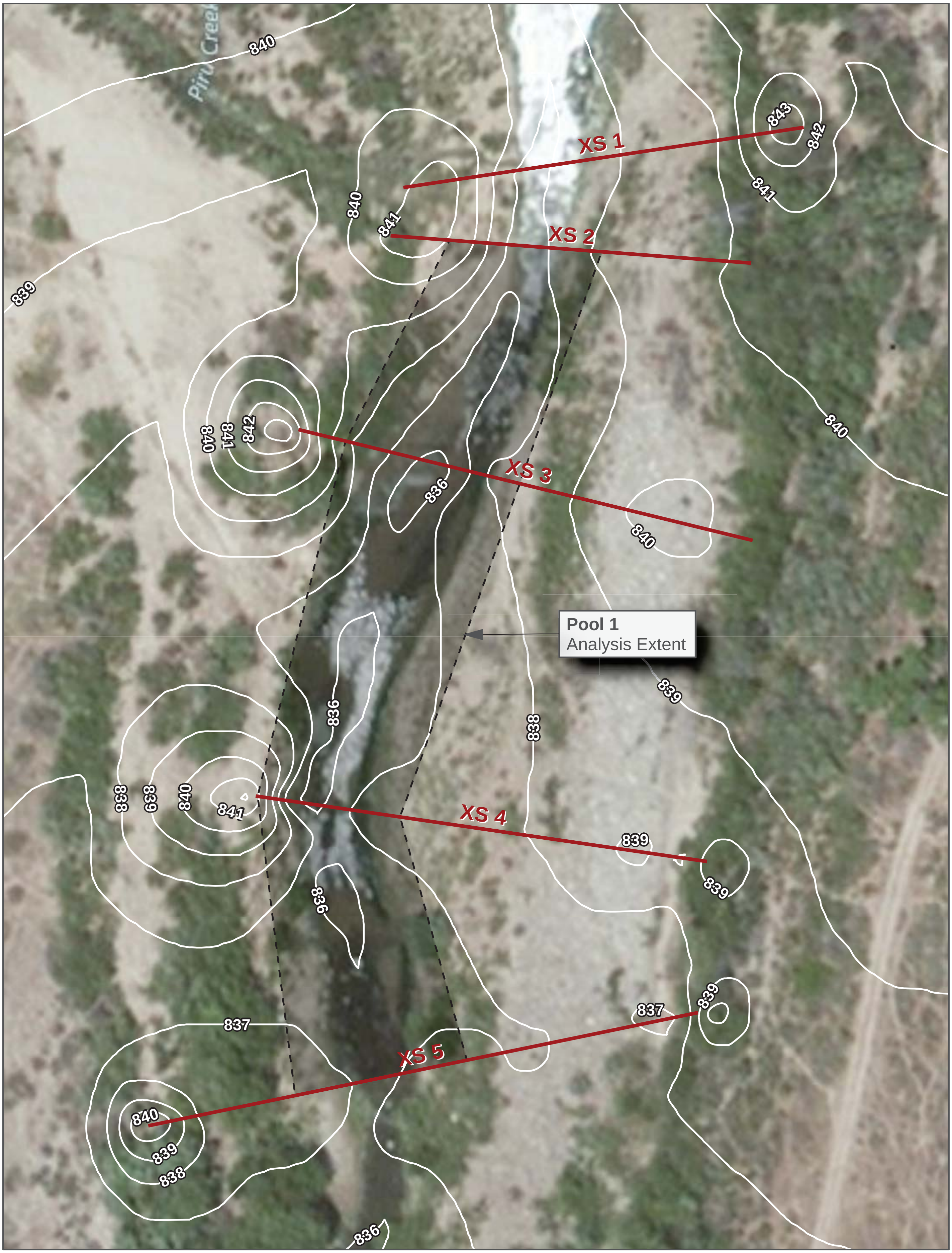
1 inch = 50 feet

Date: 5/11/2012

PIRU CREEK

Site 02

Pre 425 Flows



Cardno ENTRIX

0 30 60 Feet

N

1 inch = 50 feet

Date: 5/11/2012

PIRU CREEK

Site 02

Post 425 Flows

0 30 60 Feet

N

1 inch = 50 feet

Date: 5/11/2012

Cardno ENTRIX

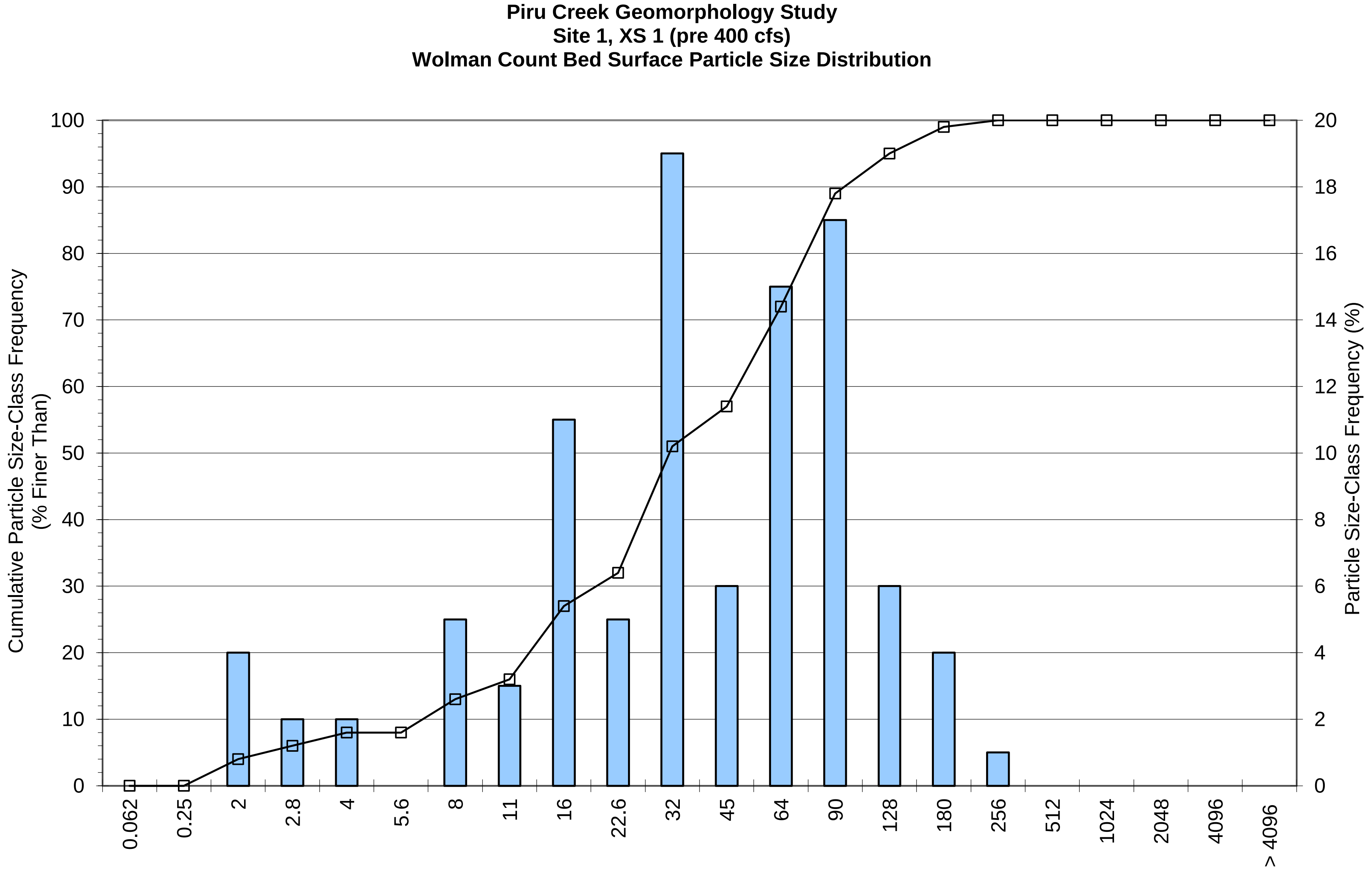
PIRU CREEK

Site 02

Post 591 Flows

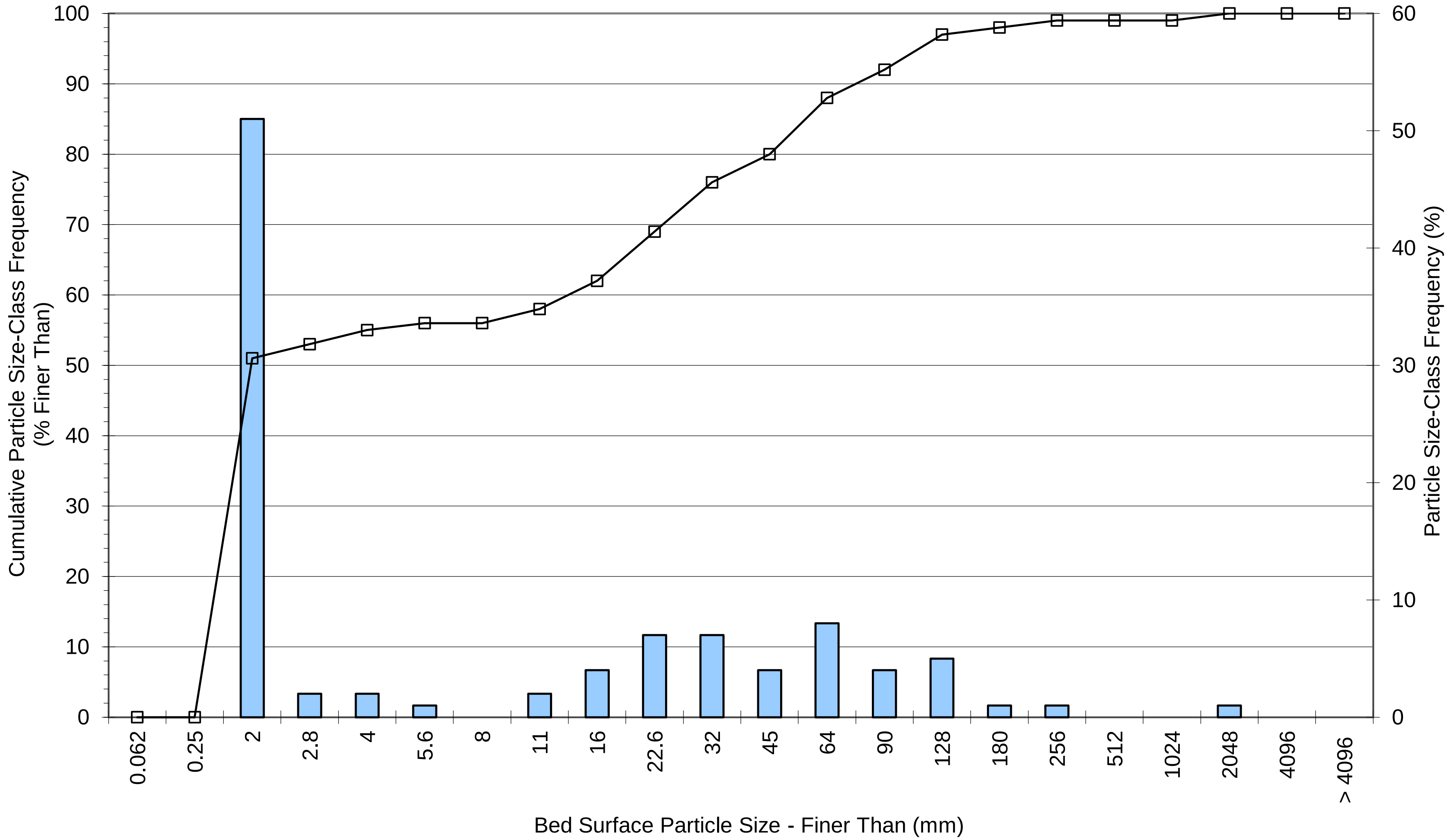
Appendix E

Cumulative Particle Size Distribution Plots and Frequency Histograms – Pebble Count Data

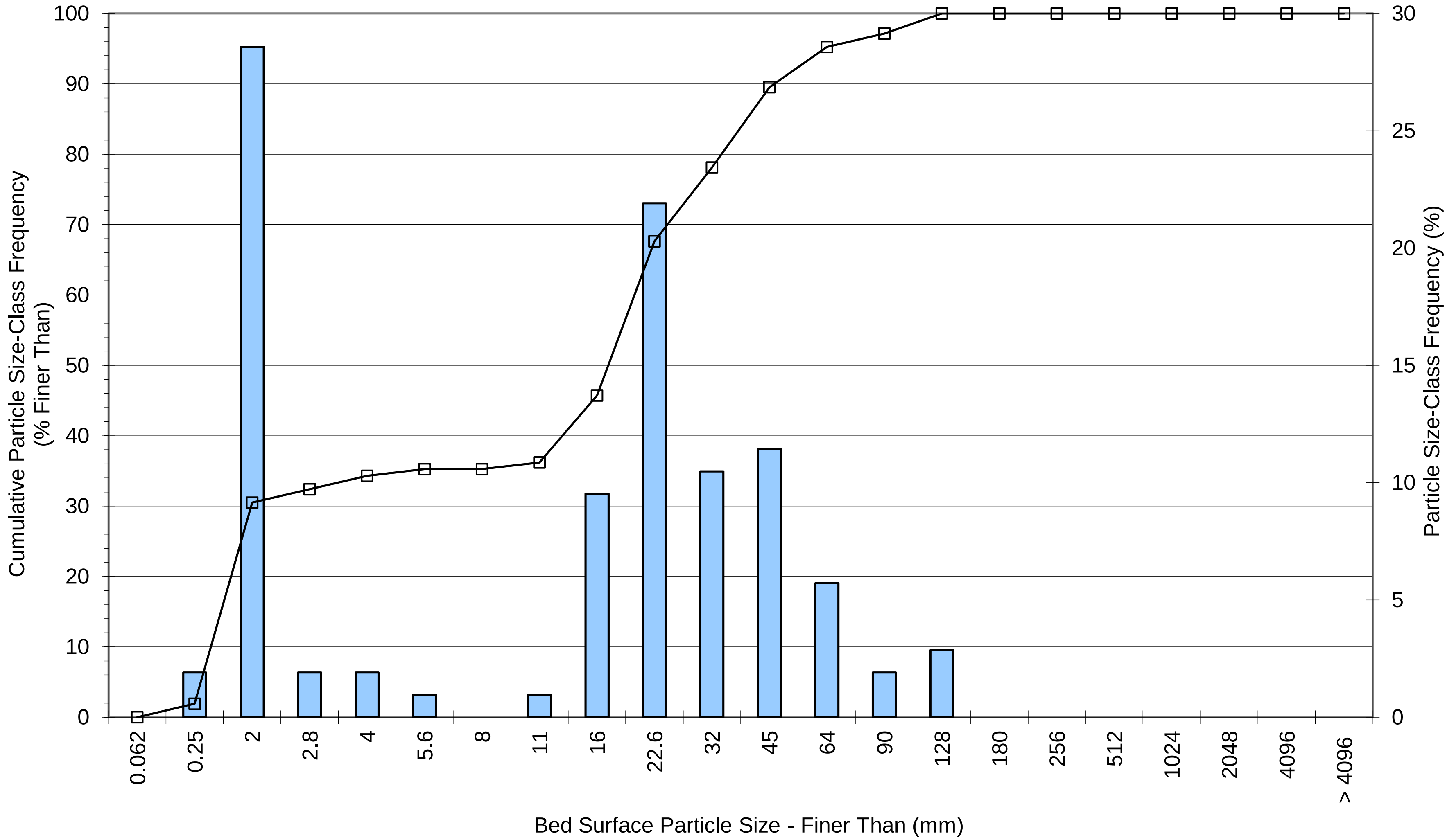


Piru Creek Geomorphology Study
Site 1, XS 1 (pre 400 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency (% Finer Than)
Particle Size-Class Frequency (%)
Bed Surface Particle Size - Finer Than (mm)
0
10
20
30
40
50
60
70
80
90
100
0
2
4
6
8
10
12
14
16
18
20
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096

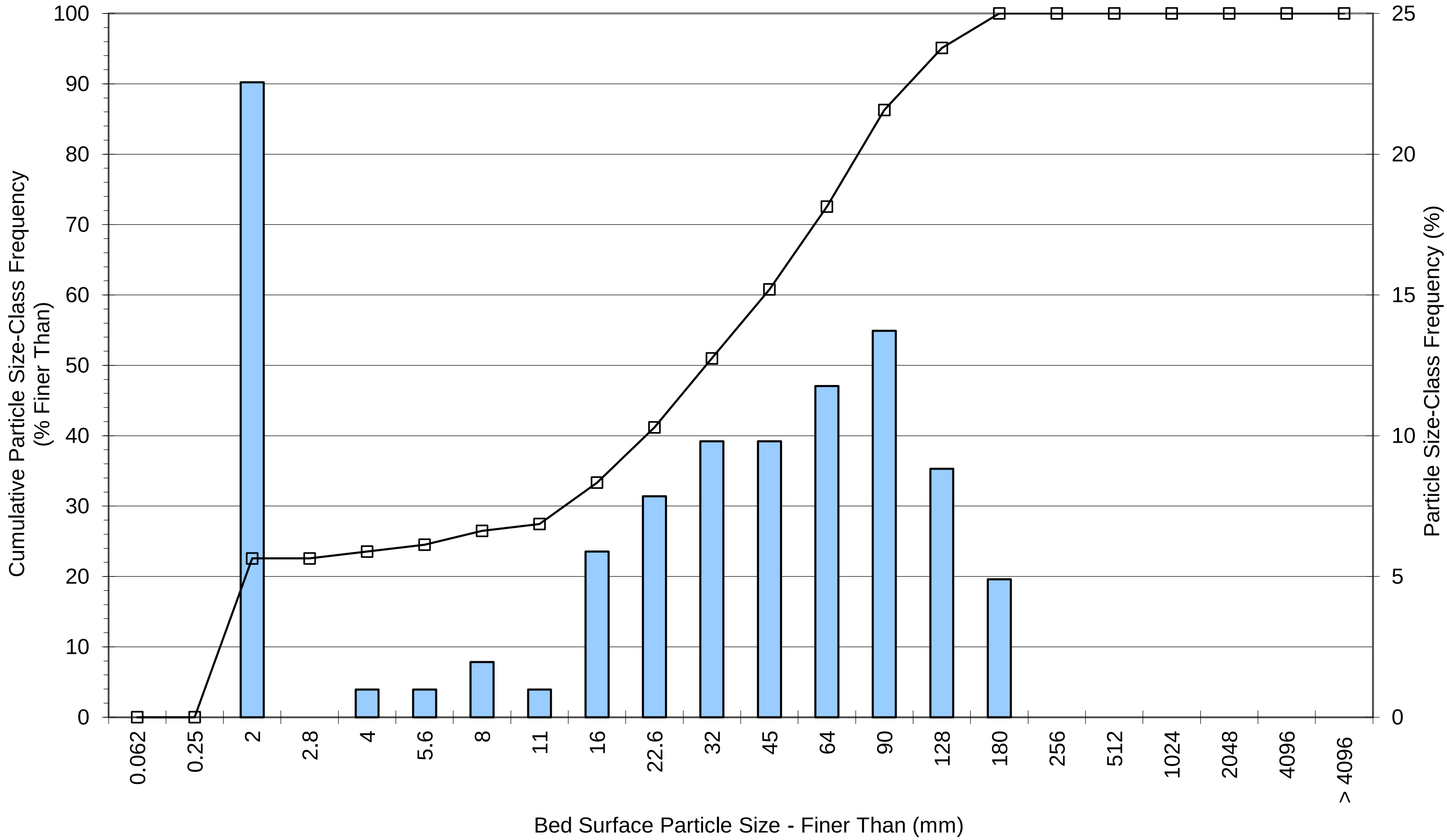
Piru Creek Geomorphology Study
Site 1, XS 2 (pre 400 cfs)
Wolman Count Bed Surface Particle Size Distribution



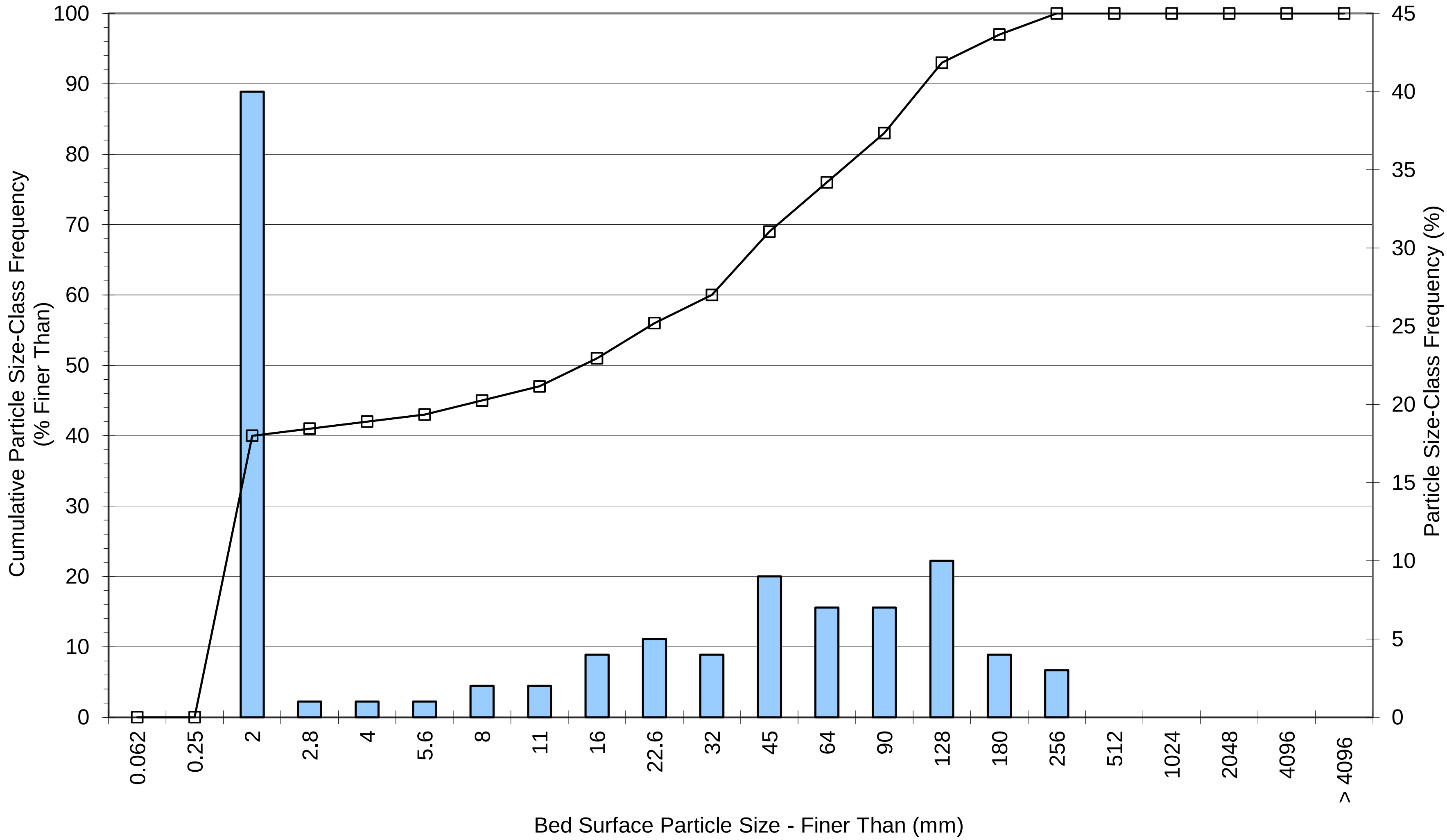
Piru Creek Geomorphology Study
Site 1, XS 3 (pre 400 cfs)
Wolman Count Bed Surface Particle Size Distribution



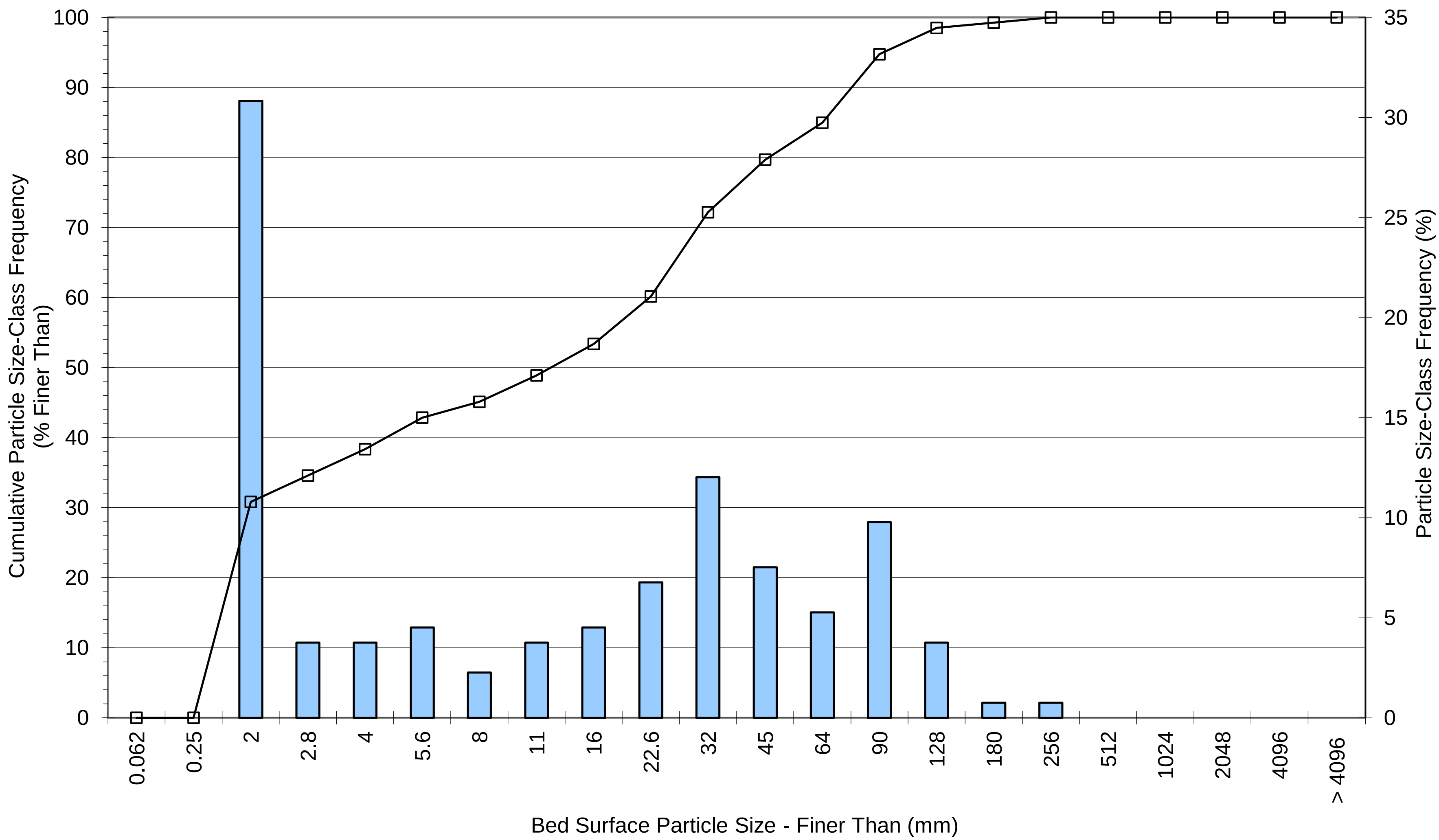
Piru Creek Geomorphology Study
Site 1, XS 4 (pre 400 cfs)
Wolman Count Bed Surface Particle Size Distribution

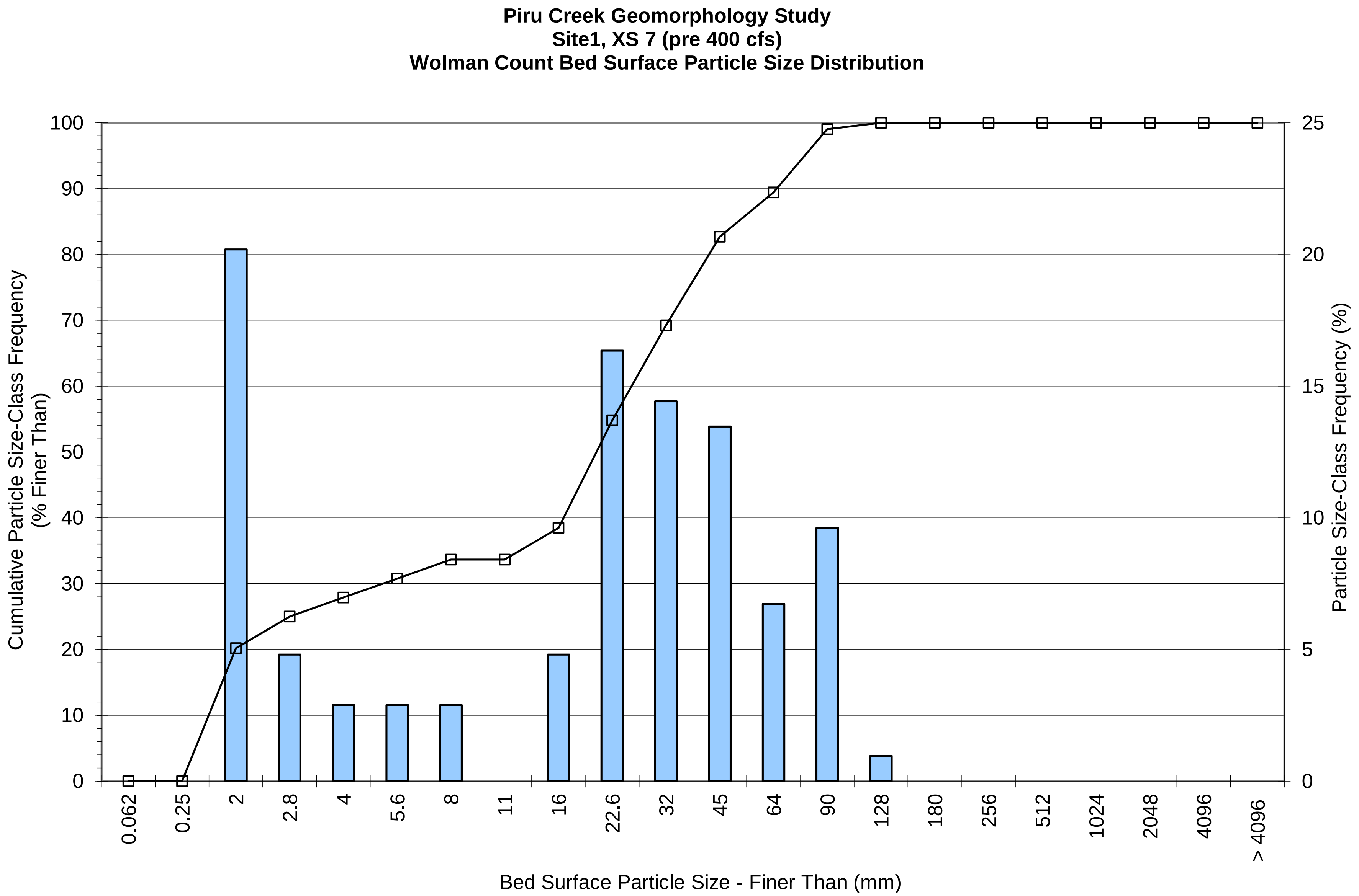


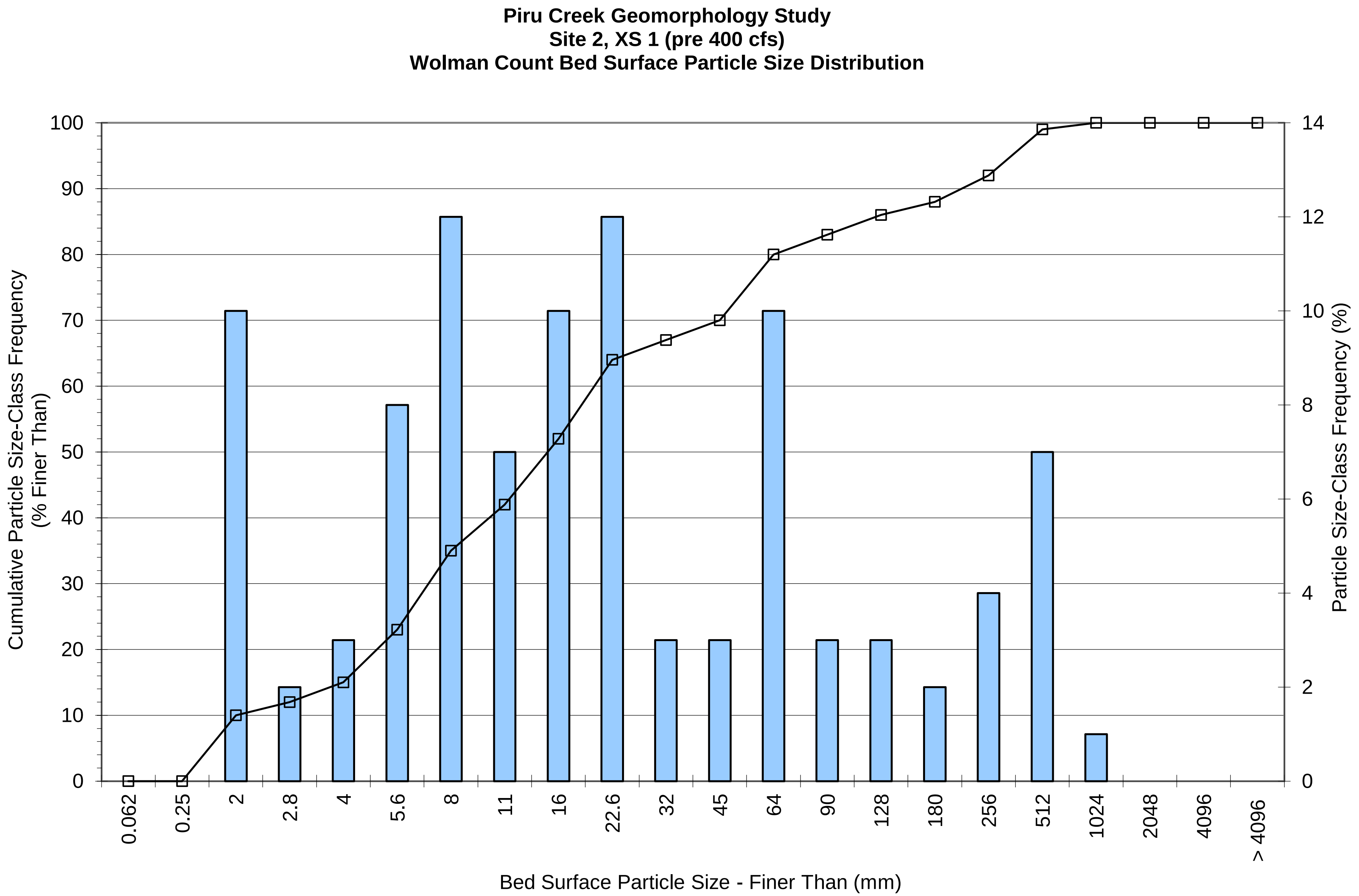
Piru Creek Geomorphology Study
Site 1, XS 5 (pre 400 cfs)
Wolman Count Bed Surface Particle Size Distribution



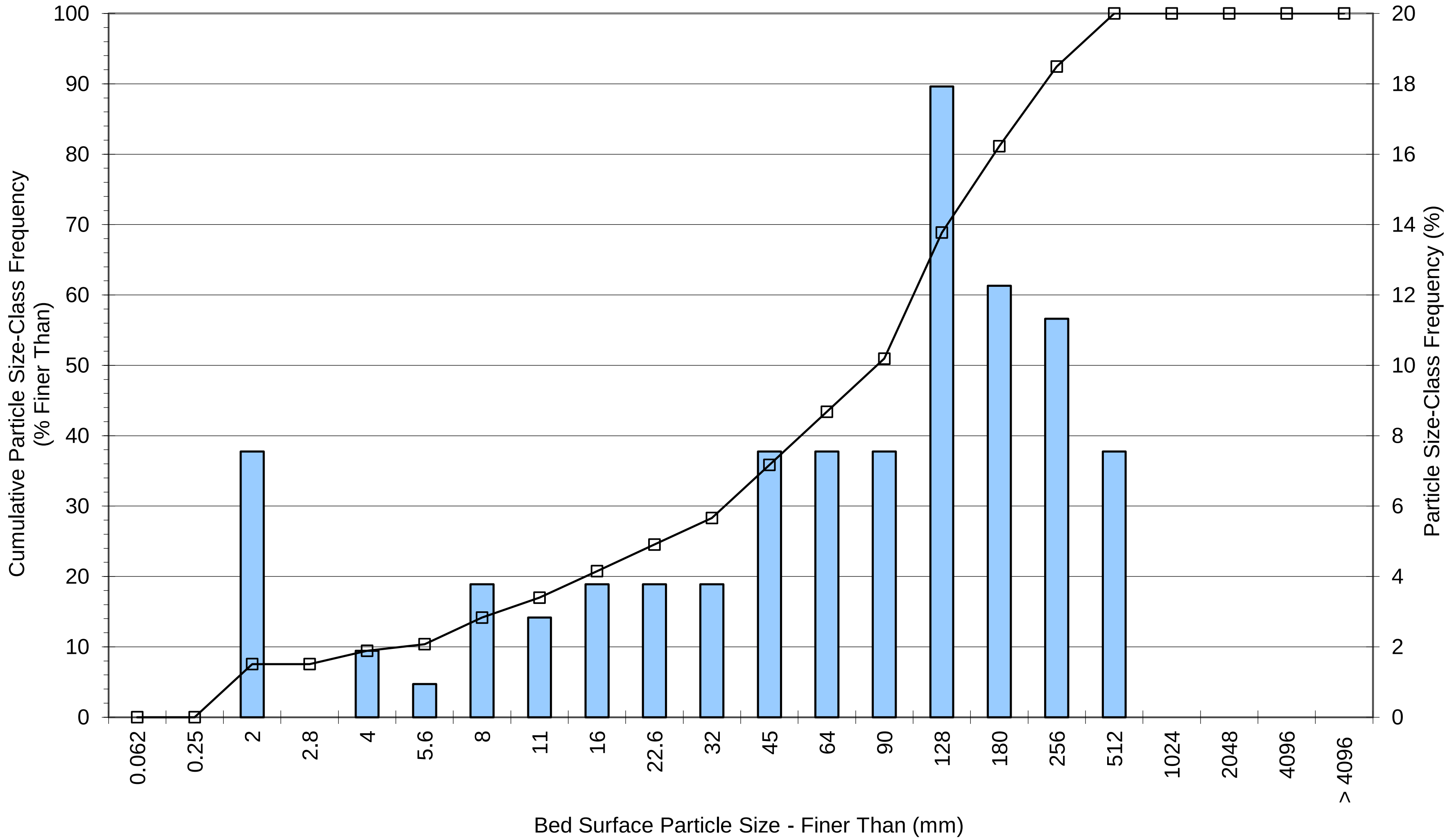
Piru Creek Geomorphology Study
Site 1, XS 6 (pre 400 cfs)
Wolman Count Bed Surface Particle Size Distribution

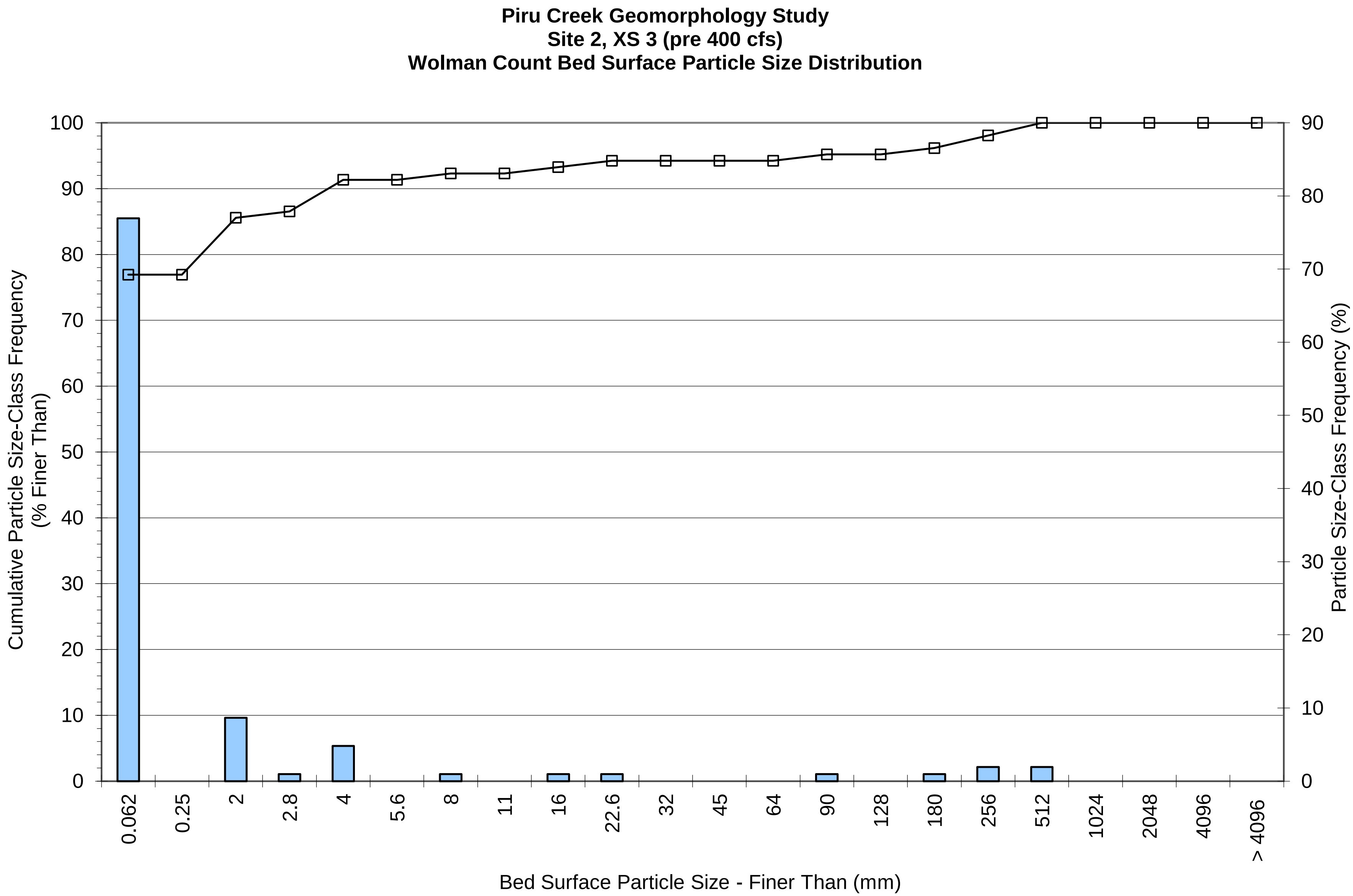



Piru Creek Geomorphology Study
Site1, XS 7 (pre 400 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency
(% Finer Than)
Particle Size-Class Frequency (%)
Bed Surface Particle Size - Finer Than (mm)
0
10
20
30
40
50
60
70
80
90
100
0
5
10
15
20
25
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096


Piru Creek Geomorphology Study
Site 2, XS 1 (pre 400 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency
(% Finer Than)
Particle Size-Class Frequency (%)
Bed Surface Particle Size - Finer Than (mm)
0
10
20
30
40
50
60
70
80
90
100
2
4
6
8
10
12
14
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096

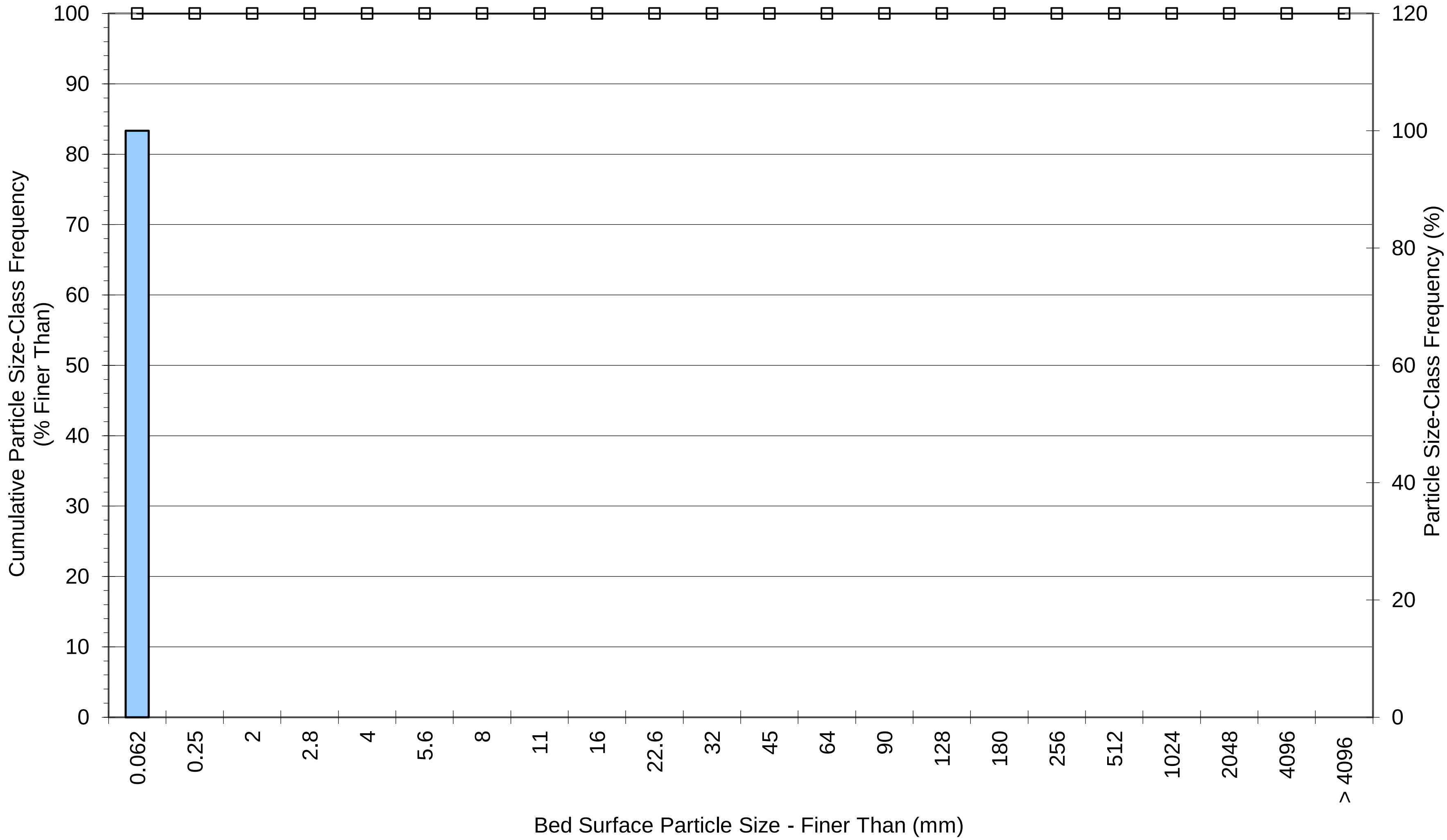
Piru Creek Geomorphology Study
Site 2, XS 2 (pre 400 cfs)
Wolman Count Bed Surface Particle Size Distribution



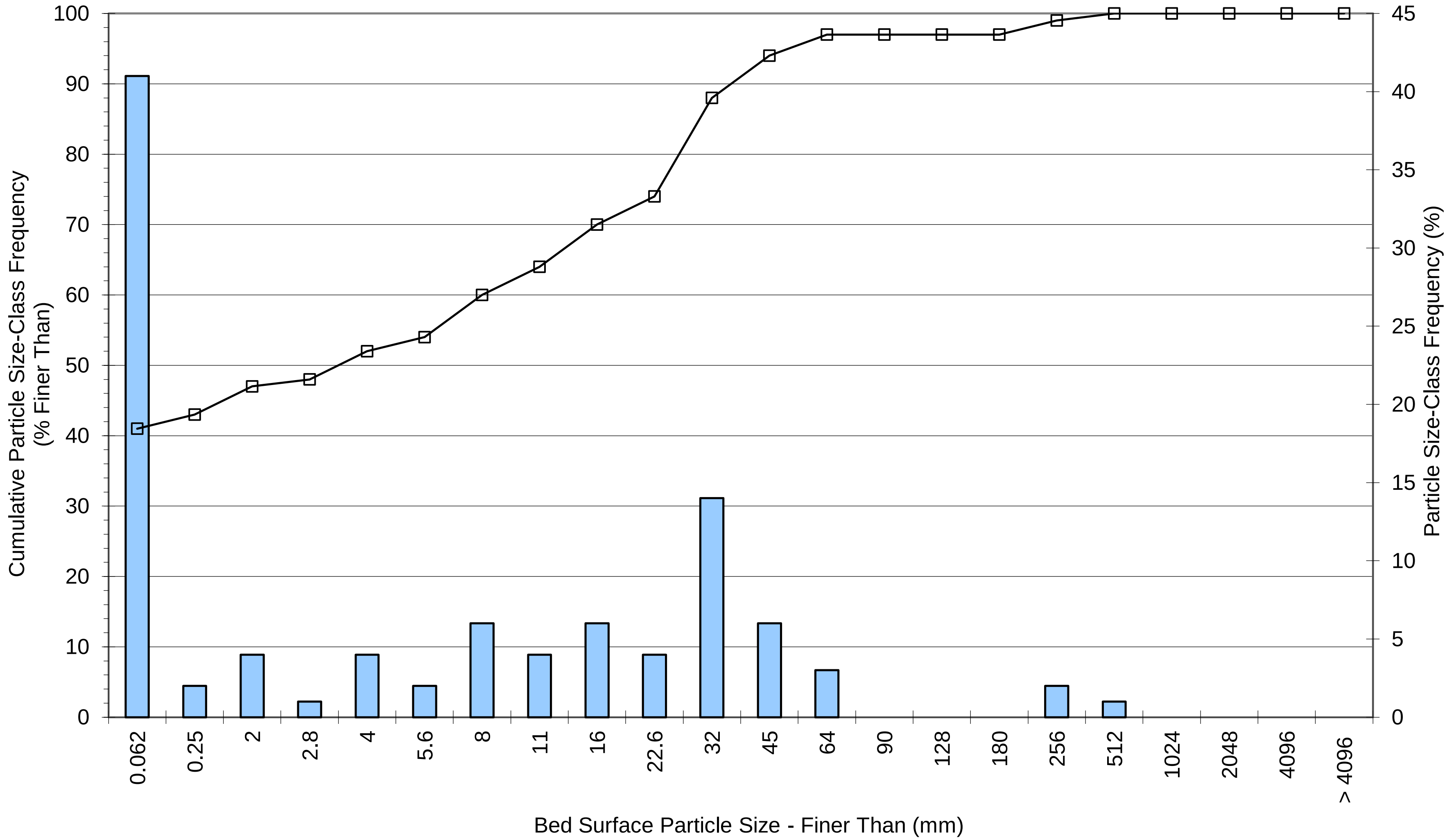


Piru Creek Geomorphology Study
Site 2, XS 3 (pre 400 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency (% Finer Than)
Particle Size-Class Frequency (%)
Bed Surface Particle Size - Finer Than (mm)
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096

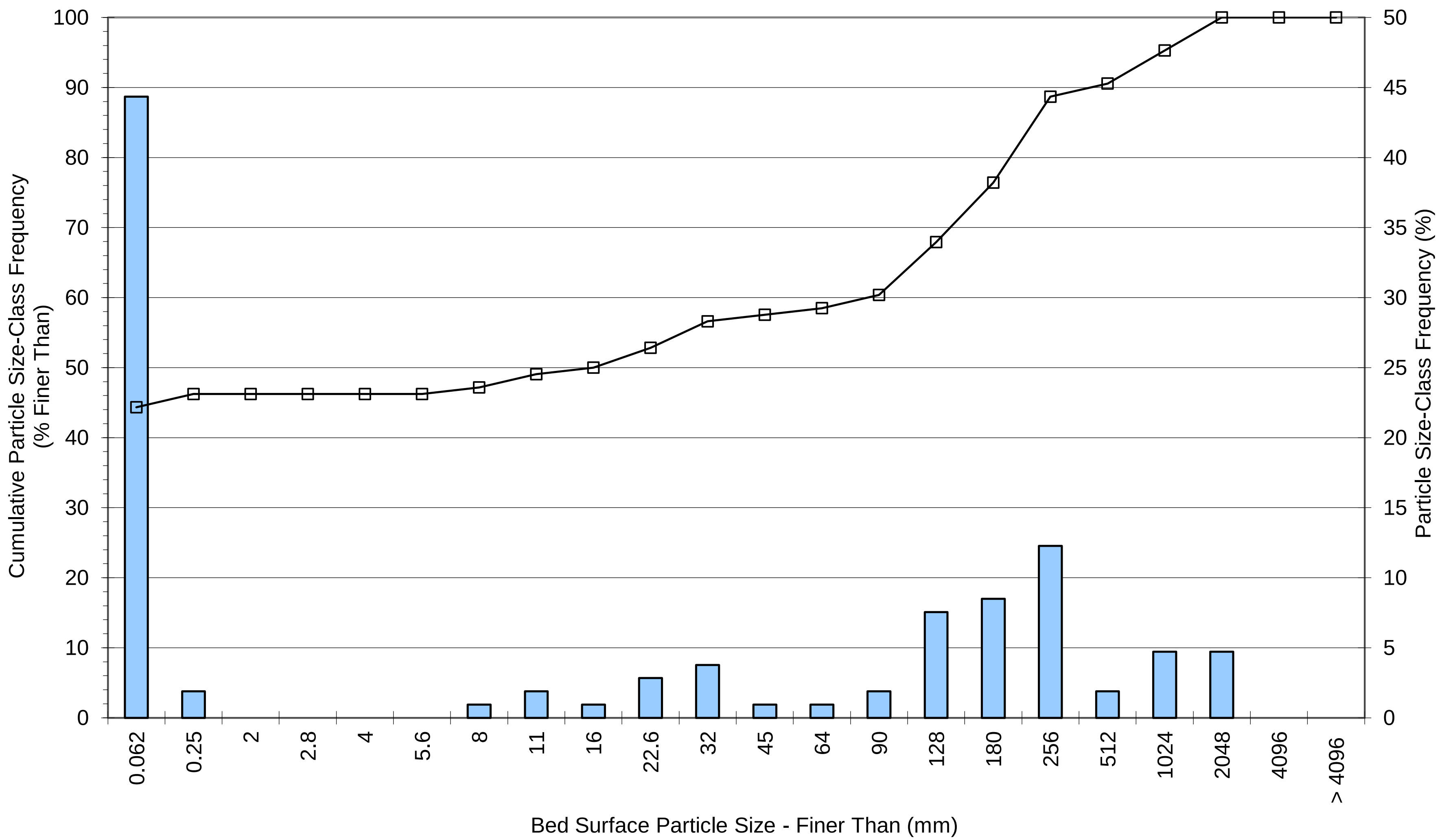
Piru Creek Geomorphology Study
Site 2, XS 4 (pre 400 cfs)
Wolman Count Bed Surface Particle Size Distribution



