Middle Truckee River
Total Maximum Daily Load (TMDL)
Bed Conditions Monitoring Report
Water Years 2010 and 2011
Nevada County, California

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EXECUTIVE SUMMARY

During water year 2011 (WY 2011)[1], the Middle Truckee River was subjected to near-average precipitation and runoff conditions, and we expect that sediment transport through this reach of the Middle Truckee River was also near-average. This study, along with accompanying flow and sediment transport monitoring (Hastings and Shaw, 2011; Hastings and Shaw, 2012): 1) establishes baseline conditions against which to compare the effectiveness of upstream erosion control and watershed management measures in reducing fine sediment loading in the Middle Truckee River, and 2) provides initial comparative observations between WY 2010 and WY 2011.

- Bed texture changes from WY 2010 to WY2011 were observed at each of the reaches we evaluated. There was an overall coarsening of the bed at nearly all locations and a reduction in the reach-wide sand fraction.

- We hypothesize that higher and longer-duration flows through the Middle Truckee River in WY 2011 mobilized and flushed fines from these reaches. The generally higher baseflow through summer 2011 may also have contributed to the reduction of fines on the bed and limited settling of suspended sediment from upstream sources. Finally, watershed-based sediment management and control strategies may be helping to limit the volume of sand delivered to the system.

- We do not expect the "very large" fraction of the bed (e.g., large cobble-boulder material) to move frequently, and also anticipate that channel and bed form is largely controlled by many of these features. As a result, relatively little change is apparent between geomorphic maps developed in 2010 and 2011. The addition of cross-section surveys to this long-term monitoring program will help identify changes in bed topography that may not be detectable through mapping alone.

- The Hirschdale Road site (MTHR) experienced the most macro-scale shifts in bed texture. It is difficult to tell whether there was net gain or loss of fine sediment through this reach between the 2010 and 2011 surveys. It is also important to note that the percent of the bed covered by fines decreased at MTHR, indicating that the geomorphic changes at this reach may be associated with gravel, rather than sand and fine sediment

[1] Monitoring is carried out on a water year basis, from October 1 to September 30. Water year 2010 began on October 1, 2009.

carried in suspension. This station is also downstream of the mouth of the Little Truckee River, and Boca and Stampede Reservoirs, and may be influenced by flows from the Little Truckee River and the "sediment-starved" waters released from those impoundments

- Generally, we observed more milfoil mats during the 2011 site visits than in 2010. These features should be monitored to see if they persist in the same locations and grow from year to year. Milfoil appears to have a tendency to alter local hydraulics, and induce sedimentation within the mat and immediately downstream. Grain-size data, however, do not indicate an increase in the sand fraction between the 2010 and 2011 bed surveys.

- We recommend that streamflow and sediment transport measurements be continued and that a long-term physical monitoring plan be established. Continued repeated data collection including pebble counts, sketch maps, topographic surveys, and photography, along with additional sediment transport monitoring stations being established by the Town of Truckee in WY 2013, will better identify trends in fine sediment loading and transport, and better detect the potential effects of mitigation measures taken in the basin. Annual monitoring will provide the highest-fidelity record and will facilitate a more detailed look at the effects of annual variation in the hydrology and hydraulics of the Middle Truckee River and better differentiation of annual-scale changes from long-term fine sediment reduction trends and improvement of aquatic habitat.

1. INTRODUCTION

The State Water Resources Control Board (State Board) has placed the Middle Truckee River on the Clean Water Act 303(d) list as an impaired water body where sediment and siltation affect aquatic habitat. To address this impairment, the Lahontan Regional Water Quality Control Board developed a Total Maximum Daily Load (TMDL) for suspended sediment (Middle Truckee River Sediment TMDL). The TMDL, adopted in 2008, establishes sediment load allocations for particular sub-watersheds and intervening areas, with a total sediment load allocation for the entire Middle Truckee River Watershed of 40,300 tons per year. The TMDL consists of a number of indicators and target values for each indicator. The only *direct* indicator is suspended sediment concentration in the Middle Truckee River, with a target of less than or equal to 25 milligrams per liter (mg/L) as an annual 90^{th} percentile value measured at Farad (USGS Station 10346000). This target was established based on a review of scientific literature, analysis of suspended-sediment measurements taken in the Truckee River over a 30-year period, and continuous monitoring of turbidity during water years 2002 and 2003. Additional *indirect* indicators include implementation and maintenance of best management practices (BMPs) for road sand application and on ski runs, and restoration activities such as decommissioning of dirt roads and repair of legacy sites.