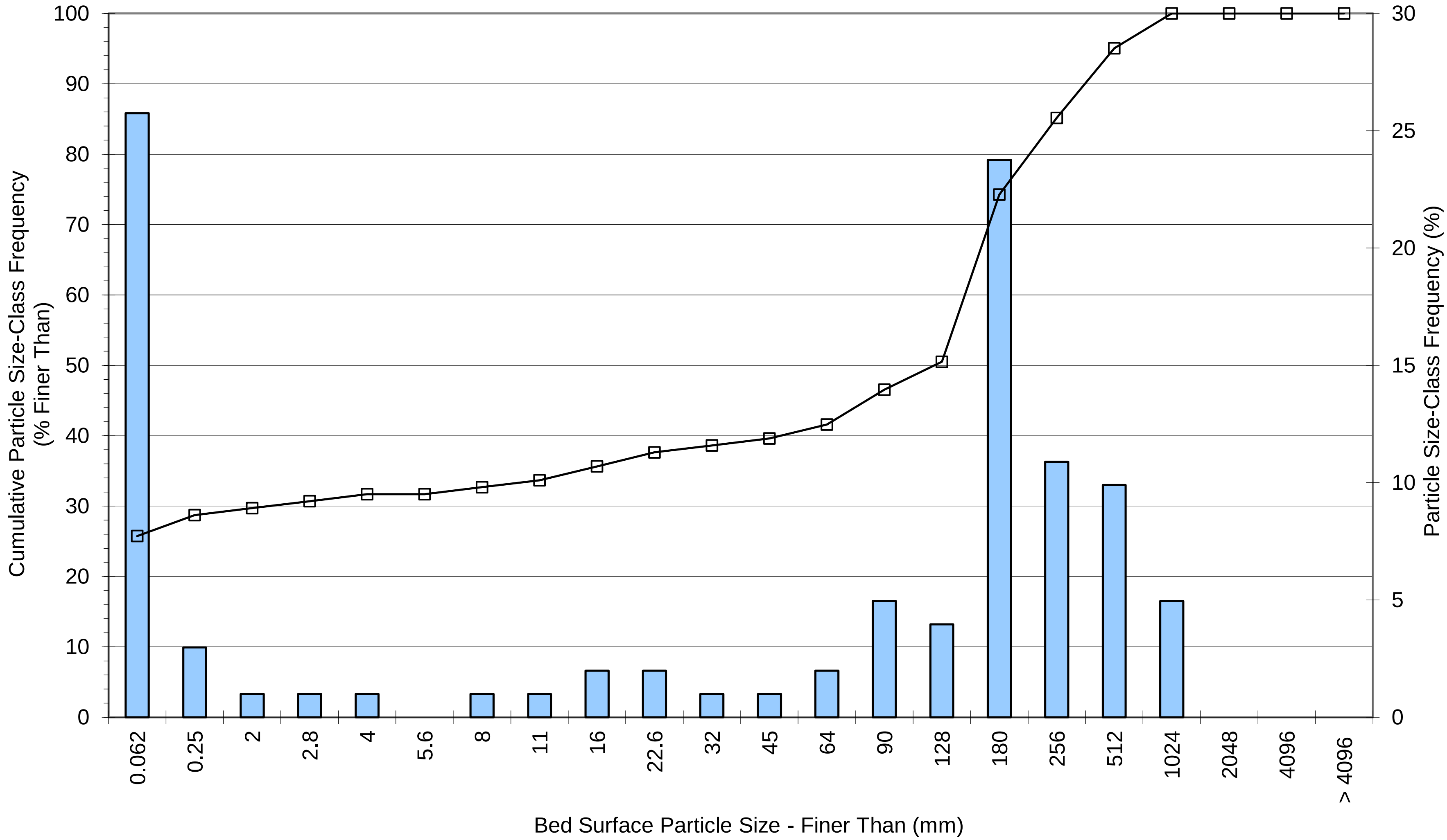
Piru Creek Geomorphology Study
Site 2, XS 5 (pre 400 cfs)
Wolman Count Bed Surface Particle Size Distribution



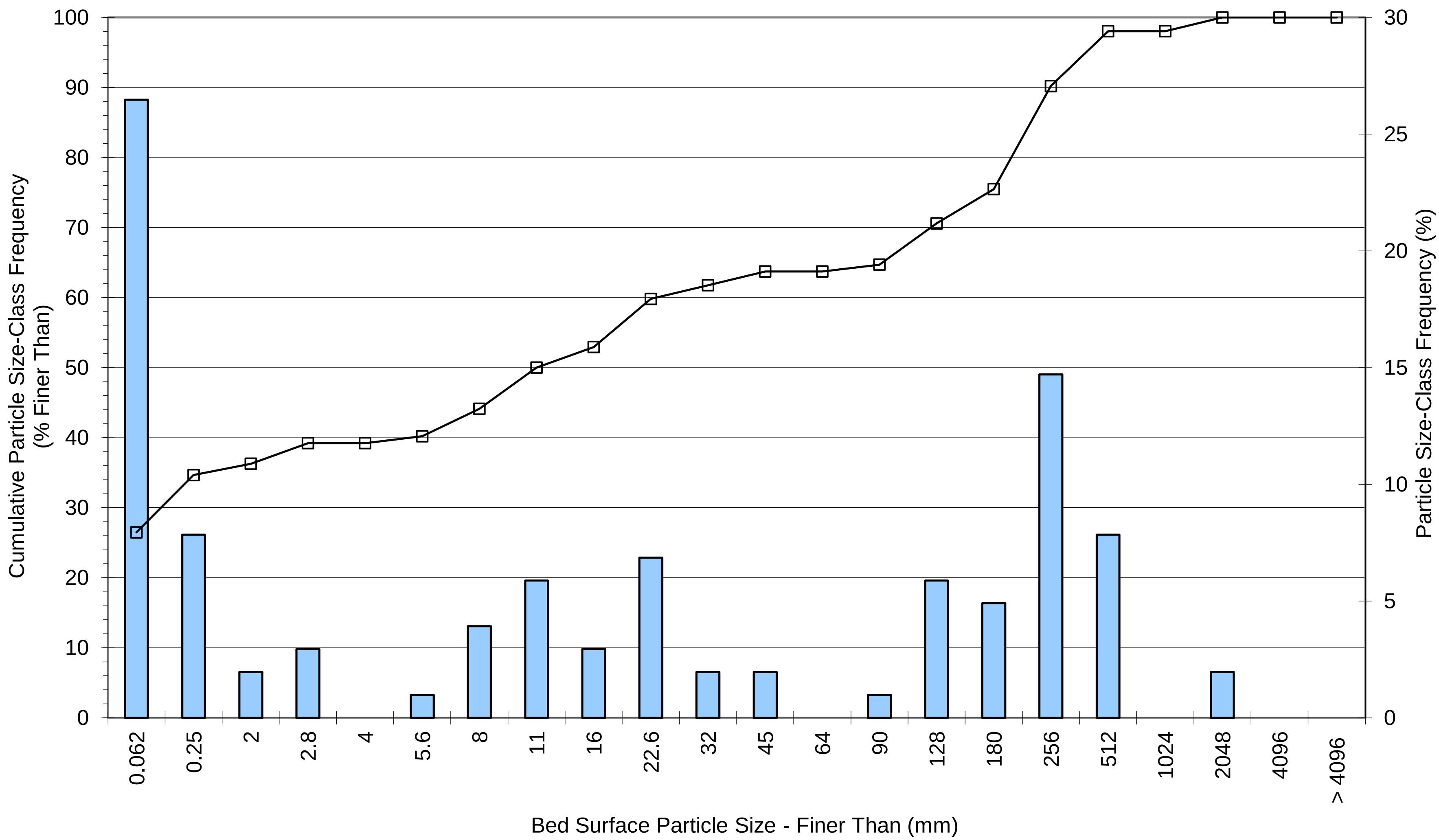
Piru Creek Geomorphology Study
Site 3, XS 1 (pre 400 cfs)
Wolman Count Bed Surface Particle Size Distribution

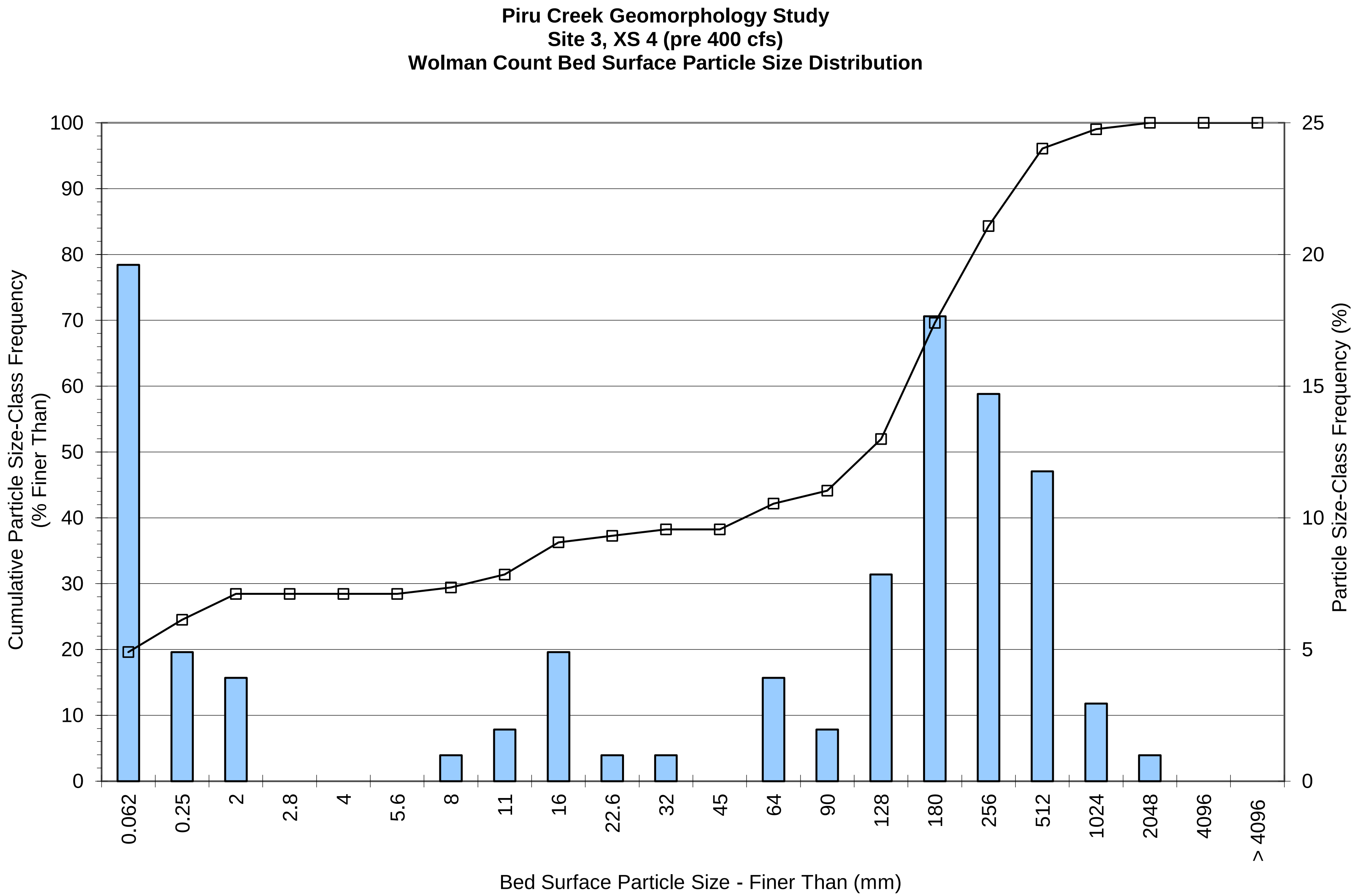


Piru Creek Geomorphology Study
Site 3, XS 2 (pre 400 cfs)
Wolman Count Bed Surface Particle Size Distribution

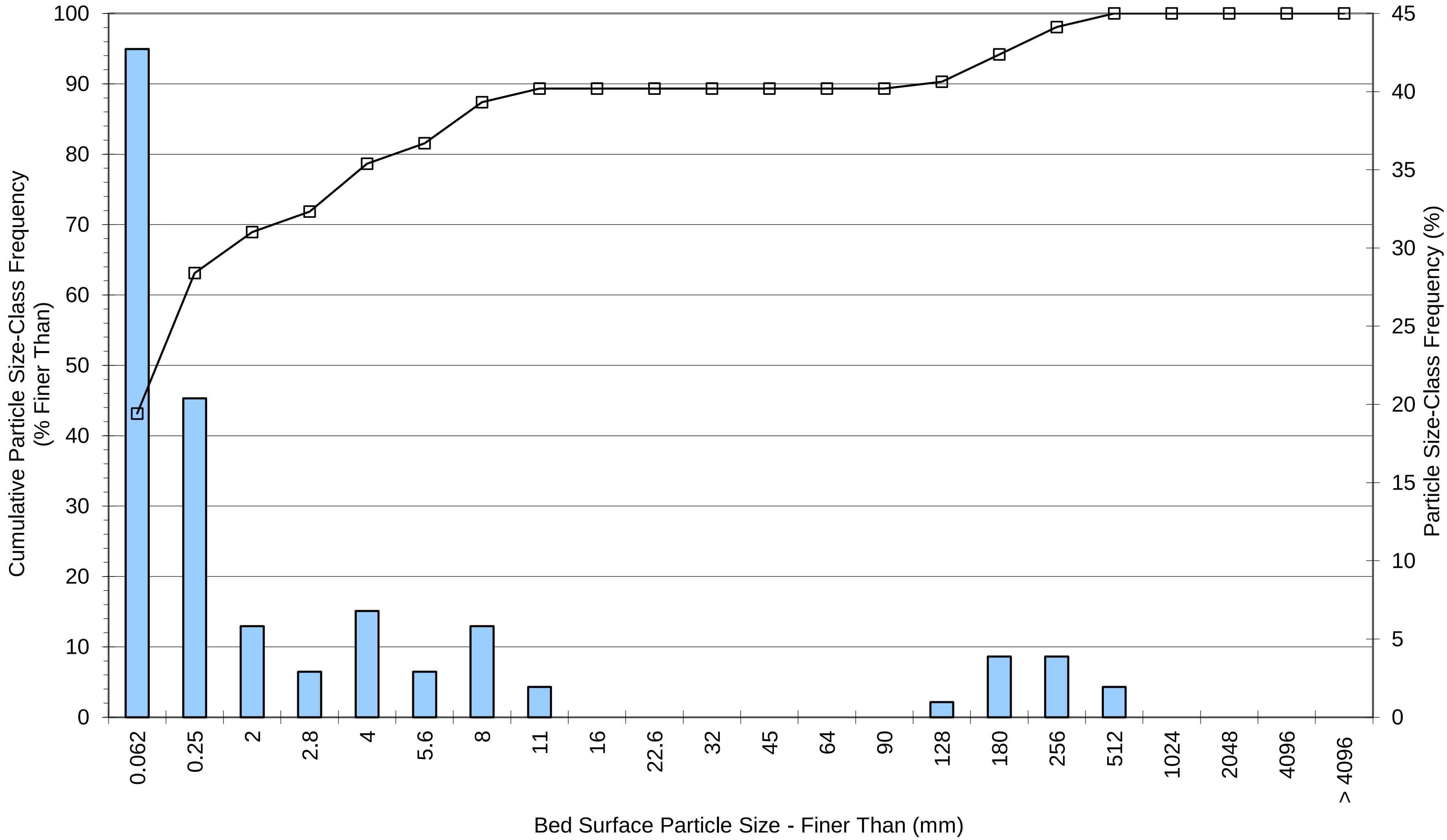


Piru Creek Geomorphology Study
Site 3, XS 3 (pre 400 cfs)
Wolman Count Bed Surface Particle Size Distribution

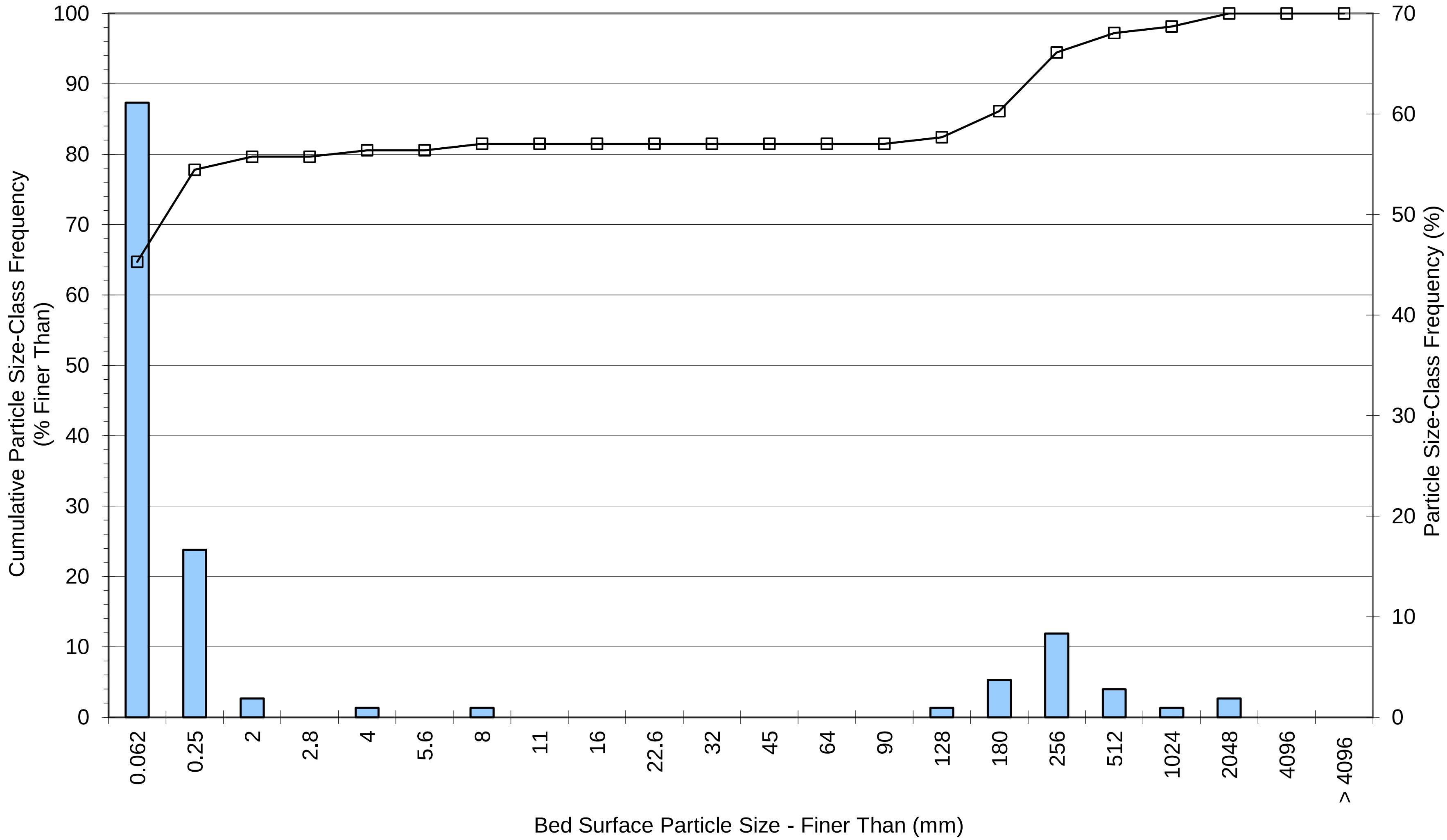



Piru Creek Geomorphology Study
Site 3, XS 4 (pre 400 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency (% Finer Than)
Particle Size-Class Frequency (%)
Bed Surface Particle Size - Finer Than (mm)
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096

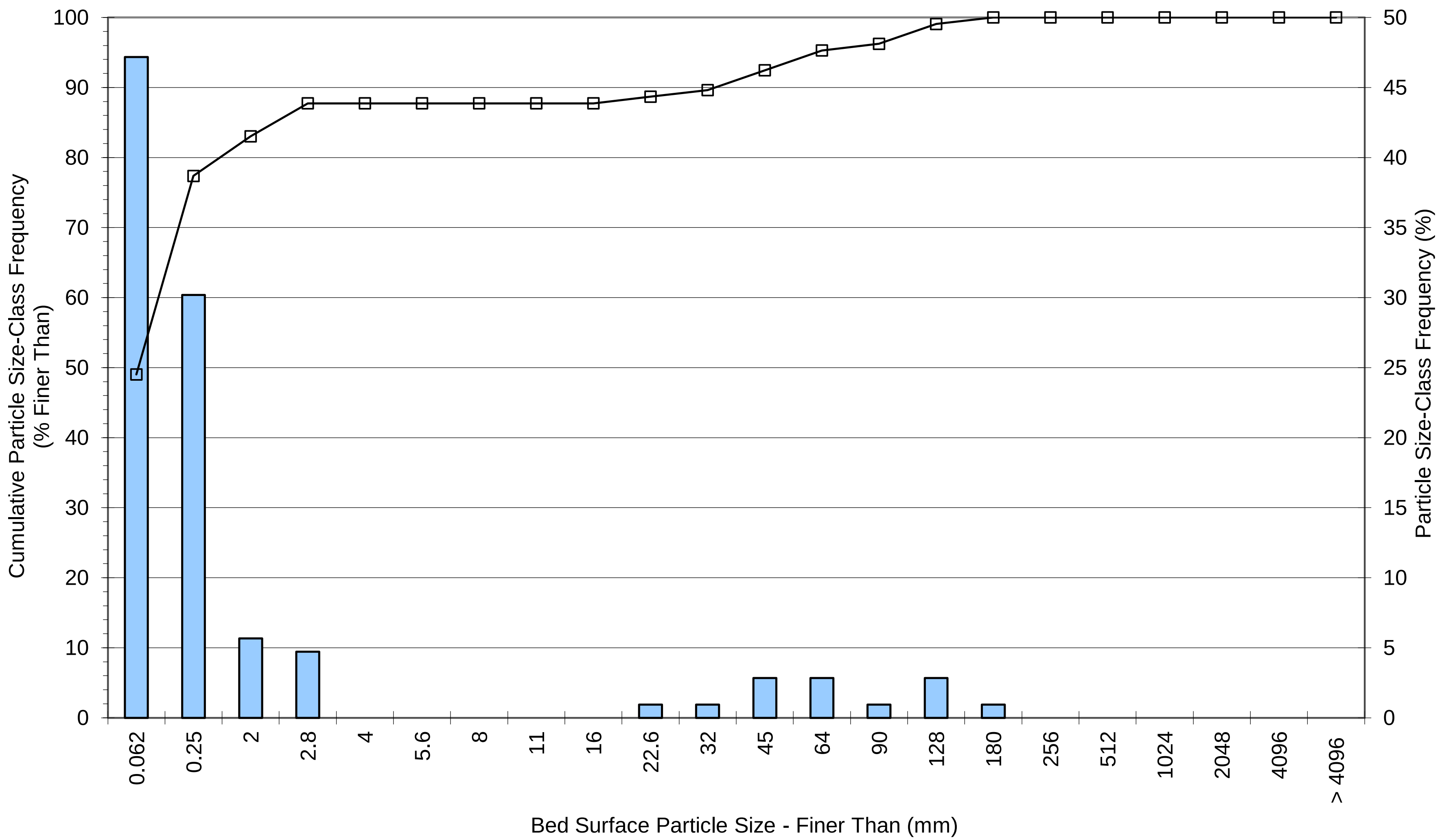
Piru Creek Geomorphology Study
Site 3, XS 5 (pre 400 cfs)
Wolman Count Bed Surface Particle Size Distribution



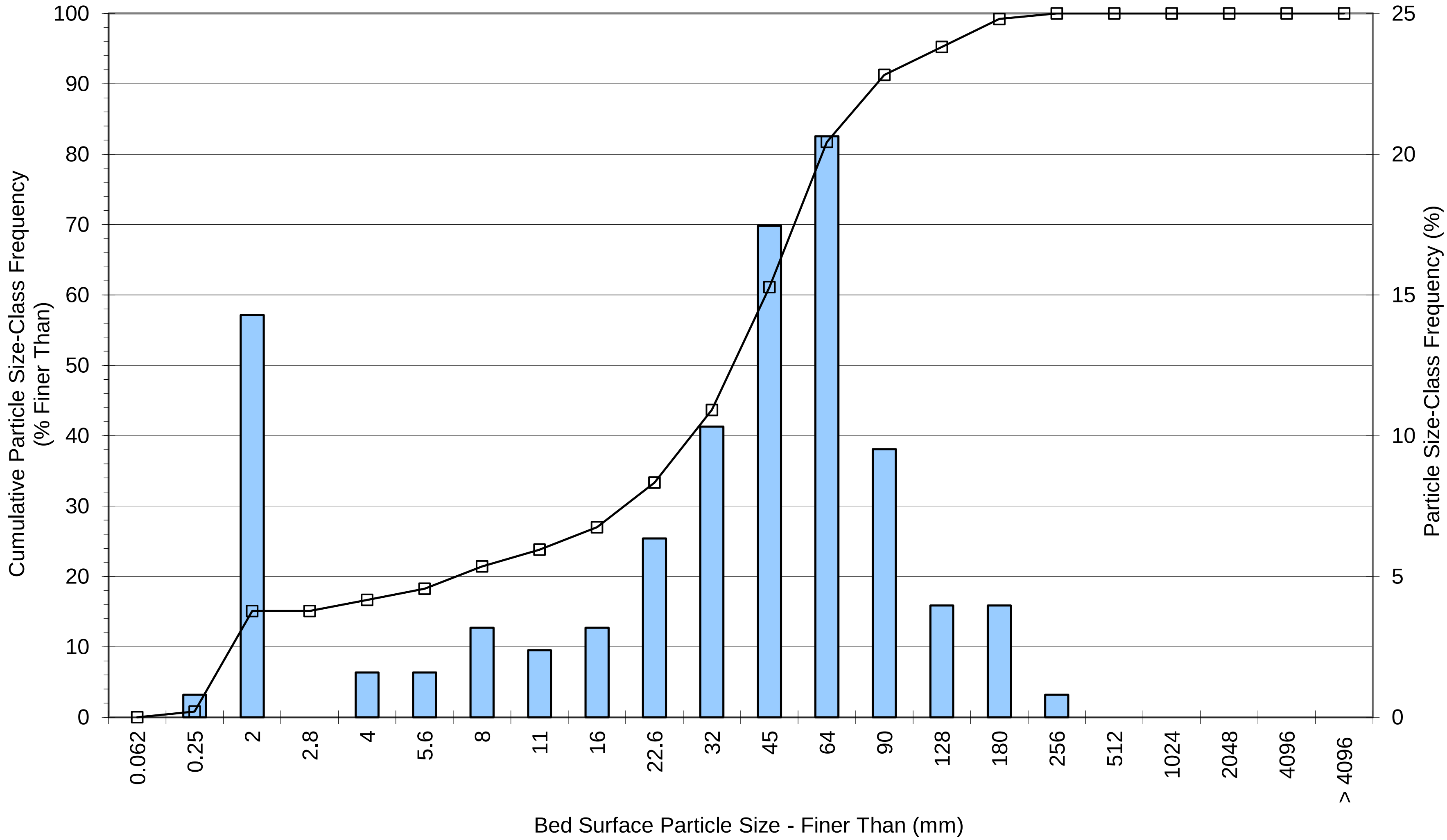
Piru Creek Geomorphology Study
Site 3, XS 6 (pre 400 cfs)
Wolman Count Bed Surface Particle Size Distribution



Piru Creek Geomorphology Study
Site 4, XS 1 (pre 400 cfs)
Wolman Count Bed Surface Particle Size Distribution

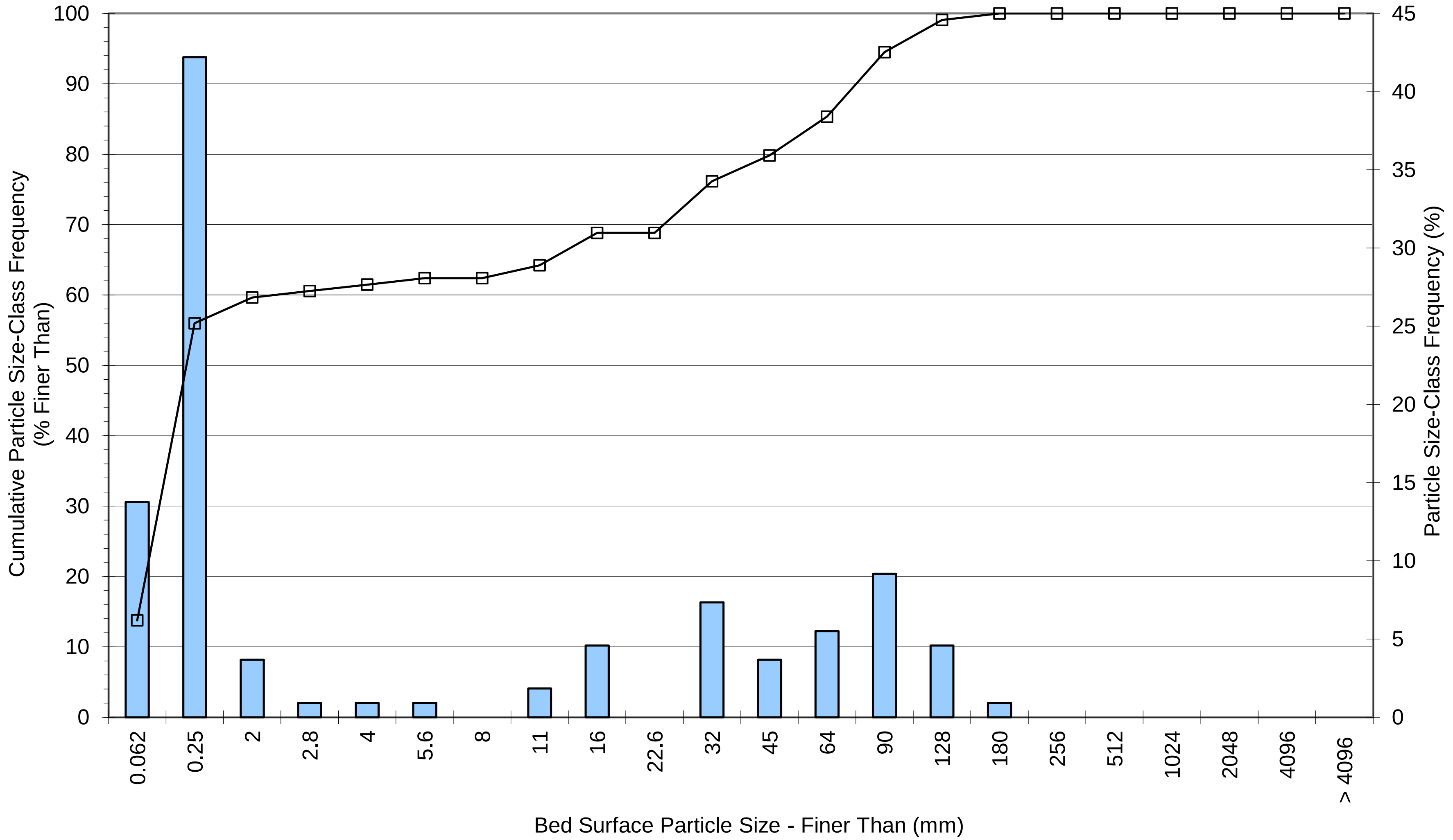


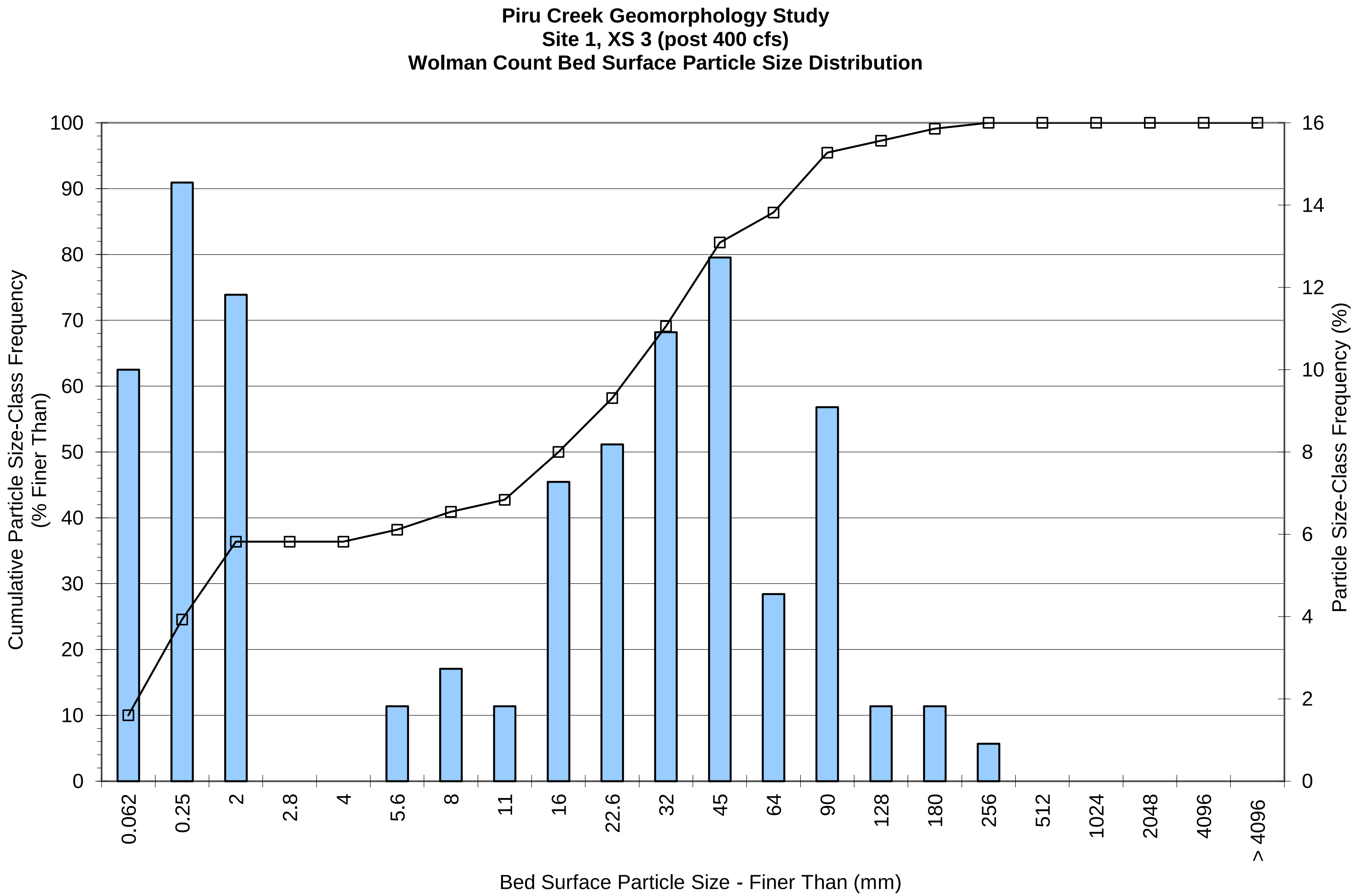
Piru Creek Geomorphology Study
Site 1, XS 1 (post 400 cfs)
Wolman Count Bed Surface Particle Size Distribution



Piru Creek Pebble Count Data Worksheet.xls Site1_XS1 (post 400cfs) 5/9/2012

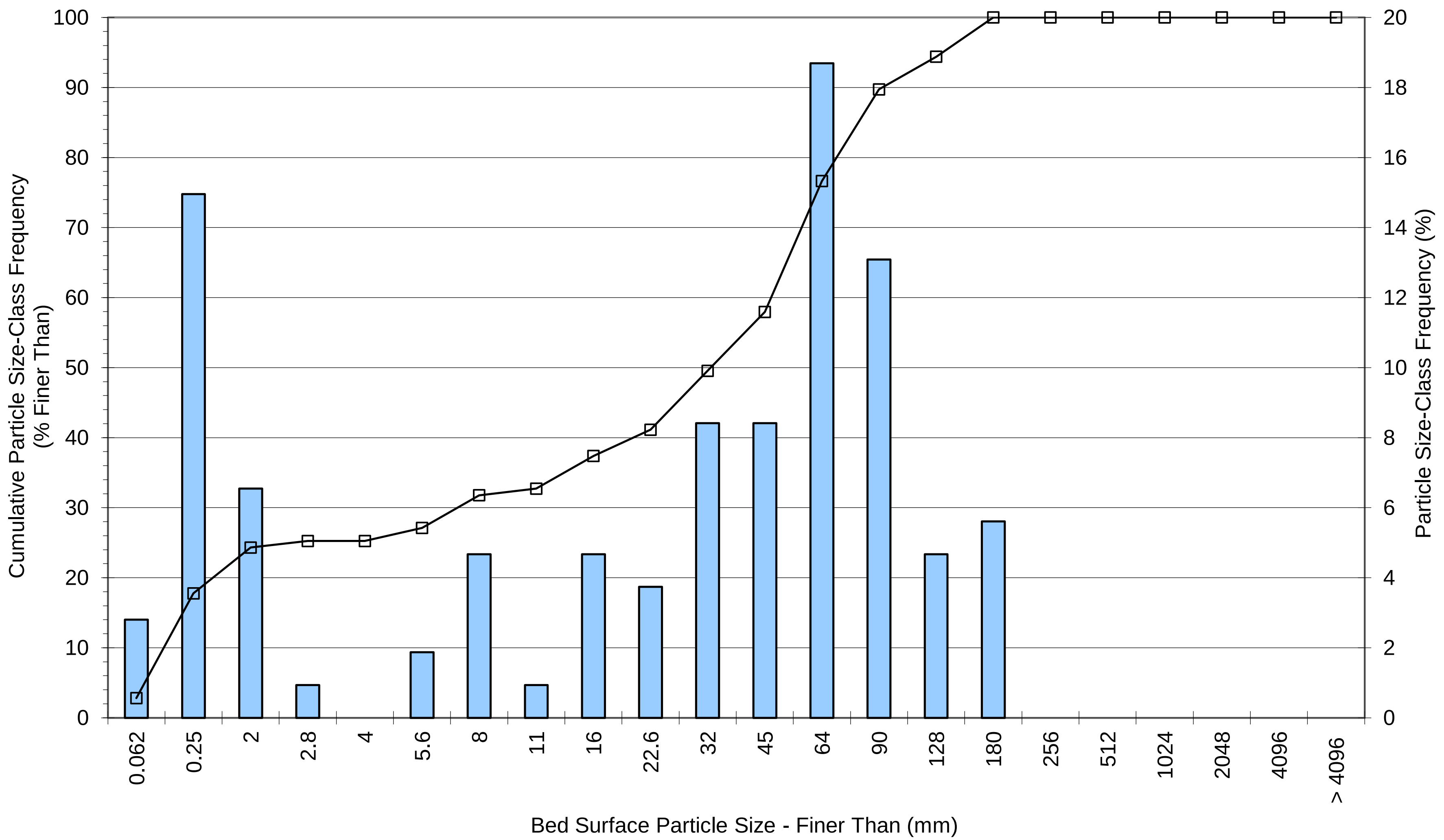
Piru Creek Geomorphology Study
Site 1, XS 2 (post 400 cfs)
Wolman Count Bed Surface Particle Size Distribution

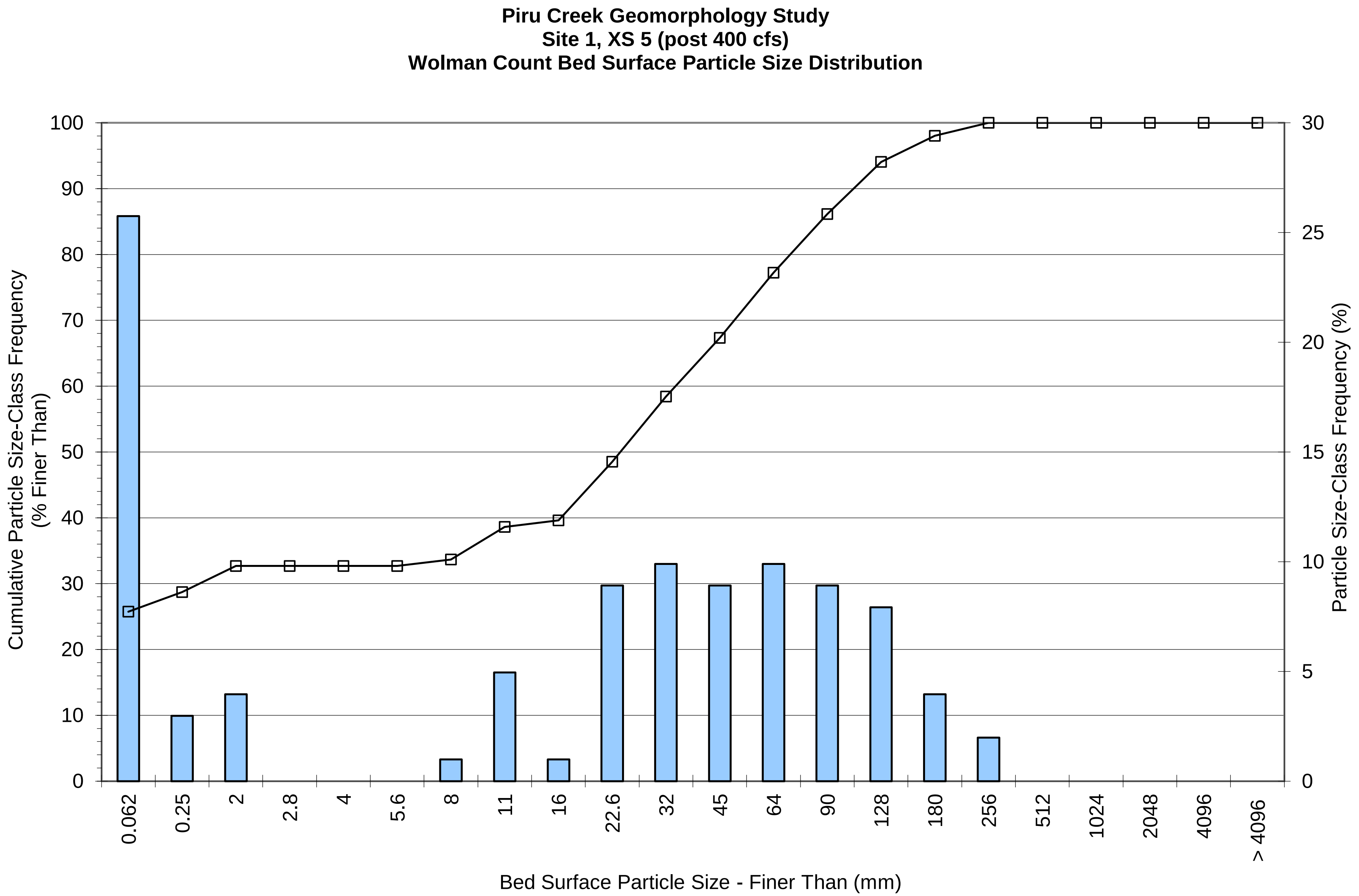




Piru Creek Geomorphology Study
Site 1, XS 3 (post 400 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency
(% Finer Than)
Particle Size-Class Frequency (%)
Bed Surface Particle Size - Finer Than (mm)
0
10
20
30
40
50
60
70
80
90
100
0
2
4
6
8
10
12
14
16
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096

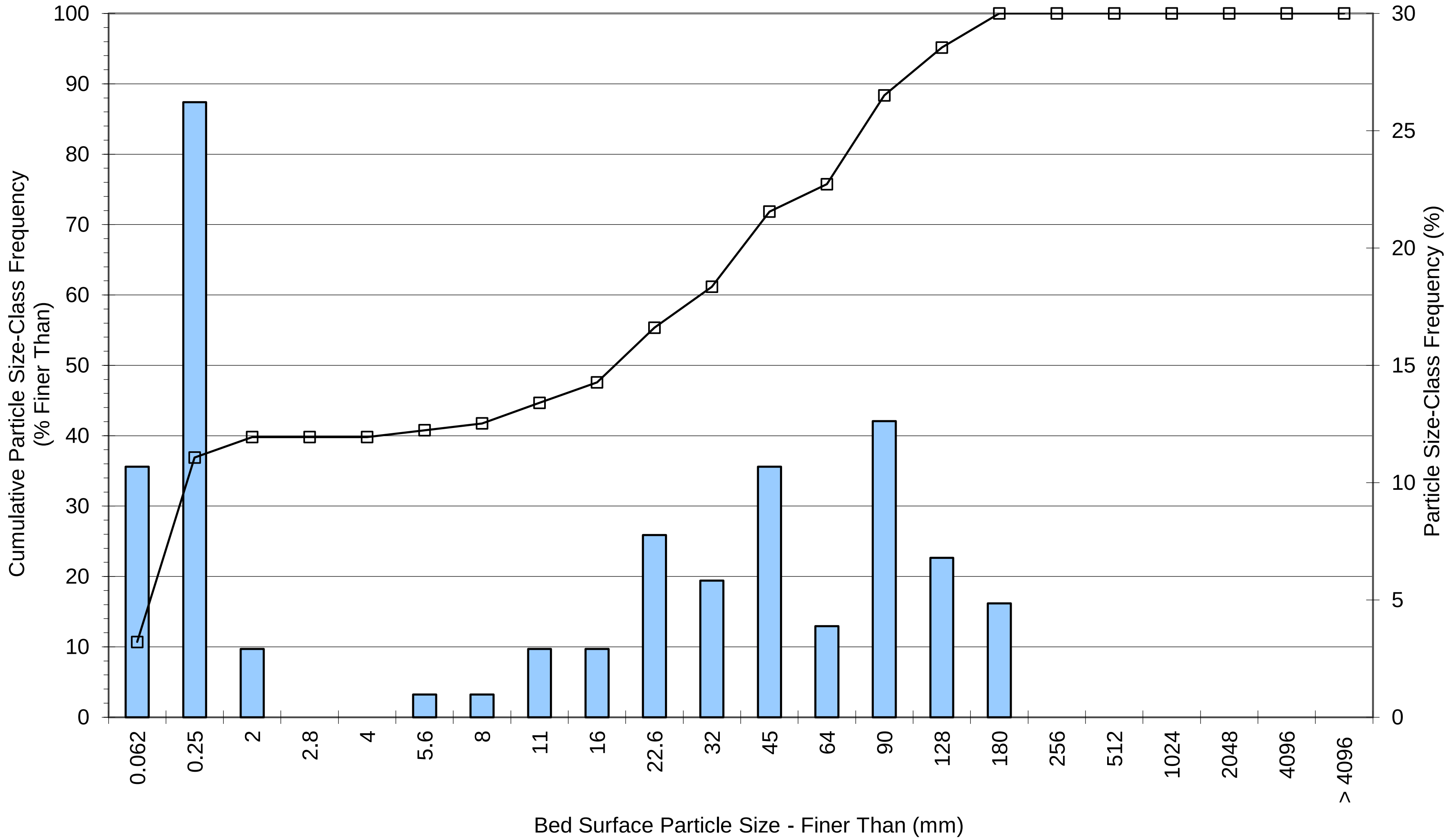
Piru Creek Geomorphology Study
Site 1, XS 4 (post 400 cfs)
Wolman Count Bed Surface Particle Size Distribution



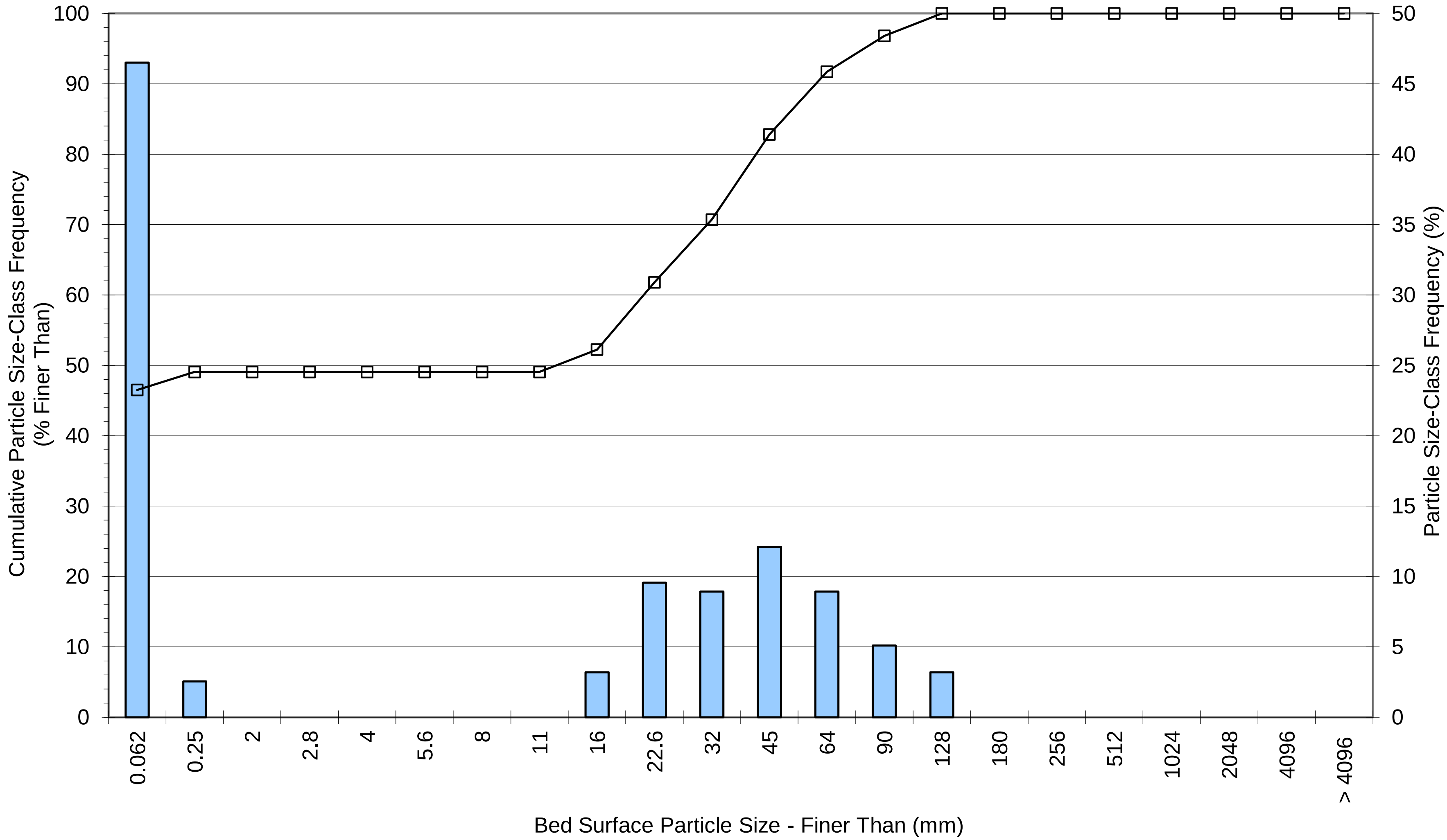


Piru Creek Geomorphology Study
Site 1, XS 5 (post 400 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency
(% Finer Than)
Particle Size-Class Frequency (%)
0
10
20
30
40
50
60
70
80
90
100
0
5
10
15
20
25
30
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096
Bed Surface Particle Size - Finer Than (mm)

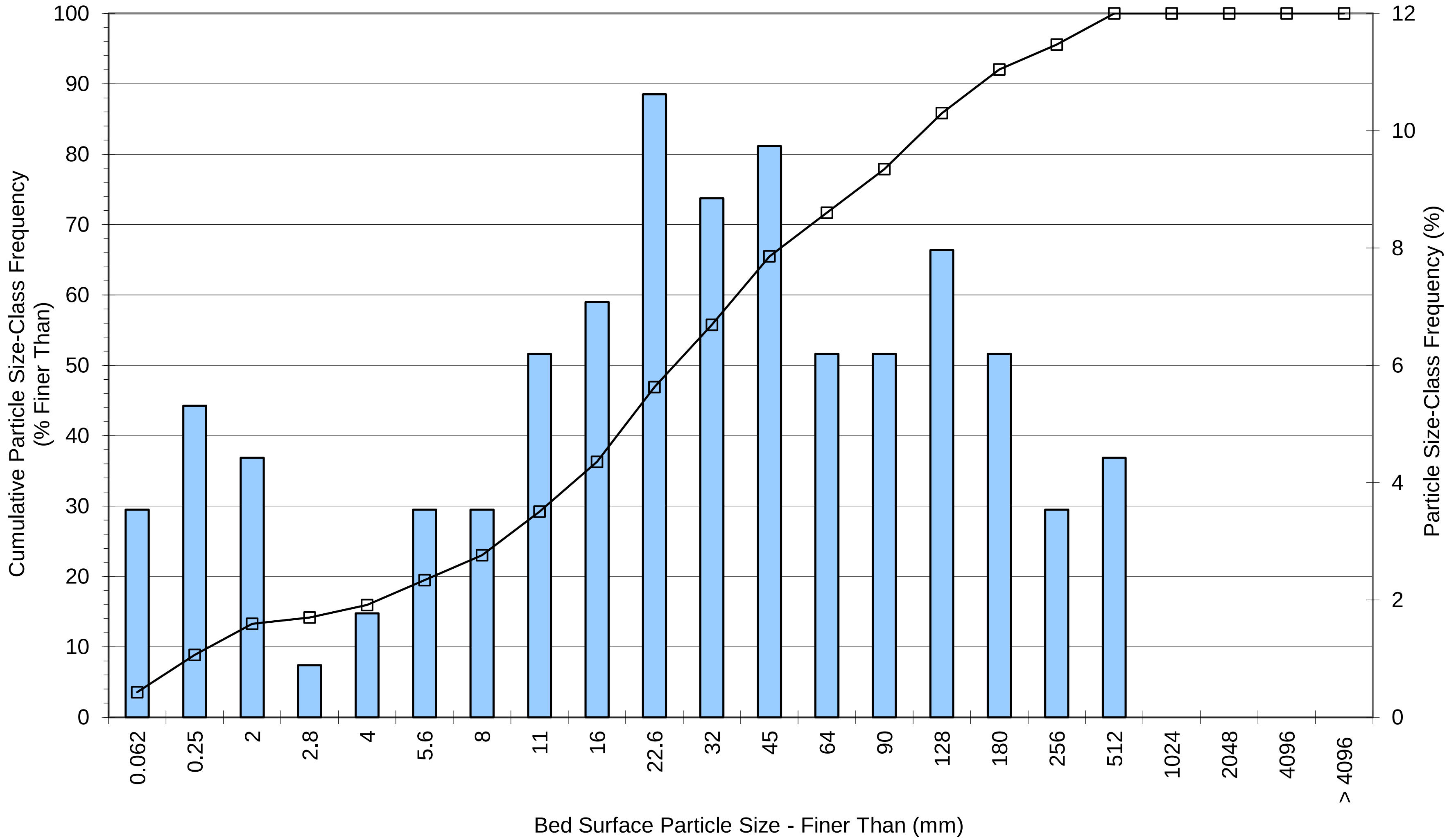
Piru Creek Geomorphology Study
Site 1, XS 6 (post 400 cfs)
Wolman Count Bed Surface Particle Size Distribution



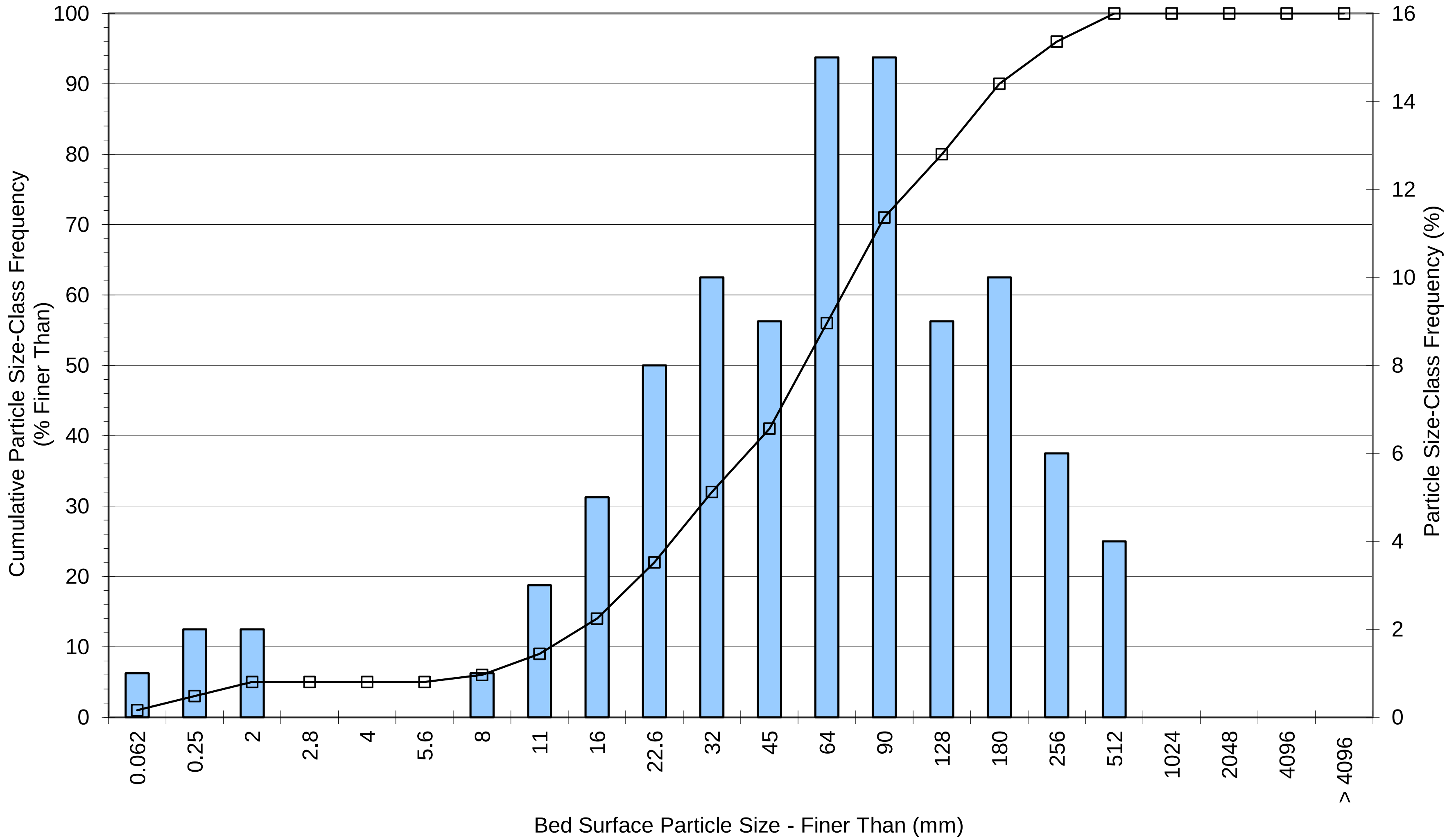
Piru Creek Geomorphology Study
Site 1, XS 7 (post 400 cfs)
Wolman Count Bed Surface Particle Size Distribution

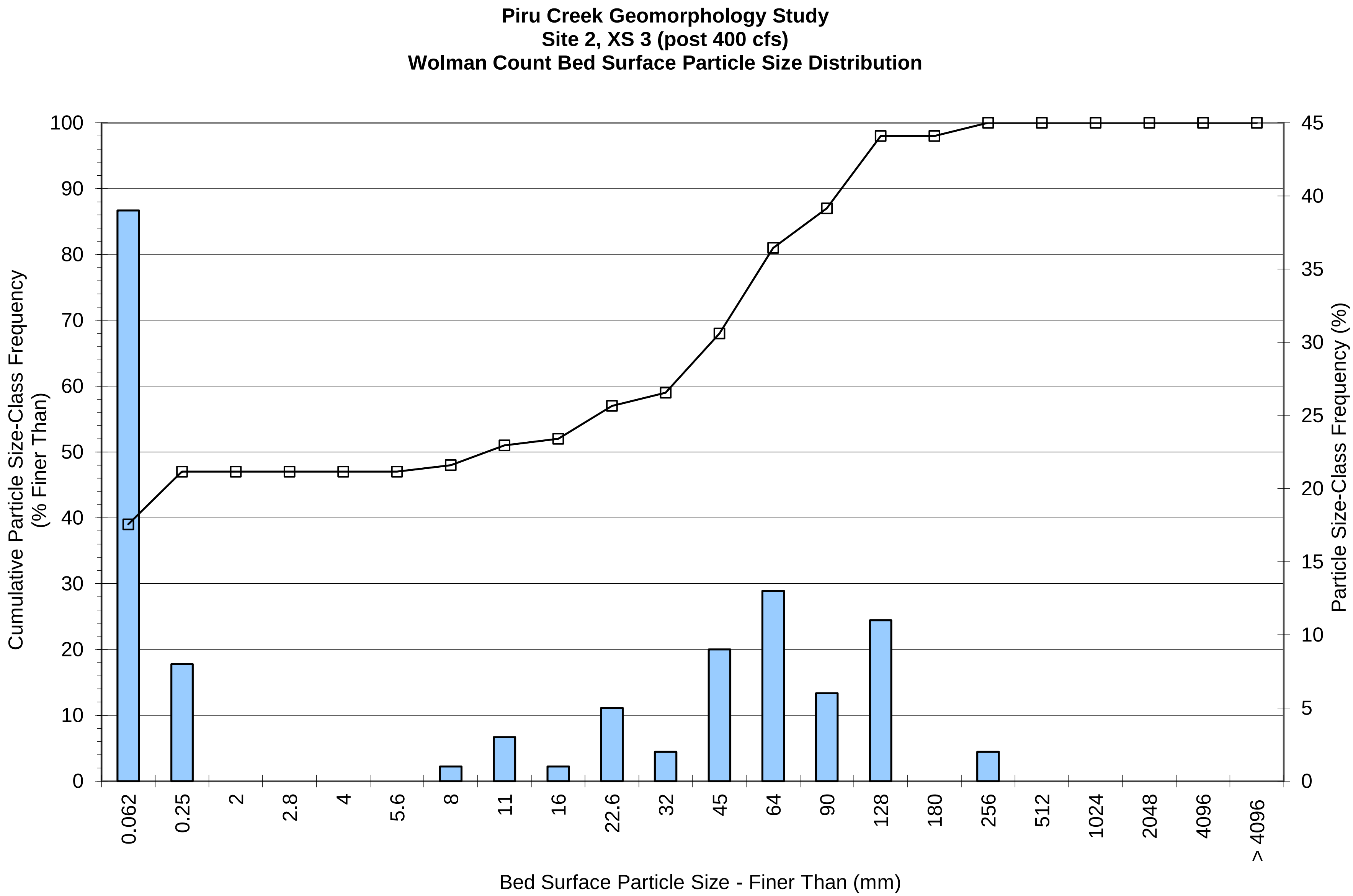


Piru Creek Geomorphology Study
Site 2, XS 1 (post 400 cfs)
Wolman Count Bed Surface Particle Size Distribution



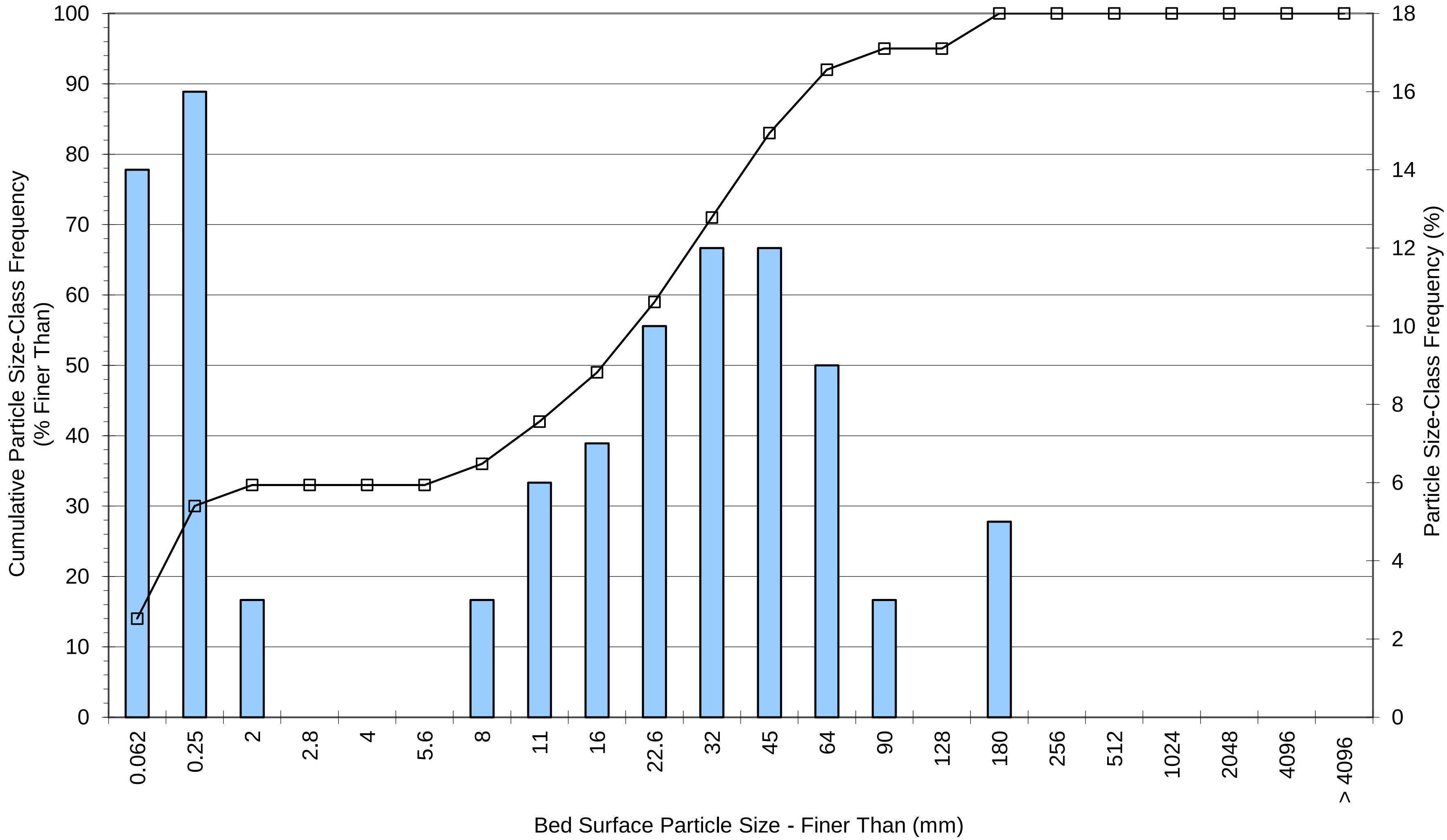
Piru Creek Geomorphology Study
Site 2, XS 2 (post 400 cfs)
Wolman Count Bed Surface Particle Size Distribution

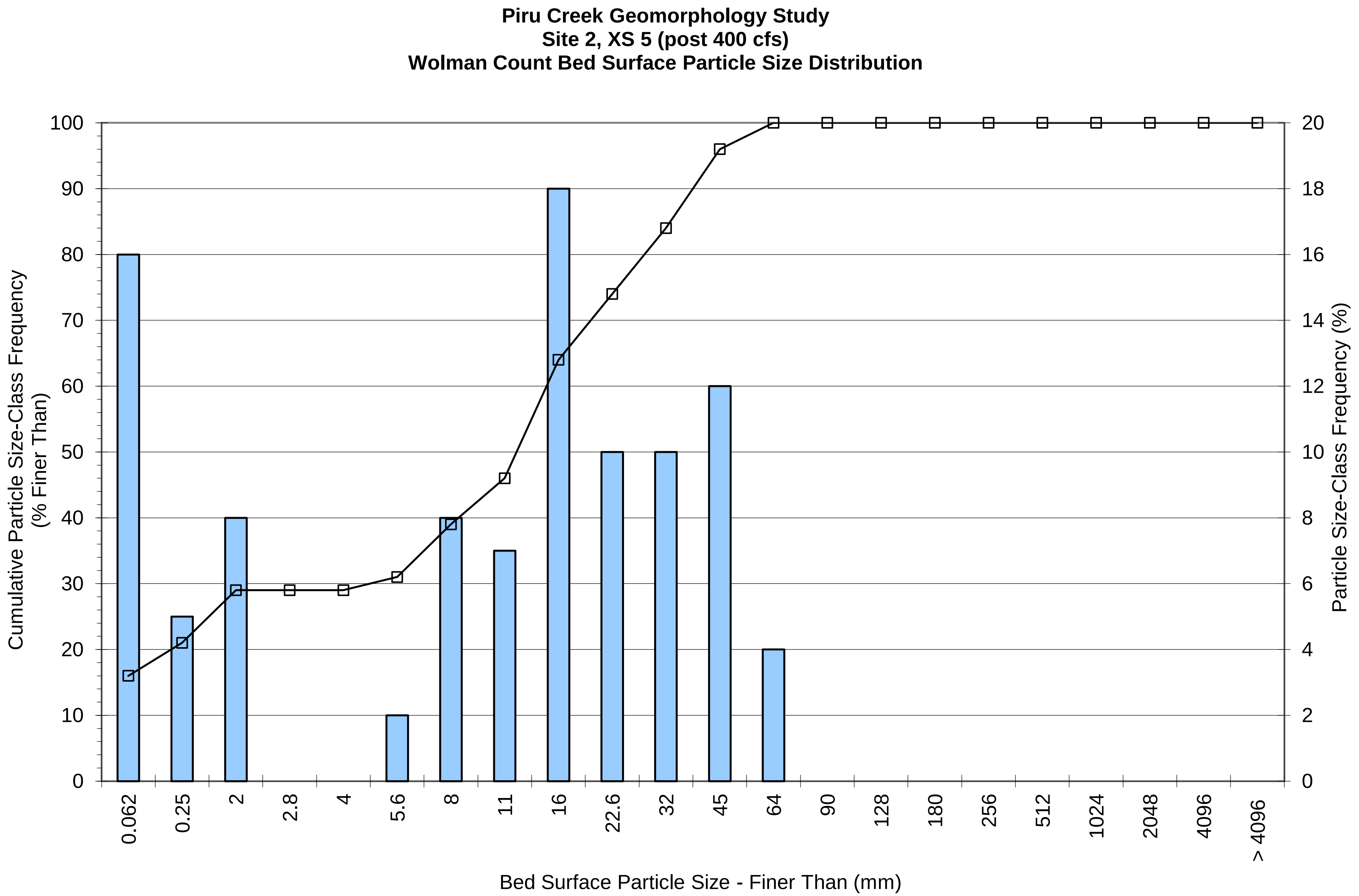




Piru Creek Geomorphology Study
Site 2, XS 3 (post 400 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency (% Finer Than)
Particle Size-Class Frequency (%)
Bed Surface Particle Size - Finer Than (mm)
0
10
20
30
40
50
60
70
80
90
100
0
5
10
15
20
25
30
35
40
45
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096

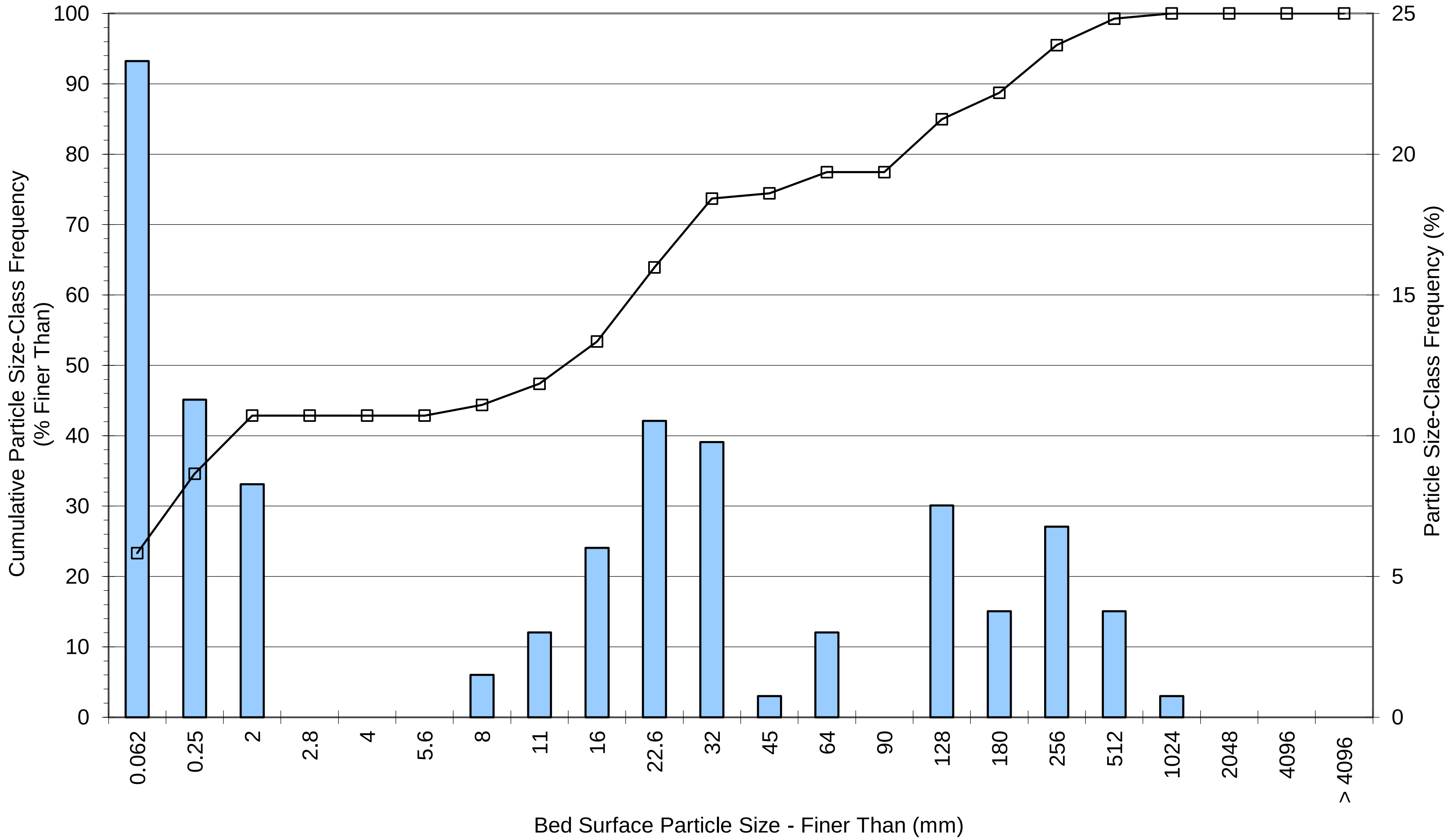
Piru Creek Geomorphology Study
Site 2, XS 4 (post 400 cfs)
Wolman Count Bed Surface Particle Size Distribution



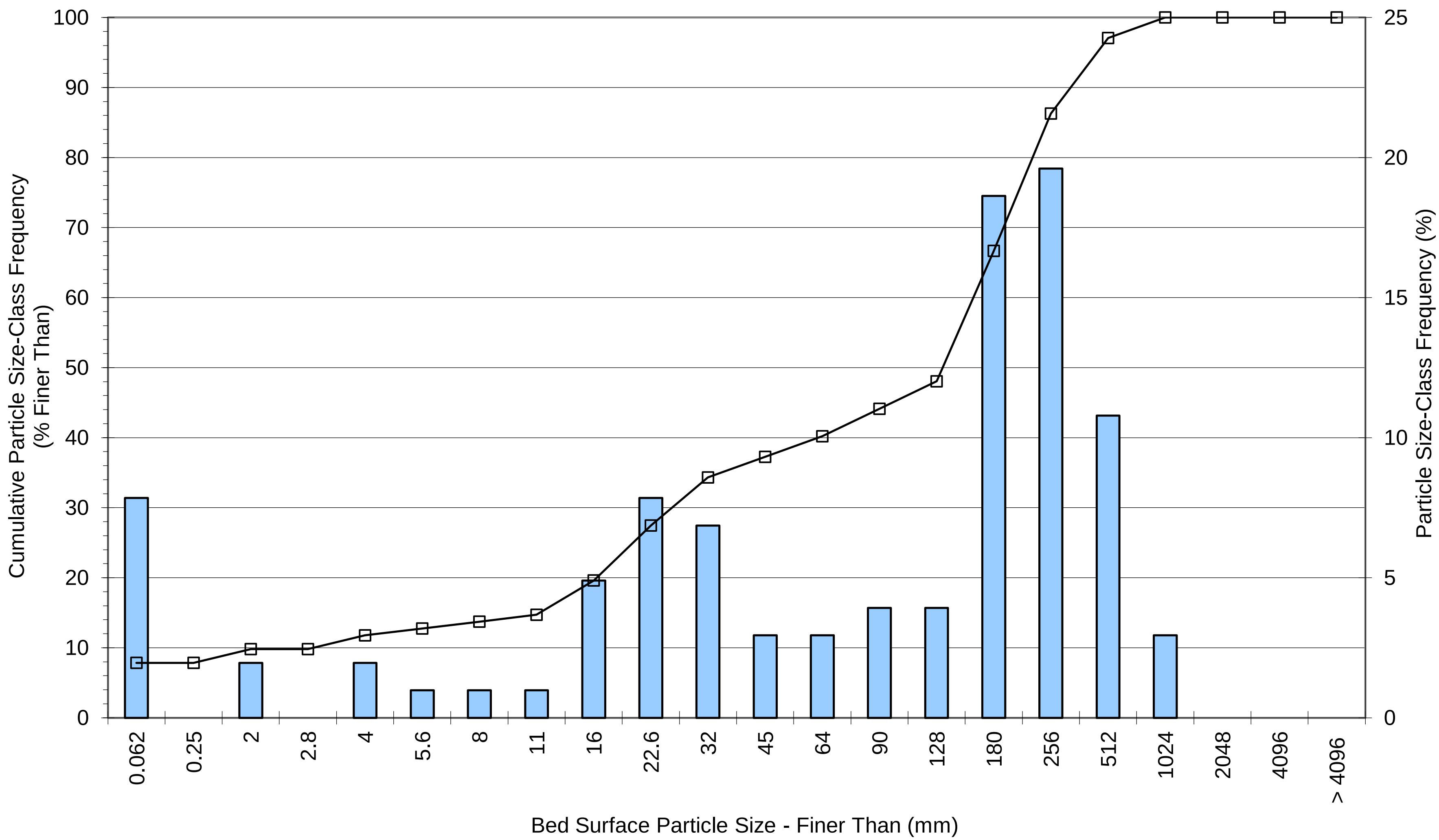


Piru Creek Pebble Count Data Worksheet.xls Site2_XS5 (post 400cfs) 5/9/2012

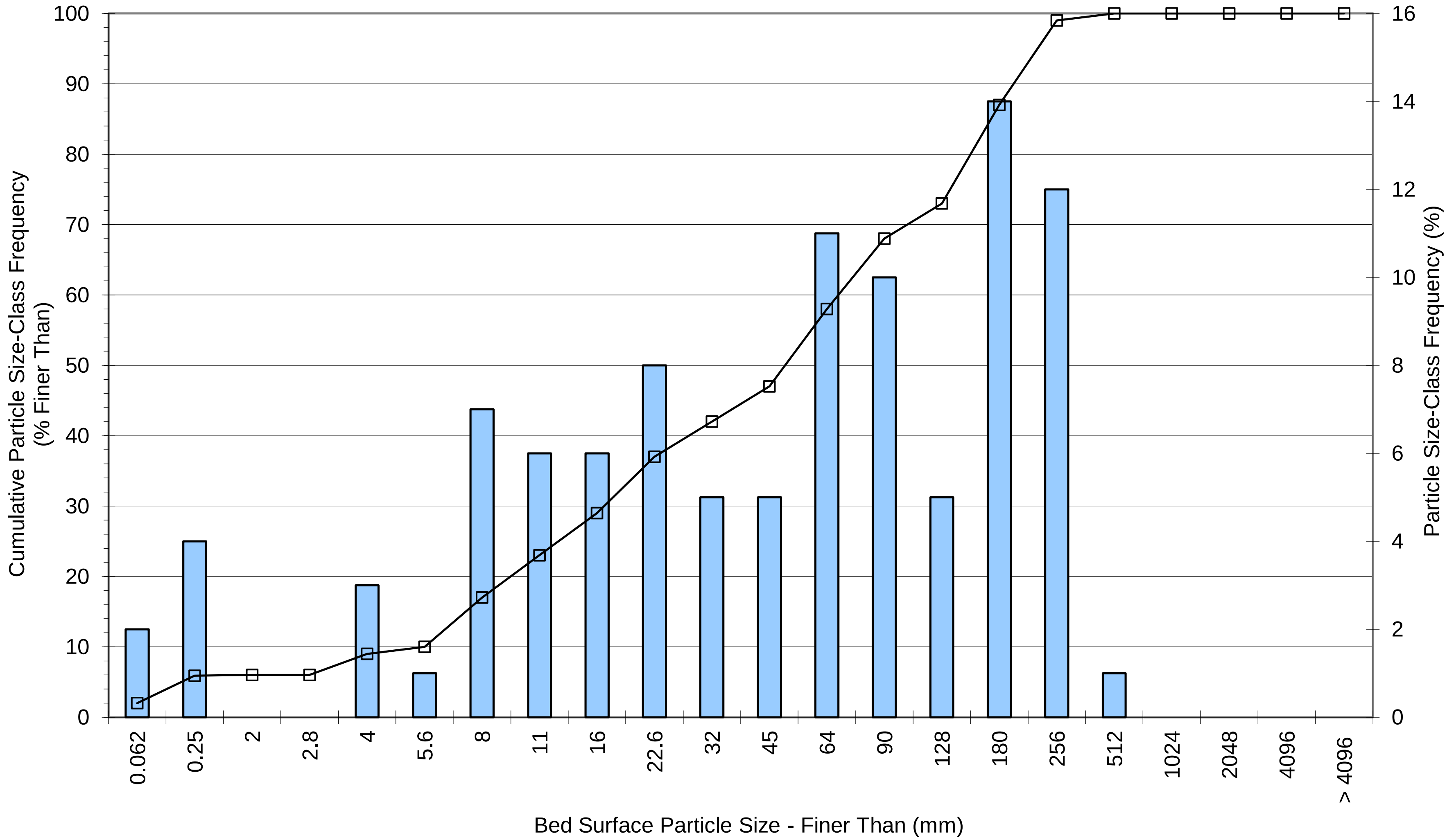
Piru Creek Geomorphology Study
Site 3, XS 1 (post 400 cfs)
Wolman Count Bed Surface Particle Size Distribution

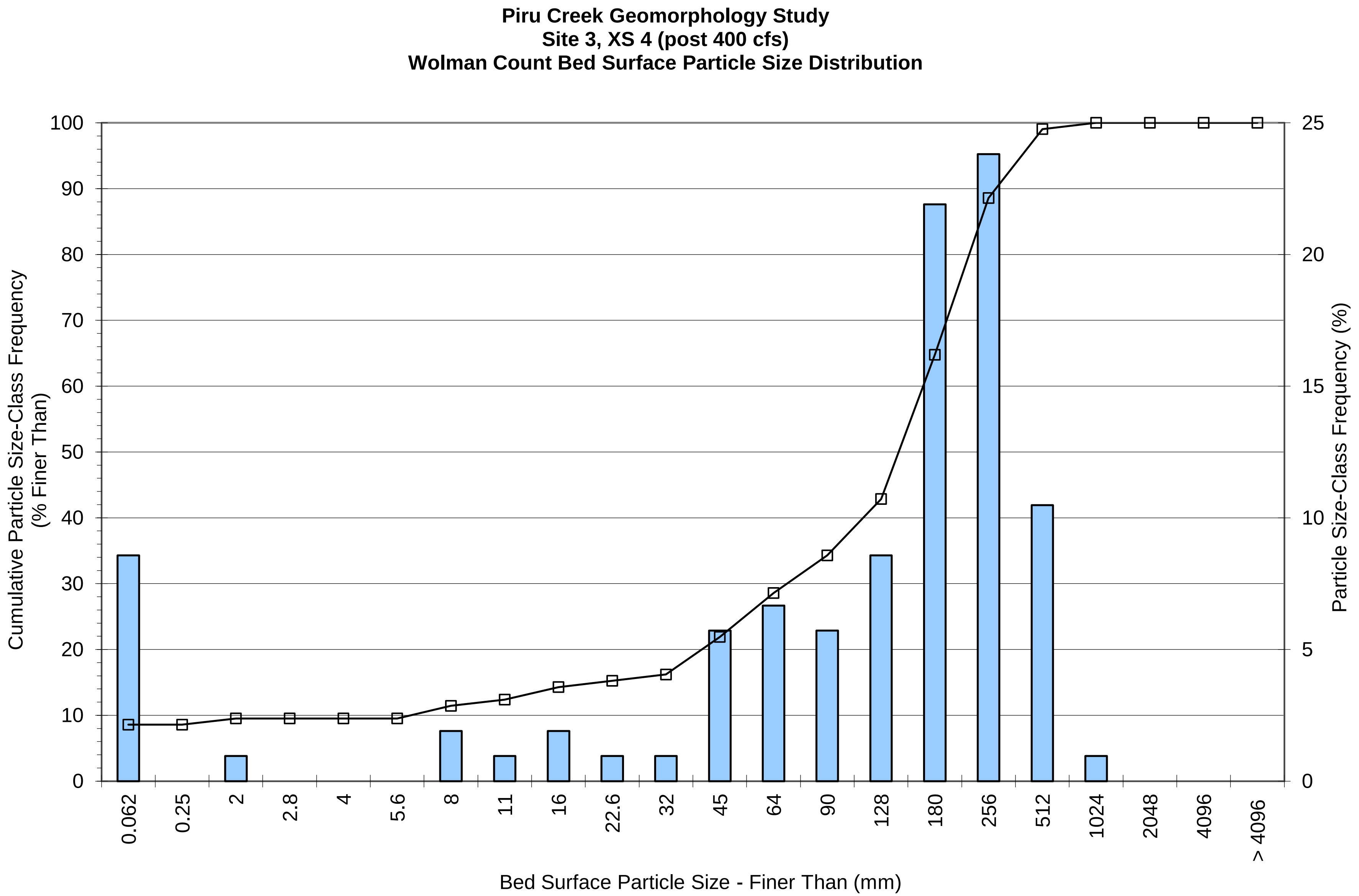


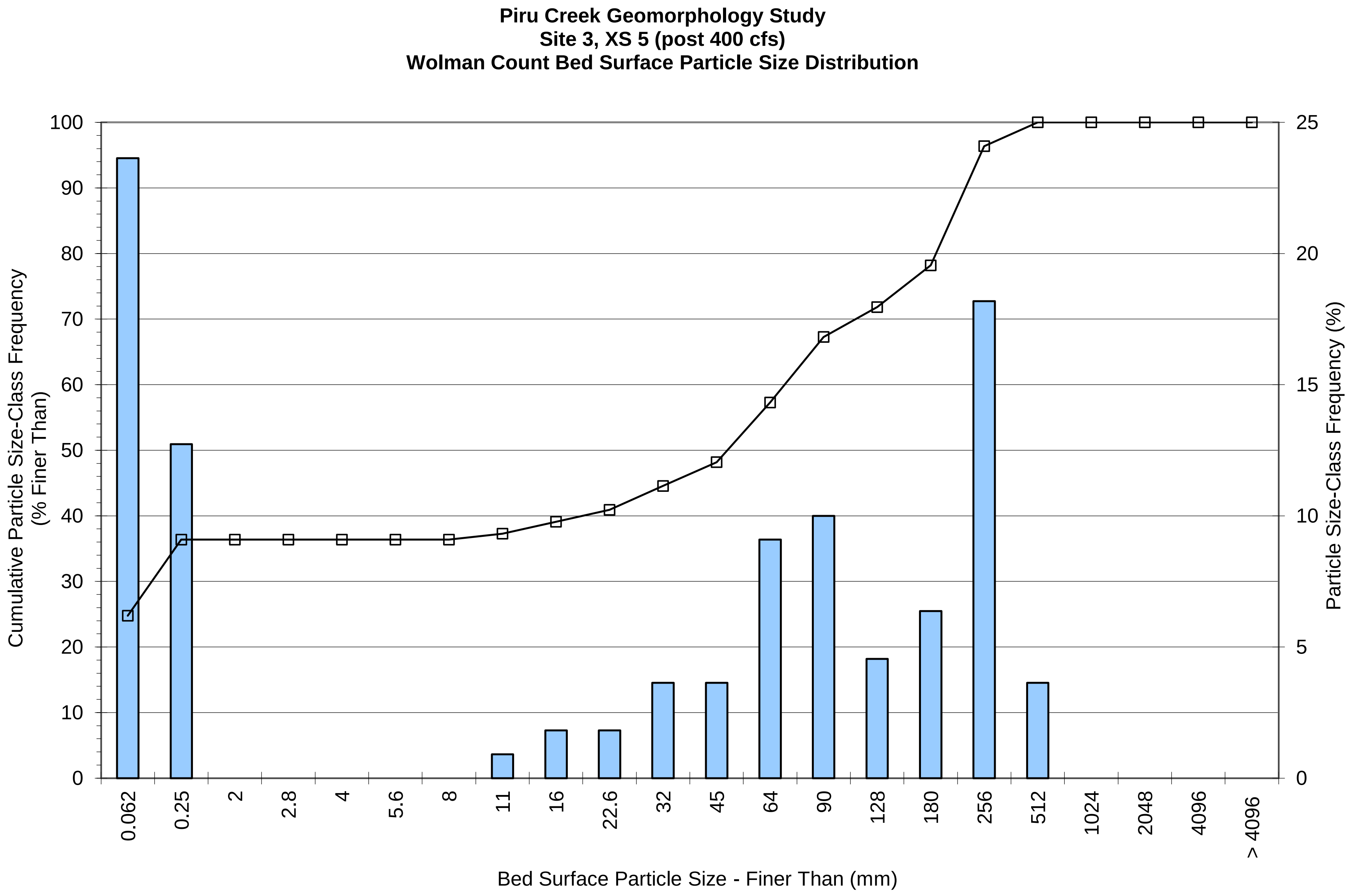
Piru Creek Geomorphology Study
Site 3, XS 2 (post 400 cfs)
Wolman Count Bed Surface Particle Size Distribution



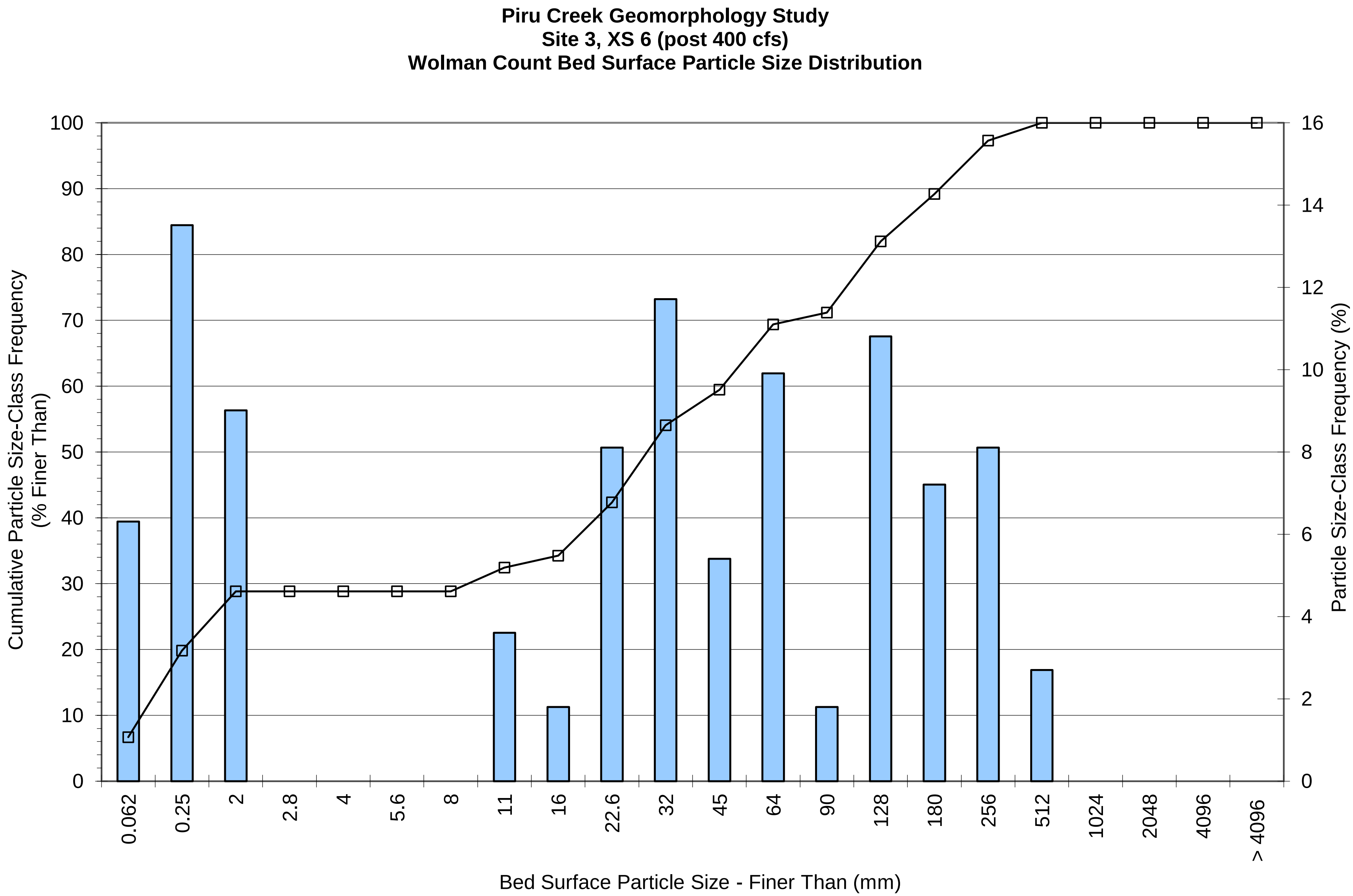
Piru Creek Geomorphology Study
Site 3, XS 3 (post 400 cfs)
Wolman Count Bed Surface Particle Size Distribution



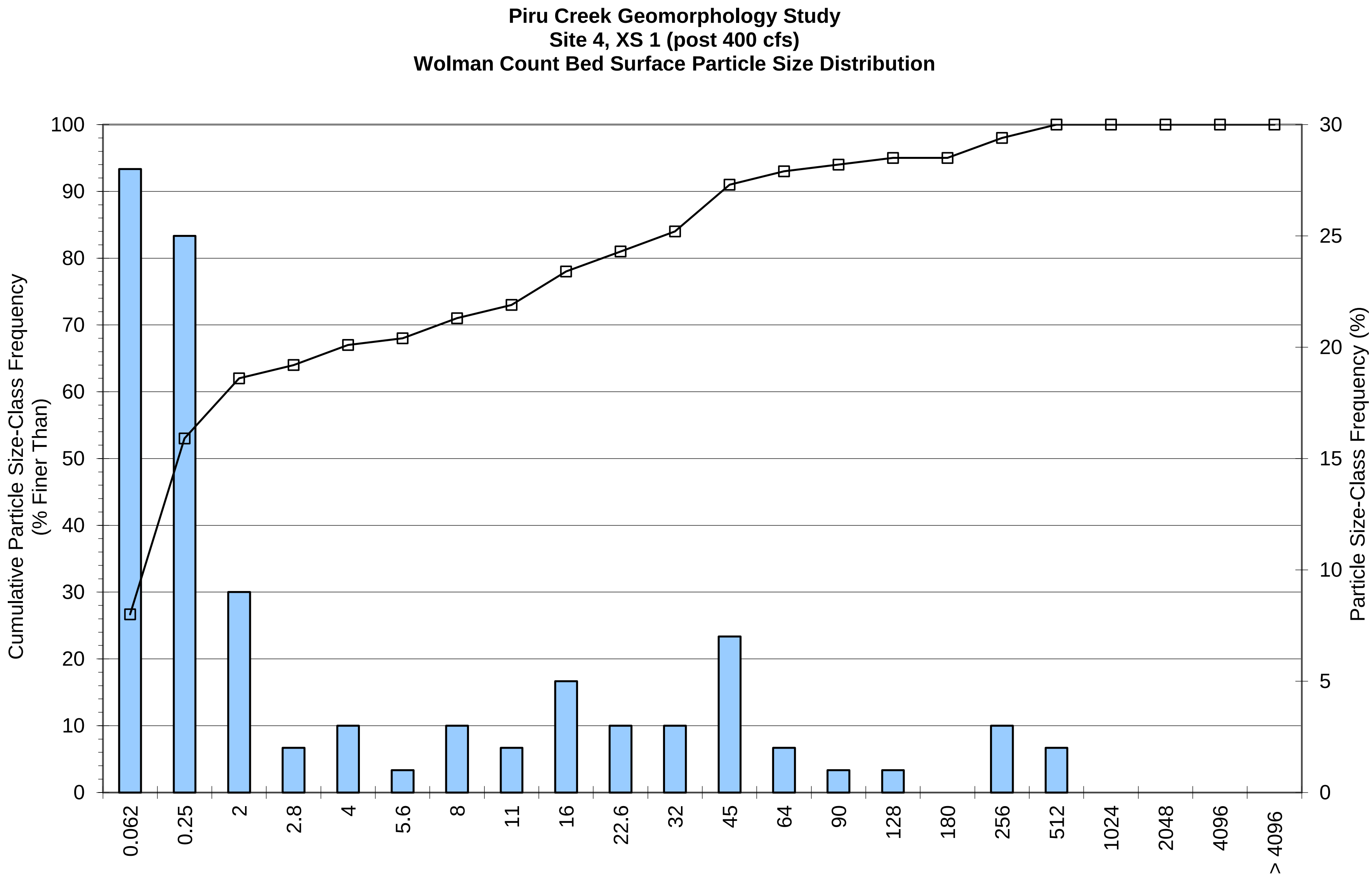

Piru Creek Geomorphology Study
Site 3, XS 4 (post 400 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency (% Finer Than)
Particle Size-Class Frequency (%)
Bed Surface Particle Size - Finer Than (mm)
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096



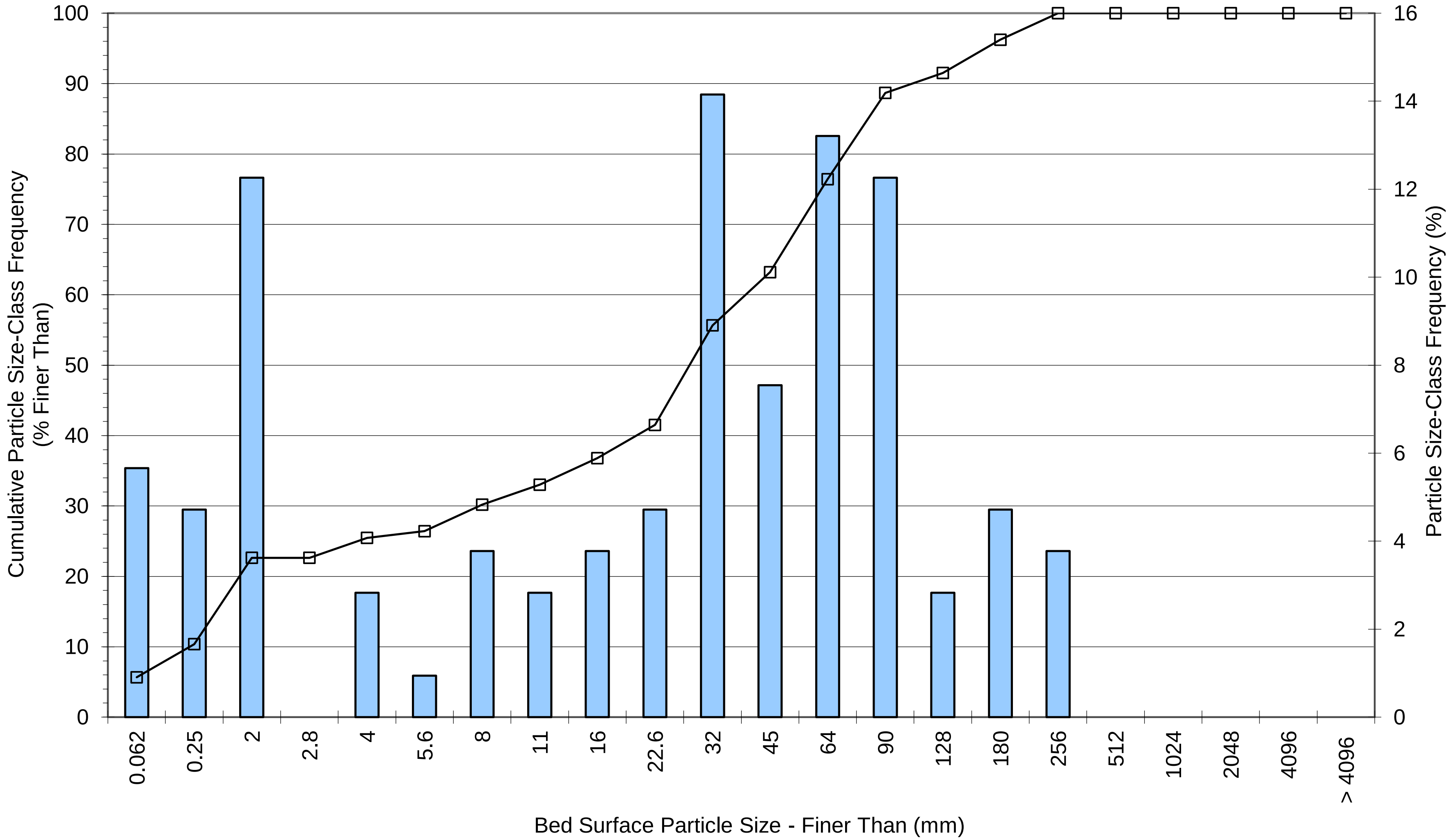
Piru Creek Geomorphology Study
Site 3, XS 5 (post 400 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency (% Finer Than)
Particle Size-Class Frequency (%)
Bed Surface Particle Size - Finer Than (mm)
0
10
20
30
40
50
60
70
80
90
100
5
15
25
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096

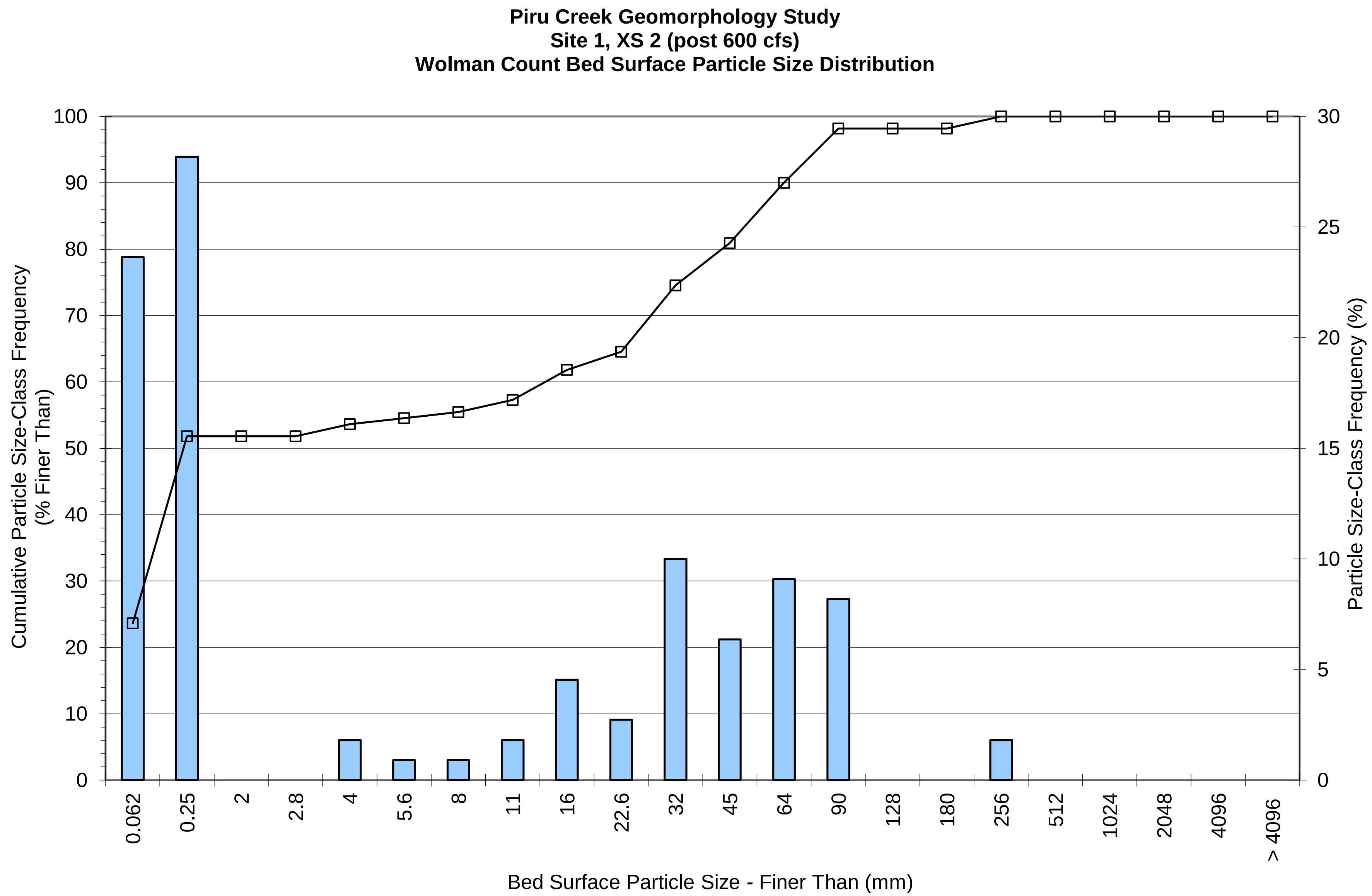


Piru Creek Geomorphology Study
Site 3, XS 6 (post 400 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency (% Finer Than)
Particle Size-Class Frequency (%)
0
10
20
30
40
50
60
70
80
90
100
0
2
4
6
8
10
12
14
16
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096
Bed Surface Particle Size - Finer Than (mm)


Piru Creek Geomorphology Study
Site 4, XS 1 (post 400 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency (% Finer Than)
Particle Size-Class Frequency (%)
Bed Surface Particle Size - Finer Than (mm)
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096

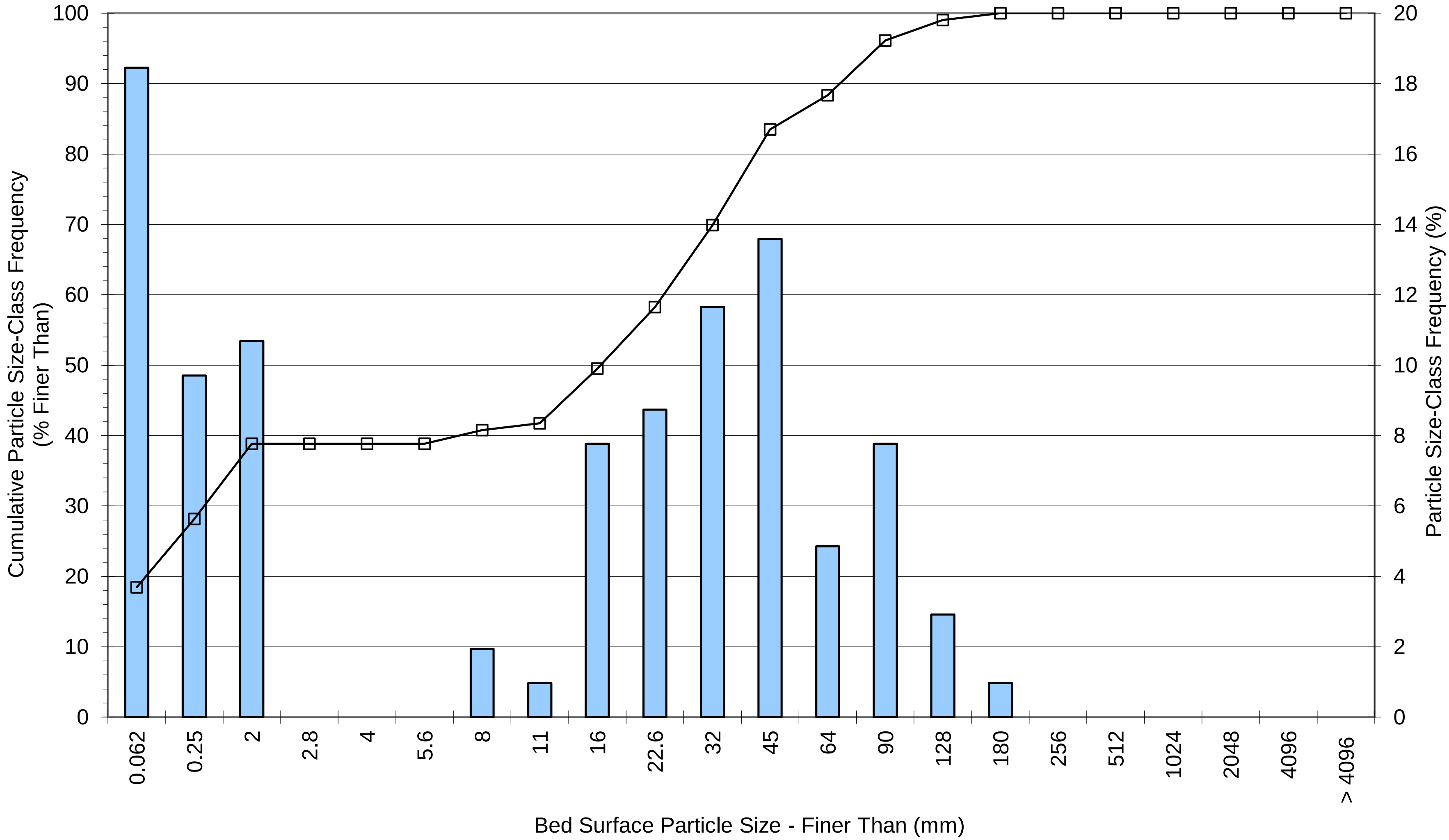
Piru Creek Geomorphology Study
Site 1, XS 1 (post 600 cfs)
Wolman Count Bed Surface Particle Size Distribution

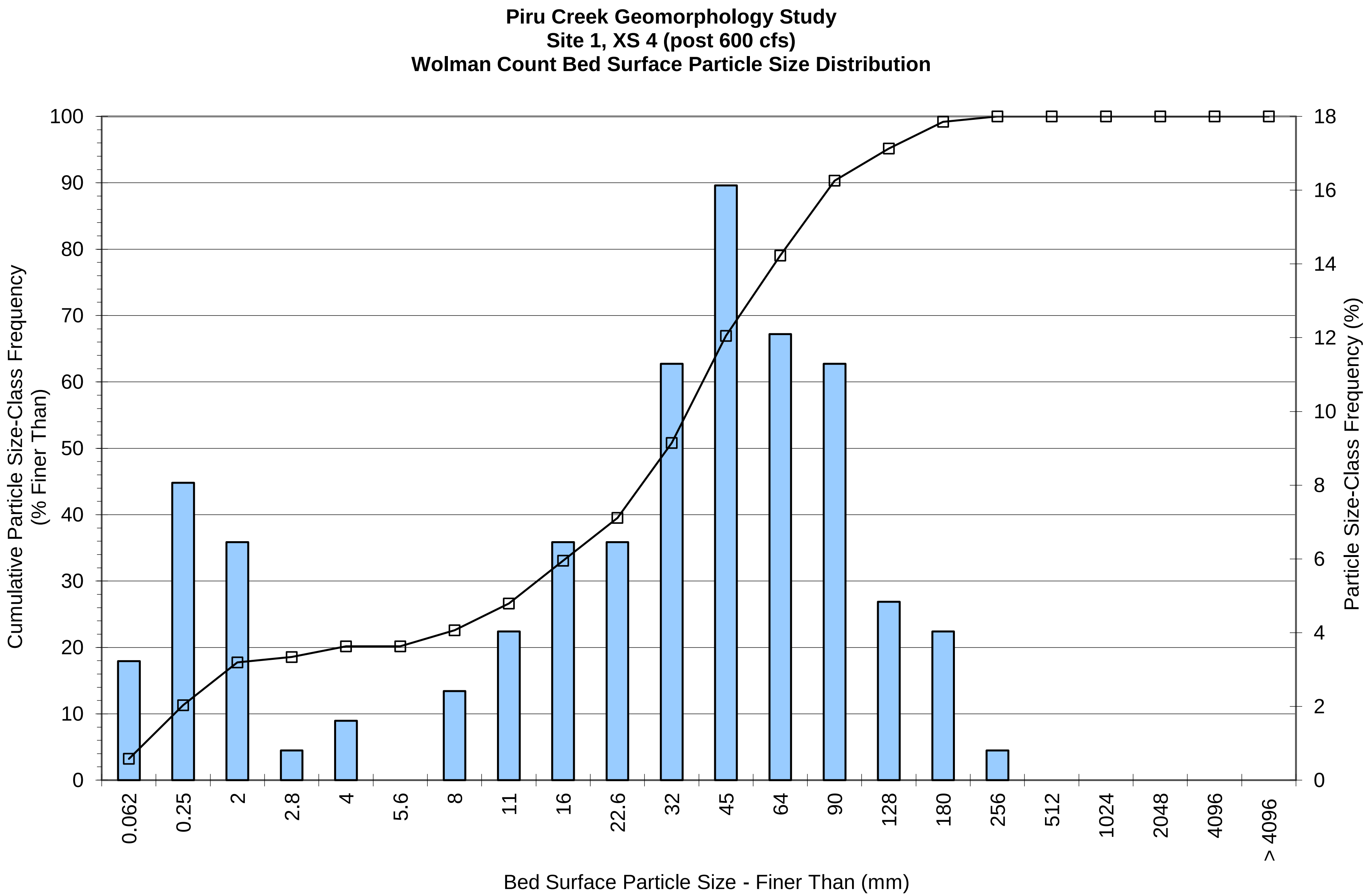




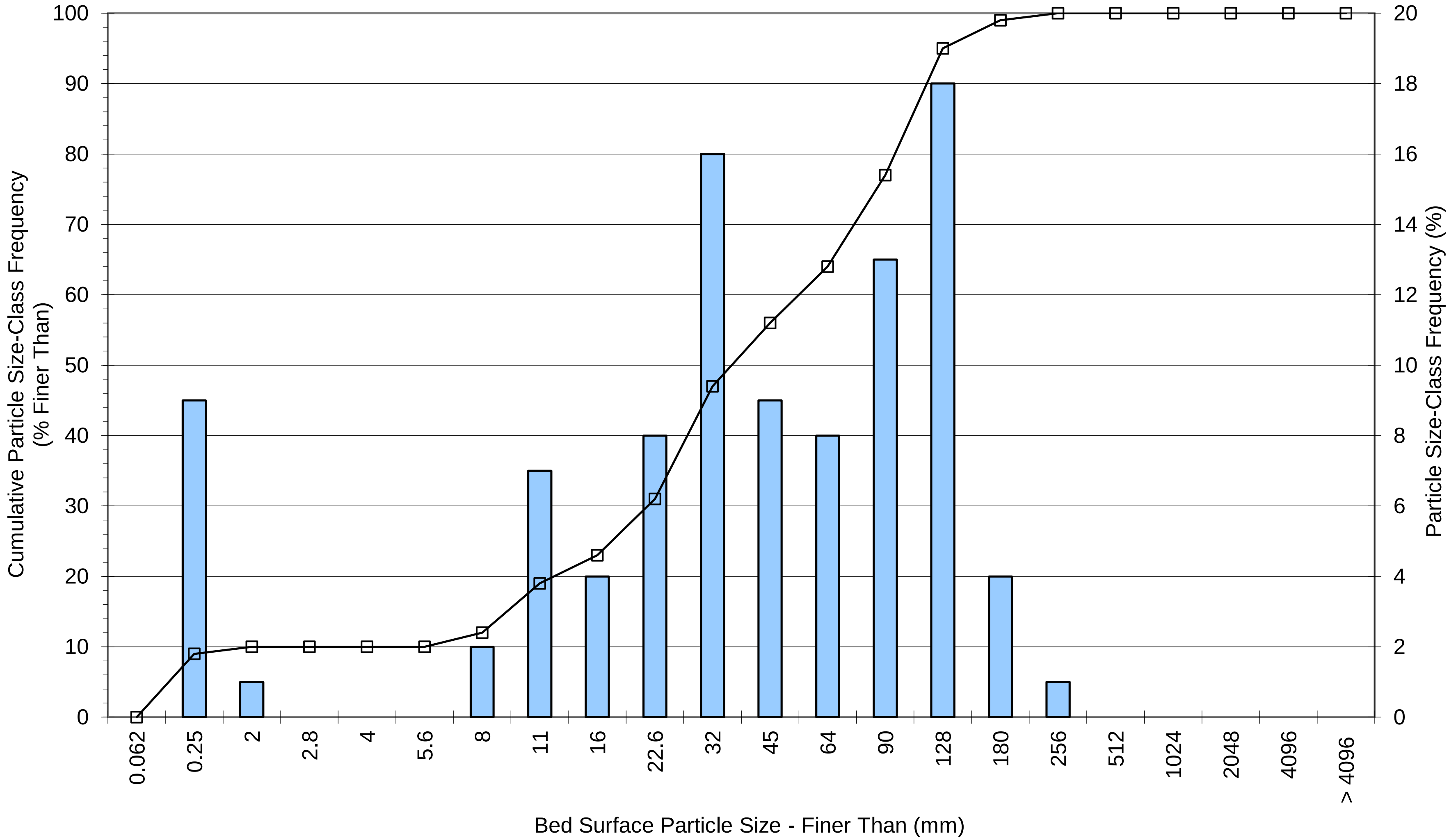
Piru Creek Geomorphology Study
Site 1, XS 2 (post 600 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency (% Finer Than)
Particle Size-Class Frequency (%)
Bed Surface Particle Size - Finer Than (mm)
0
10
20
30
40
50
60
70
80
90
100
5
15
25
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096

Piru Creek Geomorphology Study
Site 1, XS 3 (post 600 cfs)
Wolman Count Bed Surface Particle Size Distribution

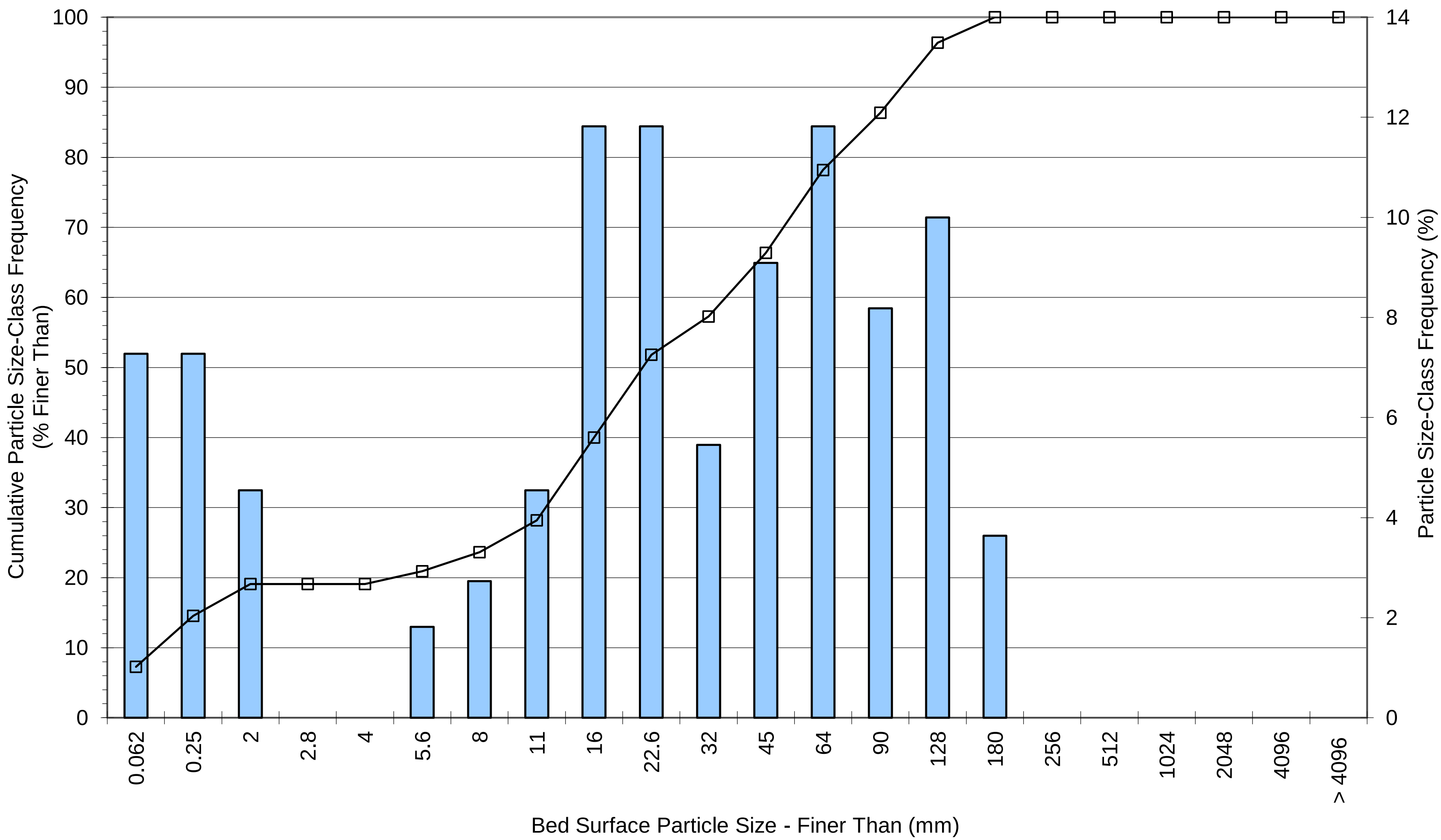



Piru Creek Geomorphology Study
Site 1, XS 4 (post 600 cfs)
Wolman Count Bed Surface Particle Size Distribution
100
90
80
70
60
50
40
30
20
10
0
Cumulative Particle Size-Class Frequency
(% Finer Than)
18
16
14
12
10
8
6
4
2
0
Particle Size-Class Frequency (%)
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096
Bed Surface Particle Size - Finer Than (mm)

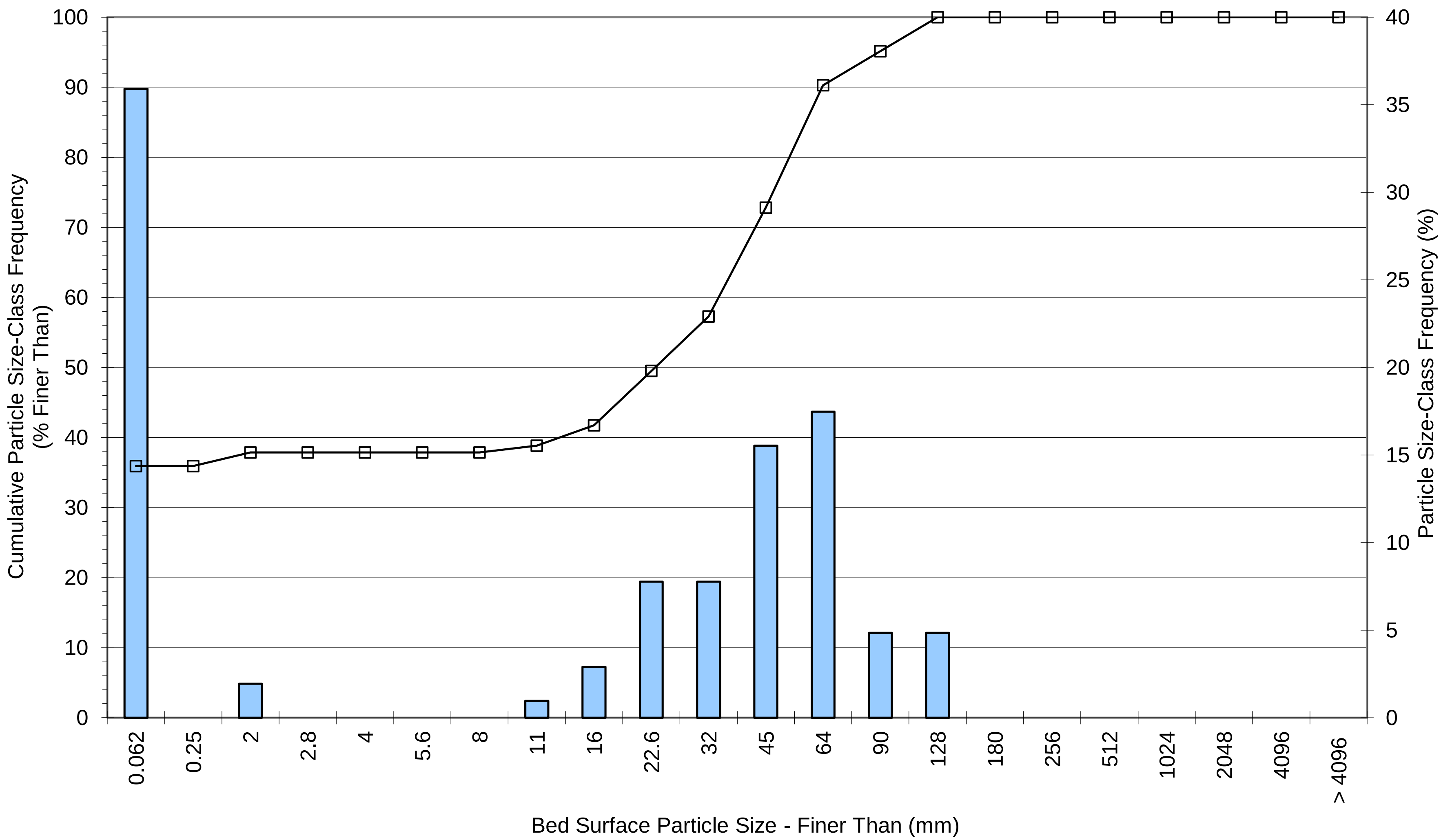
Piru Creek Geomorphology Study
Site 1, XS 5 (post 600 cfs)
Wolman Count Bed Surface Particle Size Distribution



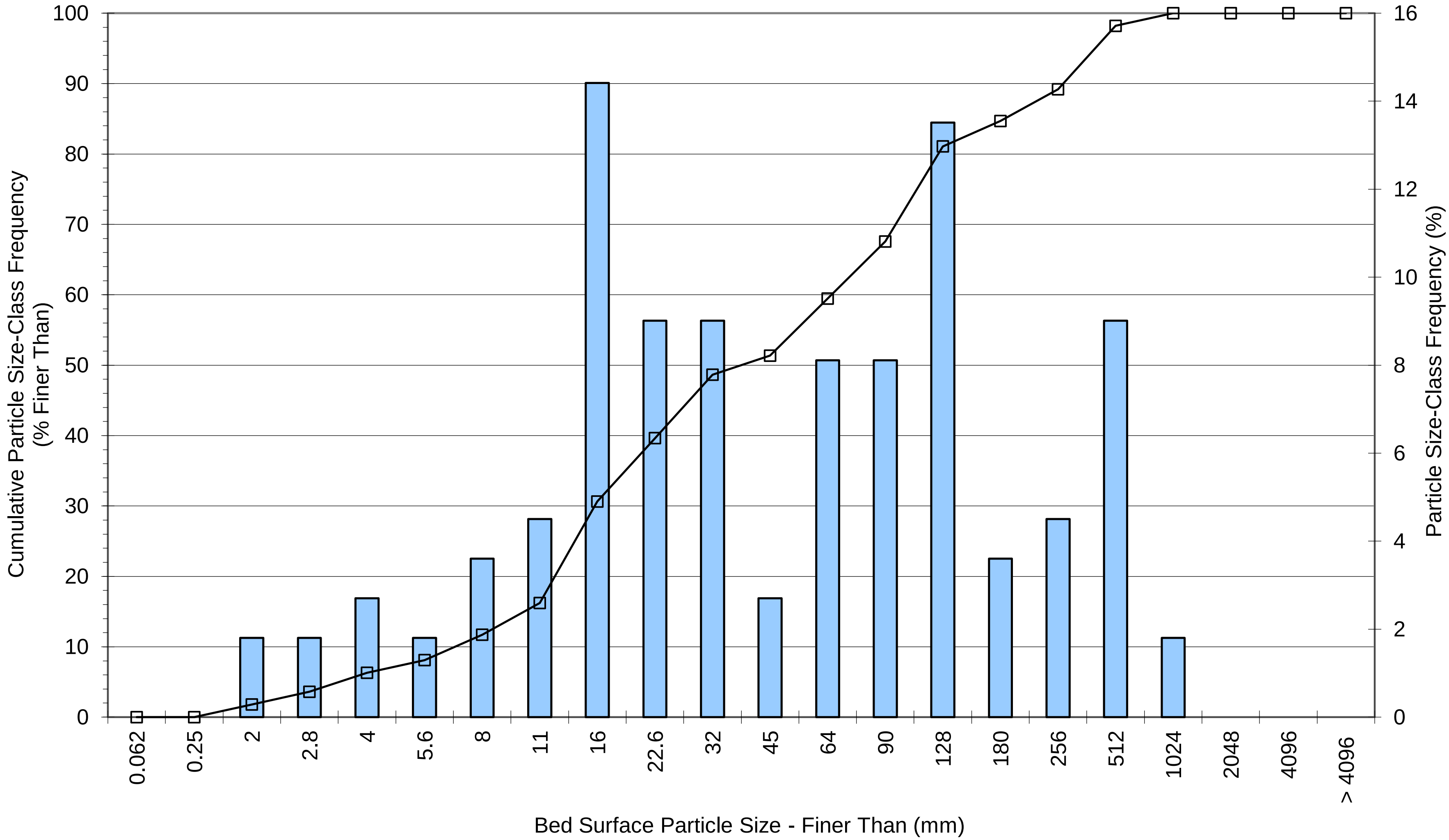
Piru Creek Geomorphology Study
Site 1, XS 6 (post 600 cfs)
Wolman Count Bed Surface Particle Size Distribution

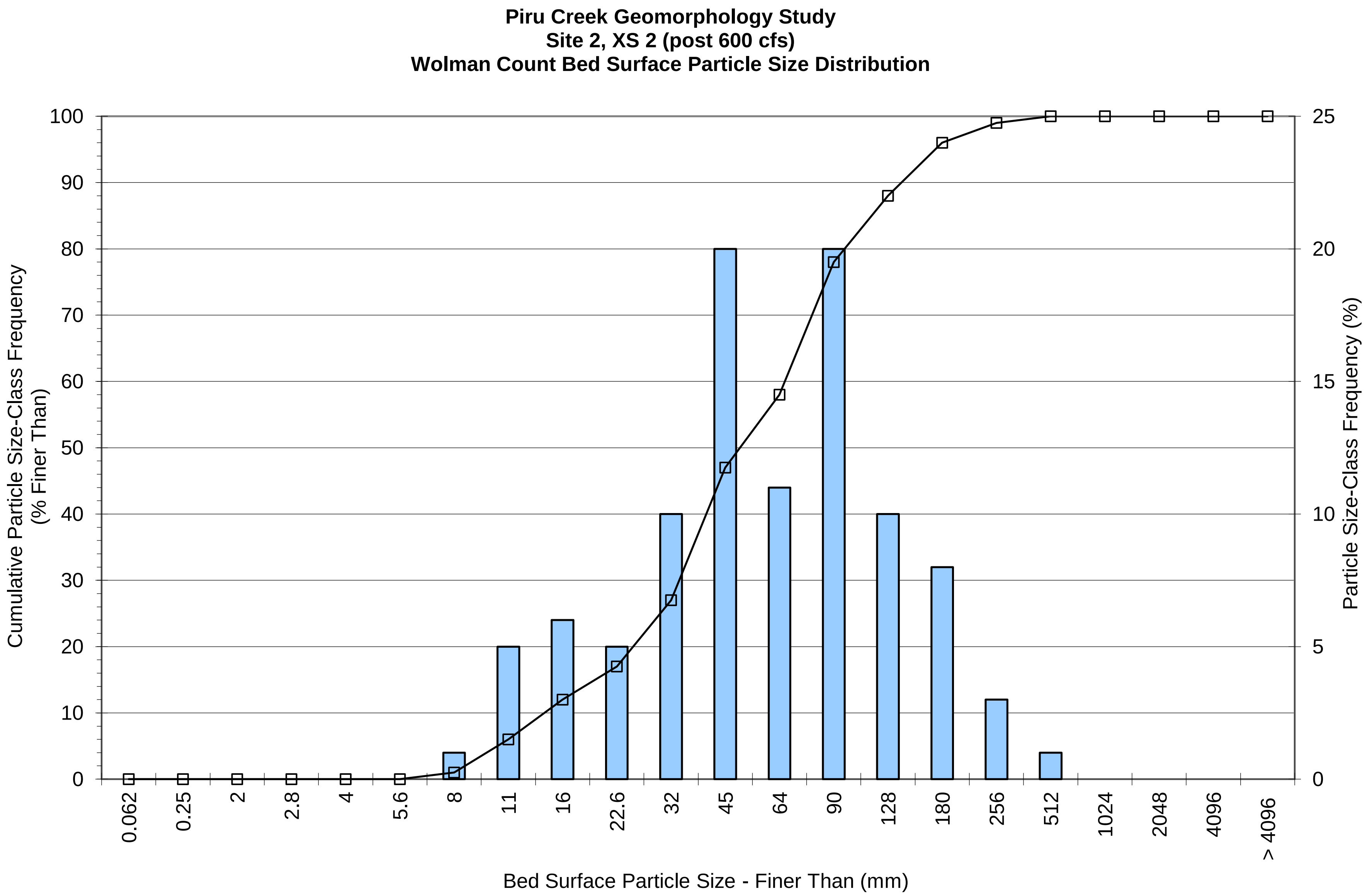


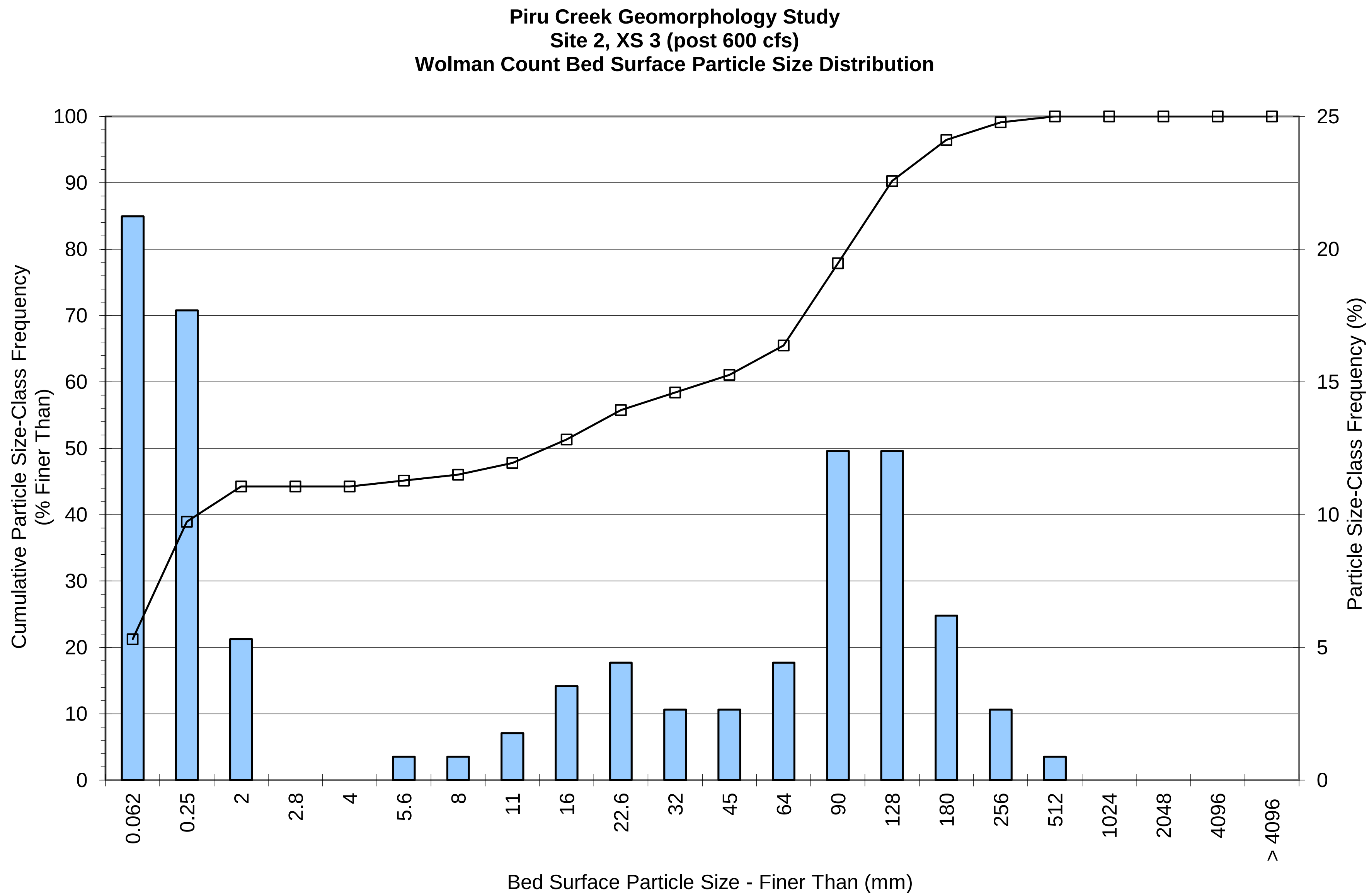
Piru Creek Geomorphology Study
Site 1, XS 7 (post 600 cfs)
Wolman Count Bed Surface Particle Size Distribution



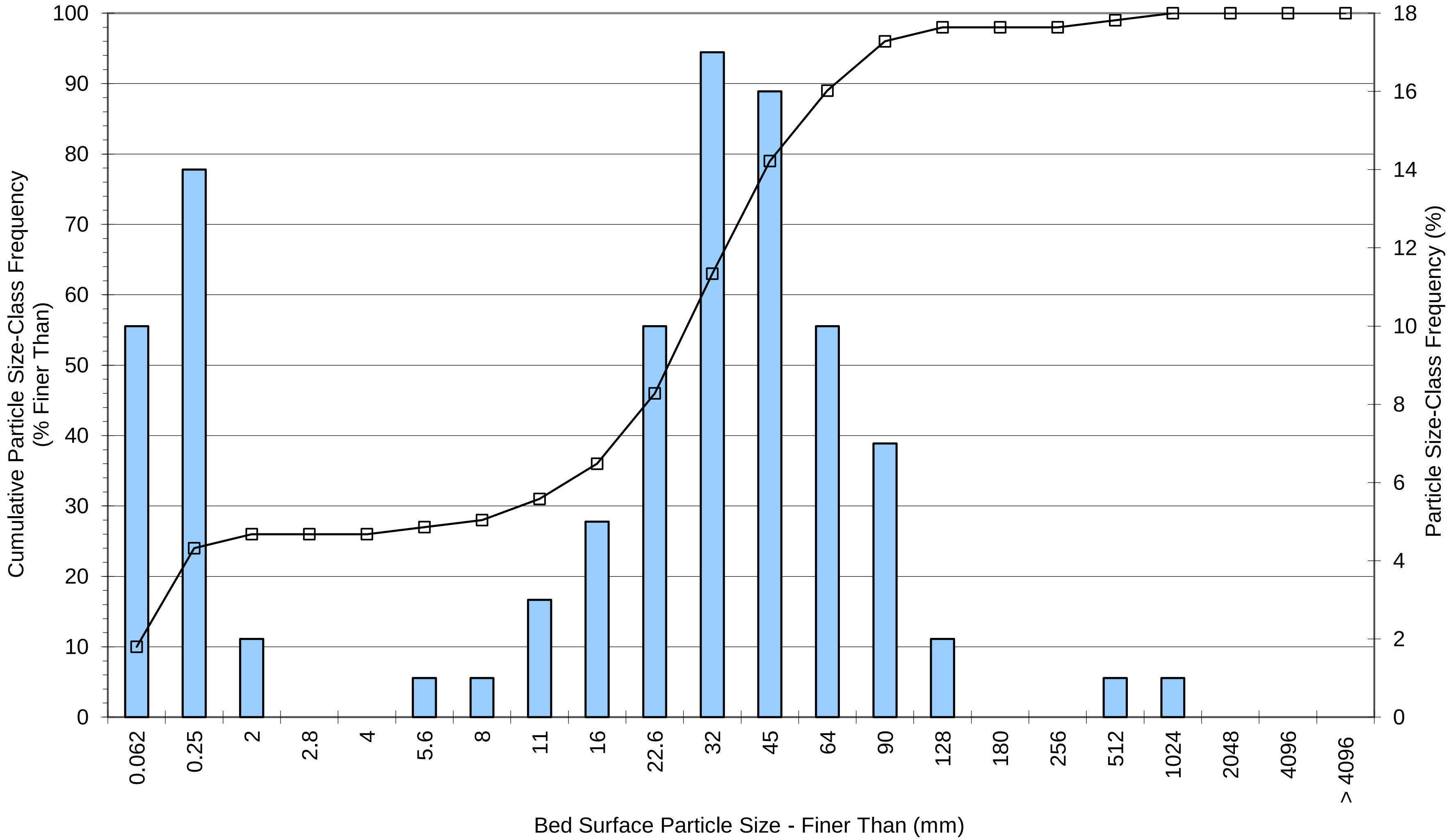
Piru Creek Geomorphology Study
Site 2, XS 1 (post 600 cfs)
Wolman Count Bed Surface Particle Size Distribution



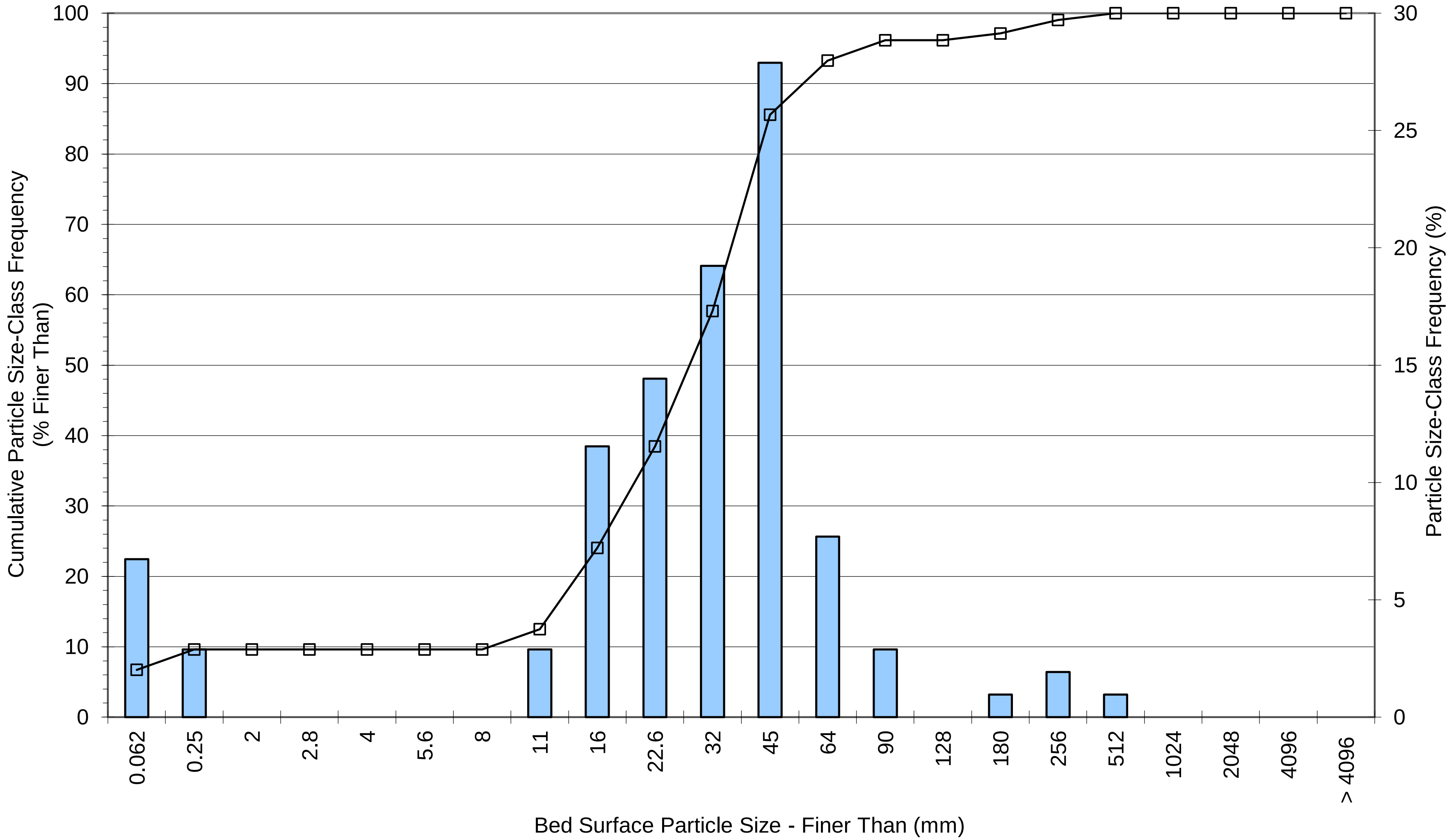

Piru Creek Geomorphology Study
Site 2, XS 2 (post 600 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency (% Finer Than)
Particle Size-Class Frequency (%)
Bed Surface Particle Size - Finer Than (mm)
0
10
20
30
40
50
60
70
80
90
100
5
15
25
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096

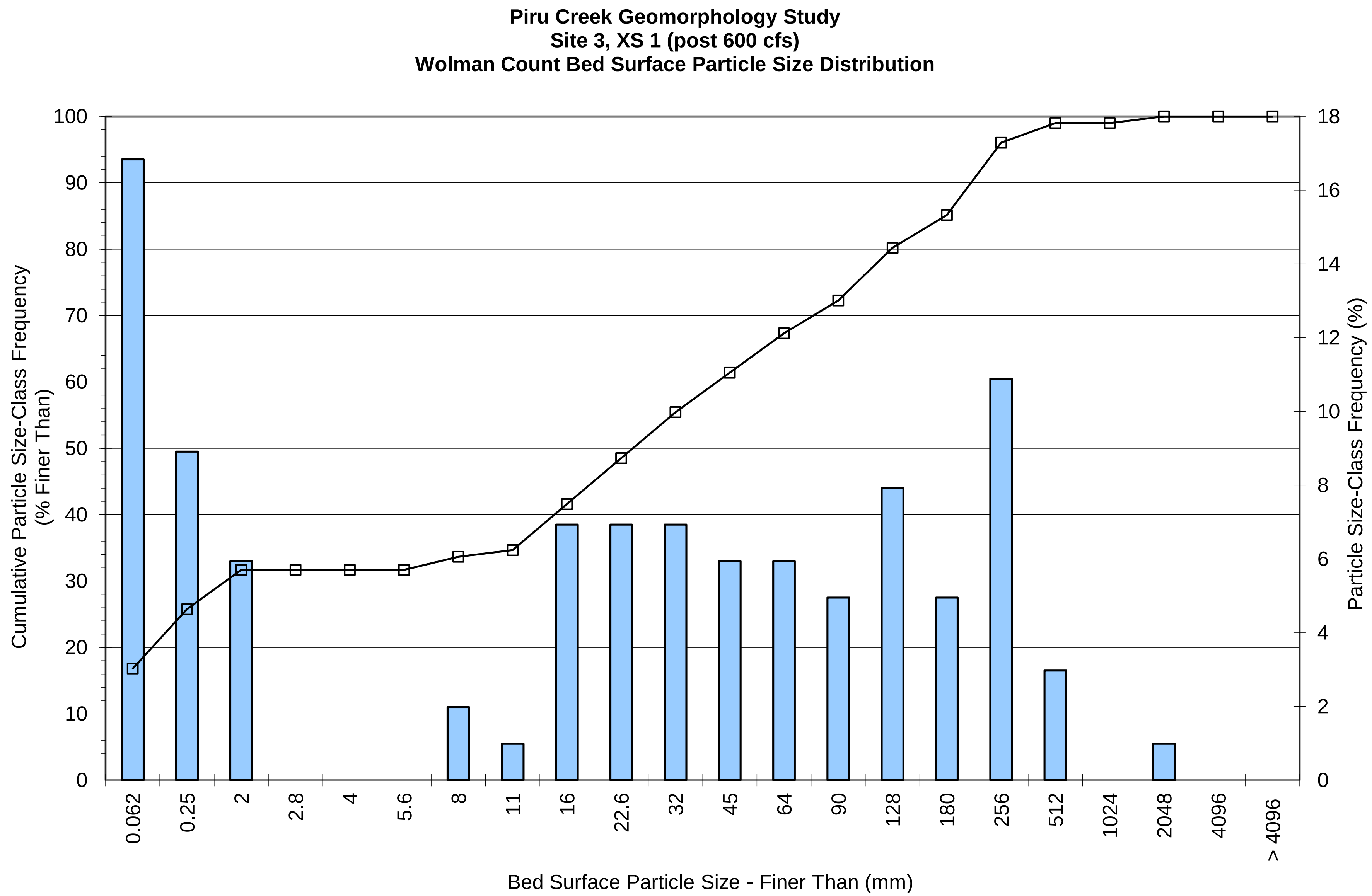

Piru Creek Geomorphology Study
Site 2, XS 3 (post 600 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency
(% Finer Than)
Particle Size-Class Frequency (%)
100
90
80
70
60
50
40
30
20
10
0
25
20
15
10
5
0
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096
Bed Surface Particle Size - Finer Than (mm)

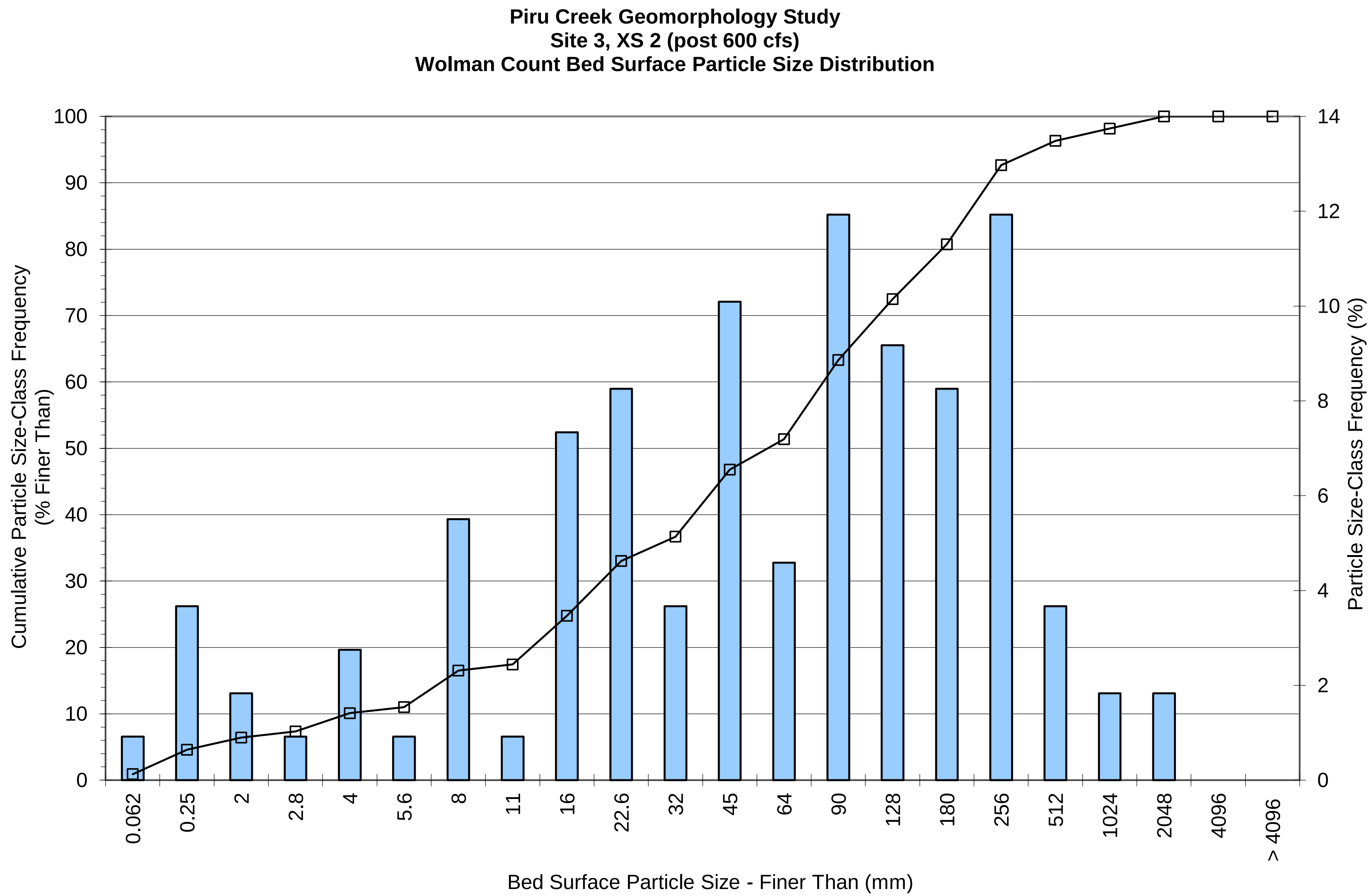
Piru Creek Geomorphology Study
Site 2, XS 4 (post 600 cfs)
Wolman Count Bed Surface Particle Size Distribution

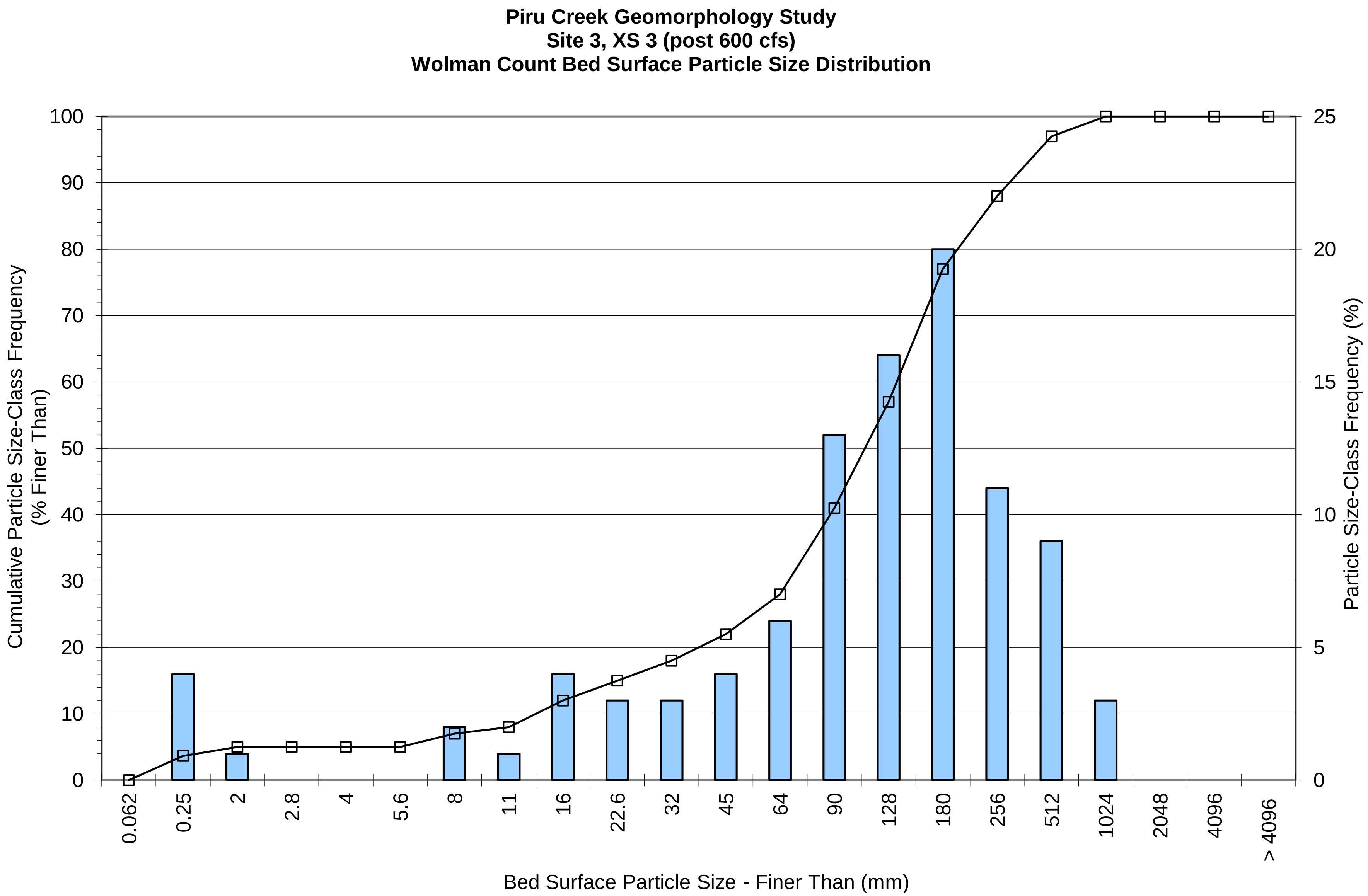


Piru Creek Geomorphology Study
Site 2, XS 5 (post 600 cfs)
Wolman Count Bed Surface Particle Size Distribution



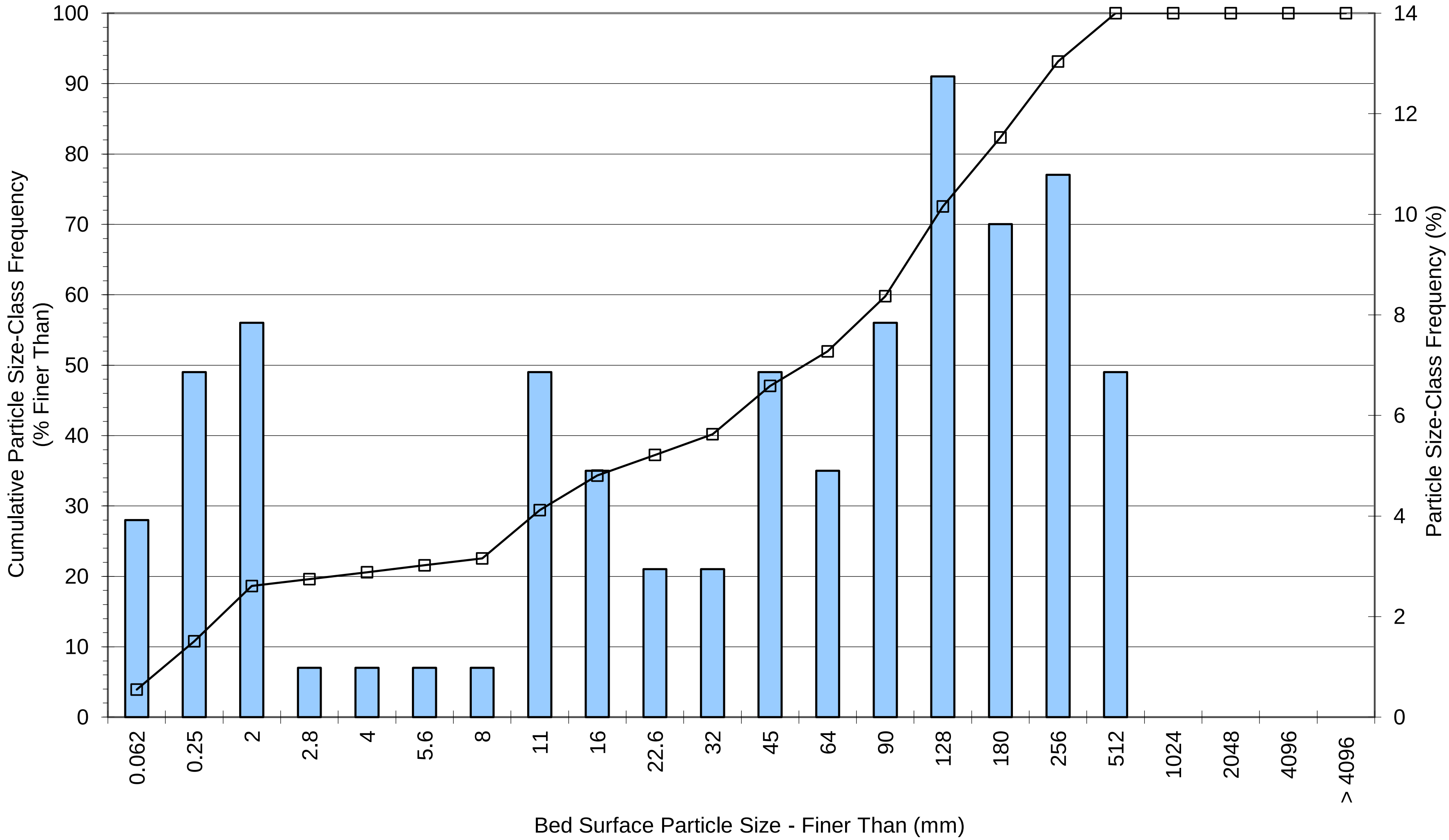

Piru Creek Geomorphology Study
Site 3, XS 1 (post 600 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency (% Finer Than)
Particle Size-Class Frequency (%)
0 10 20 30 40 50 60 70 80 90 100
0 2 4 6 8 10 12 14 16 18
0.062 0.25 2 2.8 4 5.6 8 11 16 22.6 32 45 64 90 128 180 256 512 1024 2048 4096 > 4096
Bed Surface Particle Size - Finer Than (mm)


Piru Creek Geomorphology Study
Site 3, XS 2 (post 600 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency (% Finer Than)
Particle Size-Class Frequency (%)
Bed Surface Particle Size - Finer Than (mm)
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096

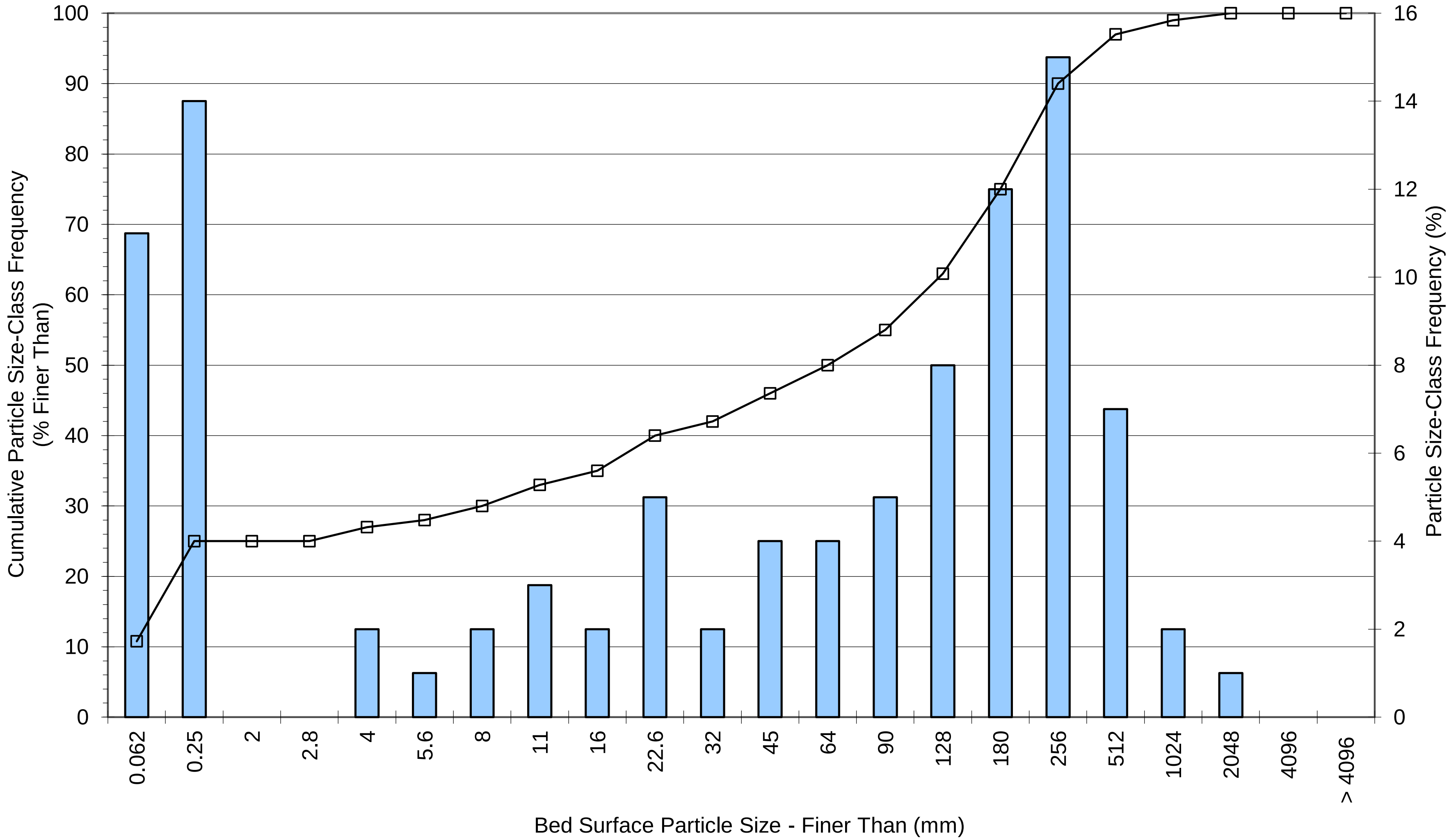


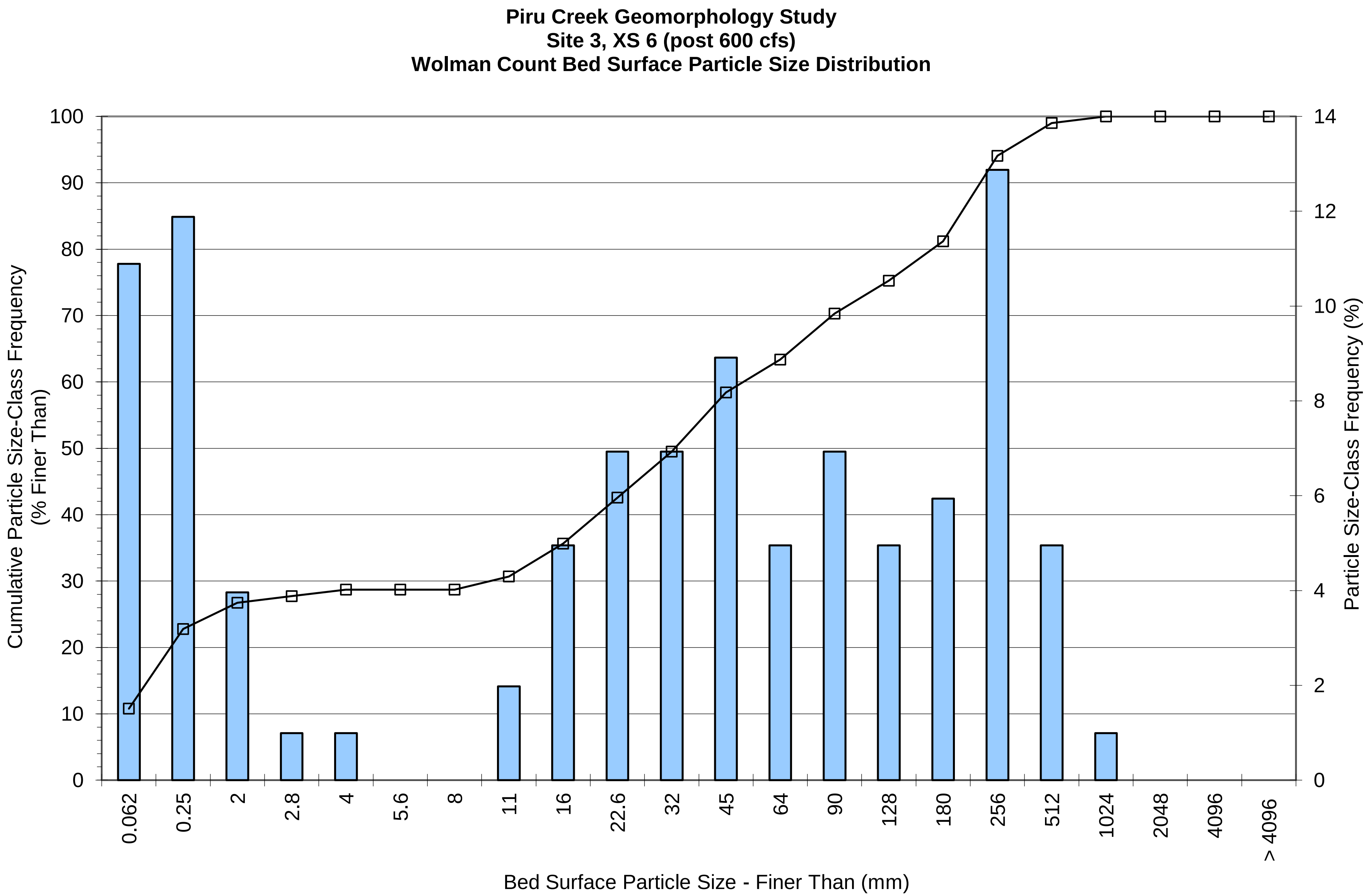
Piru Creek Geomorphology Study
Site 3, XS 3 (post 600 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency
(% Finer Than)
Particle Size-Class Frequency (%)
Bed Surface Particle Size - Finer Than (mm)
0
10
20
30
40
50
60
70
80
90
100
0
5
10
15
20
25
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096

Piru Creek Geomorphology Study
Site 3, XS 4 (post 600 cfs)
Wolman Count Bed Surface Particle Size Distribution

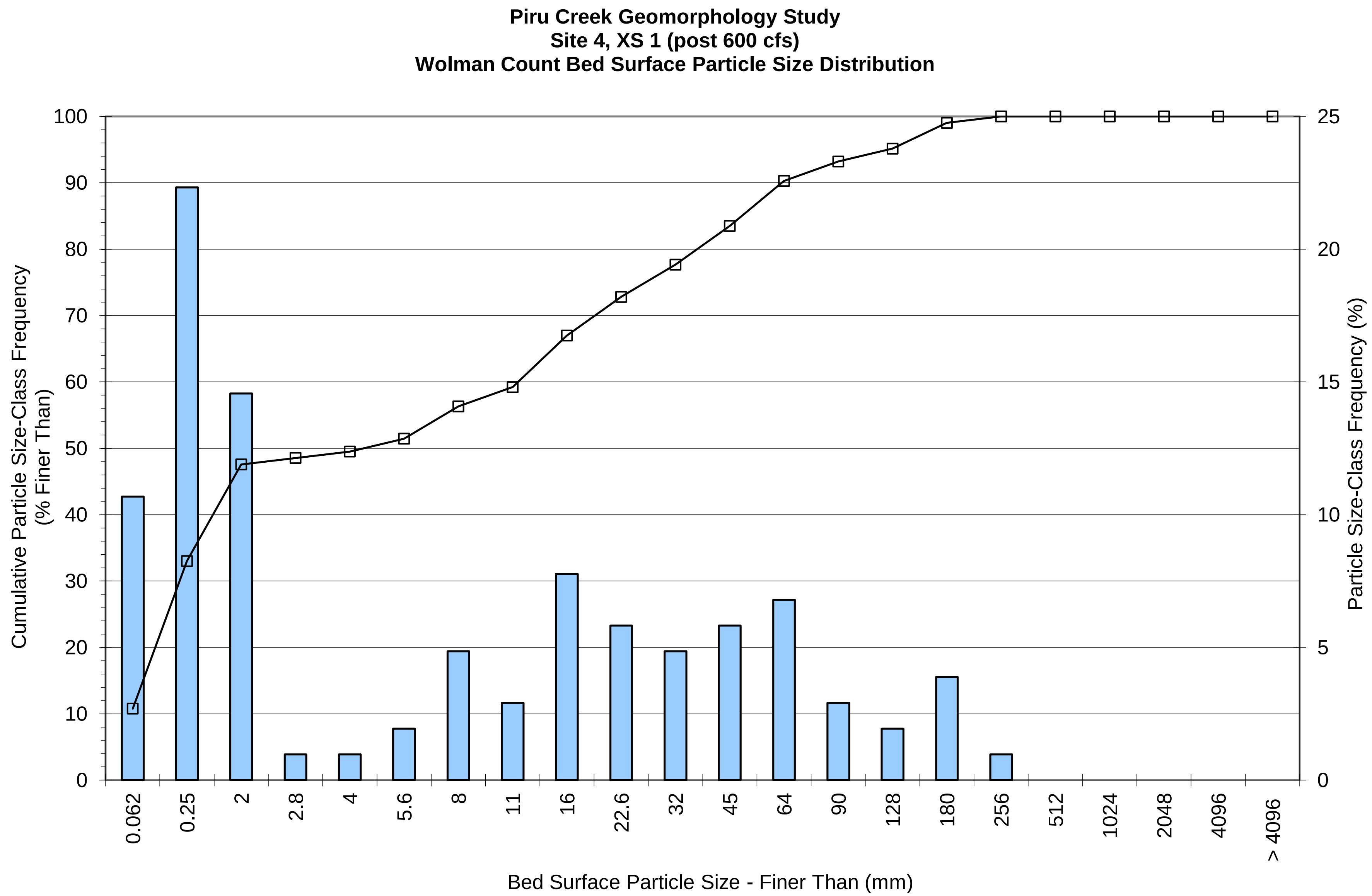


Piru Creek Geomorphology Study
Site 3, XS 5 (post 600 cfs)
Wolman Count Bed Surface Particle Size Distribution





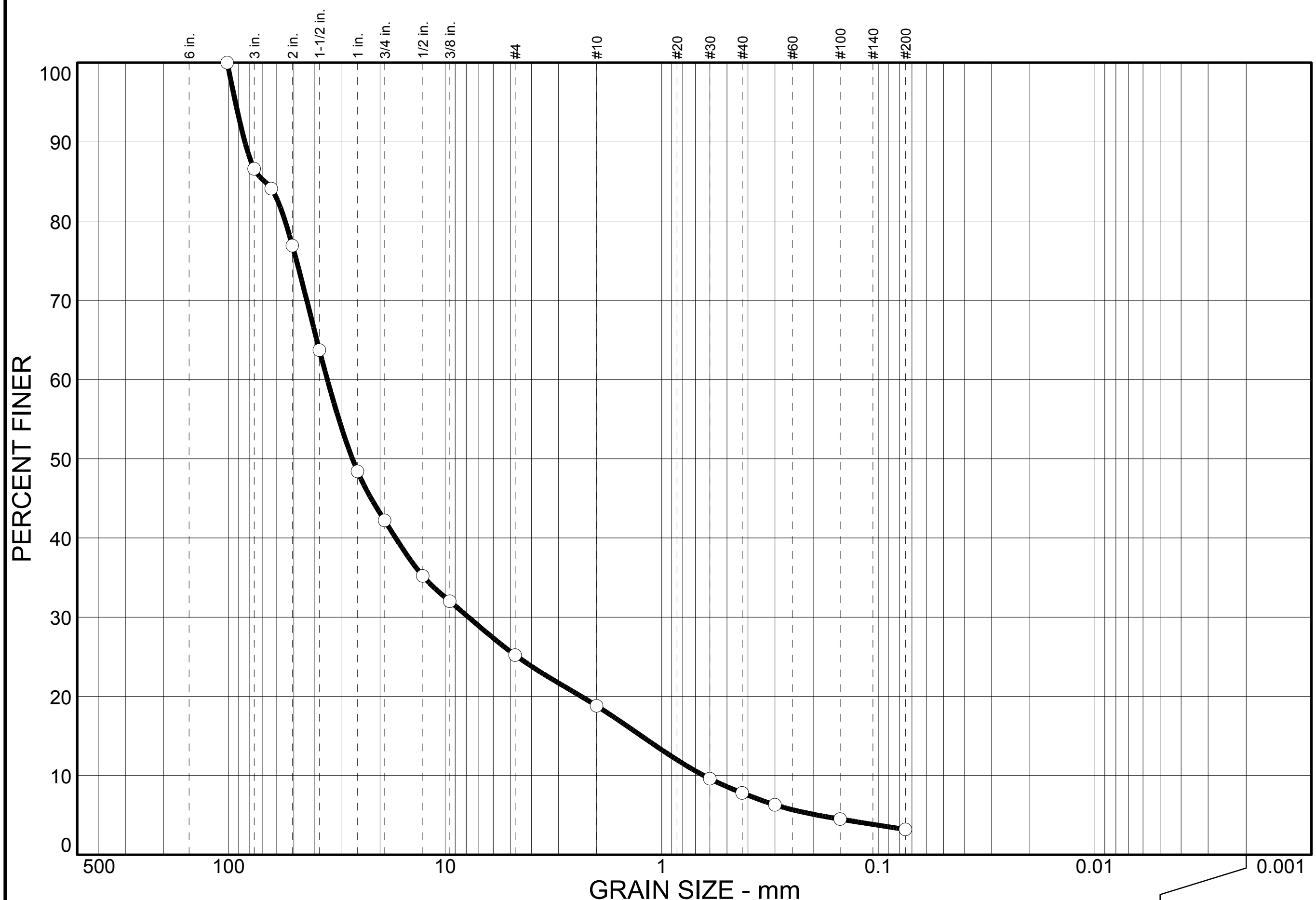
Piru Creek Geomorphology Study
Site 3, XS 6 (post 600 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency (% Finer Than)
Particle Size-Class Frequency (%)
Bed Surface Particle Size - Finer Than (mm)
0
10
20
30
40
50
60
70
80
90
100
0
2
4
6
8
10
12
14
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096


Piru Creek Geomorphology Study
Site 4, XS 1 (post 600 cfs)
Wolman Count Bed Surface Particle Size Distribution
Cumulative Particle Size-Class Frequency
(% Finer Than)
Particle Size-Class Frequency (%)
Bed Surface Particle Size - Finer Than (mm)
0
10
20
30
40
50
60
70
80
90
100
0
5
10
15
20
25
0.062
0.25
2
2.8
4
5.6
8
11
16
22.6
32
45
64
90
128
180
256
512
1024
2048
4096
> 4096

Appendix F

Laboratory Results for Bulk Sample Data

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
13.4	61.4	22.0	3.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4 in.	100.0		
3 in.	86.6		
2.5 in.	84.1		
2 in.	76.9		
1.5 in.	63.7		
1 in.	48.4		
3/4 in.	42.2		
1/2 in.	35.2		
3/8 in.	32.0		
#4	25.2		
#10	18.8		
#30	9.6		
#40	7.8		
#50	6.3		
#100	4.5		
#200	3.2		

* (no specification provided)

Soil Description

Dark Olive Brown Well-Graded GRAVEL w/ Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 68.1 D_{60}= 35.1 D_{50}= 26.8
D_{30}= 7.82 D_{15}= 1.24 D_{10}= 0.640
C_u= 54.74 C_c= 2.72

Classification

USCS= AASHTO=

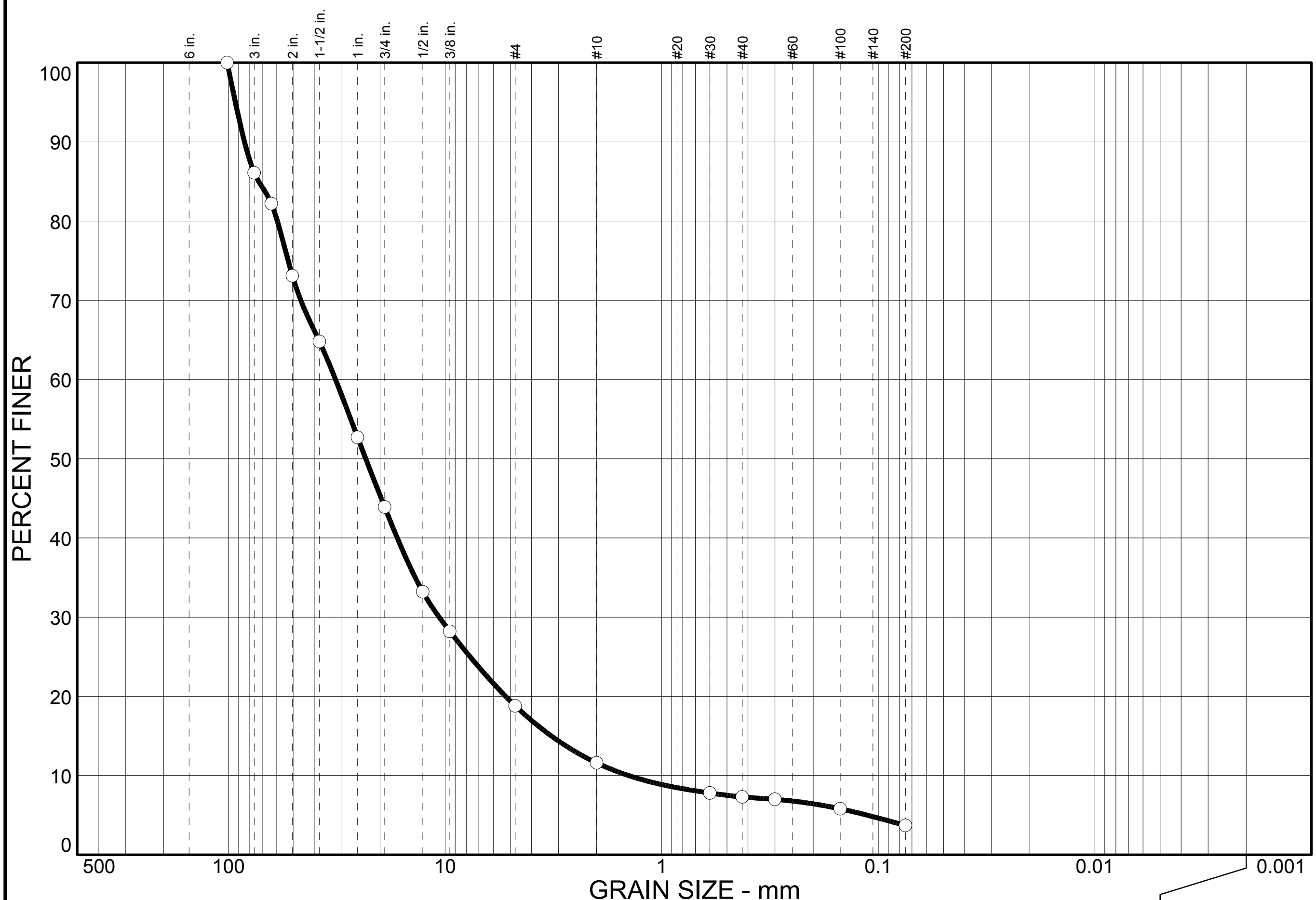
Remarks

Sample No.: 8/30/2011 **Source of Sample:** Site 1: Sample#1 (XS-1) **Date:** 10/31/11
Location: **Elev./Depth:**

COOPER TESTING LABORATORY

Client: Cardno ENTRIX
Project: Piru Creek Gemorphology Study
Project No: 070-010 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
13.9	67.3	15.1	3.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4 in.	100.0		
3 in.	86.1		
2.5 in.	82.2		
2 in.	73.1		
1.5 in.	64.8		
1 in.	52.7		
3/4 in.	43.9		
.5 in.	33.2		
3/8 in.	28.2		
#4	18.8		
#10	11.6		
#30	7.8		
#40	7.3		
#50	7.0		
#100	5.8		
#200	3.7		

* (no specification provided)

Soil Description

Olive Brown well-graded GRAVEL w/ Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 72.7 D_{60}= 32.1 D_{50}= 23.3
D_{30}= 10.7 D_{15}= 3.24 D_{10}= 1.42
C_u= 22.56 C_c= 2.49

Classification

USCS= AASHTO=

Remarks

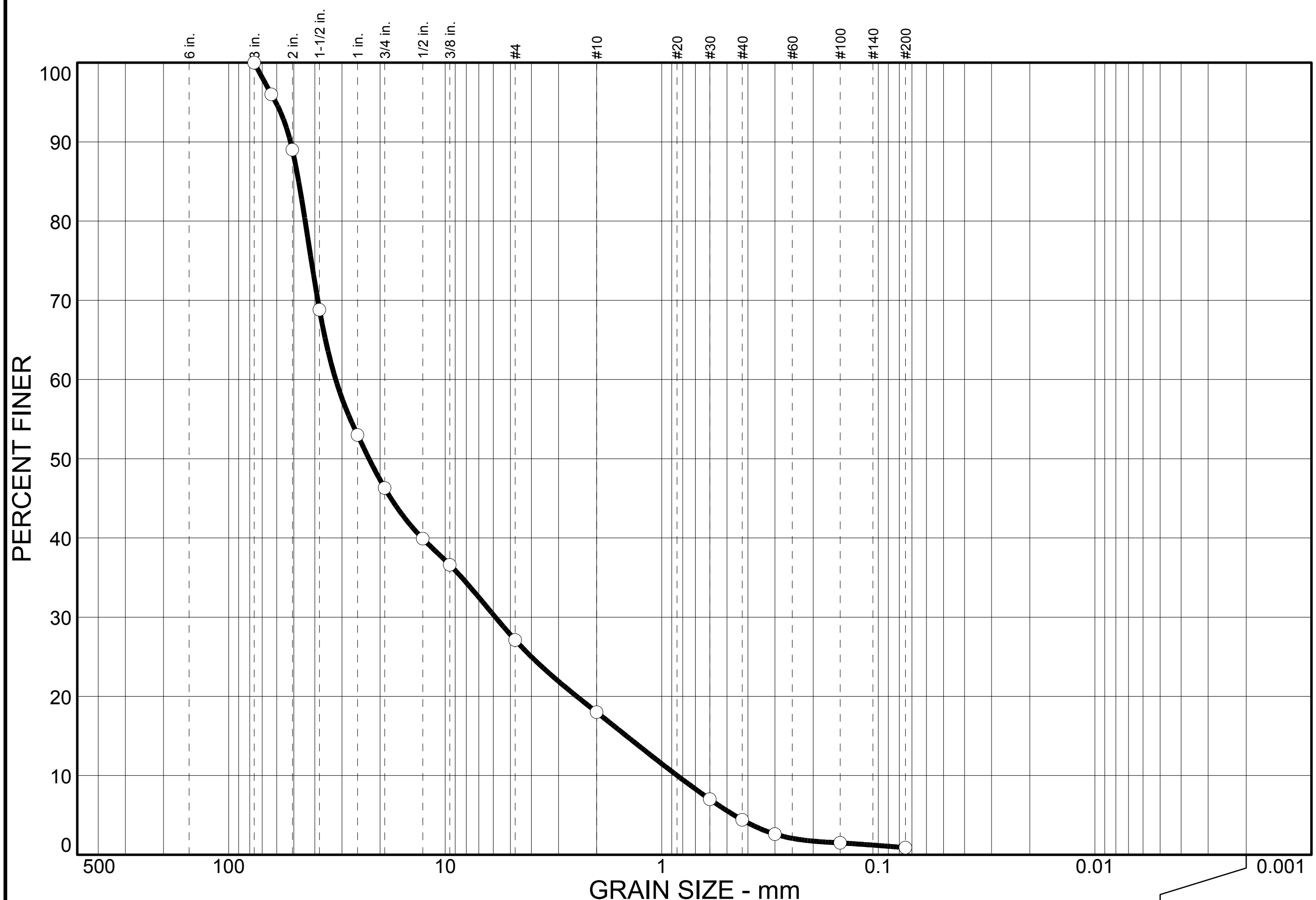
Sample No.: 8/30/2011 **Source of Sample:** Site 1: Sample#2 (XS-7) **Date:**
Location: **Elev./Depth:**

COOPER TESTING LABORATORY

Client: Cardno ENTRIX
Project: Piru Creek Gemorphology Study

Project No: 070-010 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	72.9	26.2	0.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
2.5 in.	96.0		
2 in.	89.0		
1.5 in.	68.8		
1 in.	53.0		
3/4 in.	46.3		
1/2 in.	39.9		
3/8 in.	36.6		
#4	27.1		
#10	18.0		
#30	7.0		
#40	4.4		
#50	2.6		
#100	1.5		
#200	0.9		

* (no specification provided)

Soil Description

Olive Brown & Blue Well-Graded GRAVEL w/ Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 47.5 D_{60}= 32.1 D_{50}= 22.5
D_{30}= 5.87 D_{15}= 1.46 D_{10}= 0.849
C_u= 37.75 C_c= 1.27

Classification

USCS= AASHTO=

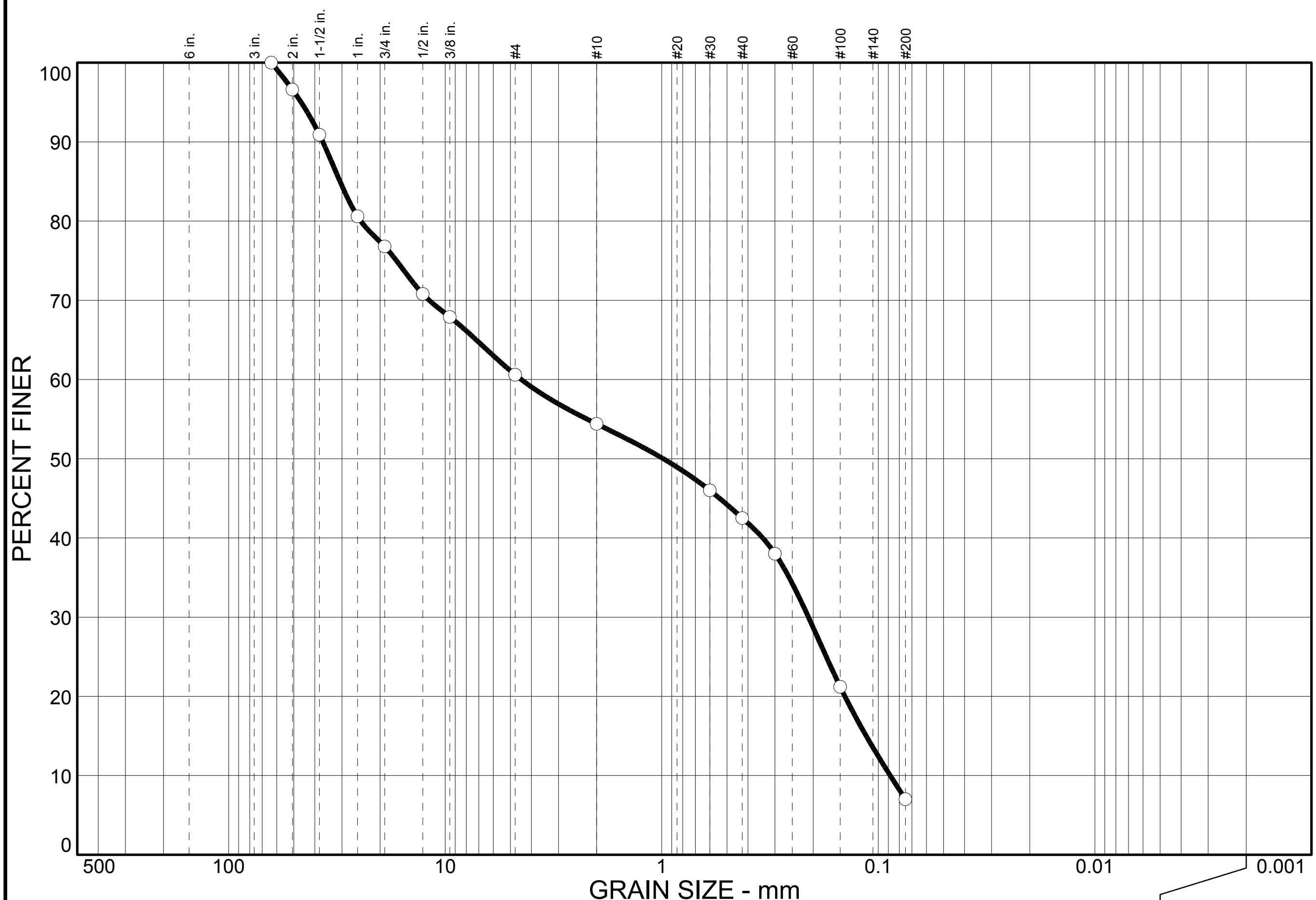
Remarks

Sample No.: 8/31/2011 **Source of Sample:** Site 2: Sample#1 (XS-1) **Date:** 11/2/11
Location: **Elev./Depth:**

COOPER TESTING LABORATORY

Client: Cardno ENTRIX
Project: Piru Creek Gemorphology Study
Project No: 070-010 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	39.4	53.6	7.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2.5 in.	100.0		
2 in.	96.6		
1.5 in.	90.9		
1 in.	80.6		
3/4 in.	76.8		
.5 in.	70.8		
3/8 in.	67.9		
#4	60.6		
#10	54.4		
#30	46.0		
#40	42.5		
#50	38.0		
#100	21.2		
#200	7.0		

* (no specification provided)

Soil Description

Olive Gray poorly-graded SAND w/ Silt and Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 30.6 D_{60}= 4.45 D_{50}= 0.984
D_{30}= 0.210 D_{15}= 0.114 D_{10}= 0.0882
C_u= 50.52 C_c= 0.11

Classification

USCS= AASHTO=

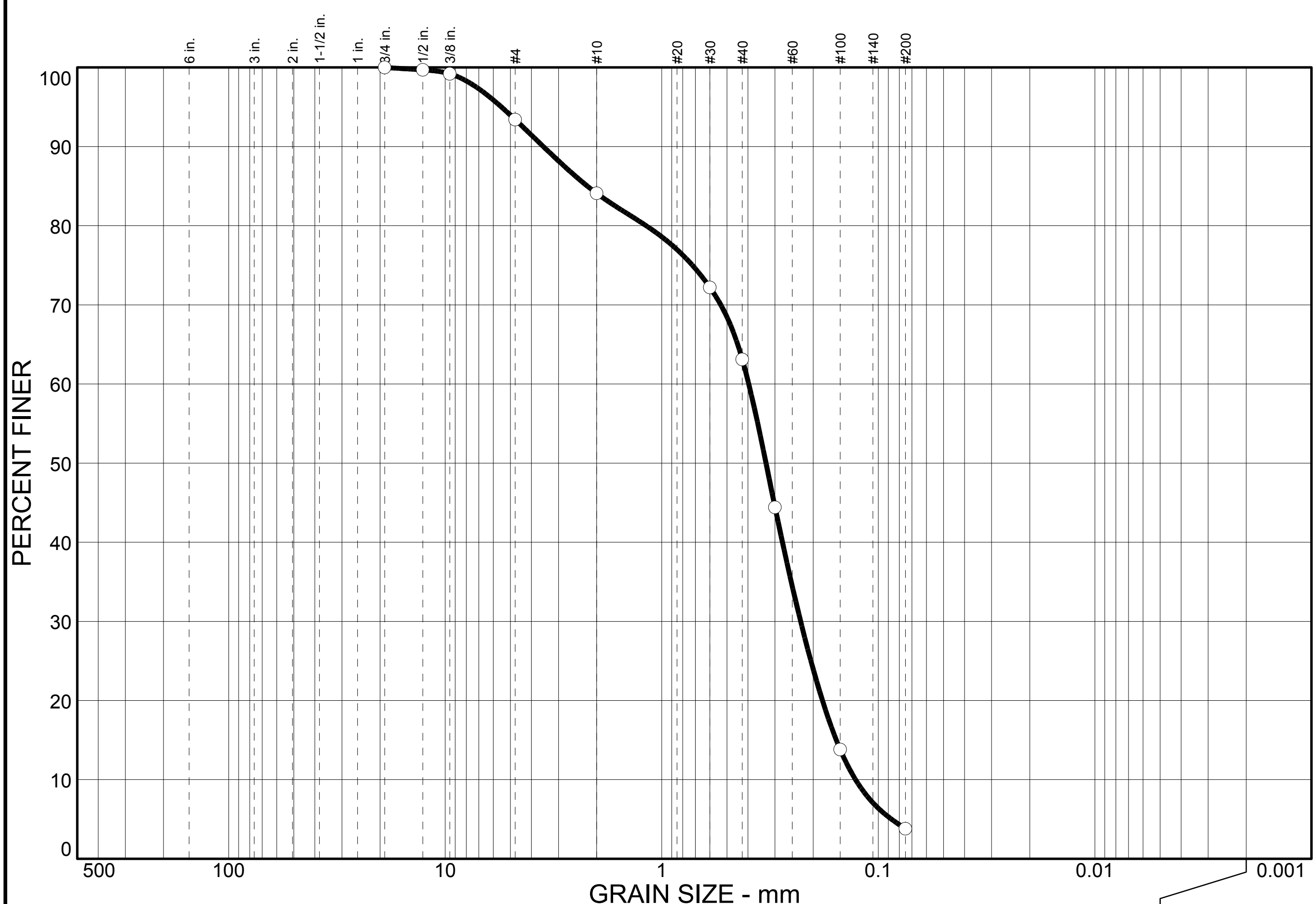
Remarks

Sample No.: 8/31/2011 **Source of Sample:** Site 2: Sample#2 (XS-5) **Date:**
Location: **Elev./Depth:**

COOPER TESTING LABORATORY

Client: Cardno ENTRIX
Project: Piru Creek Gemorphology Study
Project No: 070-010 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	6.6	89.6	3.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
1/2 in.	99.7		
3/8 in.	99.2		
#4	93.4		
#10	84.1		
#30	72.2		
#40	63.1		
#50	44.4		
#100	13.8		
#200	3.8		

* (no specification provided)

Soil Description

Olive Gray poorly-graded SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 2.21 D_{60}= 0.397 D_{50}= 0.330
D_{30}= 0.229 D_{15}= 0.156 D_{10}= 0.127
C_u= 3.11 C_c= 1.03

Classification

USCS= AASHTO=

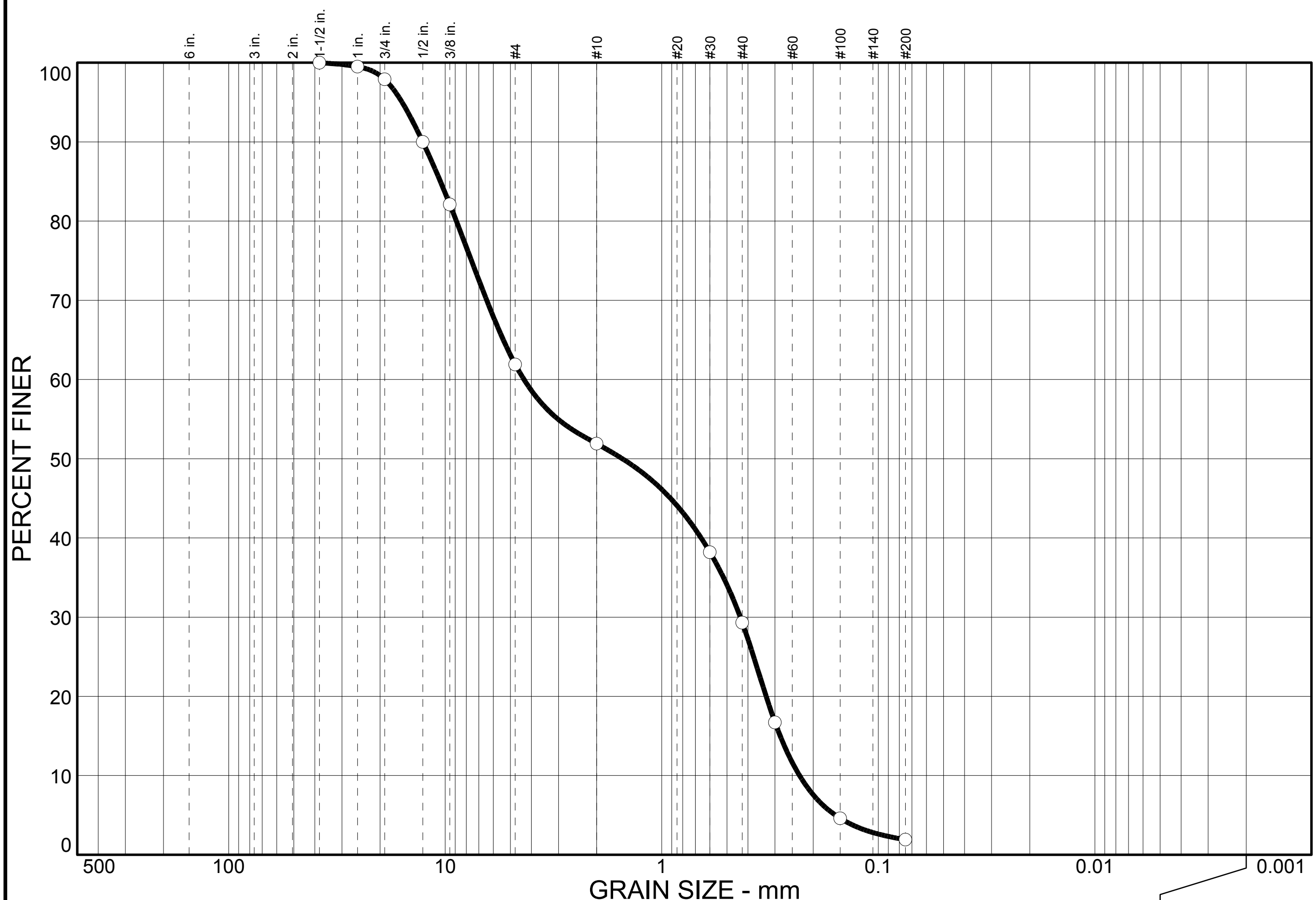
Remarks

Sample No.: 9/1/2011 **Source of Sample:** Site 3: Sample#1 (XS-5) **Date:**
Location: **Elev./Depth:**

COOPER TESTING LABORATORY

Client: Cardno ENTRIX
Project: Piru Creek Gemorphology Study
Project No: 070-010 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	38.1	60.0	1.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5 in.	100.0		
1 in.	99.5		
3/4 in.	97.9		
1/2 in.	90.0		
3/8 in.	82.1		
#4	61.9		
#10	51.9		
#30	38.2		
#40	29.3		
#50	16.7		
#100	4.6		
#200	1.9		

* (no specification provided)

Soil Description

Olive Brown poorly-graded SAND w/ Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 10.5 D_{60}= 4.33 D_{50}= 1.52
D_{30}= 0.434 D_{15}= 0.284 D_{10}= 0.231
C_u= 18.73 C_c= 0.19

Classification

USCS= AASHTO=

Remarks

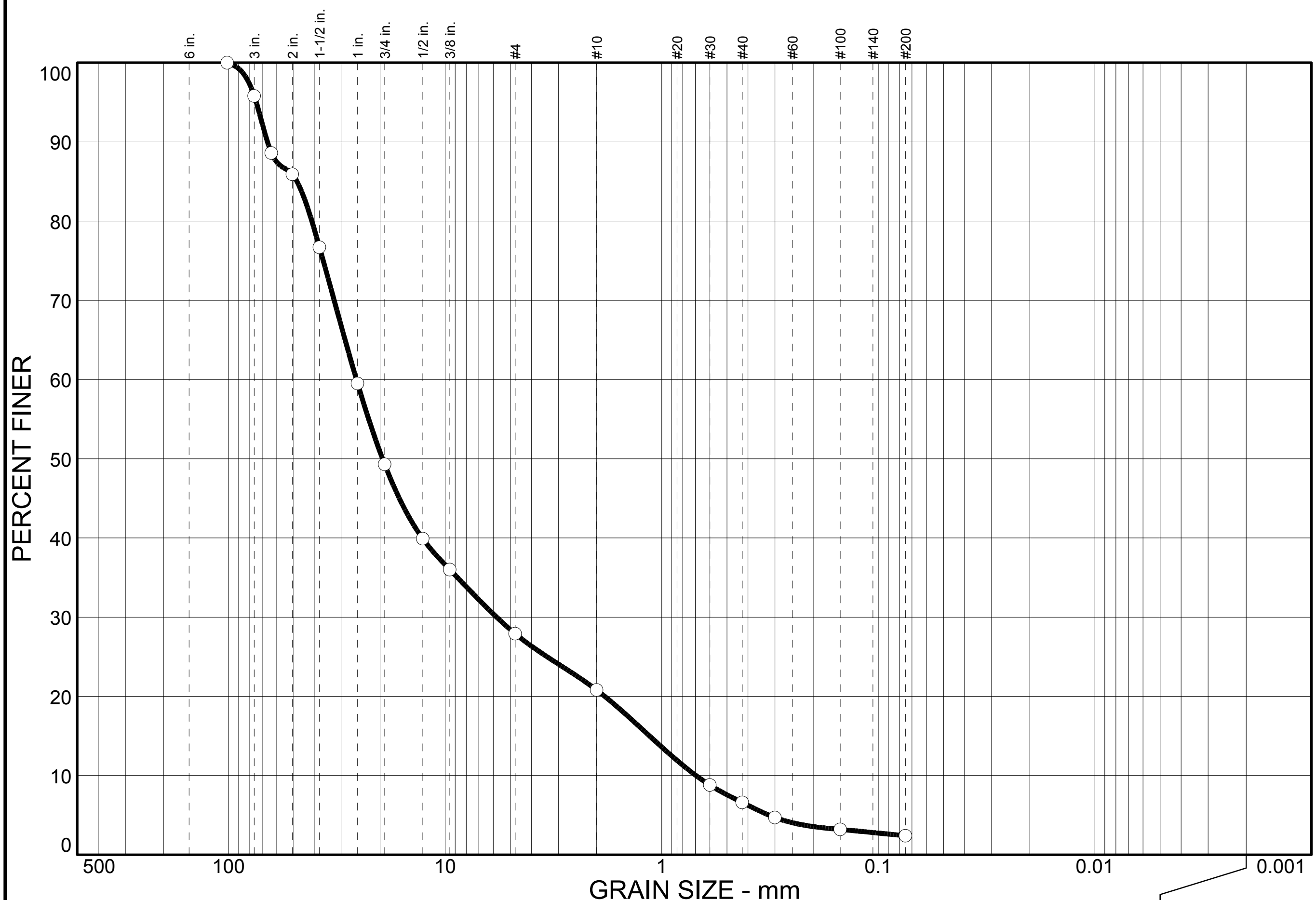
Sample No.: 9/1/2011 **Source of Sample:** Site 3: Sample#2 (XS-3) **Date:**
Location: **Elev./Depth:**

COOPER TESTING LABORATORY

Client: Cardno ENTRIX
Project: Piru Creek Gemorphology Study

Project No: 070-010 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
4.2	67.9	25.5	2.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4 in.	100.0		
3 in.	95.8		
2.5 in.	88.6		
2 in.	85.9		
1.5 in.	76.7		
1 in.	59.5		
3/4 in.	49.3		
1/2 in.	39.9		
3/8 in.	36.0		
#4	27.9		
#10	20.8		
#30	8.8		
#40	6.6		
#50	4.7		
#100	3.2		
#200	2.4		

* (no specification provided)

Soil Description

Olive Brown Well-Graded GRAVEL w/ Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 48.4 D_{60}= 25.7 D_{50}= 19.5
D_{30}= 5.80 D_{15}= 1.14 D_{10}= 0.695
C_u= 36.99 C_c= 1.88

Classification

USCS= AASHTO=

Remarks

Due to the small sample size relative to the largest particle size, this data should be considered approximate.

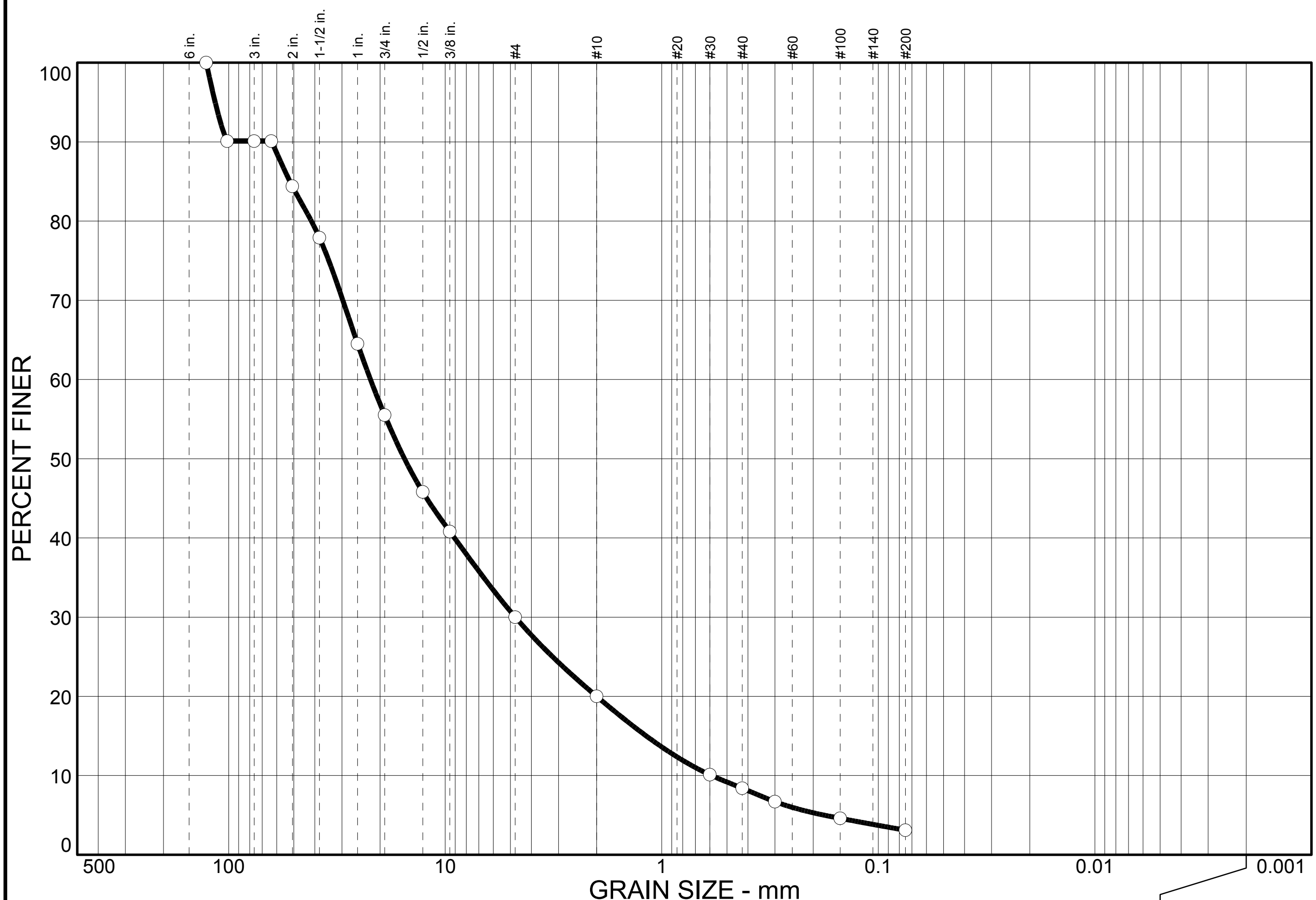
Sample No.: 10/30/2011 **Source of Sample:** Site 1: Sample #1 (XS-1) **Date:** 1/6/12
Location: **Elev./Depth:**

COOPER TESTING LABORATORY

Client: Cardno Entrix
Project: Piru Sediment Samples

Project No: 070-011 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
9.9	60.1	26.9	3.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
5 in.	100.0		
4 in.	90.1		
3 in.	90.1		
2.5 in.	90.1		
2 in.	84.4		
1.5 in.	77.9		
1 in.	64.5		
3/4 in.	55.5		
1/2 in.	45.8		
3/8 in.	40.8		
#4	30.0		
#10	20.0		
#30	10.1		
#40	8.4		
#50	6.7		
#100	4.6		
#200	3.1		

* (no specification provided)

Soil Description

Olive Brown Well-Graded GRAVEL w/ Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 52.1 D_{60}= 22.1 D_{50}= 15.4
D_{30}= 4.75 D_{15}= 1.18 D_{10}= 0.589
C_u= 37.60 C_c= 1.73

Classification

USCS= AASHTO=

Remarks

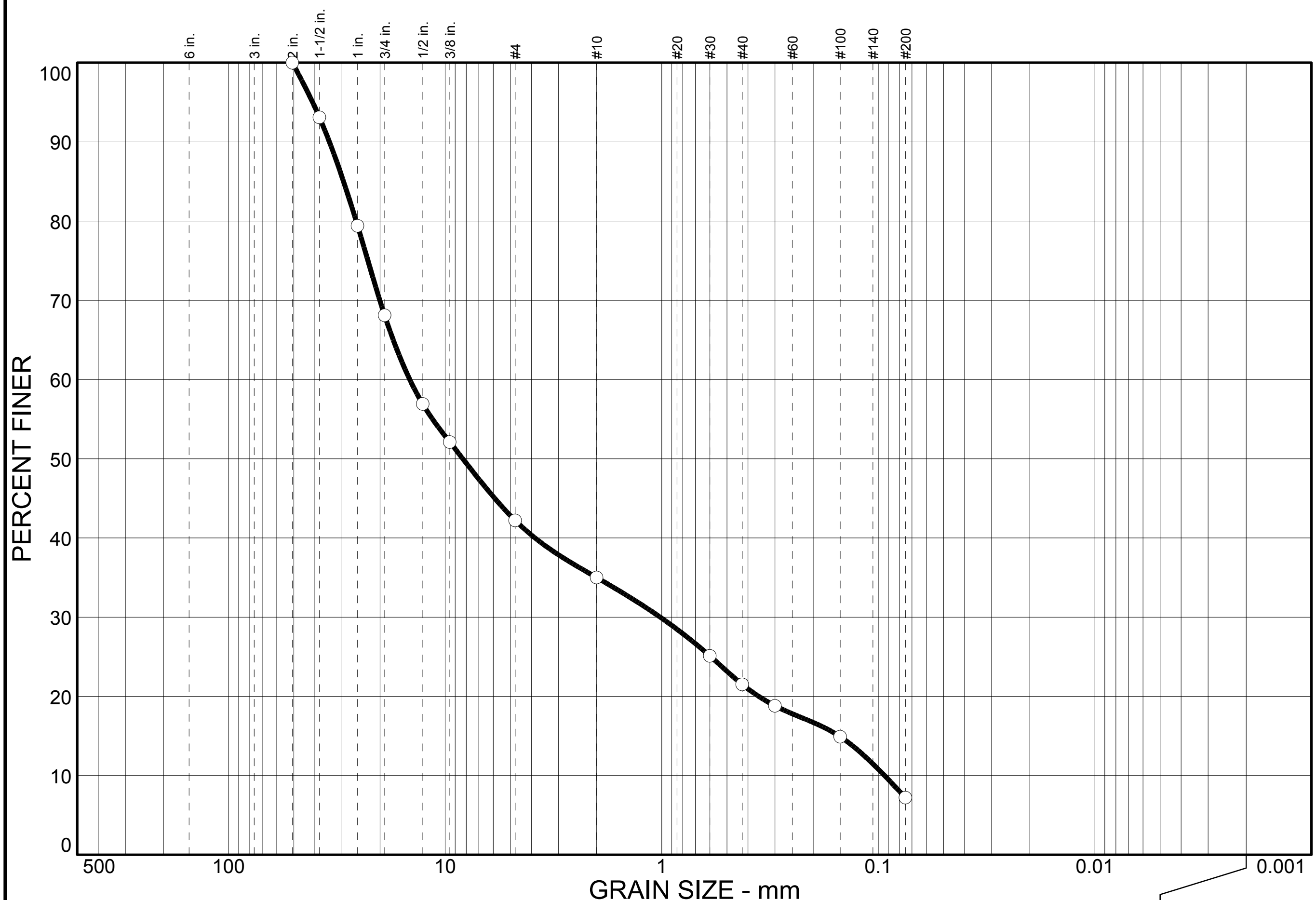
Due to the small sample size, relative to the largest particle size, this data should be considered to be approximate.

Sample No.: 10/30/2011 **Source of Sample:** Site 1: Sample #1 (XS-7) **Date:** 1/3/2012
Location: **Elev./Depth:**

COOPER TESTING LABORATORY

Client: Cardno Entrix
Project: Piru Sediment Samples
Project No: 070-011 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	57.8	35.0	7.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2 in.	100.0		
1.5 in.	93.1		
1 in.	79.4		
3/4 in.	68.1		
1/2 in.	56.9		
3/8 in.	52.1		
#4	42.2		
#10	35.0		
#30	25.1		
#40	21.5		
#50	18.8		
#100	14.9		
#200	7.2		

* (no specification provided)

Soil Description

Dark Grayish Brown Poorly Graded GRAVEL w/ Silt & Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 29.5 D_{60}= 14.6 D_{50}= 8.30
D_{30}= 1.02 D_{15}= 0.152 D_{10}= 0.0937
C_u= 155.65 C_c= 0.76

Classification

USCS= AASHTO=

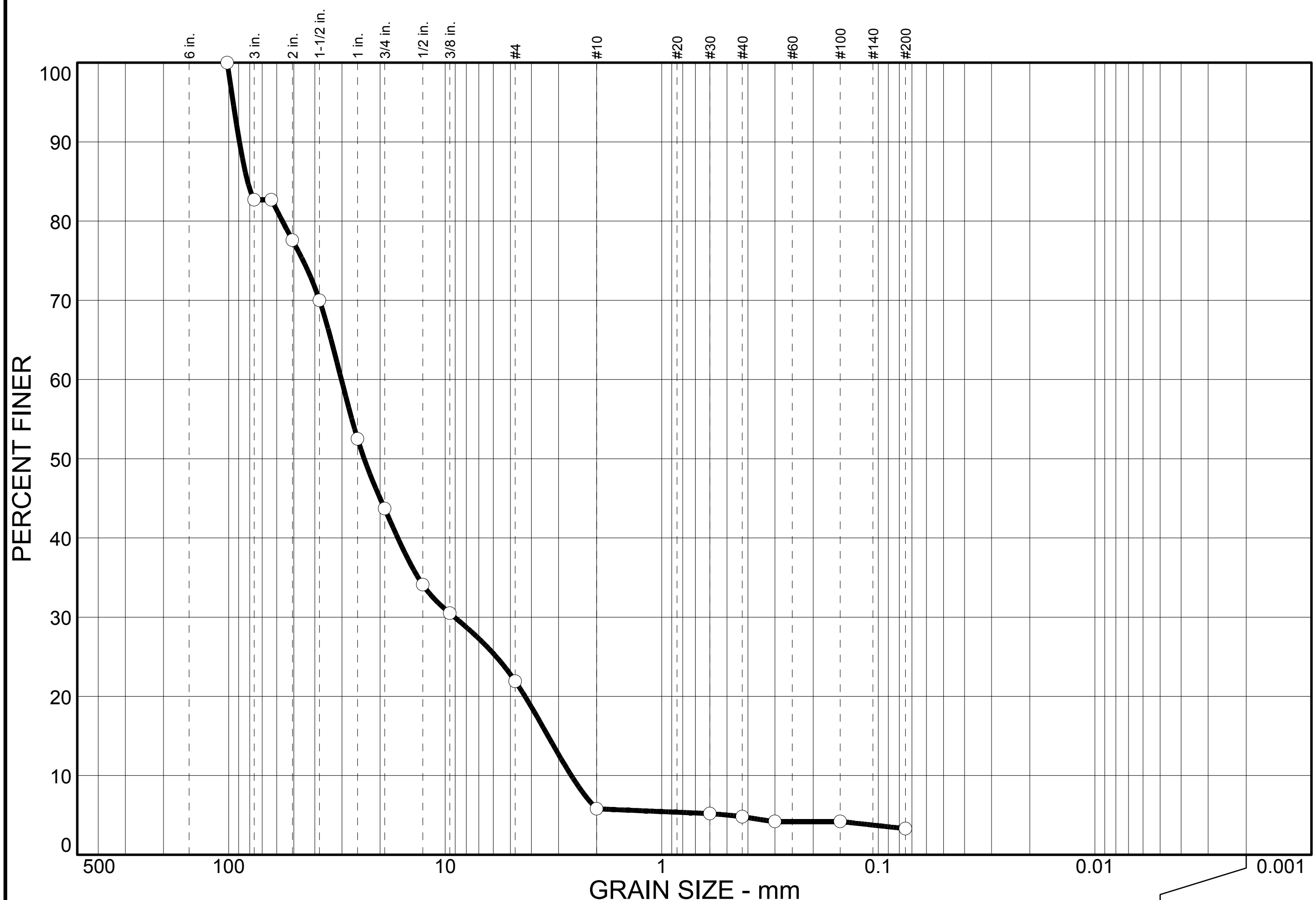
Remarks

Sample No.: 10/30/2011 **Source of Sample:** Site 2: Sample #1 (XS-5) **Date:** 1/3/2012
Location: **Elev./Depth:**

COOPER TESTING LABORATORY

Client: Cardno Entrix
Project: Piru Sediment Samples
Project No: 070-011 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
17.3	60.8	18.6	3.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4 in.	100.0		
3 in.	82.7		
2.5 in.	82.7		
2 in.	77.6		
1.5 in.	70.0		
1 in.	52.5		
3/4 in.	43.7		
1/2 in.	34.1		
3/8 in.	30.5		
#4	21.9		
#10	5.8		
#30	5.2		
#40	4.8		
#50	4.2		
#100	4.2		
#200	3.3		

* (no specification provided)

Soil Description

Olive Brown Well-Graded GRAVEL w/ Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 81.8 D_{60}= 30.2 D_{50}= 23.7
D_{30}= 9.06 D_{15}= 3.35 D_{10}= 2.62
C_u= 11.52 C_c= 1.04

Classification

USCS= AASHTO=

Remarks

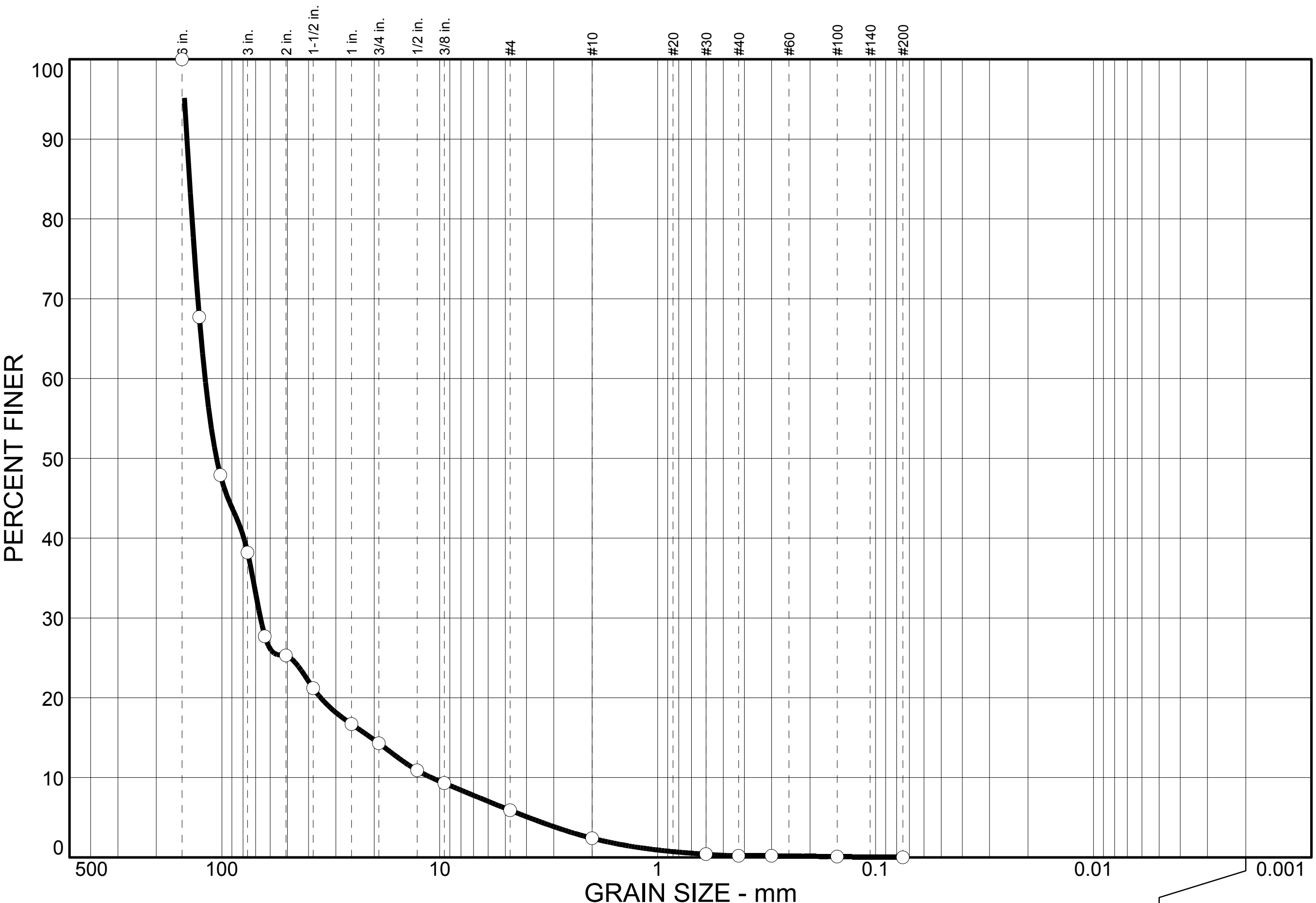
Due to the small sample size relative to the largest particle size, this data should be considered approximate.

Sample No.: 10/30/2011 **Source of Sample:** Site 2: Sample #1(XS-1) **Date:** 1/3/2012
Location: **Elev./Depth:**

COOPER TESTING LABORATORY

Client: Cardno Entrix
Project: Piru Sediment Samples
Project No: 070-011 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
61.8	32.3	5.9	0.0	0.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
6 in.	100.0		
5 in.	67.7		
4 in.	47.9		
3 in.	38.2		
2.5 in.	27.7		
2 in.	25.3		
1.5 in.	21.2		
1 in.	16.7		
3/4 in.	14.3		
1/2 in.	10.9		
3/8 in.	9.3		
#4	5.9		
#10	2.4		
#30	0.4		
#40	0.2		
#50	0.2		
#100	0.1		
#200	0.0		

* (no specification provided)

Soil Description

Grayish Brown Poorly Graded GRAVEL w/ Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 140.9 D_{60}= 119.4 D_{50}= 105.8
D_{30}= 66.6 D_{15}= 20.7 D_{10}= 10.9
C_u= 10.92 C_c= 3.39

Classification

USCS= AASHTO=

Remarks

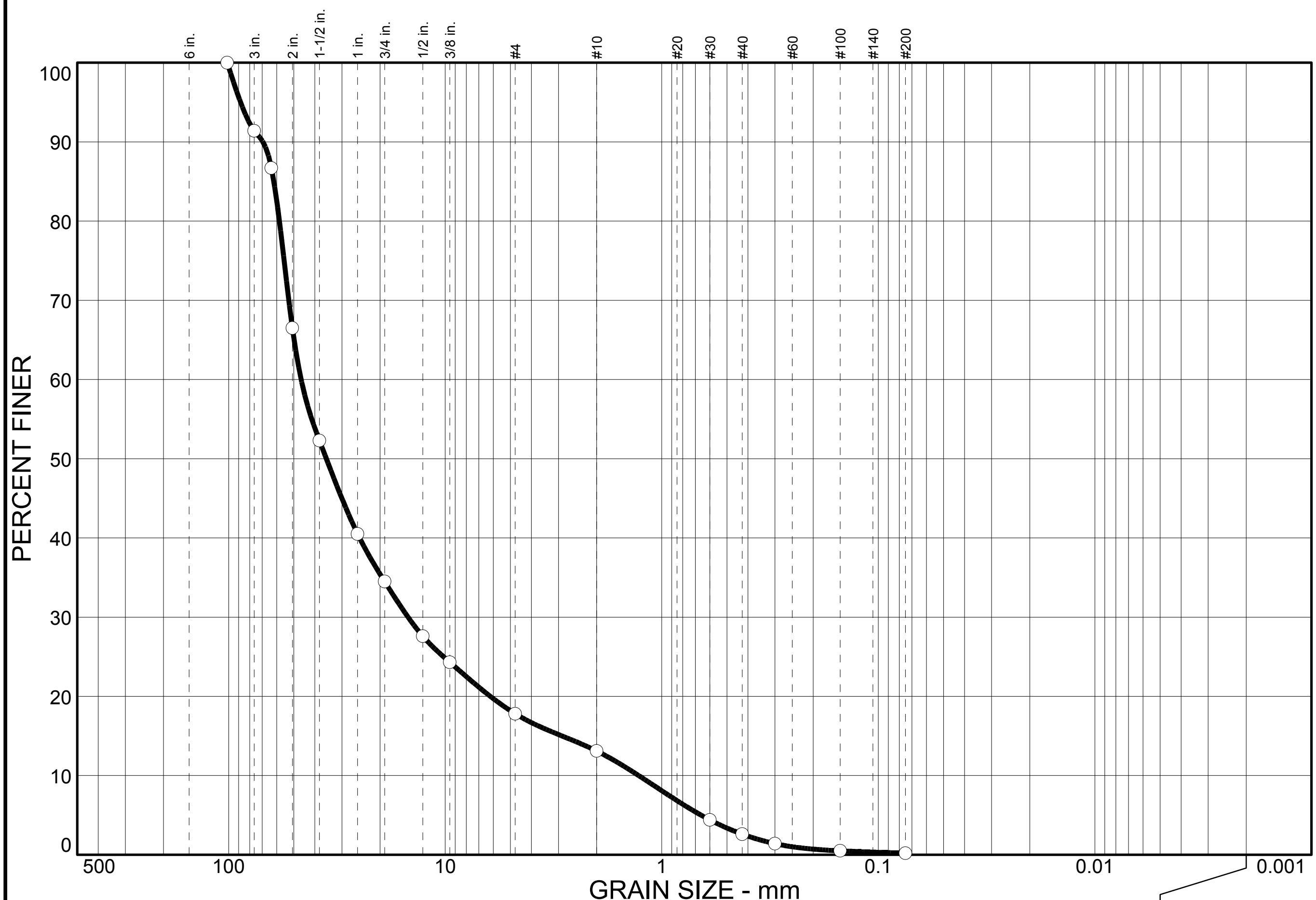
Due to the small sample size, relative to the largest particle size, this data should be considered to be approximate.

Sample No.: 10/30/2011 **Source of Sample:** Site 3: Sample #1(XS-6) **Date:** 1/13/12
Location: **Elev./Depth:**

COOPER TESTING LABORATORY

Client: Cardno Entrix
Project: Piru Sediment Samples
Project No: 070-011 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
8.6	73.6	17.6	0.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4 in.	100.0		
3 in.	91.4		
2.5 in.	86.7		
2 in.	66.5		
1.5 in.	52.3		
1 in.	40.5		
3/4 in.	34.5		
1/2 in.	27.6		
3/8 in.	24.3		
#4	17.8		
#10	13.1		
#30	4.4		
#40	2.6		
#50	1.4		
#100	0.5		
#200	0.2		

* (no specification provided)

Soil Description

Olive Brown Poorly Graded GRAVEL w/ Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 61.9 D_{60}= 46.3 D_{50}= 35.4
D_{30}= 14.9 D_{15}= 2.89 D_{10}= 1.28
C_u= 36.16 C_c= 3.73

Classification

USCS= AASHTO=

Remarks

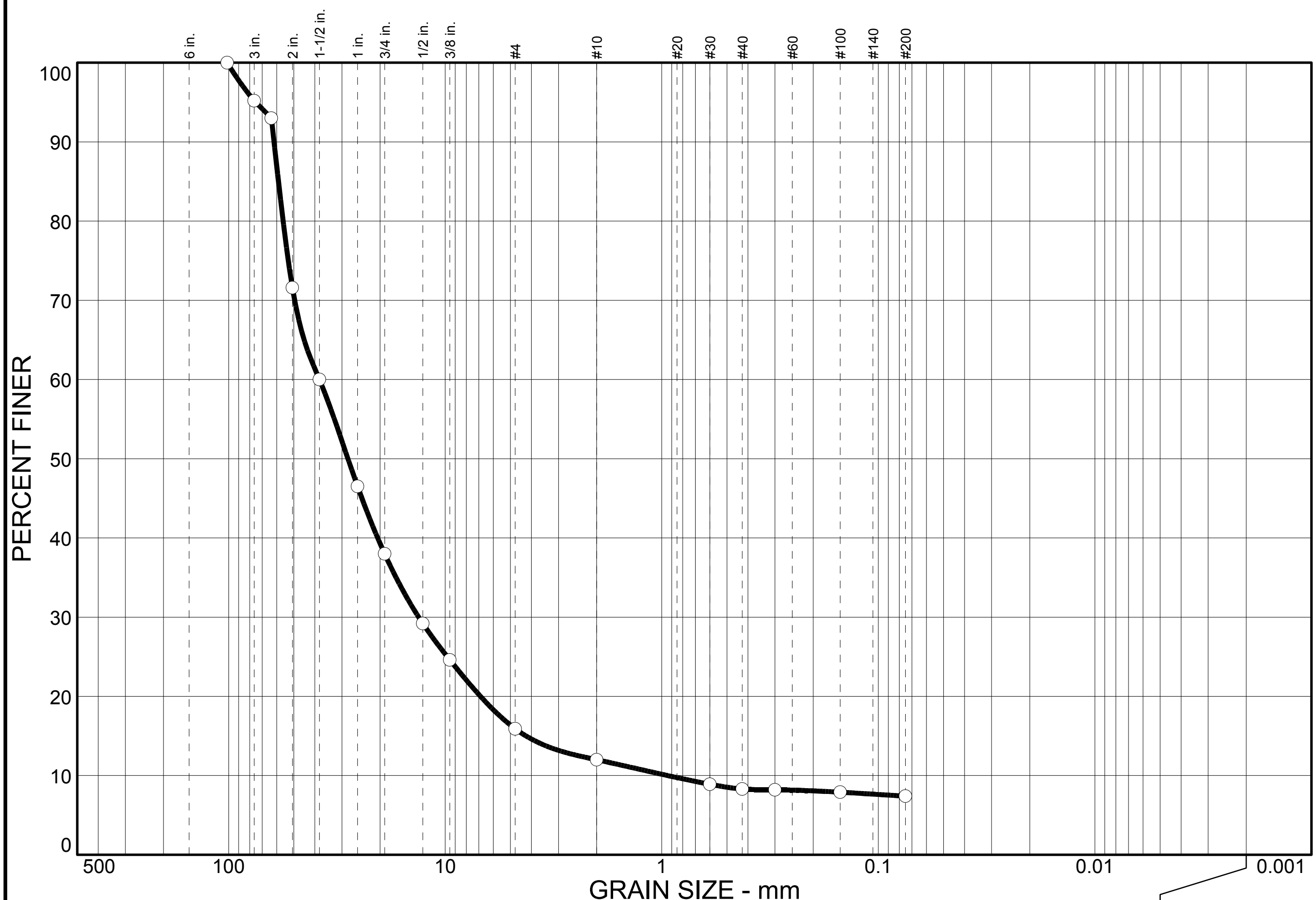
Due to the small sample size, relative to the largest particle size, this data should be considered to be approximate.

Sample No.: 11/9/2011 **Source of Sample:** Site 1: Sample #1(XS-1) **Date:** 1/6/12
Location: **Elev./Depth:**

COOPER TESTING LABORATORY

Client: Cardno Entrix
Project: Piru Sediment Samples
Project No: 070-011 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
4.8	79.3	8.5	7.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4 in.	100.0		
3 in.	95.2		
2.5 in.	93.0		
2 in.	71.6		
1.5 in.	60.0		
1 in.	46.5		
3/4 in.	38.0		
1/2 in.	29.2		
3/8 in.	24.6		
#4	15.9		
#10	12.0		
#30	8.9		
#40	8.3		
#50	8.2		
#100	7.9		
#200	7.4		

* (no specification provided)

Soil Description

Olive Brown Poorly Graded GRAVEL w/ Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 58.9 D_{60}= 38.1 D_{50}= 28.1
D_{30}= 13.3 D_{15}= 4.24 D_{10}= 0.940
C_u= 40.53 C_c= 4.92

Classification

USCS= AASHTO=

Remarks

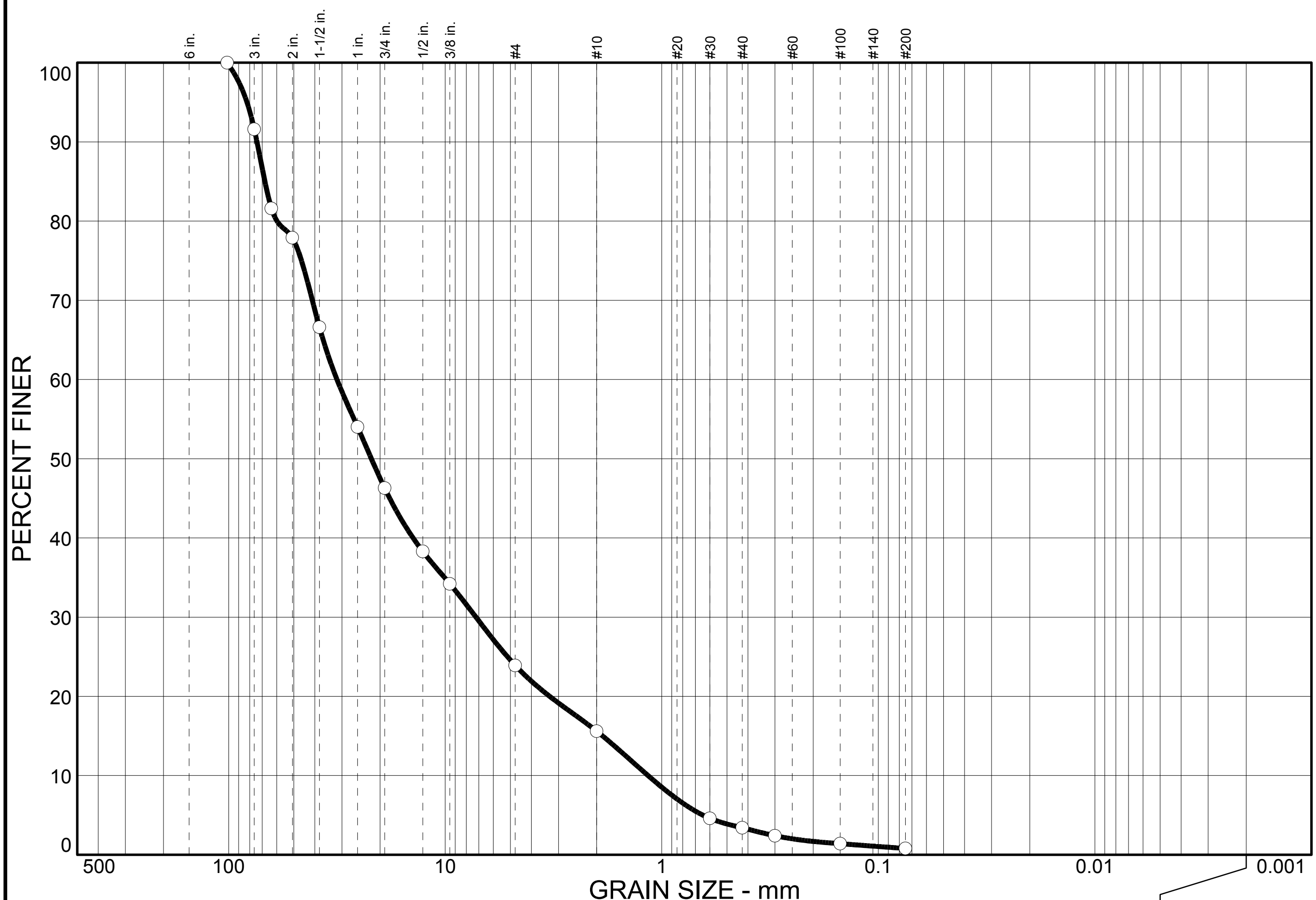
Due to the small sample size, relative to the largest particle size, this data should be considered to be approximate.

Sample No.: 11/9/2011 **Source of Sample:** Site 1: Sample #1(XS-7) **Date:** 1/6/12
Location: **Elev./Depth:**

COOPER TESTING LABORATORY

Client: Cardno Entrix
Project: Piru Sediment Samples
Project No: 070-011 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
8.4	67.7	23.1	0.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4 in.	100.0		
3 in.	91.6		
2.5 in.	81.6		
2 in.	77.9		
1.5 in.	66.6		
1 in.	54.0		
3/4 in.	46.3		
1/2 in.	38.3		
3/8 in.	34.2		
#4	23.9		
#10	15.6		
#30	4.6		
#40	3.4		
#50	2.4		
#100	1.4		
#200	0.8		

* (no specification provided)

Soil Description

Olive Brown Well-Graded GRAVEL w/ Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 68.1 D_{60}= 31.6 D_{50}= 21.9
D_{30}= 7.22 D_{15}= 1.88 D_{10}= 1.16
C_u= 27.31 C_c= 1.42

Classification

USCS= AASHTO=

Remarks

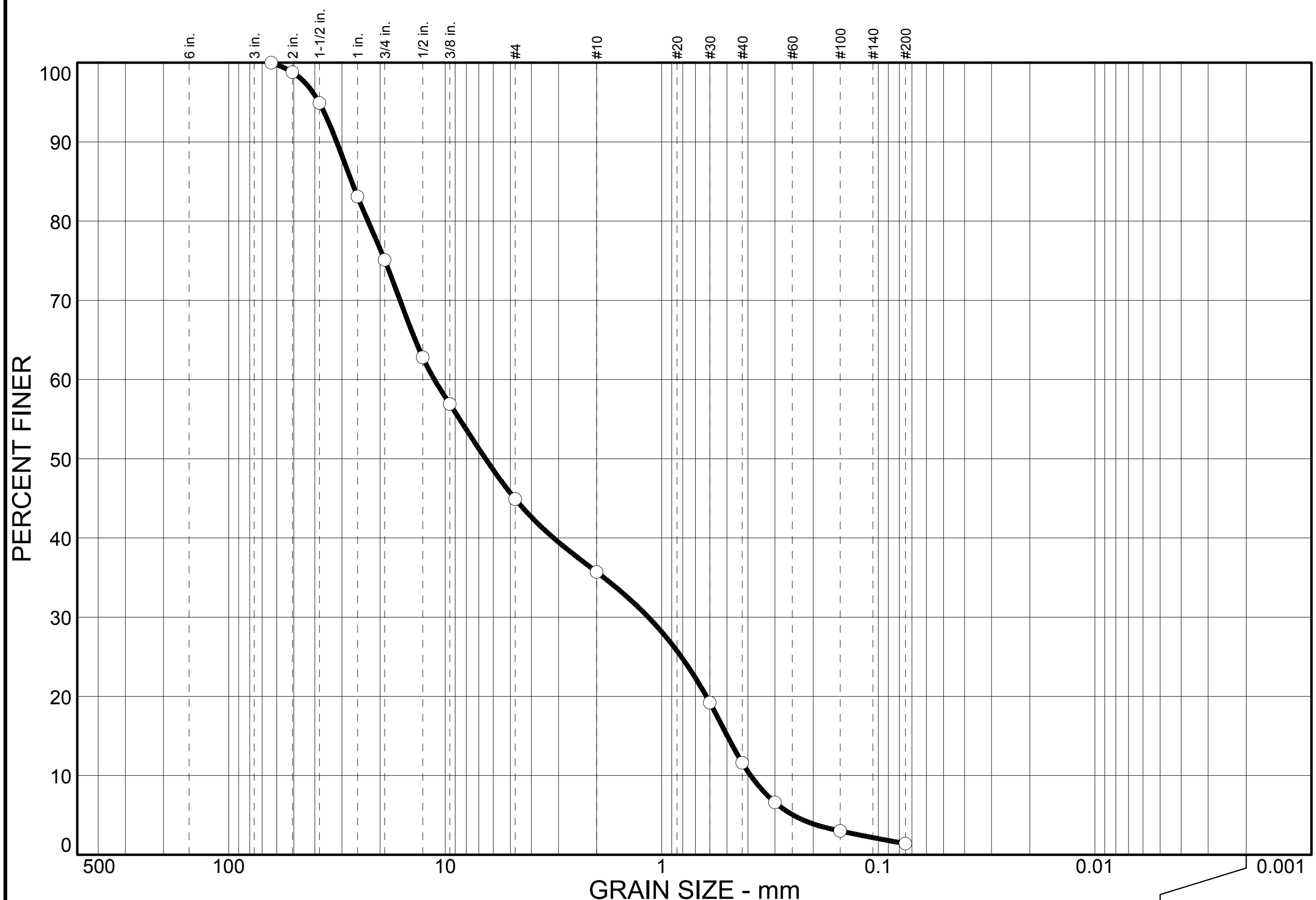
Due to the small sample size, relative to the largest particle size, this data should be considered to be approximate.

Sample No.: 11/8/2011 **Source of Sample:** Site 2: Sample #1 (XS-1) **Date:** 1/13/12
Location: **Elev./Depth:**

COOPER TESTING LABORATORY

Client: Cardno Entrix
Project: Piru Sediment Samples
Project No: 070-011 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	55.1	43.5	1.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2.5 in.	100.0		
2 in.	98.8		
1.5 in.	94.9		
1 in.	83.1		
3/4 in.	75.1		
1/2 in.	62.8		
3/8 in.	56.9		
#4	44.9		
#10	35.7		
#30	19.2		
#40	11.6		
#50	6.6		
#100	3.0		
#200	1.4		

* (no specification provided)

Soil Description

Olive Brown Poorly Graded GRAVEL w/ Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 27.0 D_{60}= 11.2 D_{50}= 6.51
D_{30}= 1.15 D_{15}= 0.498 D_{10}= 0.389
C_u= 28.87 C_c= 0.31

Classification

USCS= AASHTO=

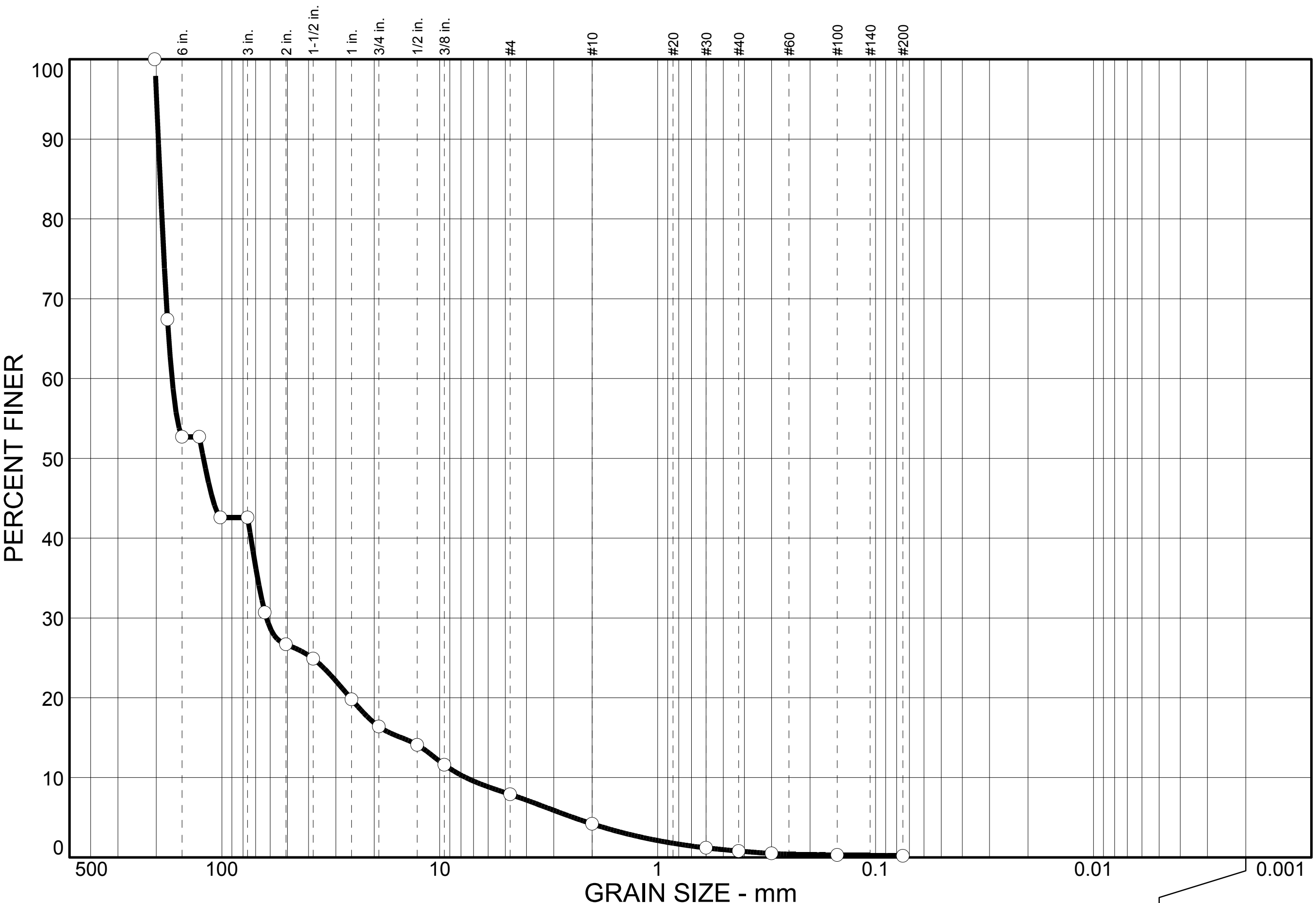
Remarks

Sample No.: 11/8/2011 **Source of Sample:** Site 2: Sample #1(XS-5) **Date:** 1/6/12
Location: **Elev./Depth:**

COOPER TESTING LABORATORY

Client: Cardno Entrix
Project: Piru Sediment Samples
Project No: 070-011 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
57.4	34.7	7.7	0.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
8 in.	100.0		
7 in.	67.4		
6 in.	52.7		
5 in.	52.7		
4 in.	42.6		
3 in.	42.6		
2.5 in.	30.7		
2 in.	26.7		
1.5 in.	24.9		
1 in.	19.8		
3/4 in.	16.4		
1/2 in.	14.1		
3/8 in.	11.6		
#4	7.9		
#10	4.2		
#30	1.2		
#40	0.8		
#50	0.5		
#100	0.3		
#200	0.2		

* (no specification provided)

Soil Description

Olive Brown Poorly Graded GRAVEL w/ Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 192.2 D_{60}= 169.4 D_{50}= 121.5
D_{30}= 62.4 D_{15}= 15.0 D_{10}= 7.59
C_u= 22.32 C_c= 3.03

Classification

USCS= AASHTO=

Remarks

Due to the small sample size, relative to the largest particle size, this data should be considered to be approximate.

Sample No.: 11/9/2011 **Source of Sample:** Site 3: Sample #1(XS-6) **Date:** 1/6/12
Location: **Elev./Depth:**

COOPER TESTING LABORATORY

Client: Cardno Entrix
Project: Piru Sediment Samples

Project No: 070-011 **Figure**

Appendix G

Hydraulic Model Data

APPENDIX G

Hec Ras Hydraulic Output - Site 1

Piru Creek 2011 Controlled Flow Release Geomorphology Study

United Water Conservation District

River Sta XS	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Top Width (ft)	Hydr Depth (ft)	Shear Chan (lb/sq ft)
1	2 cfs	2	91.8	92.1	0.005	1	10.3	0.2	0.06
1	5 cfs	5	91.8	92.3	0.0055	1.3	13.6	0.3	0.09
1	10 cfs	10	91.8	92.4	0.0121	2.2	14.1	0.3	0.24
1	25 cfs	25	91.8	92.5	0.0244	3.8	15.3	0.4	0.65
1	50 cfs	50	91.8	92.8	0.0242	3.7	31	0.4	0.65
1	75 cfs	75	91.8	93	0.0196	3.8	38.6	0.5	0.62
1	100 cfs	100	91.8	93.2	0.011	3.5	42.9	0.7	0.47
1	150 cfs	150	91.8	93.6	0.0064	3.4	48.3	0.9	0.4
1	200 cfs	200	91.8	93.9	0.0048	3.5	52.1	1.1	0.39
1	250 cfs	250	91.8	94.1	0.004	3.6	55.1	1.3	0.39
1	300 cfs	300	91.8	94.4	0.0035	3.7	57.6	1.5	0.39
1	350 cfs	350	91.8	94.6	0.0032	3.8	62.4	1.6	0.4
1	400 cfs	400	91.8	94.8	0.0029	3.9	63.7	1.8	0.41
1	450 cfs	450	91.8	95	0.0028	4	65	1.9	0.42
1	500 cfs	500	91.8	95.2	0.0026	4.1	66.2	2.1	0.42
1	550 cfs	550	91.8	95.4	0.0025	4.2	67.3	2.2	0.43
1	600 cfs	600	91.8	95.6	0.0024	4.3	68.5	2.4	0.44
1	650 cfs	650	91.8	95.7	0.0023	4.3	69.5	2.5	0.45
1	700 cfs	700	91.8	95.9	0.0022	4.4	70.5	2.6	0.45
1	750 cfs	750	91.8	96	0.0021	4.5	71.5	2.8	0.46
1	800 cfs	800	91.8	96.2	0.0021	4.6	72.3	2.9	0.47
1	850 cfs	850	91.8	96.3	0.002	4.6	72.7	3	0.48
1	900 cfs	900	91.8	96.5	0.002	4.7	73.1	3.1	0.49
1	950 cfs	950	91.8	96.6	0.002	4.8	73.4	3.3	0.49
1	1000 cfs	1000	91.8	96.8	0.0019	4.8	73.8	3.4	0.5
1	1250 cfs	1250	91.8	97.4	0.0018	5.1	75.4	4	0.54
1	1500 cfs	1500	91.8	98	0.0017	5.4	77.4	4.4	0.58
1	1750 cfs	1750	91.8	98.5	0.0017	5.7	79.8	4.8	0.62
1	2000 cfs	2000	91.8	99	0.0016	5.9	82.1	5.2	0.66
2	2 cfs	2	91.6	91.7	0.0307	1.4	16.3	0.1	0.16
2	5 cfs	5	91.6	91.8	0.0349	2.1	16.8	0.1	0.3
2	10 cfs	10	91.6	92	0.0078	1.5	27.3	0.2	0.12
2	25 cfs	25	91.6	92.4	0.0018	1.2	41	0.5	0.06
2	50 cfs	50	91.6	92.7	0.0014	1.3	47.7	0.8	0.07
2	75 cfs	75	91.6	93	0.0012	1.5	51.1	1	0.08
2	100 cfs	100	91.6	93.2	0.0011	1.6	54	1.1	0.09
2	150 cfs	150	91.6	93.6	0.0011	1.9	57.4	1.4	0.11
2	200 cfs	200	91.6	93.9	0.0011	2.1	59.7	1.7	0.13
2	250 cfs	250	91.6	94.1	0.0011	2.3	61.6	1.9	0.14
2	300 cfs	300	91.6	94.4	0.0011	2.5	63.5	2.1	0.16
2	350 cfs	350	91.6	94.6	0.0011	2.6	64.4	2.2	0.17
2	400 cfs	400	91.6	94.8	0.0011	2.8	65.3	2.4	0.19

2	450 cfs	450	91.6	95	0.0011	2.9	65.7	2.6	0.2
2	500 cfs	500	91.6	95.2	0.0011	3	66.1	2.8	0.21
2	550 cfs	550	91.6	95.4	0.001	3.1	66.5	3	0.22
2	600 cfs	600	91.6	95.6	0.001	3.2	66.9	3.1	0.23
2	650 cfs	650	91.6	95.7	0.001	3.3	67.2	3.3	0.24
2	700 cfs	700	91.6	95.9	0.001	3.4	67.6	3.4	0.26
2	750 cfs	750	91.6	96.1	0.001	3.5	67.9	3.5	0.27
2	800 cfs	800	91.6	96.2	0.0011	3.6	68.3	3.7	0.28
2	850 cfs	850	91.6	96.4	0.0011	3.7	68.7	3.8	0.29
2	900 cfs	900	91.6	96.5	0.0011	3.8	69	3.9	0.3
2	950 cfs	950	91.6	96.6	0.0011	3.8	69.4	4	0.31
2	1000 cfs	1000	91.6	96.8	0.0011	3.9	69.8	4.2	0.32
2	1250 cfs	1250	91.6	97.4	0.0011	4.3	74.9	4.5	0.36
2	1500 cfs	1500	91.6	98	0.0011	4.6	80.1	4.8	0.4
2	1750 cfs	1750	91.6	98.6	0.0011	4.9	81.5	5.2	0.45
2	2000 cfs	2000	91.6	99.1	0.0011	5.2	82.1	5.7	0.48
3	2 cfs	2	90.2	91.6	0	0.1	26.6	0.8	0
3	5 cfs	5	90.2	91.8	0	0.2	27.6	0.9	0
3	10 cfs	10	90.2	92	0	0.3	28.8	1.1	0
3	25 cfs	25	90.2	92.4	0.0001	0.6	31.8	1.4	0.01
3	50 cfs	50	90.2	92.7	0.0002	1	34.7	1.6	0.03
3	75 cfs	75	90.2	93	0.0003	1.3	36.6	1.8	0.04
3	100 cfs	100	90.2	93.2	0.0004	1.6	38	1.9	0.06
3	150 cfs	150	90.2	93.6	0.0006	2	40.4	2.1	0.1
3	200 cfs	200	90.2	93.8	0.0007	2.4	41.4	2.3	0.14
3	250 cfs	250	90.2	94.1	0.0009	2.7	42.3	2.5	0.18
3	300 cfs	300	90.2	94.3	0.001	3.1	43.1	2.7	0.21
3	350 cfs	350	90.2	94.5	0.0011	3.3	43.9	2.9	0.25
3	400 cfs	400	90.2	94.7	0.0012	3.6	44.5	3	0.28
3	450 cfs	450	90.2	94.9	0.0012	3.8	45.2	3.2	0.32
3	500 cfs	500	90.2	95.1	0.0013	4.1	45.8	3.3	0.35
3	550 cfs	550	90.2	95.2	0.0014	4.3	46.4	3.4	0.39
3	600 cfs	600	90.2	95.4	0.0015	4.5	47.3	3.5	0.42
3	650 cfs	650	90.2	95.6	0.0015	4.7	48.3	3.6	0.45
3	700 cfs	700	90.2	95.7	0.0016	4.9	49.2	3.7	0.49
3	750 cfs	750	90.2	95.8	0.0017	5.1	50.2	3.7	0.52
3	800 cfs	800	90.2	96	0.0017	5.3	51.2	3.8	0.55
3	850 cfs	850	90.2	96.1	0.0018	5.4	52.1	3.9	0.59
3	900 cfs	900	90.2	96.2	0.0018	5.6	53	3.9	0.62
3	950 cfs	950	90.2	96.4	0.0019	5.7	53.9	4	0.65
3	1000 cfs	1000	90.2	96.5	0.0019	5.9	54.8	4	0.68
3	1250 cfs	1250	90.2	97	0.0021	6.6	59	4.3	0.82
3	1500 cfs	1500	90.2	97.6	0.0022	7.2	62.9	4.5	0.94
3	1750 cfs	1750	90.2	98	0.0024	7.8	70.1	4.5	1.09
3	2000 cfs	2000	90.2	98.5	0.0025	8.2	71.5	4.9	1.19
4	2 cfs	2	91.3	91.6	0.0056	1	10.2	0.2	0.07
4	5 cfs	5	91.3	91.8	0.0047	1.3	12.2	0.3	0.09
4	10 cfs	10	91.3	91.9	0.0041	1.6	14	0.4	0.12
4	25 cfs	25	91.3	92.3	0.0039	1.7	29.1	0.5	0.12
4	50 cfs	50	91.3	92.7	0.0032	2	33.2	0.8	0.15

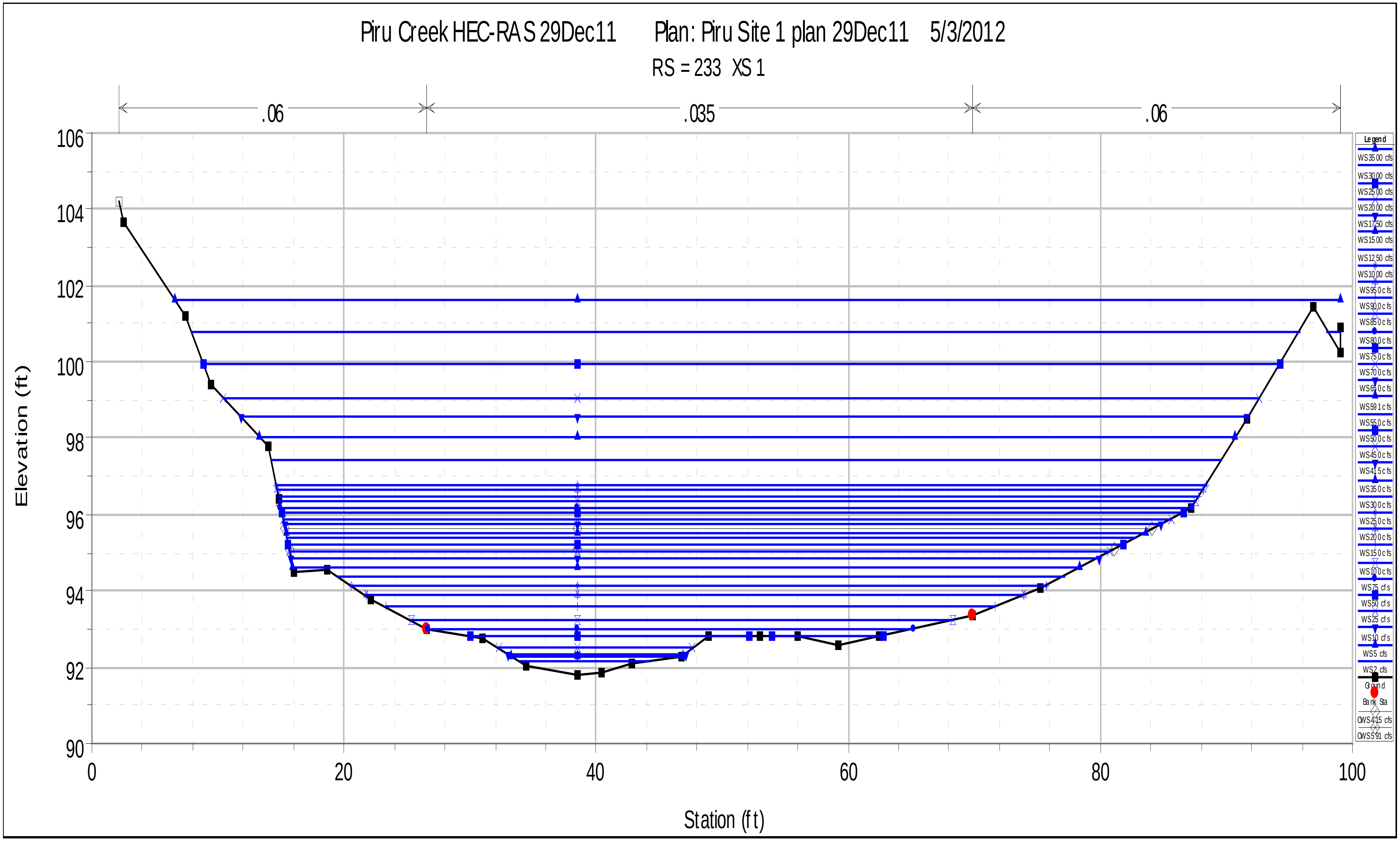
4	75 cfs	75	91.3	92.9	0.0029	2.2	35	1	0.17
4	100 cfs	100	91.3	93.1	0.0028	2.5	36.1	1.1	0.2
4	150 cfs	150	91.3	93.4	0.0028	2.9	37.1	1.4	0.25
4	200 cfs	200	91.3	93.7	0.0029	3.2	37.8	1.6	0.3
4	250 cfs	250	91.3	93.9	0.0029	3.5	38.4	1.9	0.35
4	300 cfs	300	91.3	94.2	0.003	3.8	39	2	0.39
4	350 cfs	350	91.3	94.3	0.003	4.1	39.5	2.2	0.44
4	400 cfs	400	91.3	94.5	0.003	4.3	40	2.4	0.48
4	450 cfs	450	91.3	94.7	0.0031	4.5	40.5	2.5	0.52
4	500 cfs	500	91.3	94.9	0.0031	4.8	41	2.6	0.55
4	550 cfs	550	91.3	95	0.0031	5	41.6	2.8	0.59
4	600 cfs	600	91.3	95.2	0.0032	5.1	42.1	2.9	0.62
4	650 cfs	650	91.3	95.3	0.0032	5.3	42.6	3	0.66
4	700 cfs	700	91.3	95.5	0.0032	5.5	43.1	3.1	0.69
4	750 cfs	750	91.3	95.6	0.0033	5.7	43.5	3.2	0.73
4	800 cfs	800	91.3	95.7	0.0033	5.8	44	3.3	0.76
4	850 cfs	850	91.3	95.9	0.0033	6	44.4	3.4	0.79
4	900 cfs	900	91.3	96	0.0033	6.1	44.8	3.5	0.82
4	950 cfs	950	91.3	96.1	0.0034	6.3	45.2	3.6	0.85
4	1000 cfs	1000	91.3	96.2	0.0034	6.4	45.7	3.6	0.88
4	1250 cfs	1250	91.3	96.8	0.0035	7	47.7	4	1.02
4	1500 cfs	1500	91.3	97.2	0.0036	7.7	55.3	3.9	1.17
4	1750 cfs	1750	91.3	97.7	0.0036	8.1	57.6	4.2	1.28
4	2000 cfs	2000	91.3	98.1	0.0037	8.6	58.5	4.6	1.4
5	2 cfs	2	90.7	91.1	0.0454	0.7	10.8	0.3	0.78
5	5 cfs	5	90.7	91.3	0.0536	1	12.6	0.4	1.38
5	10 cfs	10	90.7	91.6	0.0651	1.2	15.9	0.5	2.09
5	25 cfs	25	90.7	92	0.0643	1.5	24.3	0.7	2.79
5	50 cfs	50	90.7	92.3	0.0704	1.8	30.6	0.9	3.98
5	75 cfs	75	90.7	92.6	0.0622	2.1	31.8	1.1	4.64
5	100 cfs	100	90.7	92.8	0.0677	2.4	32.4	1.3	5.84
5	150 cfs	150	90.7	93.1	0.0777	2.9	33.4	1.6	8.17
5	200 cfs	200	90.7	93.4	0.0865	3.4	33.9	1.8	10.43
5	250 cfs	250	90.7	93.6	0.0944	3.8	34.3	2	12.63
5	300 cfs	300	90.7	93.8	0.1011	4.2	34.7	2.2	14.75
5	350 cfs	350	90.7	94	0.107	4.5	35	2.3	16.79
5	400 cfs	400	90.7	94.1	0.1125	4.8	35.3	2.5	18.8
5	450 cfs	450	90.7	94.3	0.1173	5.1	35.6	2.6	20.74
5	500 cfs	500	90.7	94.4	0.1219	5.4	35.9	2.7	22.66
5	550 cfs	550	90.7	94.6	0.126	5.6	36.2	2.8	24.52
5	600 cfs	600	90.7	94.7	0.1299	5.9	36.5	2.9	26.35
5	650 cfs	650	90.7	94.8	0.134	6.1	36.9	3	28.21
5	700 cfs	700	90.7	94.9	0.1382	6.4	37.1	3.1	30.09
5	750 cfs	750	90.7	95.1	0.1425	6.6	37.4	3.2	32.01
5	800 cfs	800	90.7	95.2	0.1466	6.8	37.7	3.3	33.9
5	850 cfs	850	90.7	95.3	0.1507	7	37.9	3.4	35.79
5	900 cfs	900	90.7	95.4	0.1544	7.2	38.2	3.5	37.64
5	950 cfs	950	90.7	95.5	0.1579	7.4	38.5	3.5	39.47
5	1000 cfs	1000	90.7	95.6	0.1627	7.7	39.4	3.5	41.57
5	1250 cfs	1250	90.7	96	0.1828	8.7	43.1	3.6	51.34
5	1500 cfs	1500	90.7	96.3	0.1978	9.5	45	3.8	60.14

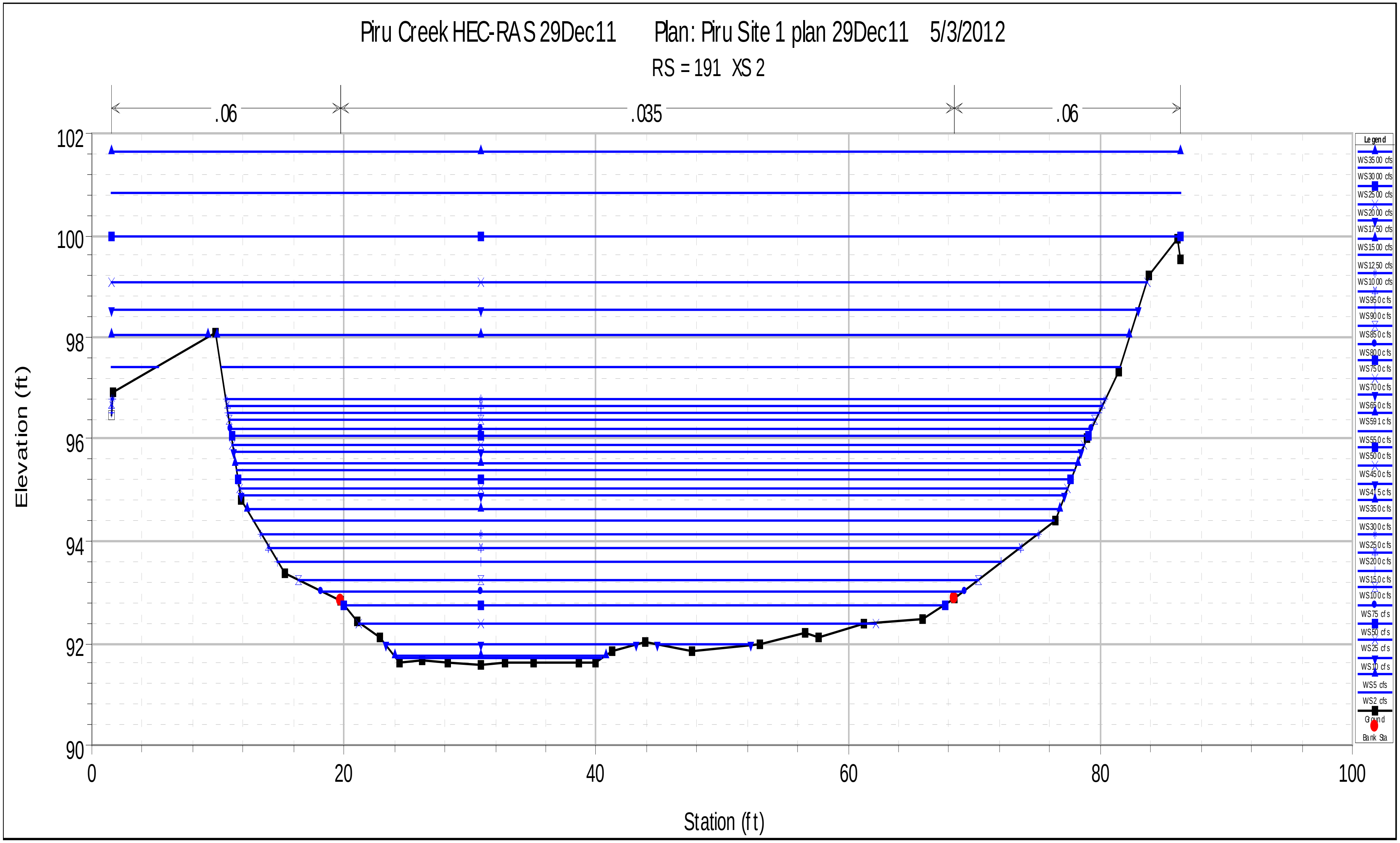
5	1750 cfs	1750	90.7	96.7	0.2119	10.3	47	4	68.82
5	2000 cfs	2000	90.7	97	0.2232	11	48.2	4.2	76.81
6	2 cfs	2	89.6	91.1	0	0.1	28.6	1.1	0
6	5 cfs	5	89.6	91.3	0	0.1	30	1.2	0
6	10 cfs	10	89.6	91.6	0	0.2	31.8	1.4	0
6	25 cfs	25	89.6	92	0.0001	0.4	36.3	1.6	0.01
6	50 cfs	50	89.6	92.3	0.0002	0.7	41.9	1.7	0.03
6	75 cfs	75	89.6	92.6	0.0003	0.9	46.8	1.8	0.05
6	100 cfs	100	89.6	92.8	0.0004	1.2	48	1.9	0.07
6	150 cfs	150	89.6	93.1	0.0006	1.5	49.5	2.2	0.12
6	200 cfs	200	89.6	93.4	0.0009	1.9	51.2	2.3	0.17
6	250 cfs	250	89.6	93.6	0.0011	2.1	52.4	2.5	0.22
6	300 cfs	300	89.6	93.8	0.0012	2.4	53.5	2.6	0.27
6	350 cfs	350	89.6	93.9	0.0014	2.6	54.4	2.8	0.32
6	400 cfs	400	89.6	94.1	0.0015	2.9	55.3	2.9	0.37
6	450 cfs	450	89.6	94.3	0.0017	3.1	56.1	3	0.42
6	500 cfs	500	89.6	94.4	0.0018	3.3	56.9	3.1	0.47
6	550 cfs	550	89.6	94.6	0.0019	3.4	57.7	3.2	0.51
6	600 cfs	600	89.6	94.7	0.002	3.6	58.2	3.3	0.56
6	650 cfs	650	89.6	94.8	0.0021	3.8	58.8	3.4	0.6
6	700 cfs	700	89.6	95	0.0022	3.9	59.3	3.5	0.65
6	750 cfs	750	89.6	95.1	0.0023	4.1	59.8	3.6	0.69
6	800 cfs	800	89.6	95.2	0.0024	4.2	60.3	3.7	0.74
6	850 cfs	850	89.6	95.3	0.0025	4.4	60.7	3.8	0.78
6	900 cfs	900	89.6	95.4	0.0026	4.5	61.2	3.9	0.83
6	950 cfs	950	89.6	95.5	0.0027	4.6	61.7	3.9	0.87
6	1000 cfs	1000	89.6	95.6	0.0027	4.8	62.3	4	0.91
6	1250 cfs	1250	89.6	96.1	0.0031	5.4	64.9	4.3	1.13
6	1500 cfs	1500	89.6	96.5	0.0034	5.9	67.2	4.6	1.33
6	1750 cfs	1750	89.6	96.9	0.0037	6.3	69.3	4.8	1.52
6	2000 cfs	2000	89.6	97.3	0.0039	6.8	72.3	5	1.71
7	2 cfs	2	90.8	91.1	0.0044	0.7	11.4	0.2	0.06
7	5 cfs	5	90.8	91.3	0.0044	1	13.9	0.4	0.1
7	10 cfs	10	90.8	91.5	0.0044	1.2	16.8	0.5	0.13
7	25 cfs	25	90.8	91.9	0.0044	1.4	32	0.6	0.16
7	50 cfs	50	90.8	92.3	0.0044	1.6	41.6	0.7	0.2
7	75 cfs	75	90.8	92.6	0.0044	1.7	53.7	0.8	0.22
7	100 cfs	100	90.8	92.7	0.0044	1.9	57.2	0.9	0.26
7	150 cfs	150	90.8	93	0.0044	2.2	60.8	1.1	0.32
7	200 cfs	200	90.8	93.2	0.0044	2.4	62	1.3	0.38
7	250 cfs	250	90.8	93.4	0.0044	2.7	62.5	1.5	0.43
7	300 cfs	300	90.8	93.6	0.0044	2.9	62.9	1.7	0.48
7	350 cfs	350	90.8	93.8	0.0044	3	63.3	1.9	0.53
7	400 cfs	400	90.8	93.9	0.0044	3.2	63.7	2	0.57
7	450 cfs	450	90.8	94.1	0.0044	3.4	64.1	2.2	0.61
7	500 cfs	500	90.8	94.2	0.0044	3.5	64.4	2.3	0.65
7	550 cfs	550	90.8	94.4	0.0044	3.6	65.9	2.4	0.69
7	600 cfs	600	90.8	94.5	0.0044	3.8	68	2.4	0.72
7	650 cfs	650	90.8	94.6	0.0044	3.9	70.1	2.5	0.76
7	700 cfs	700	90.8	94.8	0.0044	4	71.4	2.6	0.79

7	750 cfs	750	90.8	94.9	0.0044	4.1	71.9	2.7	0.83
7	800 cfs	800	90.8	95	0.0044	4.2	72.4	2.8	0.86
7	850 cfs	850	90.8	95.1	0.0044	4.3	72.8	2.9	0.89
7	900 cfs	900	90.8	95.2	0.0044	4.4	73.8	2.9	0.92
7	950 cfs	950	90.8	95.3	0.0044	4.5	75.2	3	0.95
7	1000 cfs	1000	90.8	95.4	0.0044	4.6	76.6	3	0.97
7	1250 cfs	1250	90.8	95.9	0.0044	5	78.3	3.4	1.1
7	1500 cfs	1500	90.8	96.4	0.0044	5.3	79.6	3.8	1.22
7	1750 cfs	1750	90.8	96.8	0.0044	5.7	80.8	4.2	1.34
7	2000 cfs	2000	90.8	97.2	0.0044	5.9	81.9	4.5	1.44

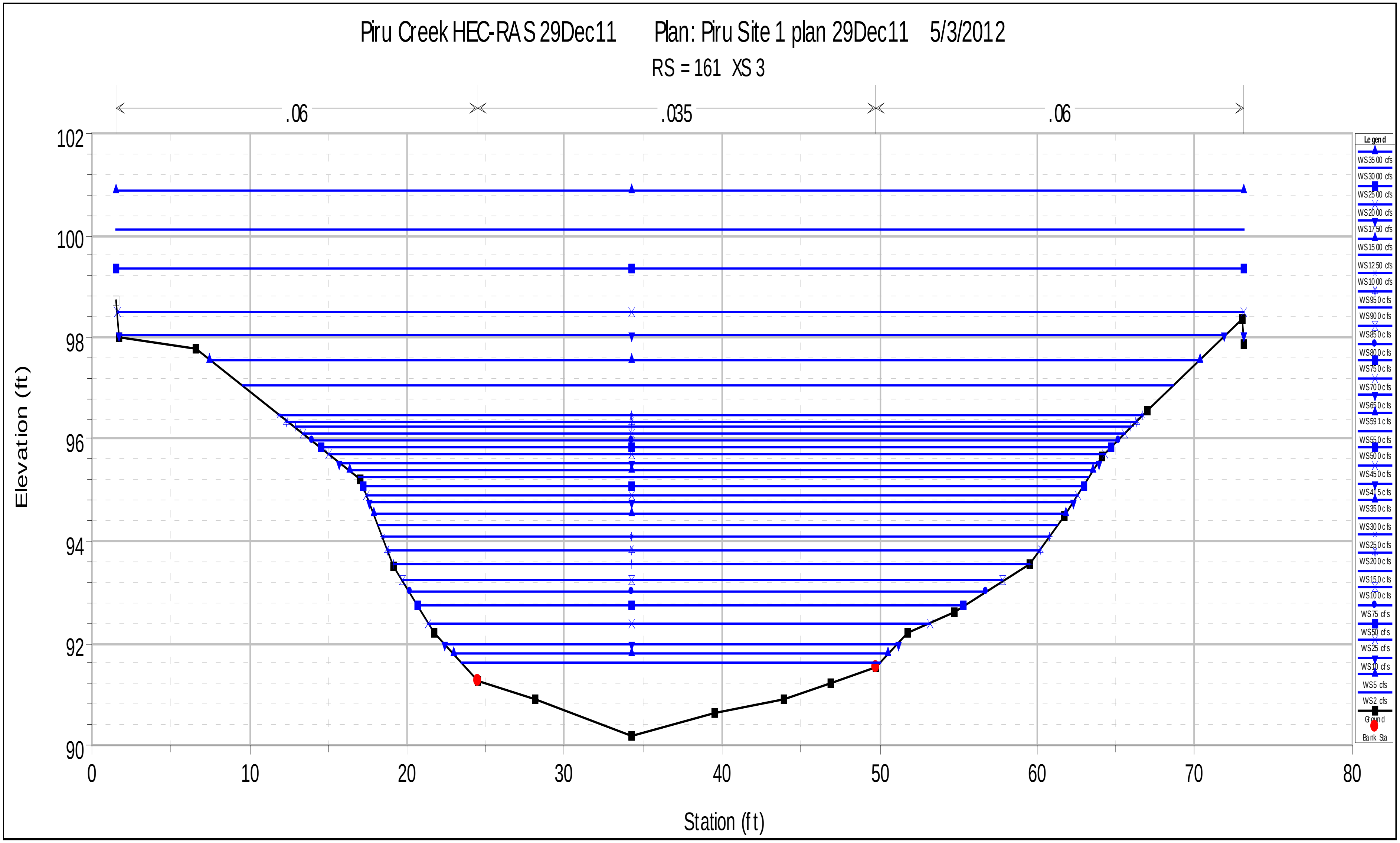
Note
cfs = cubic feet per second
ft = feet
sq ft = square feet
lb = pounds

SITE 1. XS PLOTS and WSEL'S

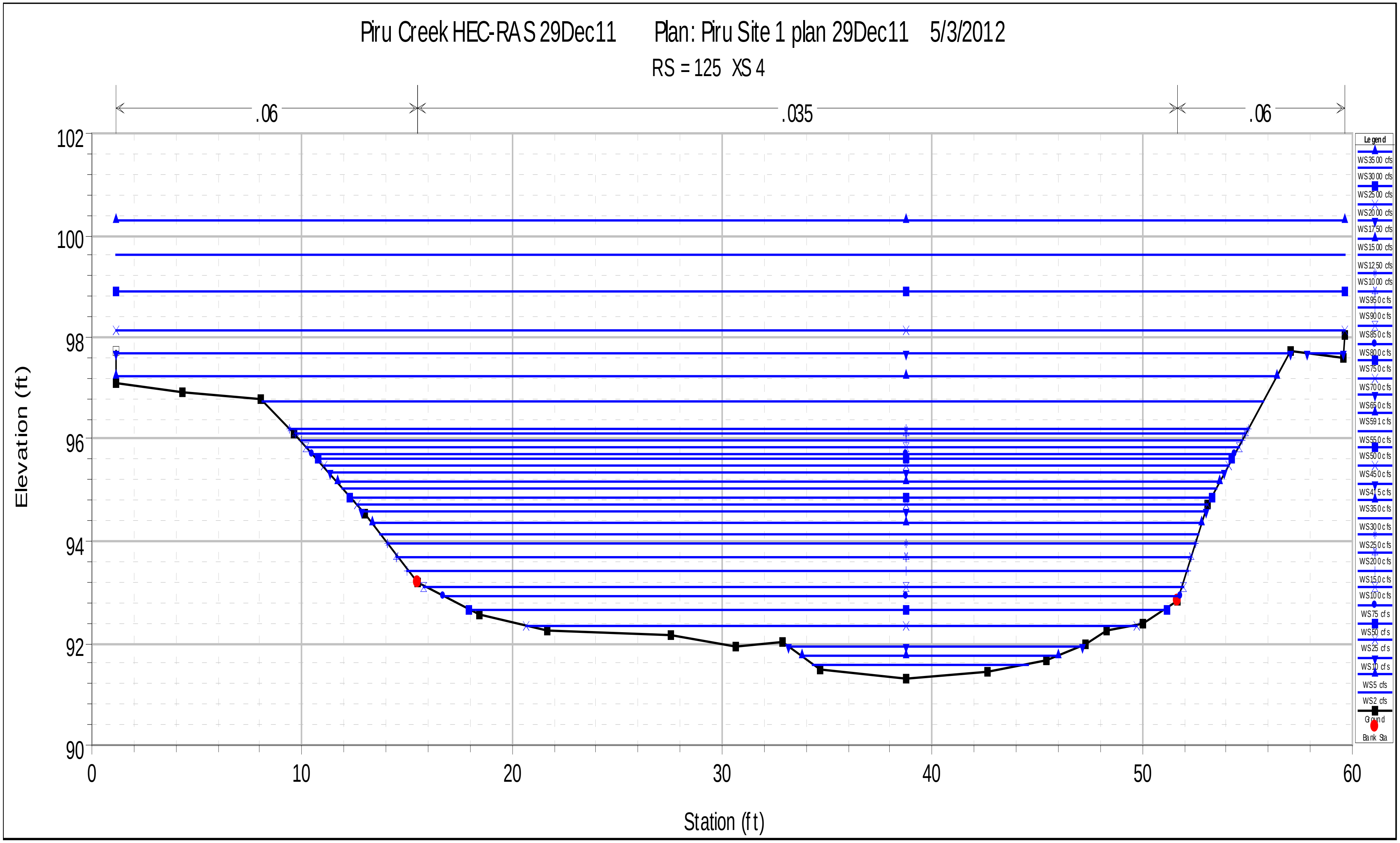




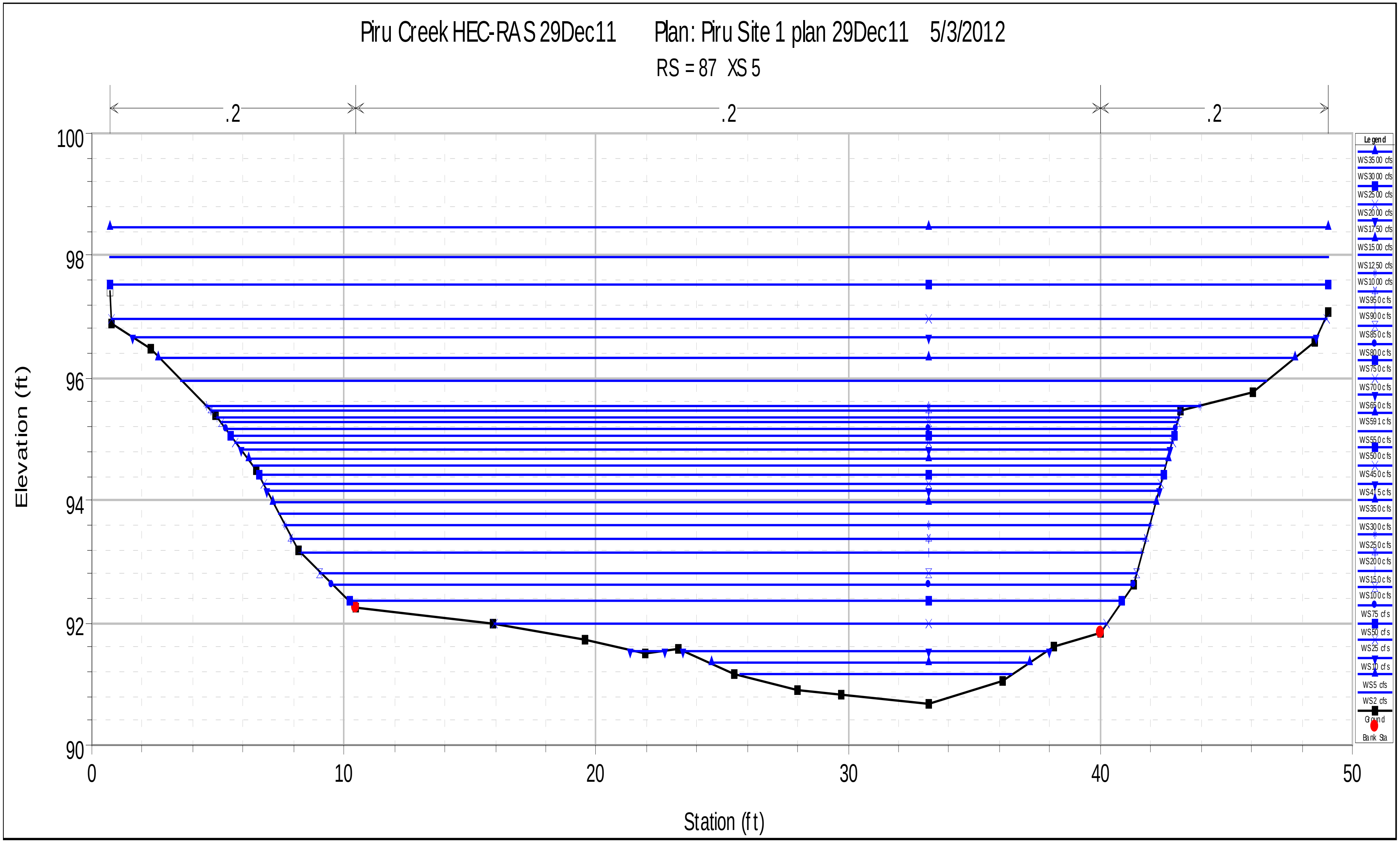
Piru Creek HEC-RAS 29Dec11 Plan: Piru Site 1 plan 29Dec11 5/3/2012
RS = 191 XS 2
.06
.035
.06
Elevation (ft)
Station (ft)
Legend
WS3500 cfs
WS3000 cfs
WS2500 cfs
WS2000 cfs
WS1750 cfs
WS1500 cfs
WS1250 cfs
WS1000 cfs
WS950 cfs
WS900 cfs
WS850 cfs
WS800 cfs
WS750 cfs
WS700 cfs
WS650 cfs
WS591 cfs
WS550 cfs
WS500 cfs
WS450 cfs
WS415 cfs
WS350 cfs
WS300 cfs
WS250 cfs
WS200 cfs
WS150 cfs
WS100 cfs
WS75 cfs
WS50 cfs
WS25 cfs
WS10 cfs
WS5 cfs
WS2 cfs
Ground
Bank Sta



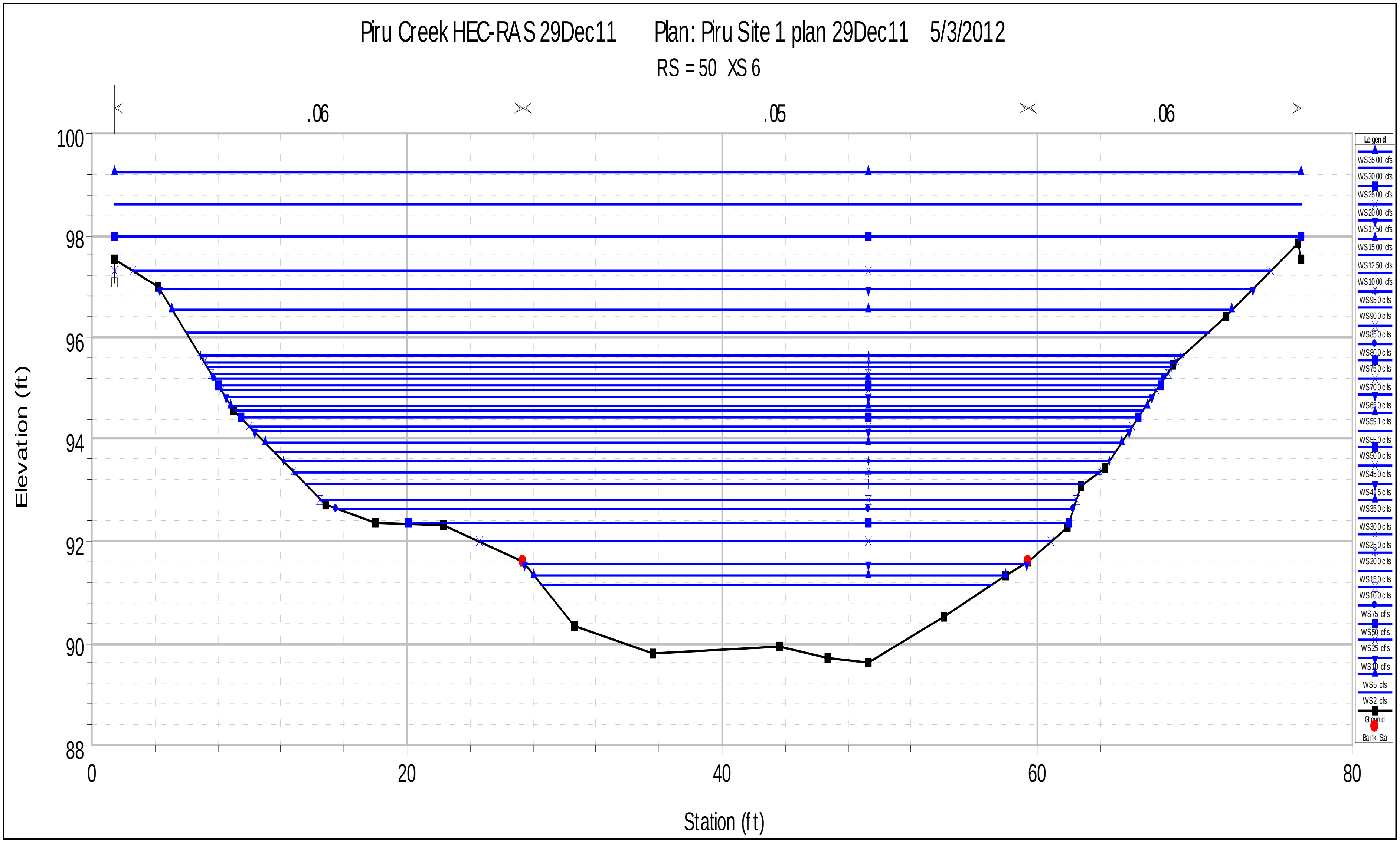
Piru Creek HEC-RAS 29Dec11 Plan: Piru Site 1 plan 29Dec11 5/3/2012
RS = 161 XS 3
.06
.035
.06
Elevation (ft)
Station (ft)
102
100
98
96
94
92
90
0
10
20
30
40
50
60
70
80
Legend
WS 3500 cfs
WS 3000 cfs
WS 2500 cfs
WS 2000 cfs
WS 1750 cfs
WS 1500 cfs
WS 1250 cfs
WS 1000 cfs
WS 950 cfs
WS 900 cfs
WS 850 cfs
WS 800 cfs
WS 750 cfs
WS 700 cfs
WS 650 cfs
WS 591 cfs
WS 550 cfs
WS 500 cfs
WS 450 cfs
WS 415 cfs
WS 350 cfs
WS 300 cfs
WS 250 cfs
WS 200 cfs
WS 150 cfs
WS 100 cfs
WS 75 cfs
WS 50 cfs
WS 25 cfs
WS 10 cfs
WS 5 cfs
WS 2 cfs
Ground
Bank Sta

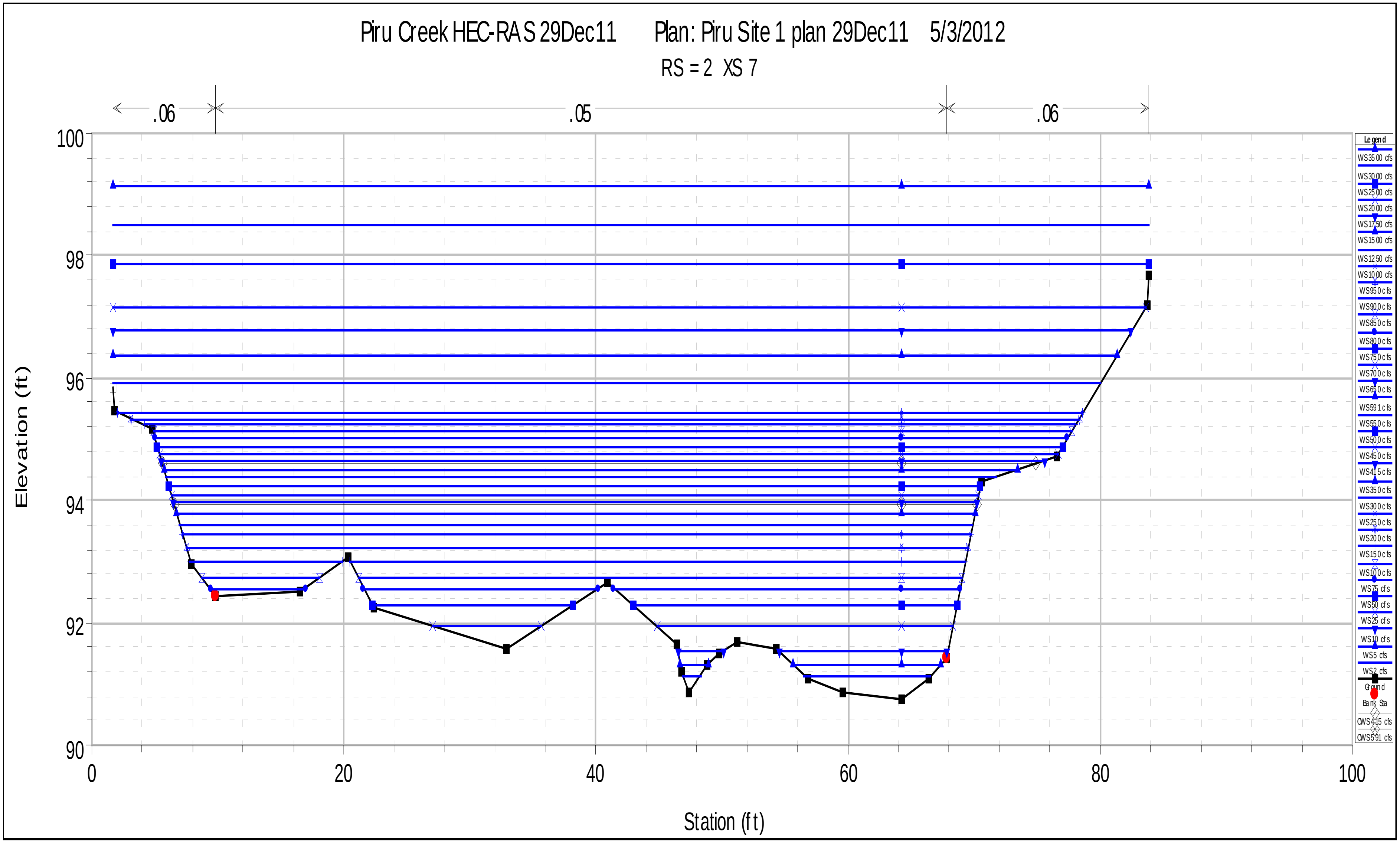


Piru Creek HEC-RAS 29Dec11 Plan: Piru Site 1 plan 29Dec11 5/3/2012
RS = 125 XS 4
.06
.035
.06
Elevation (ft)
Station (ft)
102
100
98
96
94
92
90
0
10
20
30
40
50
60
Legend
WS 3500 cfs
WS 3000 cfs
WS 2500 cfs
WS 2000 cfs
WS 1750 cfs
WS 1500 cfs
WS 1250 cfs
WS 1000 cfs
WS 950 cfs
WS 900 cfs
WS 850 cfs
WS 800 cfs
WS 750 cfs
WS 700 cfs
WS 650 cfs
WS 591 cfs
WS 550 cfs
WS 500 cfs
WS 450 cfs
WS 415 cfs
WS 350 cfs
WS 300 cfs
WS 250 cfs
WS 200 cfs
WS 150 cfs
WS 100 cfs
WS 75 cfs
WS 50 cfs
WS 25 cfs
WS 10 cfs
WS 5 cfs
WS 2 cfs
Ground
Bank Sta



Piru Creek HEC-RAS 29Dec11 Plan: Piru Site 1 plan 29Dec11 5/3/2012
RS = 87 XS 5
.2
.2
.2
Elevation (ft)
100
98
96
94
92
90
0
10
20
30
40
50
Station (ft)
Legend
WS 3500 cfs
WS 3000 cfs
WS 2500 cfs
WS 2000 cfs
WS 1750 cfs
WS 1500 cfs
WS 1250 cfs
WS 1000 cfs
WS 950 cfs
WS 900 cfs
WS 850 cfs
WS 800 cfs
WS 750 cfs
WS 700 cfs
WS 650 cfs
WS 591 cfs
WS 550 cfs
WS 500 cfs
WS 450 cfs
WS 415 cfs
WS 350 cfs
WS 300 cfs
WS 250 cfs
WS 200 cfs
WS 150 cfs
WS 100 cfs
WS 75 cfs
WS 50 cfs
WS 25 cfs
WS 10 cfs
WS 5 cfs
WS 2 cfs
Ground
Bank Sta


Piru Creek HEC-RAS 29Dec11 Plan: Piru Site 1 plan 29Dec11 5/3/2012
RS = 50 XS 6
.06
.05
.06
Legend
WS3500 cfs
WS3000 cfs
WS2500 cfs
WS2000 cfs
WS1750 cfs
WS1500 cfs
WS1250 cfs
WS1000 cfs
WS950 cfs
WS900 cfs
WS850 cfs
WS800 cfs
WS750 cfs
WS700 cfs
WS650 cfs
WS591 cfs
WS550 cfs
WS500 cfs
WS450 cfs
WS415 cfs
WS350 cfs
WS300 cfs
WS250 cfs
WS200 cfs
WS150 cfs
WS100 cfs
WS75 cfs
WS50 cfs
WS25 cfs
WS10 cfs
WS5 cfs
WS2 cfs
Ground
Bank Sta
Elevation (ft)
Station (ft)
100
98
96
94
92
90
88
0
20
40
60
80



Piru Creek HEC-RAS 29Dec11 Plan: Piru Site 1 plan 29Dec11 5/3/2012
RS = 2 XS 7
.06
.05
.06
Elevation (ft)
Station (ft)
100
98
96
94
92
90
0
20
40
60
80
100
Legend
WS 3500 cfs
WS 3000 cfs
WS 2500 cfs
WS 2000 cfs
WS 1750 cfs
WS 1500 cfs
WS 1250 cfs
WS 1000 cfs
WS 950 cfs
WS 900 cfs
WS 850 cfs
WS 800 cfs
WS 750 cfs
WS 700 cfs
WS 650 cfs
WS 591 cfs
WS 550 cfs
WS 500 cfs
WS 450 cfs
WS 415 cfs
WS 350 cfs
WS 300 cfs
WS 250 cfs
WS 200 cfs
WS 150 cfs
WS 100 cfs
WS 75 cfs
WS 50 cfs
WS 25 cfs
WS 10 cfs
WS 5 cfs
WS 2 cfs
Ground
Bank Sta
OWS 415 cfs
OWS 591 cfs

APPENDIX G

Hec Ras Hydraulic Output - Site 2

Piru Creek 2011 Controlled Flow Release Geomorphology Study

United Water Conservation District

River Sta XS	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Top Width (ft)	Hydr Depth (ft)	Shear Chan (lb/sq ft)
1	2 cfs	2	96.5	96.7	0.0133	0.8	19.4	0.1	0.11
1	5 cfs	5	96.5	96.8	0.0128	1.1	21.2	0.2	0.17
1	10 cfs	10	96.5	96.9	0.0127	1.4	23.1	0.3	0.25
1	25 cfs	25	96.5	97.2	0.0125	1.7	37.0	0.4	0.32
1	50 cfs	50	96.5	97.5	0.0110	1.9	46.0	0.6	0.39
1	75 cfs	75	96.5	97.7	0.0100	2.2	49.0	0.7	0.45
1	100 cfs	100	96.5	97.8	0.0101	2.4	50.9	0.8	0.53
1	150 cfs	150	96.5	98.1	0.0092	2.7	58.1	1.0	0.62
1	200 cfs	200	96.5	98.3	0.0083	3.0	90.5	0.8	0.68
1	250 cfs	250	96.5	98.5	0.0076	3.1	93.0	1.0	0.73
1	300 cfs	300	96.5	98.7	0.0072	3.3	94.7	1.2	0.77
1	350 cfs	350	96.5	98.9	0.0069	3.4	96.2	1.4	0.82
1	400 cfs	400	96.5	99.1	0.0066	3.6	98.2	1.5	0.86
1	450 cfs	450	96.5	99.3	0.0065	3.7	100.8	1.6	0.9
1	500 cfs	500	96.5	99.4	0.0064	3.9	103.1	1.7	0.95
1	550 cfs	550	96.5	99.5	0.0063	4.0	105.4	1.8	1
1	600 cfs	600	96.5	99.7	0.0063	4.1	107.6	1.9	1.04
1	650 cfs	650	96.5	99.8	0.0063	4.2	109.6	2.0	1.09
1	700 cfs	700	96.5	99.9	0.0062	4.3	111.5	2.1	1.13
1	750 cfs	750	96.5	100.1	0.0062	4.4	113.3	2.2	1.17
1	800 cfs	800	96.5	100.2	0.0061	4.5	115.4	2.3	1.21
1	850 cfs	850	96.5	100.3	0.0061	4.6	118.1	2.3	1.24
1	900 cfs	900	96.5	100.4	0.0061	4.7	120.6	2.4	1.28
1	950 cfs	950	96.5	100.5	0.0060	4.8	122.6	2.5	1.31
1	1000 cfs	1000	96.5	100.6	0.0060	4.9	123.1	2.6	1.34
1	1250 cfs	1250	96.5	101.1	0.0060	5.3	129.7	2.9	1.53
1	1500 cfs	1500	96.5	101.5	0.0060	5.7	142.0	3.1	1.7
1	1750 cfs	1750	96.5	101.9	0.0061	6.1	146.0	3.4	1.86
1	2000 cfs	2000	96.5	102.3	0.0061	6.4	149.1	3.7	2
2	2 cfs	2	95.6	95.8	0.0859	2.1	7.2	0.1	0.72
2	5 cfs	5	95.6	95.9	0.0807	2.6	9.4	0.2	1.01
2	10 cfs	10	95.6	96.0	0.0690	3.0	11.7	0.3	1.21
2	25 cfs	25	95.6	96.3	0.0593	3.8	14.6	0.5	1.65
2	50 cfs	50	95.6	96.6	0.0546	4.4	19.2	0.6	1.99
2	75 cfs	75	95.6	96.8	0.0445	4.6	22.6	0.7	2
2	100 cfs	100	95.6	97.1	0.0346	4.4	28.0	0.8	1.75
2	150 cfs	150	95.6	97.4	0.0262	4.5	34.5	1.0	1.7
2	200 cfs	200	95.6	97.7	0.0232	4.7	38.1	1.2	1.77
2	250 cfs	250	95.6	97.9	0.0216	4.9	52.3	1.0	1.87
2	300 cfs	300	95.6	98.1	0.0200	5.2	64.3	1.0	1.96
2	350 cfs	350	95.6	98.3	0.0188	5.4	75.5	1.0	2.05
2	400 cfs	400	95.6	98.5	0.0180	5.6	96.3	1.0	2.14

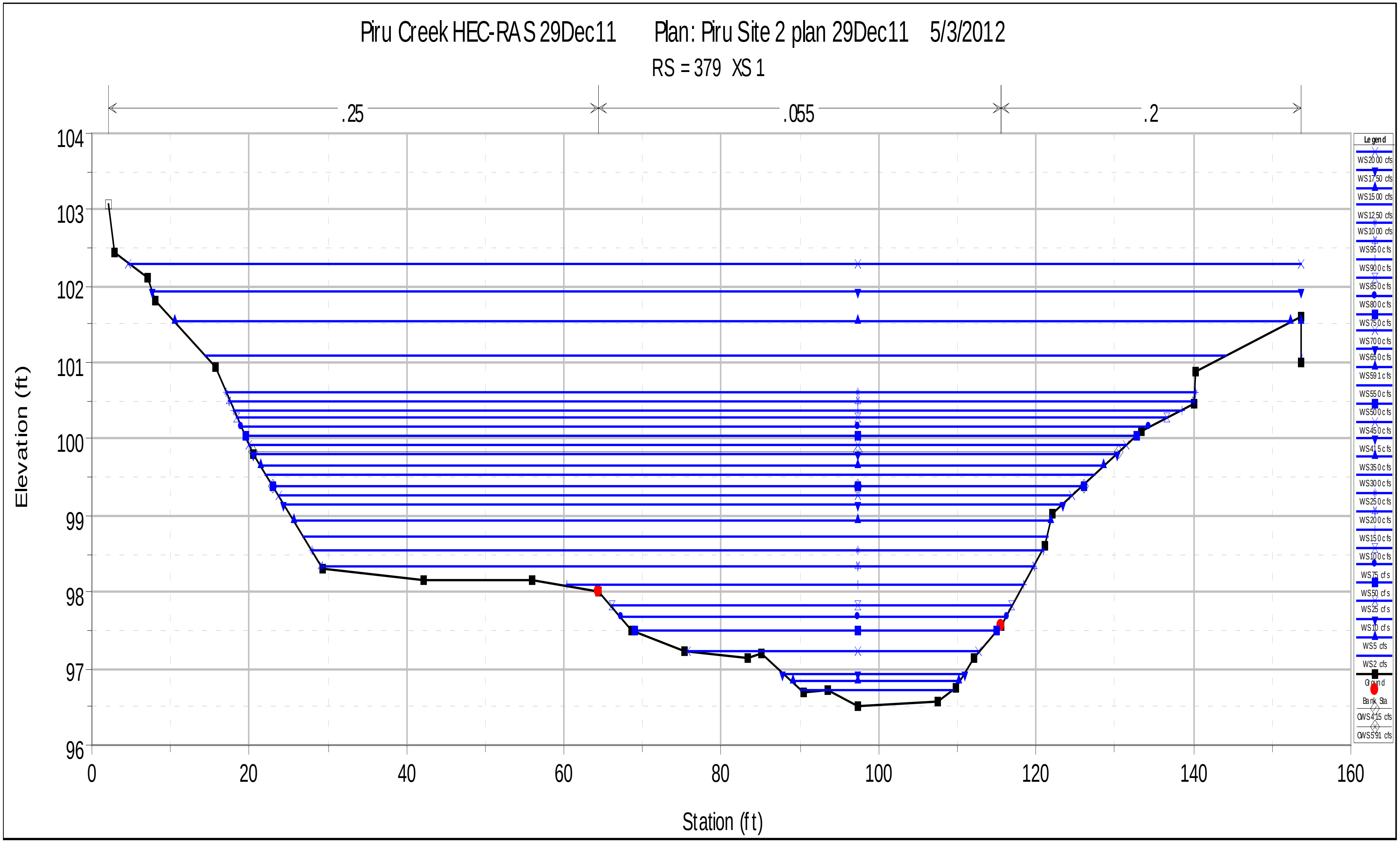
2	450 cfs	450	95.6	98.6	0.0172	5.7	99.1	1.1	2.21
2	500 cfs	500	95.6	98.8	0.0164	5.9	100.9	1.2	2.27
2	550 cfs	550	95.6	98.9	0.0158	6.0	102.1	1.3	2.33
2	600 cfs	600	95.6	99.0	0.0154	6.1	102.7	1.5	2.38
2	650 cfs	650	95.6	99.2	0.0150	6.3	103.4	1.6	2.45
2	700 cfs	700	95.6	99.3	0.0147	6.4	104.0	1.7	2.51
2	750 cfs	750	95.6	99.4	0.0145	6.5	104.3	1.8	2.57
2	800 cfs	800	95.6	99.5	0.0143	6.7	104.6	1.9	2.63
2	850 cfs	850	95.6	99.6	0.0141	6.8	104.9	2.0	2.7
2	900 cfs	900	95.6	99.7	0.0140	6.9	114.3	2.0	2.76
2	950 cfs	950	95.6	99.8	0.0139	7.0	115.6	2.0	2.84
2	1000 cfs	1000	95.6	99.9	0.0138	7.1	116.7	2.1	2.91
2	1250 cfs	1250	95.6	100.4	0.0139	7.7	125.8	2.4	3.28
2	1500 cfs	1500	95.6	100.8	0.0138	8.2	136.0	2.6	3.61
2	1750 cfs	1750	95.6	101.1	0.0136	8.7	136.0	3.0	3.86
2	2000 cfs	2000	95.6	101.5	0.0134	9.0	136.0	3.3	4.1
3	2 cfs	2	94.2	95.4	0.0000	0.1	26.3	0.7	0
3	5 cfs	5	94.2	95.6	0.0001	0.2	28.6	0.8	0
3	10 cfs	10	94.2	95.8	0.0002	0.4	30.2	0.9	0.01
3	25 cfs	25	94.2	96.2	0.0005	0.6	46.4	0.9	0.03
3	50 cfs	50	94.2	96.5	0.0007	0.8	48.9	1.2	0.06
3	75 cfs	75	94.2	96.8	0.0009	1.0	53.4	1.4	0.08
3	100 cfs	100	94.2	97.0	0.0011	1.2	61.3	1.4	0.11
3	150 cfs	150	94.2	97.3	0.0014	1.5	80.7	1.3	0.16
3	200 cfs	200	94.2	97.5	0.0016	1.8	91.8	1.4	0.21
3	250 cfs	250	94.2	97.7	0.0018	2.0	98.2	1.5	0.26
3	300 cfs	300	94.2	97.9	0.0019	2.2	109.7	1.7	0.3
3	350 cfs	350	94.2	98.1	0.0021	2.4	116.8	1.8	0.34
3	400 cfs	400	94.2	98.3	0.0022	2.5	120.7	1.9	0.39
3	450 cfs	450	94.2	98.4	0.0023	2.7	125.0	2.0	0.43
3	500 cfs	500	94.2	98.6	0.0024	2.8	129.2	2.1	0.47
3	550 cfs	550	94.2	98.7	0.0025	3.0	133.2	2.2	0.51
3	600 cfs	600	94.2	98.8	0.0026	3.1	137.0	2.3	0.56
3	650 cfs	650	94.2	99.0	0.0027	3.3	140.6	2.3	0.6
3	700 cfs	700	94.2	99.1	0.0028	3.4	144.0	2.4	0.63
3	750 cfs	750	94.2	99.2	0.0029	3.5	147.1	2.5	0.67
3	800 cfs	800	94.2	99.3	0.0030	3.6	150.1	2.5	0.71
3	850 cfs	850	94.2	99.4	0.0030	3.7	154.5	2.6	0.75
3	900 cfs	900	94.2	99.5	0.0031	3.8	161.5	2.5	0.79
3	950 cfs	950	94.2	99.6	0.0032	3.9	164.9	2.6	0.83
3	1000 cfs	1000	94.2	99.7	0.0032	4.0	166.2	2.7	0.86
3	1250 cfs	1250	94.2	100.2	0.0034	4.4	168.2	2.9	0.99
3	1500 cfs	1500	94.2	100.6	0.0035	4.8	168.9	3.3	1.13
3	1750 cfs	1750	94.2	101.0	0.0037	5.1	169.6	3.7	1.26
3	2000 cfs	2000	94.2	101.3	0.0038	5.4	170.2	4.0	1.39
4	2 cfs	2	94.5	95.4	0.0000	0.1	26.6	0.6	0
4	5 cfs	5	94.5	95.6	0.0001	0.3	29.3	0.7	0.01
4	10 cfs	10	94.5	95.7	0.0003	0.4	31.3	0.8	0.01
4	25 cfs	25	94.5	96.1	0.0007	0.7	37.8	1.0	0.04
4	50 cfs	50	94.5	96.4	0.0012	1.1	47.1	1.0	0.09

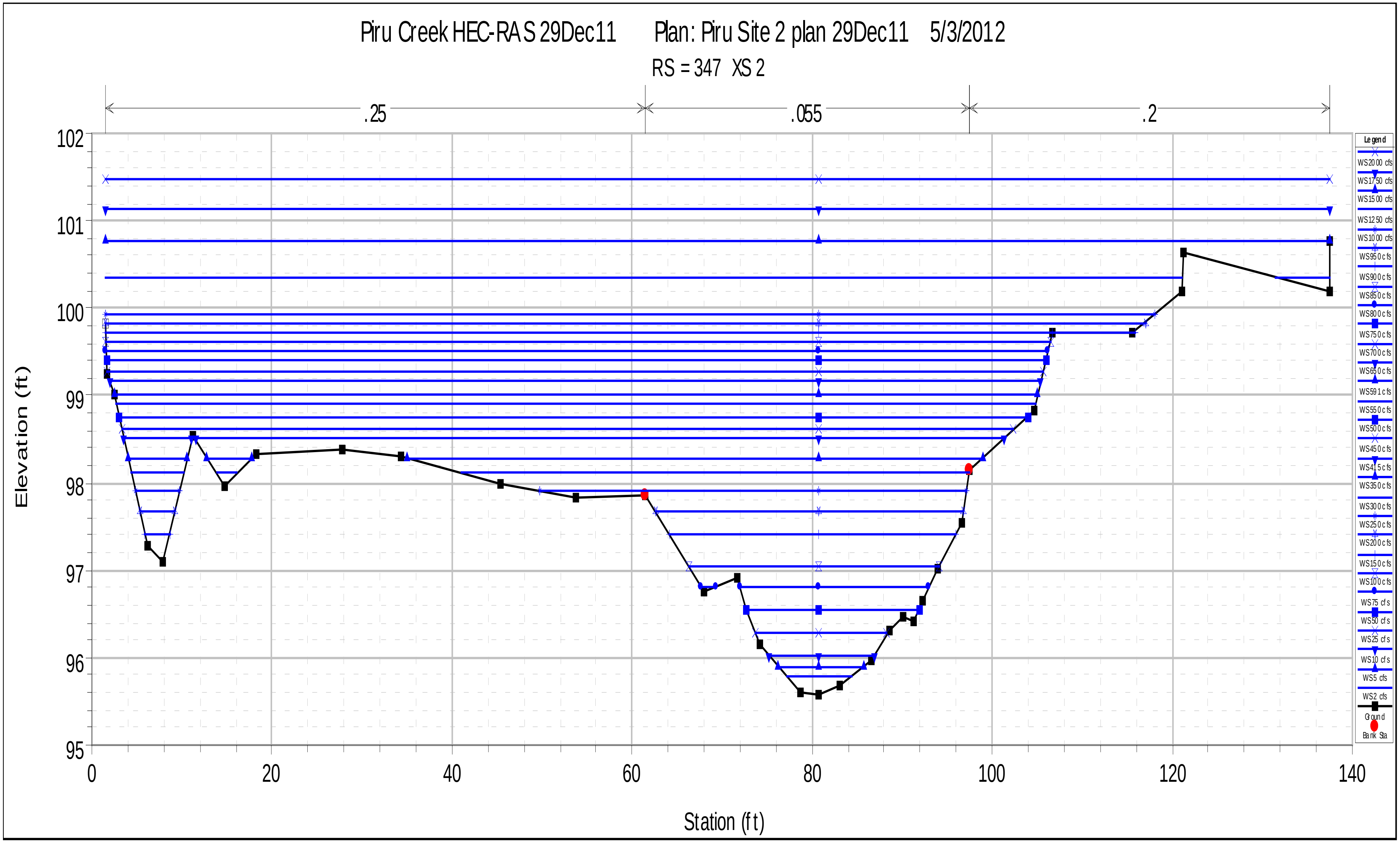
4	75 cfs	75	94.5	96.6	0.0016	1.3	68.9	0.9	0.14
4	100 cfs	100	94.5	96.7	0.0021	1.6	87.4	0.8	0.19
4	150 cfs	150	94.5	97.0	0.0028	2.0	117.0	0.8	0.3
4	200 cfs	200	94.5	97.1	0.0034	2.4	125.5	1.0	0.4
4	250 cfs	250	94.5	97.3	0.0039	2.7	133.9	1.1	0.5
4	300 cfs	300	94.5	97.5	0.0043	3.0	148.6	1.1	0.6
4	350 cfs	350	94.5	97.6	0.0047	3.3	162.0	1.1	0.69
4	400 cfs	400	94.5	97.7	0.0050	3.5	163.0	1.3	0.77
4	450 cfs	450	94.5	97.9	0.0052	3.7	163.7	1.4	0.84
4	500 cfs	500	94.5	98.0	0.0054	3.9	164.6	1.5	0.91
4	550 cfs	550	94.5	98.1	0.0056	4.0	165.5	1.6	0.98
4	600 cfs	600	94.5	98.2	0.0057	4.2	166.4	1.7	1.05
4	650 cfs	650	94.5	98.3	0.0059	4.3	167.1	1.8	1.11
4	700 cfs	700	94.5	98.4	0.0060	4.5	167.7	1.9	1.18
4	750 cfs	750	94.5	98.5	0.0061	4.6	168.2	2.0	1.24
4	800 cfs	800	94.5	98.6	0.0062	4.8	168.7	2.1	1.29
4	850 cfs	850	94.5	98.7	0.0063	4.9	169.2	2.1	1.35
4	900 cfs	900	94.5	98.8	0.0064	5.0	169.5	2.2	1.4
4	950 cfs	950	94.5	98.9	0.0065	5.1	169.6	2.3	1.46
4	1000 cfs	1000	94.5	98.9	0.0066	5.2	169.8	2.4	1.51
4	1250 cfs	1250	94.5	99.4	0.0068	5.7	170.3	2.8	1.75
4	1500 cfs	1500	94.5	99.7	0.0071	6.2	170.7	3.2	1.97
4	1750 cfs	1750	94.5	100.1	0.0072	6.6	171.1	3.5	2.17
4	2000 cfs	2000	94.5	100.4	0.0074	6.9	171.4	3.8	2.37
5	2 cfs	2	95.3	95.4	0.0015	0.3	33.7	0.2	0.01
5	5 cfs	5	95.3	95.5	0.0015	0.5	49.2	0.3	0.02
5	10 cfs	10	95.3	95.7	0.0015	0.8	61.9	0.3	0.03
5	25 cfs	25	95.3	96.0	0.0015	1.1	100.4	0.4	0.05
5	50 cfs	50	95.3	96.2	0.0015	1.2	144.8	0.5	0.06
5	75 cfs	75	95.3	96.4	0.0015	1.3	168.0	0.6	0.07
5	100 cfs	100	95.3	96.6	0.0015	1.5	186.8	0.7	0.08
5	150 cfs	150	95.3	96.8	0.0015	1.7	194.2	0.9	0.1
5	200 cfs	200	95.3	97.0	0.0015	1.9	195.1	1.1	0.12
5	250 cfs	250	95.3	97.1	0.0015	2.1	195.8	1.2	0.13
5	300 cfs	300	95.3	97.3	0.0015	2.2	196.6	1.4	0.15
5	350 cfs	350	95.3	97.4	0.0015	2.4	197.2	1.5	0.16
5	400 cfs	400	95.3	97.6	0.0015	2.5	197.9	1.6	0.17
5	450 cfs	450	95.3	97.7	0.0015	2.6	198.5	1.8	0.18
5	500 cfs	500	95.3	97.8	0.0015	2.7	199.0	1.9	0.2
5	550 cfs	550	95.3	97.9	0.0015	2.8	199.6	2.0	0.21
5	600 cfs	600	95.3	98.0	0.0015	2.9	200.1	2.1	0.22
5	650 cfs	650	95.3	98.1	0.0015	3.0	200.6	2.2	0.23
5	700 cfs	700	95.3	98.3	0.0015	3.1	201.1	2.3	0.24
5	750 cfs	750	95.3	98.4	0.0015	3.1	201.6	2.4	0.25
5	800 cfs	800	95.3	98.5	0.0015	3.2	202.2	2.5	0.26
5	850 cfs	850	95.3	98.6	0.0015	3.3	202.7	2.6	0.27
5	900 cfs	900	95.3	98.6	0.0015	3.4	203.2	2.7	0.27
5	950 cfs	950	95.3	98.7	0.0015	3.4	203.7	2.8	0.28
5	1000 cfs	1000	95.3	98.8	0.0015	3.5	204.4	2.9	0.29
5	1250 cfs	1250	95.3	99.3	0.0015	3.8	207.3	3.2	0.33
5	1500 cfs	1500	95.3	99.7	0.0015	4.1	209.5	3.6	0.37

5	1750 cfs	1750	95.3	100.0	0.0015	4.4	212.3	3.9	0.4
5	2000 cfs	2000	95.3	100.4	0.0015	4.6	214.3	4.2	0.44

Note
cfs = cubic feet per second
ft = feet
sq ft = square feet
lb = pounds

SITE 2. XS PLOTS and WSEL'S





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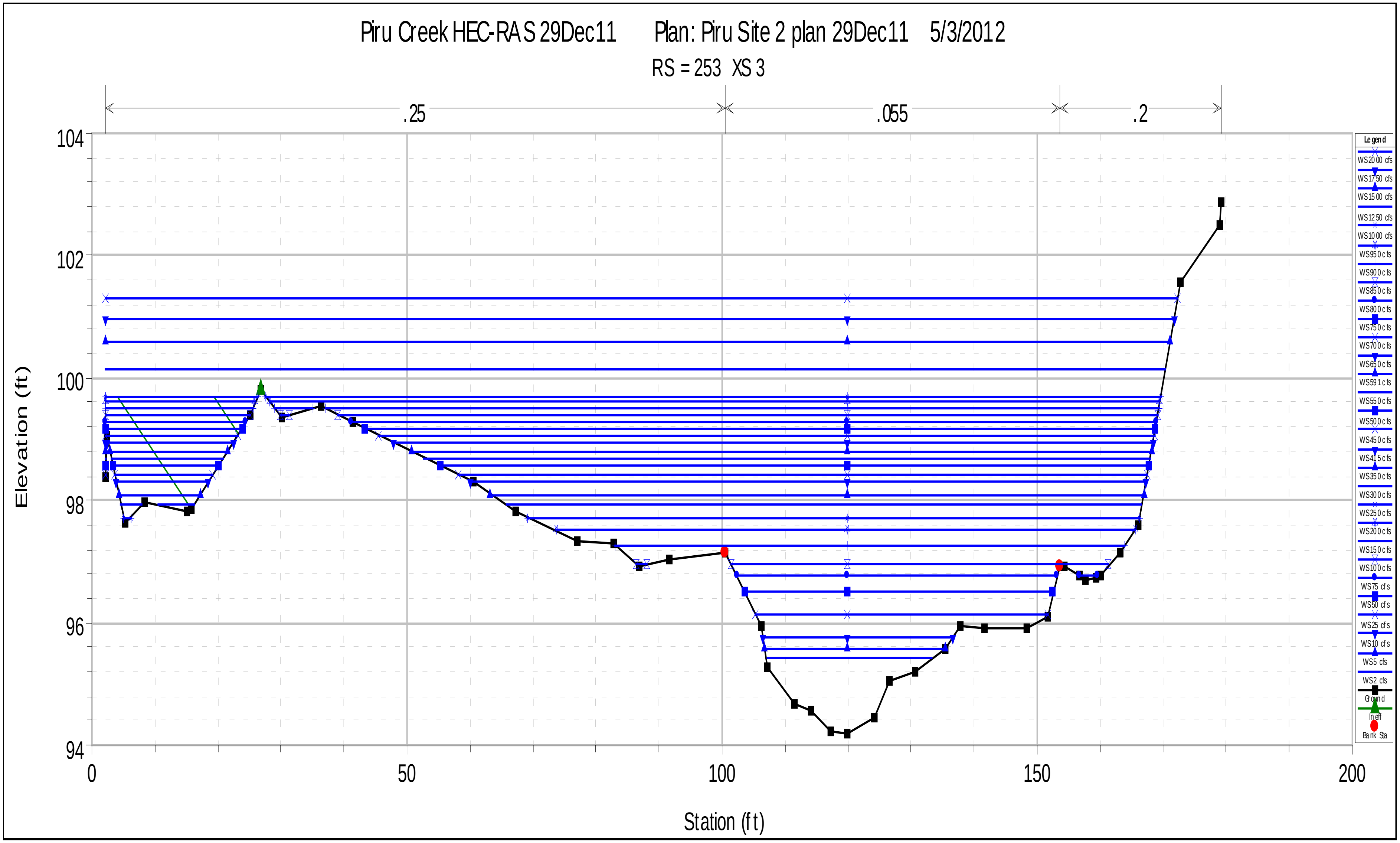
RS = 347 XS 2
.25
.055
.2
Elevation (ft)
Station (ft)
102
101
100
99
98
97
96
95
0
20
40
60
80
100
120
140
Legend
WS 2000 cfs
WS 1750 cfs
WS 1500 cfs
WS 1250 cfs
WS 1000 cfs
WS 950 cfs
WS 900 cfs
WS 850 cfs
WS 800 cfs
WS 750 cfs
WS 700 cfs
WS 650 cfs
WS 591 cfs
WS 550 cfs
WS 500 cfs
WS 450 cfs
WS 415 cfs
WS 350 cfs
WS 300 cfs
WS 250 cfs
WS 200 cfs
WS 150 cfs
WS 100 cfs
WS 75 cfs
WS 50 cfs
WS 25 cfs
WS 10 cfs
WS 5 cfs
WS 2 cfs
Ground
Bank Sta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.055
.2
Elevation (ft)
Station (ft)
104
102
100
98
96
94
0
50
100
150
200
Legend
WS 2000 cfs
WS 1750 cfs
WS 1500 cfs
WS 1250 cfs
WS 1000 cfs
WS 950 cfs
WS 900 cfs
WS 850 cfs
WS 800 cfs
WS 750 cfs
WS 700 cfs
WS 650 cfs
WS 591 cfs
WS 550 cfs
WS 500 cfs
WS 450 cfs
WS 415 cfs
WS 350 cfs
WS 300 cfs
WS 250 cfs
WS 200 cfs
WS 150 cfs
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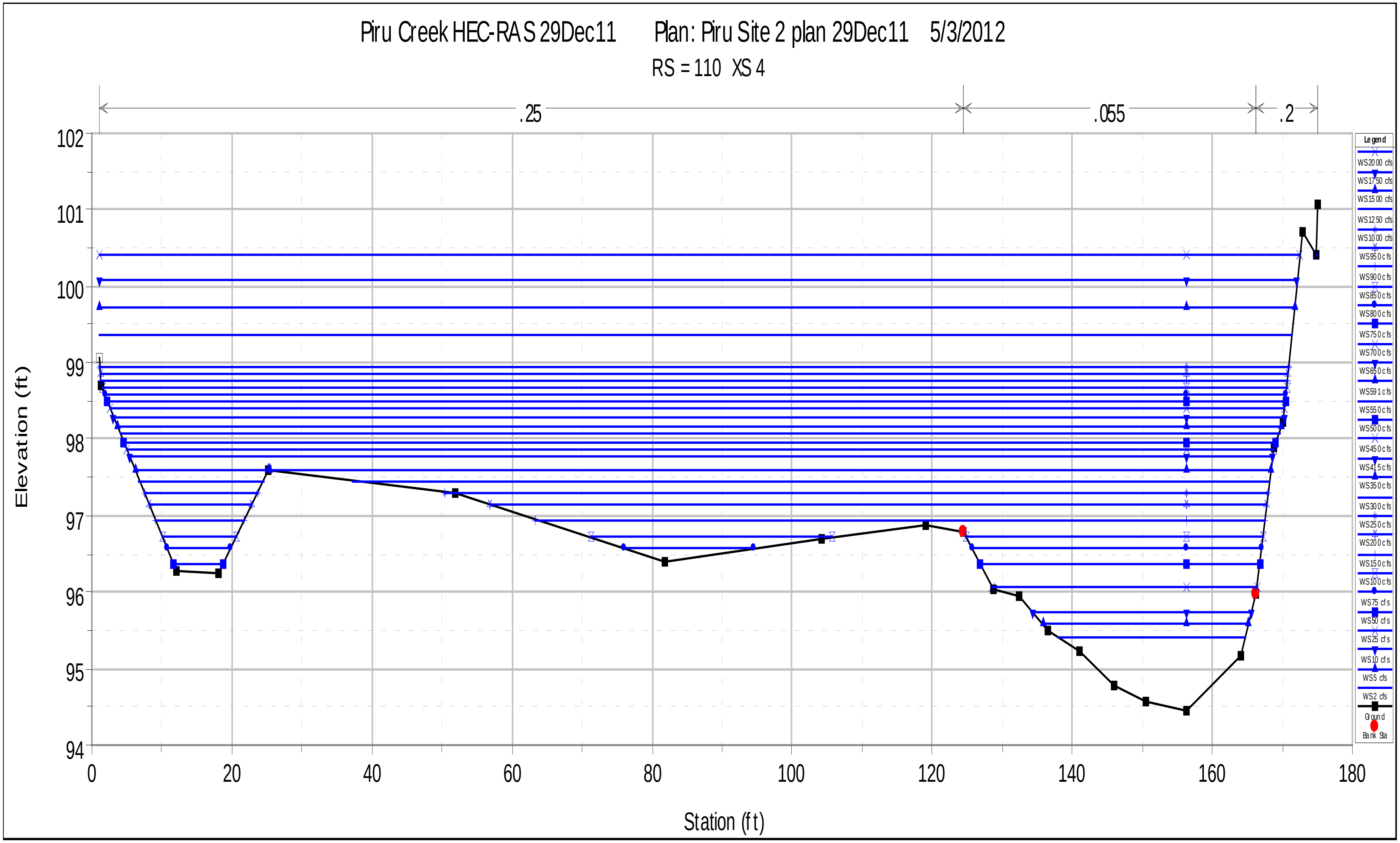
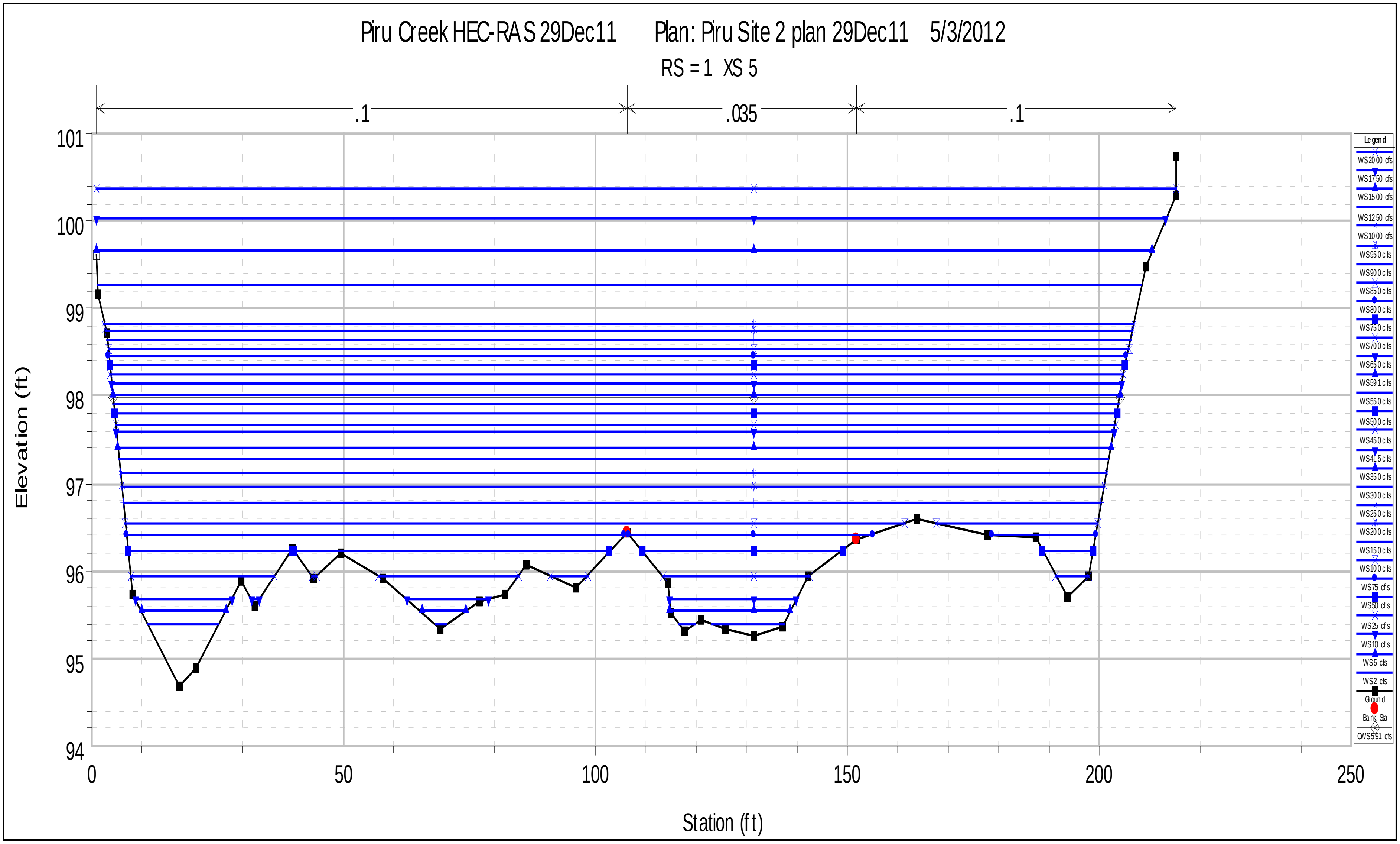
WS 75 cfs
WS 50 cfs
WS 25 cfs
WS 10 cfs
WS 5 cfs
WS 2 cfs
Ground
Ineff
Bank Sta



Piru Creek HEC-RAS 29Dec11 Plan: Piru Site 2 plan 29Dec11 5/3/2012
RS = 110 XS 4
.25
.055
.2
Elevation (ft)
Station (ft)
Legend
WS 2000 cfs
WS 1750 cfs
WS 1500 cfs
WS 1250 cfs
WS 1000 cfs
WS 950 cfs
WS 900 cfs
WS 850 cfs
WS 800 cfs
WS 750 cfs
WS 700 cfs
WS 650 cfs
WS 591 cfs
WS 550 cfs
WS 500 cfs
WS 450 cfs
WS 415 cfs
WS 350 cfs
WS 300 cfs
WS 250 cfs
WS 200 cfs
WS 150 cfs
WS 100 cfs
WS 75 cfs
WS 50 cfs
WS 25 cfs
WS 10 cfs
WS 5 cfs
WS 2 cfs
Ground
Bank Sta


Piru Creek HEC-RAS 29Dec11 Plan: Piru Site 2 plan 29Dec11 5/3/2012
RS = 1 XS 5
.1
.035
.1
Elevation (ft)
Station (ft)
101
100
99
98
97
96
95
94
0
50
100
150
200
250
Legend
WS 2000 cfs
WS 1750 cfs
WS 1500 cfs
WS 1250 cfs
WS 1000 cfs
WS 950 cfs
WS 900 cfs
WS 850 cfs
WS 800 cfs
WS 750 cfs
WS 700 cfs
WS 650 cfs
WS 591 cfs
WS 550 cfs
WS 500 cfs
WS 450 cfs
WS 415 cfs
WS 350 cfs
WS 300 cfs
WS 250 cfs
WS 200 cfs
WS 150 cfs
WS 100 cfs
WS 75 cfs
WS 50 cfs
WS 25 cfs
WS 10 cfs
WS 5 cfs
WS 2 cfs
Ground
Bank Sta
OWS 591 cfs

APPENDIX G

Hec Ras Hydraulic Output - Site 3

Piru Creek 2011 Controlled Flow Release Geomorphology Study

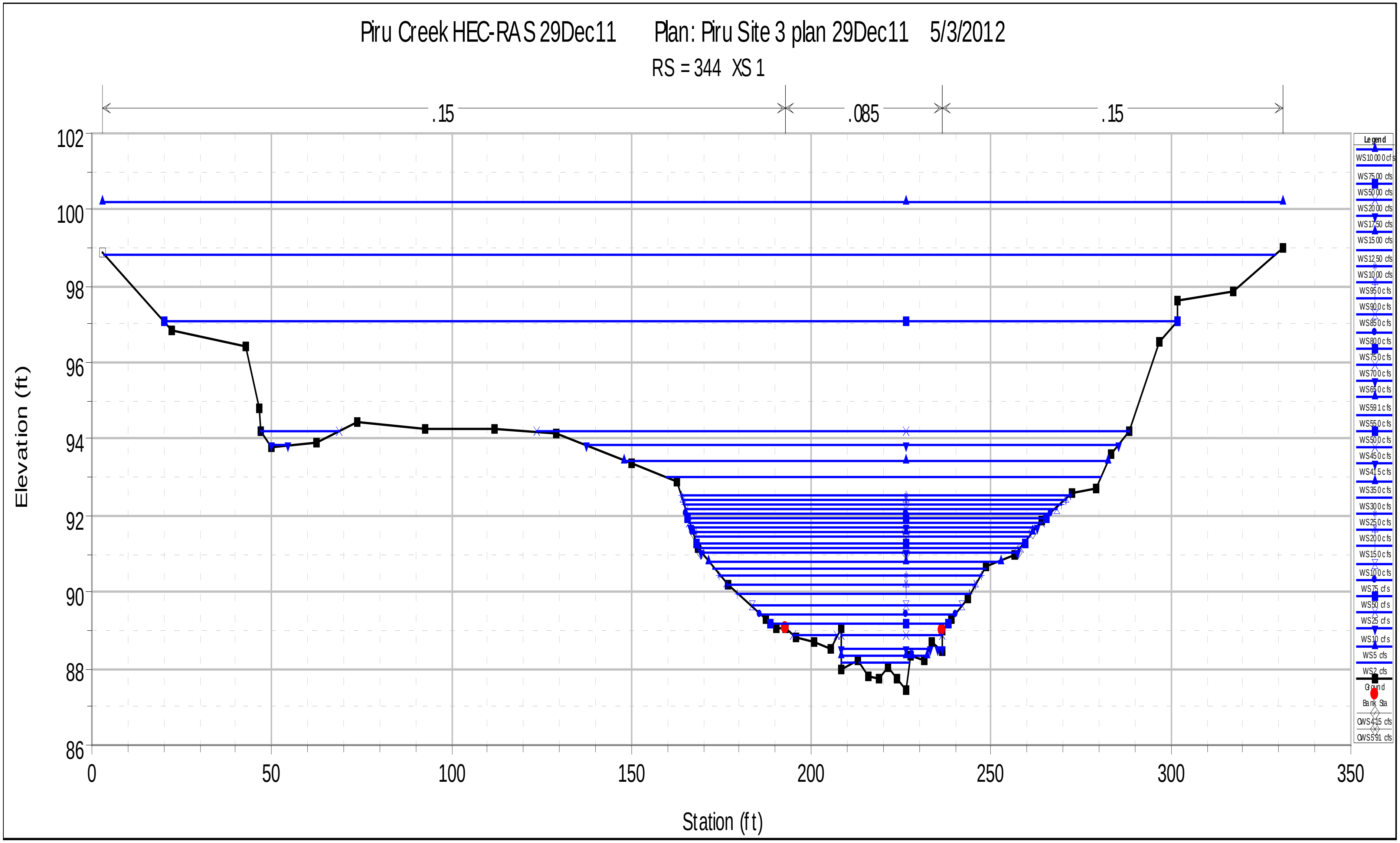
United Water Conservation District

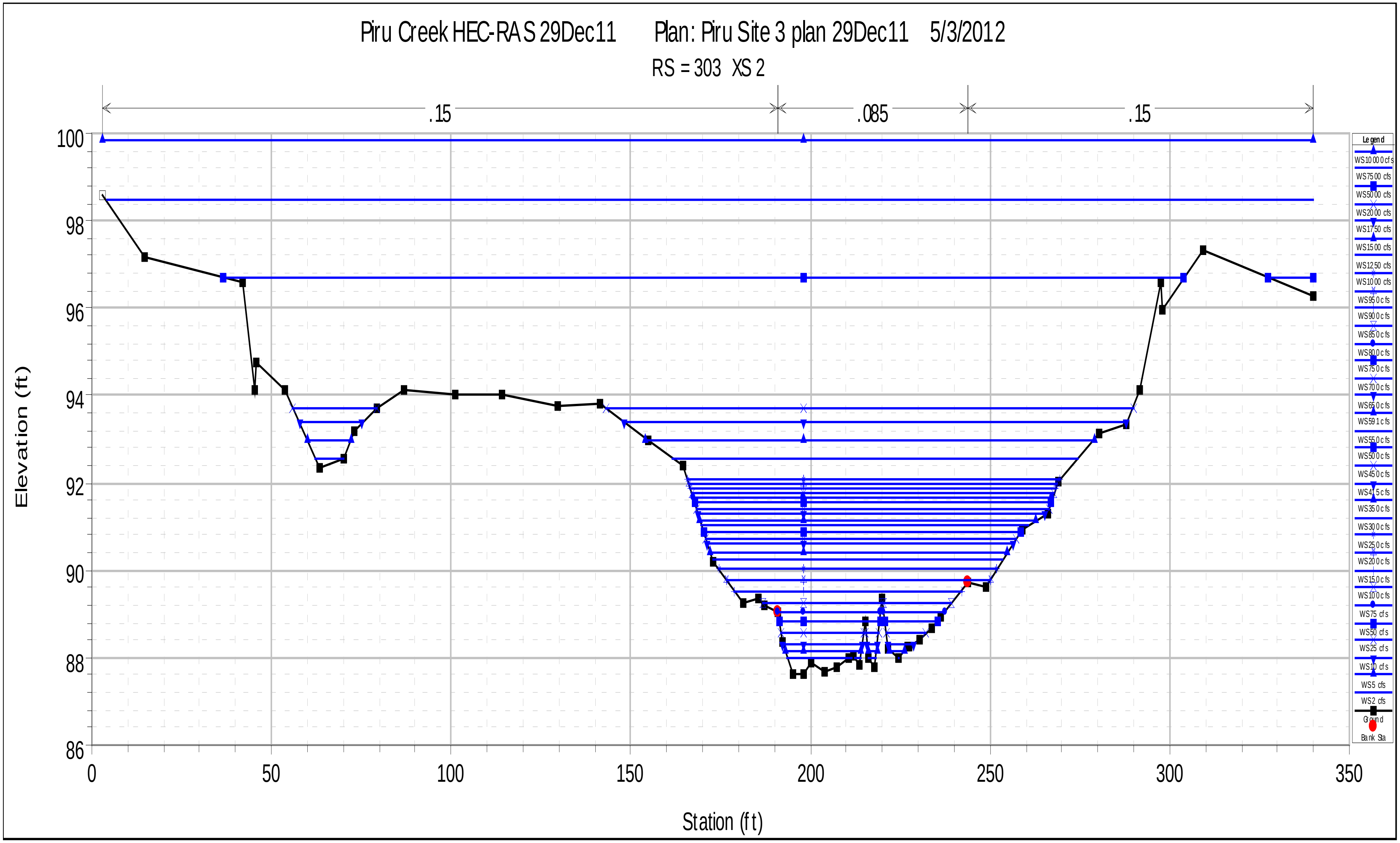
River Sta XS	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Top Width (ft)	Hydr Depth (ft)	Shear Chan (lb/sq ft)
1	50 cfs	50	87.5	89.2	0.0067	1.3	49.5	0.8	0.36
1	100 cfs	100	87.5	89.6	0.0070	1.7	58.3	1.1	0.55
1	200 cfs	200	87.5	90.2	0.0077	2.3	69.4	1.4	0.87
1	300 cfs	300	87.5	90.6	0.0083	2.7	75.5	1.7	1.16
1	400 cfs	400	87.5	91.0	0.0088	3.1	87.1	1.8	1.41
1	500 cfs	500	87.5	91.3	0.0091	3.4	91.6	2.0	1.63
1	600 cfs	600	87.5	91.6	0.0093	3.6	94.9	2.3	1.82
1	700 cfs	700	87.5	91.8	0.0096	3.8	97.9	2.4	2.01
1	800 cfs	800	87.5	92.1	0.0097	4.1	101.4	2.6	2.19
1	900 cfs	900	87.5	92.3	0.0099	4.2	104.8	2.7	2.35
1	1000 cfs	1000	87.5	92.5	0.0100	4.4	108.0	2.8	2.51
1	1500 cfs	1500	87.5	93.4	0.0106	5.2	134.5	3.1	3.26
1	2000 cfs	2000	87.5	94.2	0.0112	5.9	186.8	2.9	3.94
2	50 cfs	50	87.6	88.8	0.0109	1.5	42.6	0.8	0.51
2	100 cfs	100	87.6	89.2	0.0121	2.0	52.2	1.0	0.78
2	200 cfs	200	87.6	89.8	0.0120	2.5	73.5	1.2	1.09
2	300 cfs	300	87.6	90.2	0.0111	2.8	80.5	1.5	1.29
2	400 cfs	400	87.6	90.6	0.0106	3.1	84.8	1.8	1.46
2	500 cfs	500	87.6	90.9	0.0106	3.3	88.3	2.0	1.65
2	600 cfs	600	87.6	91.2	0.0106	3.6	93.8	2.2	1.84
2	700 cfs	700	87.6	91.4	0.0107	3.8	98.1	2.3	2.01
2	800 cfs	800	87.6	91.7	0.0107	4.0	100.0	2.5	2.15
2	900 cfs	900	87.6	91.9	0.0107	4.1	101.8	2.7	2.3
2	1000 cfs	1000	87.6	92.1	0.0107	4.3	104.0	2.8	2.43
2	1500 cfs	1500	87.6	93.0	0.0110	5.0	137.3	2.9	3.1
2	2000 cfs	2000	87.6	93.7	0.0112	5.6	170.1	3.0	3.67
3	50 cfs	50	86.5	87.7	0.0262	2.1	35.4	0.7	1.08
3	100 cfs	100	86.5	88.1	0.0201	2.6	41.7	1.0	1.34
3	200 cfs	200	86.5	88.7	0.0179	3.3	50.6	1.3	1.84
3	300 cfs	300	86.5	89.2	0.0171	3.8	67.3	1.4	2.24
3	400 cfs	400	86.5	89.5	0.0167	4.1	90.7	1.4	2.57
3	500 cfs	500	86.5	89.9	0.0160	4.4	96.6	1.6	2.78
3	600 cfs	600	86.5	90.2	0.0154	4.6	100.9	1.8	2.95
3	700 cfs	700	86.5	90.4	0.0148	4.7	103.2	2.1	3.08
3	800 cfs	800	86.5	90.7	0.0144	4.9	105.3	2.3	3.21
3	900 cfs	900	86.5	90.9	0.0141	5.1	107.3	2.4	3.34
3	1000 cfs	1000	86.5	91.1	0.0138	5.2	109.3	2.6	3.45
3	1500 cfs	1500	86.5	92.1	0.0130	5.8	138.4	3.0	4.01
3	2000 cfs	2000	86.5	92.9	0.0127	6.3	163.0	3.2	4.51
4	50 cfs	50	84.5	86.3	0.0090	1.5	36.3	0.9	0.47
4	100 cfs	100	84.5	86.7	0.0108	2.0	41.1	1.2	0.78

4	200 cfs	200	84.5	87.3	0.0120	2.7	49.4	1.6	1.27
4	300 cfs	300	84.5	87.8	0.0127	3.2	61.8	1.7	1.66
4	400 cfs	400	84.5	88.1	0.0130	3.6	66.0	1.9	1.98
4	500 cfs	500	84.5	88.5	0.0133	4.0	71.2	2.1	2.28
4	600 cfs	600	84.5	88.8	0.0136	4.3	77.3	2.2	2.56
4	700 cfs	700	84.5	89.0	0.0139	4.5	82.7	2.3	2.82
4	800 cfs	800	84.5	89.3	0.0141	4.8	86.4	2.5	3.05
4	900 cfs	900	84.5	89.5	0.0142	5.0	88.1	2.7	3.26
4	1000 cfs	1000	84.5	89.7	0.0144	5.2	92.8	2.7	3.48
4	1500 cfs	1500	84.5	90.7	0.0148	6.0	139.3	2.6	4.36
4	2000 cfs	2000	84.5	91.5	0.0139	6.4	159.7	3.0	4.74
5	50 cfs	50	84.3	85.5	0.0139	1.6	45.6	0.7	0.59
5	100 cfs	100	84.3	86.0	0.0109	1.9	50.2	1.1	0.73
5	200 cfs	200	84.3	86.5	0.0104	2.5	54.7	1.5	1.07
5	300 cfs	300	84.3	87.0	0.0107	2.9	61.9	1.7	1.39
5	400 cfs	400	84.3	87.4	0.0107	3.3	68.4	1.9	1.63
5	500 cfs	500	84.3	87.7	0.0111	3.6	73.7	2.1	1.91
5	600 cfs	600	84.3	87.9	0.0115	3.9	78.3	2.2	2.16
5	700 cfs	700	84.3	88.2	0.0118	4.2	82.8	2.4	2.41
5	800 cfs	800	84.3	88.4	0.0120	4.4	87.0	2.5	2.63
5	900 cfs	900	84.3	88.6	0.0122	4.6	90.9	2.6	2.83
5	1000 cfs	1000	84.3	88.8	0.0123	4.8	94.7	2.7	3.02
5	1500 cfs	1500	84.3	89.8	0.0126	5.6	106.9	3.2	3.8
5	2000 cfs	2000	84.3	90.6	0.0121	6.1	129.7	3.4	4.29
6	50 cfs	50	83.7	85.2	0.0026	1.9	32.4	0.8	0.13
6	100 cfs	100	83.7	85.6	0.0026	2.5	57.4	0.8	0.2
6	200 cfs	200	83.7	86.2	0.0026	3.1	67.2	1.2	0.28
6	300 cfs	300	83.7	86.6	0.0026	3.6	72.8	1.5	0.35
6	400 cfs	400	83.7	87.0	0.0026	4.0	84.2	1.7	0.4
6	500 cfs	500	83.7	87.3	0.0026	4.3	88.8	1.9	0.45
6	600 cfs	600	83.7	87.6	0.0026	4.5	91.6	2.1	0.49
6	700 cfs	700	83.7	87.9	0.0026	4.8	94.1	2.3	0.53
6	800 cfs	800	83.7	88.1	0.0026	5.0	96.4	2.5	0.56
6	900 cfs	900	83.7	88.3	0.0026	5.2	98.7	2.7	0.6
6	1000 cfs	1000	83.7	88.5	0.0026	5.3	100.6	2.8	0.63
6	1500 cfs	1500	83.7	89.5	0.0026	6.1	109.0	3.5	0.76
6	2000 cfs	2000	83.7	90.3	0.0026	6.7	128.1	3.8	0.89

Note
cfs = cubic feet per second
ft = feet
sq ft = square feet
lb = pounds

SITE 3. XS PLOTS and WSEL'S

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.085
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WS 7500 cfs
WS 5000 cfs
WS 2000 cfs
WS 1750 cfs
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WS 1250 cfs
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WS 800 cfs
WS 750 cfs
WS 700 cfs
WS 650 cfs
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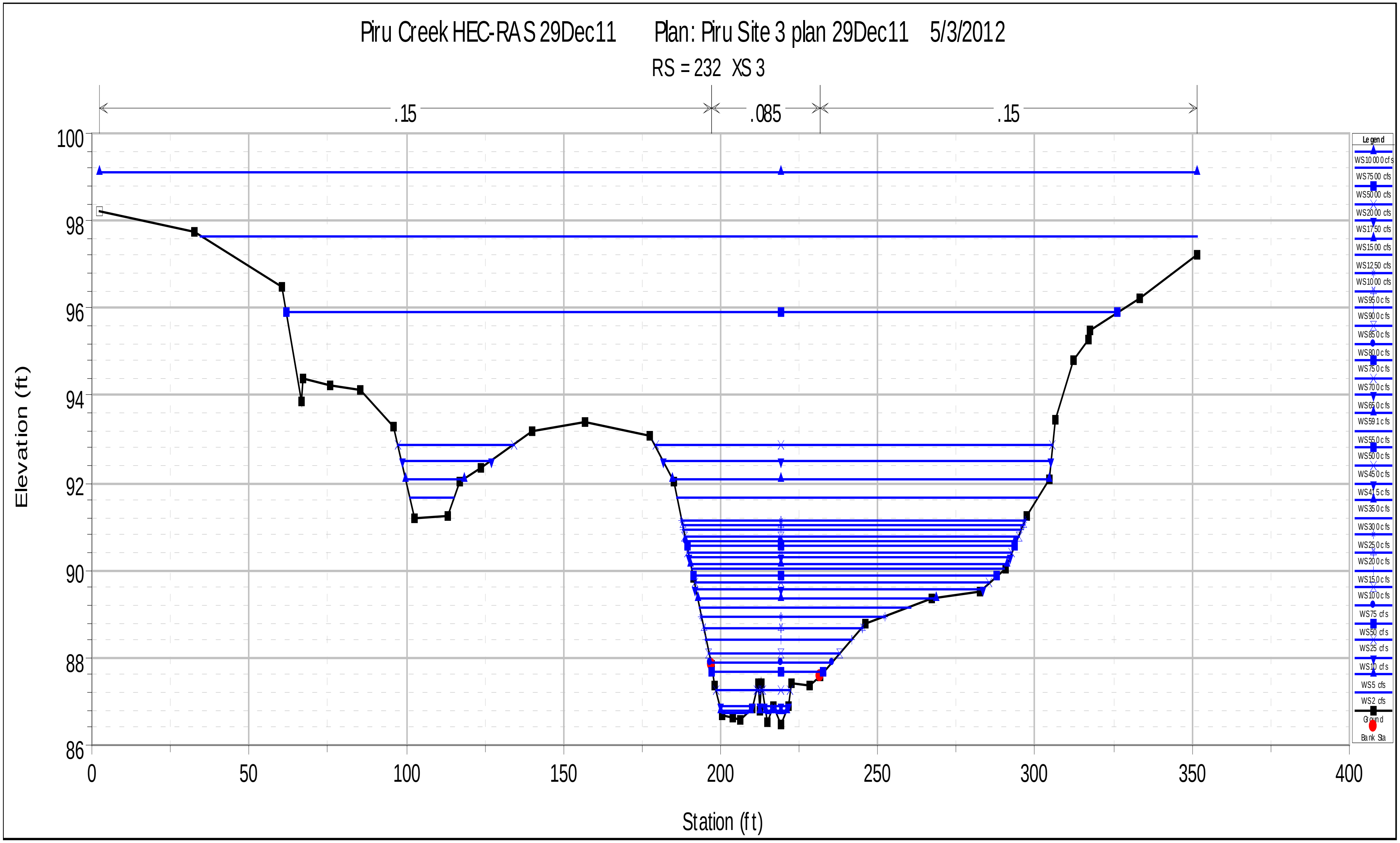

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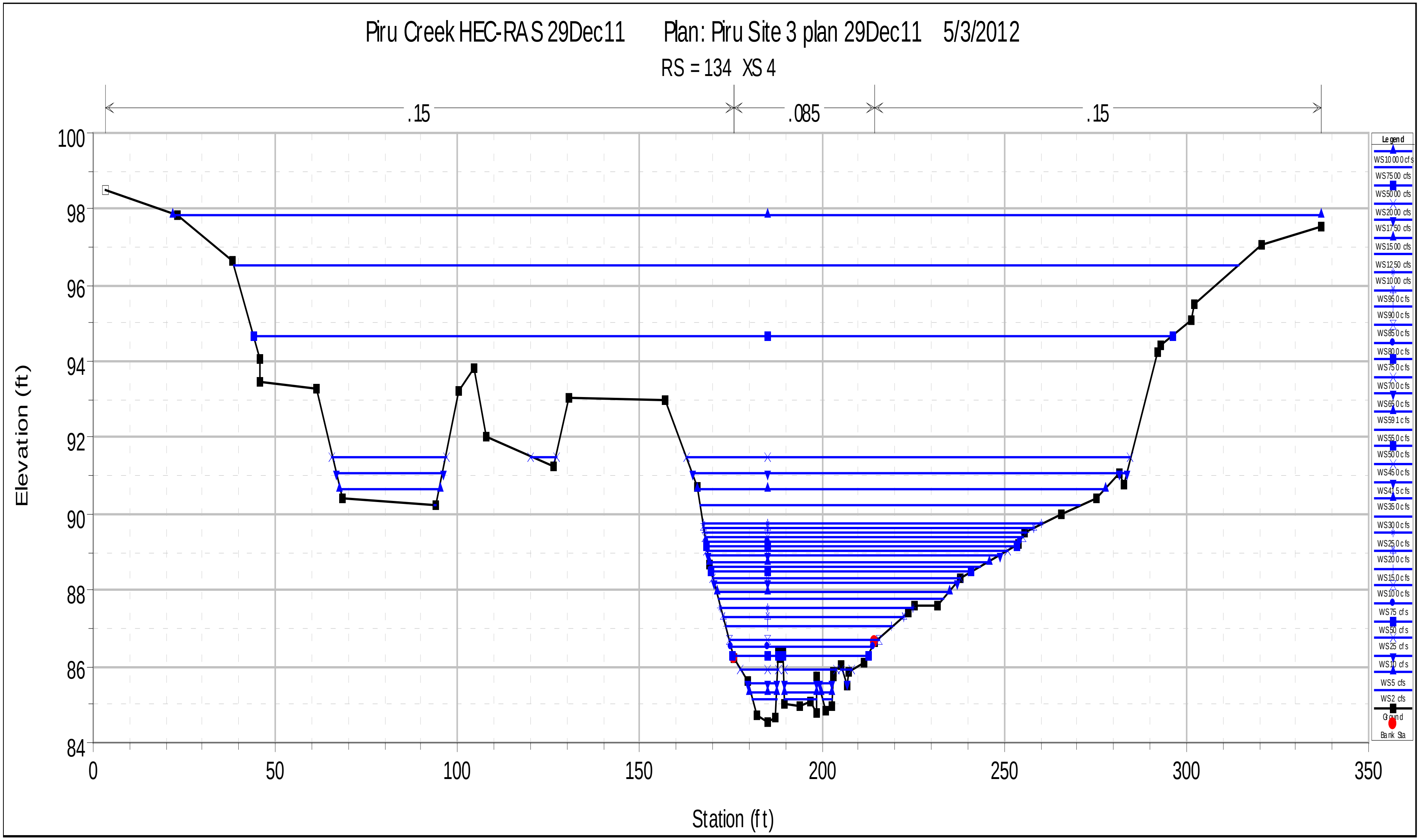
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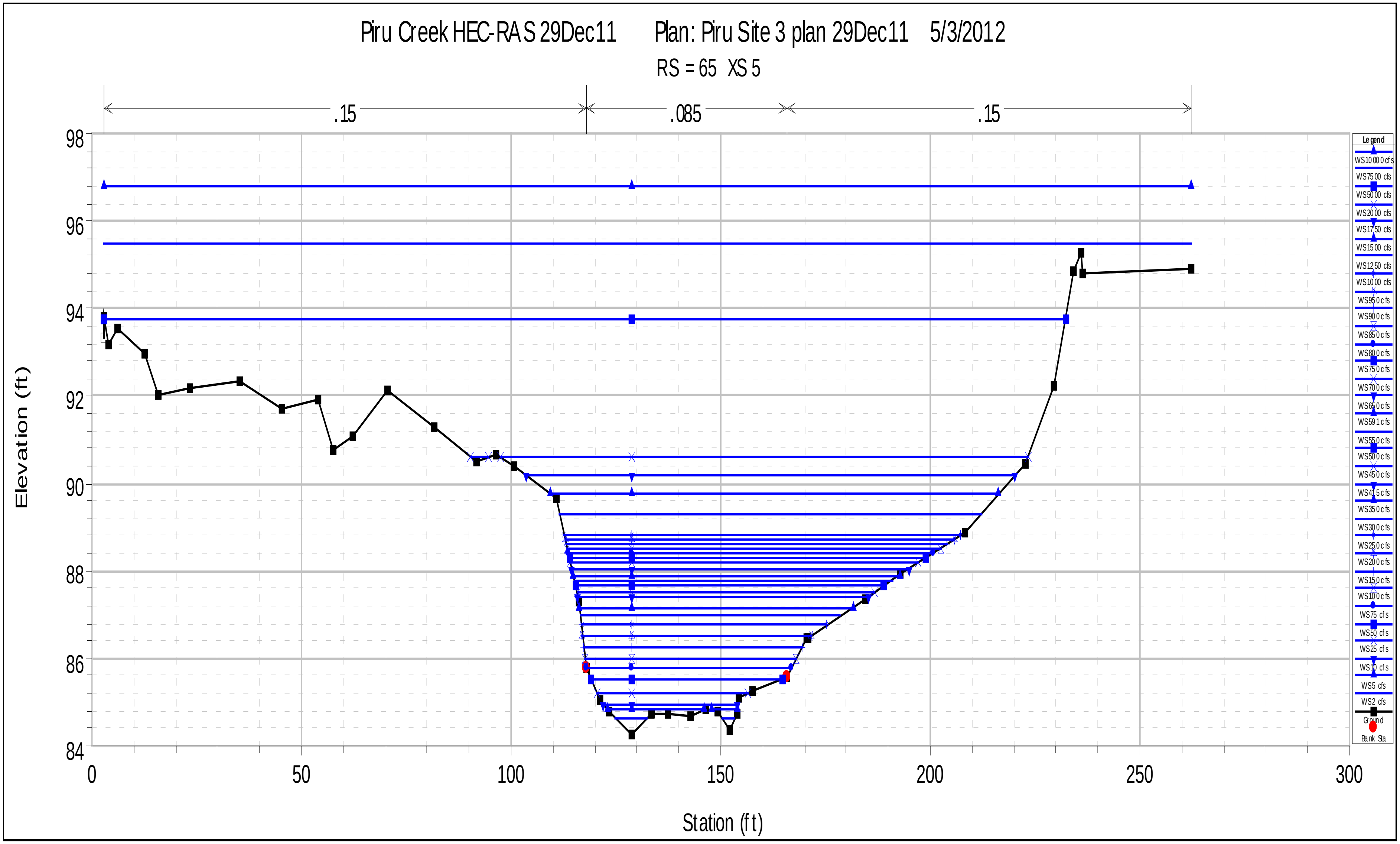

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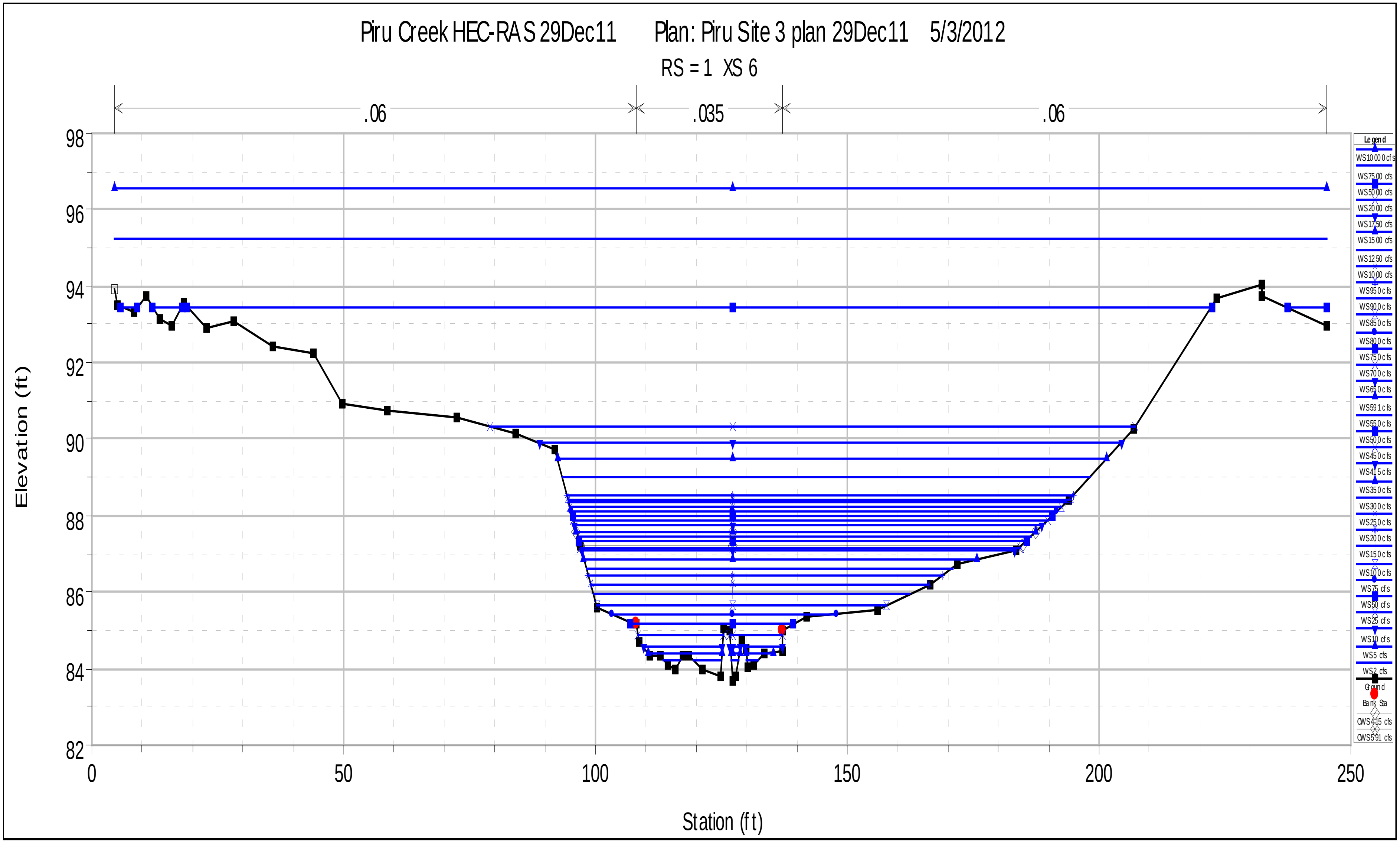

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.06
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Station (ft)
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Legend

Appendix H

Description of Incipient Motion Calculations

Shear Stress

Calculation of the stream's bed shear stress (τ_0), or tangential force per unit bed area, is necessary to understand flow intensity and its ability to mobilize and transport sediment particles resting on the bed. Bedload transport rates are steep and non-linear, which means relatively small changes in shear stress can create large changes in sediment transport. Therefore, obtaining accurate shear stress estimates is critical in calculating sediment transport.

For steady, uniform flow the momentum equation states a balance must exist between shear forces (resisting forces) and gravity component (driving forces).

$$\tau_0 P_w \Delta s = \rho g A \Delta s S$$

or

$$\tau_0 = \rho g R S$$

where τ_0 is bottom shear stress, P_w is wetted perimeter, Δs is length of control volume, ρ is fluid density, g is gravity acceleration, A is cross-section area, S is the bed slope, and R is the hydraulic radius.

To calculate bed shear stress for steady, gradually varied flow conditions common to most streams, the friction slope S_f is often substituted for the bed slope S. And for relatively wide channels where the hydraulic radius and mean flow depth are approximately similar, the "depth*slope" product is used to calculate the mean cross-sectionally averaged boundary shear stress

$$\tau_0 = \rho g H S_f$$

where H is mean flow depth.

The mean boundary shear stress includes forces acting on debris jams, vegetation, channel banks, bar forms, and other features that add resistance and increase flow depth. Research has shown that the actual bed shear stress available for sediment transport (effective shear stress) is often a third to a half the mean boundary shear stress (Dietrich 1987). To gain a better estimate of only the portion of the shear stress that is acting on the sediment grains and available to transport sediment, a local estimate of shear stress directly above the area of the bed of interest is required. This local estimate is often referred to as a grain stress.

The following section describes the method used in this study to calculate local bed shear stress.

Time averaged fluid shear stress in a streamflow is defined as the rate of change of downstream momentum per unit cross-sectional area

$$\tau = -\rho \overline{u'v'}$$

where τ is turbulent shear stress, ρ is fluid density, *u*' is downstream velocity, and *v*' is vertical velocity.

Determining the vertical variation in flow velocity in turbulent flow requires knowledge of the mixing length *l*, or the vertical distance over which a fluid parcel's momentum changes. By equating the mixing length to

$$u' = -l\left(\frac{d\bar{u}}{d\bar{y}}\right) \quad \text{and} \quad v' = l\left(\frac{d\bar{u}}{d\bar{y}}\right)$$

then turbulent shear stress is

$$\tau = -\rho \overline{u'v'} = \rho l^2 \left(\frac{d\bar{u}}{dy}\right)^2$$

By assuming that 1) the fluid shear is approximately equal to the bed shear near the streambed, and 2) mixing length increases linearly with distance from the bed, the law of the wall equation for determining the velocity gradient near the streambed (i.e., "wall") is calculated from

$$\frac{\bar{u}}{u*} = \frac{1}{\kappa}\ln\left(\frac{y}{y_0}\right)$$

where κ is Von Karman's constant (commonly set at 0.41), $\bar{u}$ is time averaged velocity at flow depth y above the bed, and y_0 is the flow depth where flow velocity equals zero. The shear velocity, $u*$, is a measure of the velocity gradient near the bed, from which local bed shear stress can be calculated

$$\tau_0 = u*^2 \rho$$

In reality, flow velocity is only zero where $y = 0$. Therefore, in order to solve the equation for hydraulically rough flows, y_0 is related to the equivalent roughness height, k_s, by

$$y_0 = \frac{k_s}{30}$$

And k_s is based on the dominant coarse bed substrate, such as the D_{84} (the particle size in which 84 percent of the bed surface is finer).

Integration of the law of the wall equation above over the entire flow depth (h) shows that the mean flow velocity occurs at a distance of 0.368h from the bed. By inserting the 0.368h and k_s values into the law of the wall equation above, the local shear velocity, and thus local shear stress related to grain-induced resistance can be determined from mean channel velocity (U) using Keulegan's (1938) resistance law for rough flow:

$$\frac{U}{u*} = \frac{1}{\kappa}\ln\left(\frac{h}{k_s}\right) + 6$$

This equation, or variations of it, is commonly used to calculate local shear stress values for use in incipient motion and sediment transport analysis.

The following equation (from Wilcock 1996) was used to calculate local grain stress in this study:

$$\frac{U}{u*} = \frac{1}{\kappa}\ln\left(\frac{h}{ez_0}\right)$$

where z_0 (the bed roughness length where flow velocity (u) is 0) is calculated from

$$z_o = \frac{3D_{84}}{30}$$

Thus, an increase in velocity for a given depth and grain size will result in a higher shear stress on the bed whereas an increase in depth for a given velocity and grain size will result in lower shear stress.

Initiation of Motion

Whether or not a particle on the stream bed will be entrained by the flow or remain in place depends on: 1) randomness (grain placement and turbulence), and 2) balance of driving fluid drag (F_D) and resisting gravity forces (F_G)

$$F_D \propto \tau_0 D^2, \text{ and } F_G \propto (\rho_s - \rho) g D^3$$

and

$$\frac{F_D}{F_G} \propto \frac{\tau_0}{(\rho_s - \rho) g D} = \Theta = \tau^*$$

Where D is grain diameter and ρ_s is sediment density. The dimensionless bed shear stress (Θ, commonly called the Shields number, or τ^*) is a measure of sediment mobility. If τ^* is greater than the threshold required for sediment motion (τ^*_c, critical dimensionless bed shear stress), then sediment motion is predicted to occur.

Selection of τ^*_c is not a minor task. Much research continues to be performed in the field of sediment movement initiation. Figure F-1 below shows initiation of motion curves from which τ^*_c is determined from the particle Reynolds number (R_{ep}). If the τ^*_c value plots above the curve, then sediment motion is predicted to occur, whereas if the value is under the curve, then no motion is predicted to occur. Both curves show that as particle size increases from coarse sand to gravel, the increased resistance to movement from the weight of the particle exceeds the additional drag exerted on the particle, and thus the critical dimensionless shear stress required for movement increases. The curves flatten out at as particle size approaches coarse gravel (32 to 64 mm) and coarser particles. Several researchers have shown the original Shields curve (in blue) values for initiation of motion are too high, and thus predict too much shear stress is required for sediment movement. Therefore, Figure F-2 shows a modified curve (in red) in which the initiation of motion curve flattens out around 0.045 instead of 0.06.

The same two original and modified Shields curves are plotted in dimensional units in Figure F-2. From this plot, the amount of shear stress (Pascal units) needed to initiate motion of a given particle size (mm units) can be determined.

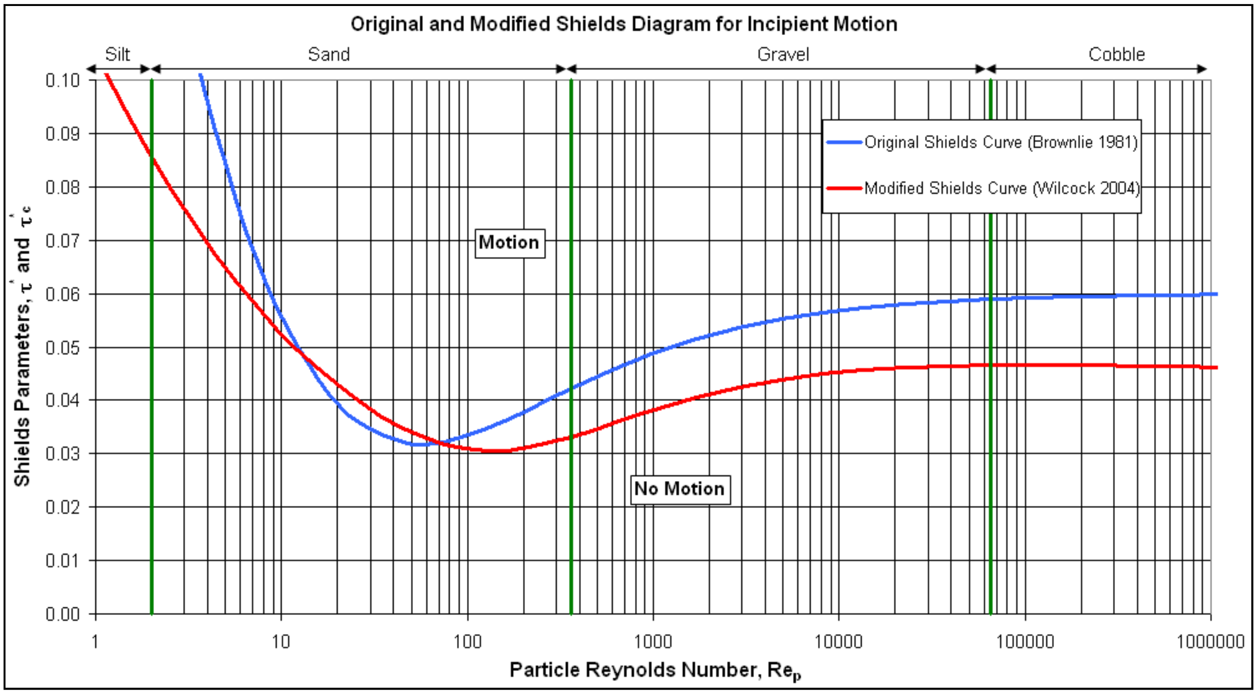

Figure F-1 Orignal and Modified Sheilds Diagram for Incipient Motion

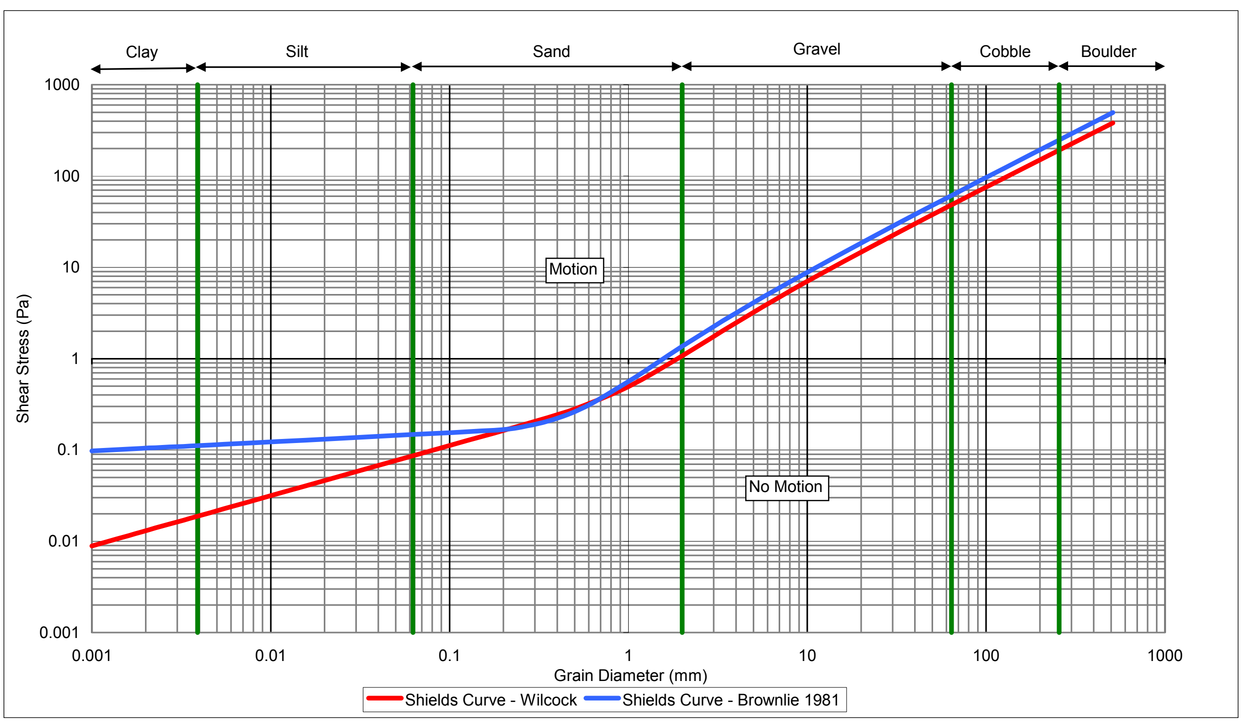

Figure F-2 Orignal and Modified Sheilds Diagram for Incipient Motion

Initiation of Motion for Sediment Mixtures

The initiation of motion curves in Figures F-3 and F-4 represent critical shear stress values needed to mobilize sediment of a uniform size resting on a nearly flat channel bed. The curves do not consider how the relative variability of grain sizes in a sediment mixture influence initiation of motion values for individual particle sizes (D_i) within the mixture. For sediment mixtures of coarse and fine particles, the coarser particles (e.g., gravel) in the mixture can be relatively easier to mobilize than if all the sediment was the same size because the coarser grains protrude higher into the flow where flow velocities are greater, and they have relatively lower pivoting angles. By contrast, the smaller particles in the sediment mixture have higher pivot angles, and are shielded from the higher flow velocities by the larger particles. Therefore, the finer (e.g., sand) particles in a mixture can be relatively harder to mobilize than if all the sediment was the same size.

Additionally, research has shown the importance of the percentage of sand in a sediment mixture on the critical shear stress needed to mobilize both sand and gravel particles (Wilcock 1998; Wilcock and Crowe 2003). As the sand content increases on the bed to larger percentages, the gravel particles become less constrained by other gravel particles, and thus more of the particle is exposed to fluid drag since it is becoming larger than its surroundings. Once the gravel particle is entrained, it moves faster over the relatively smooth bed created by the sand, and it may move a greater distance because potential resting areas are filled with sand. At even higher percentages of sand, gravel particles can be mobilized through undercutting of the underlying sand, and once mobilized the gravel keeps going over the relatively smooth sand bed. Figure F-3[6] shows how variations in bed surface sand content influence the critical dimensionless shear stress needed to initiate motion of a sediment mixtures mean particle size (D_m) (Wilcock and Crowe 2003). Figure F-4 is the same plot but with dimensional critical shear stress values for different D_m values. The plots show that as surface sand content increases from 0 to 20 percent, the shear stress needed to mobilize the D_m decreases. Sand content increases greater than 20 percent have little influence on the critical shear stress needed for sediment initiation.

The Wilcock and Crowe (2003) method for calculating the critical shear stress needed to initiate sediment movement for mixed-size sediment was used for this study. This method was chosen since it considers how relative particle size variation within the sediment mixture and sand content influence sediment mobility.

[6] The reference shear stress values presented in Wilcock and Crowe (2003) were converted to critical shear stress values by reducing the reference shear stress by 10 percent, per Wilcock 1998.

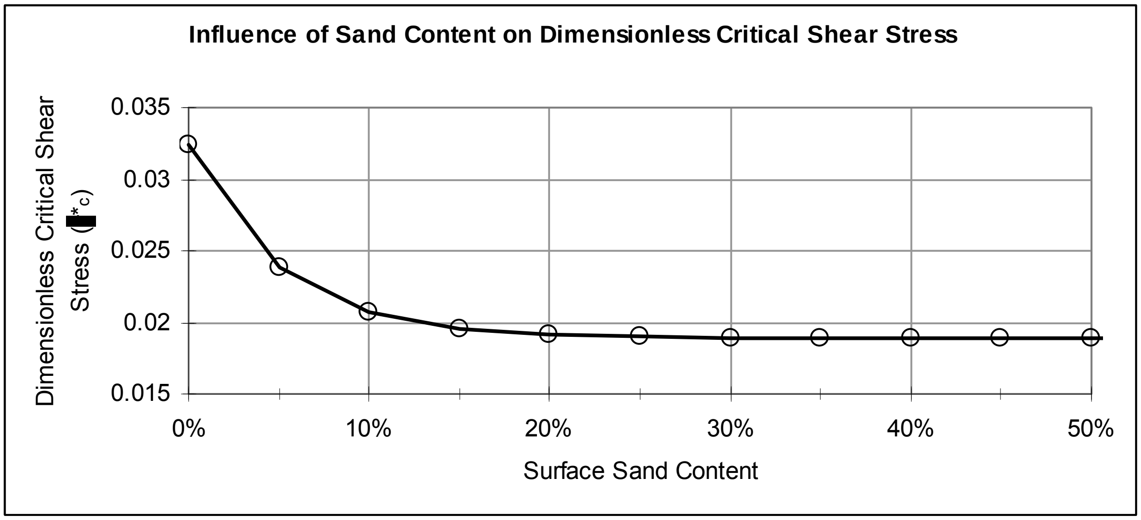

Figure F-3 Influence of Sand Content on Dimensionless Critial Shear Stress

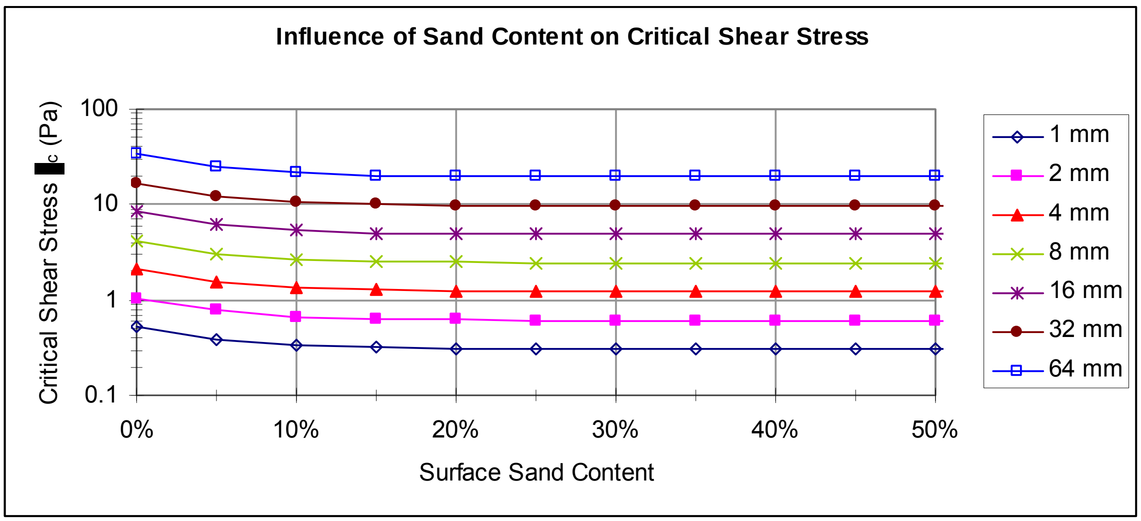

Figure F-4 Influence of Sand Content on Critical Shear Stress

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