The Truckee River Watershed Council (TRWC) asked Balance Hydrologics (Balance) to evaluate fine sediment loadings to the Middle Truckee River to support implementation of the TMDL. Multiple lines of evidence were developed using a combination of sediment and bed conditions monitoring. Here we present the results of stream reconnaissance walks conducted during summer 2010 along Trout Creek, Alder Creek, and the lower Middle Truckee River main stem between Martis Creek and Farad. The bulk of this report, however, is dedicated to presenting, comparing, and contrasting bed conditions in the fall of 2010 and 2011 at three sites on the Middle Truckee River where we performed more detailed bed material surveys. A location map that includes all pertinent water bodies and the sampling sites is included as Figure 1.

This document is a companion document to the flow and sediment gaging reports (Hastings and others, 2011; Hastings and others, 2012) which summarize annual suspended-sediment loading on tributaries previously identified by Amorfini and Holden (2008) and McGraw and others (2001) as significant sources of elevated sediment loads to the Middle Truckee River.

The study is intended to supplement, not supplant, monitoring being undertaken as part of the Truckee River Water Quality Monitoring Plan developed by the Town of Truckee and Placer

County, both to comply with the TMDL for sediment and as a component of their respective Stormwater Management Programs under the Phase 2 NPDES Municipal Storm Water (Small MS4) Permit . Funding for this study is provided by the State of California, State Water Resources Control Board (SWRCB) through Proposition 50.

2. METHODS

2.1 Channel Conditions, Reconnaissance Streamwalks and Site Selection

Balance staff conducted initial reconnaissance streamwalks of upper Trout Creek in the vicinity of the Tahoe Donner subdivision, and Alder Creek between Tahoe Donner and Highway 89, in order to: a) identify suitable locations and methods (i.e. pebble counts vs. V-star) for establishment of streambed monitoring stations; and b) document locations of fine sediment deposits and sources. We also conducted a 2-day, reconnaissance-level survey of the lower Middle Truckee River main stem between Martis Creek and Farad. During the stream reconnaissance, we made qualitative observations regarding channel condition and form, inferred sediment sources and input locations. Observation and photo locations were established using a hand-held Garmin 60CSx GPS receiver.

Based on conditions observed during the streamwalks, we concluded that Alder and Trout Creeks are not suitable to develop statistically-valid, representative, and repeatable bed condition analyses. The high variability in bed and sedimentation conditions within these two stream systems precludes the selection of sites which would adequately reflect long-term changes in the watershed. The influence of localized land uses and infrastructure appears to limit the representativeness of most potential monitoring locations. However, the reconnaissance did provide an opportunity to document sediment sources along these channels and establish baseline conditions for future comparison.

Three representative sites on the Middle Truckee River main stem were selected for bed condition surveys:

1) Downstream from Donner Creek and Trout Creek, between Martis and Prosser Creeks (Middle Truckee River at the San Francisco Fly Casting Club; station ID MTFC);
2) Between Prosser Creek and the Little Truckee River (Middle Truckee River at Horseshoe Bend; station ID MTHB); and
3) Below the Little Truckee River (Middle Truckee River at Hirschdale Road; station ID MTHR).

Each reach includes 3 sampled segments: a pool, a glide (or ‘run’), and a riffle. The proportion of the bed covered by fine sediment was quantified using modified Wolman pebble counts in tandem with detailed geomorphic sketch maps showing channel facies, photo points, and monumentation to provide for year-to-year repeatability and comparison.

2.2 Sampling Procedures: Bed Conditions Surveys

Detailed sampling protocols are described in the project sampling and analysis plan (SAP), as provided to the TRWC and summarized below. The bed condition surveys were conducted in late summer when streamflow was at or near the lowest level for the year. Each bed-monitoring site consists of one contiguous pool-riffle-glide sequence. Individual pebble counts were conducted for each feature in the unit for a total three (3) pebble counts per monitoring site, with the exception of the MTFC site, where we added a fourth pebble count in the boulder riffle. Each random sub-sample was collected in a grid format to facilitate an even sample distribution across the bed and provide a solid spatial basis for year-to-year comparisons.

2.3 Sketch Maps

During the 2010 and 2011 bed conditions surveys, Balance staff drew detailed sketch maps to: 1) generate baseline conditions maps for future work, and 2) compare changes in bed conditions, if any, between years. The maps, which are designed to capture stream unit to reach-scale (e.g., a temporal shift from sand bar to gravel-cobble), include documentation of general bed texture, prominent features and boulders, vegetation, and approximate transitions between geomorphic units (i.e. riffles, pools and glides). During 2011, the 2010 sketch maps were taken into the field and used to reference possible changes to the bed morphology. We then digitized the maps to facilitate future comparisons.

2.4 Modified Wolman Pebble Counts

The particle-size distribution of the bed surface material was quantified as part of the bed census, which also results in measurements of cobble abundance and the percentage of fine sediment on the bed. The protocol we implemented was modified from Wolman (1954) as described below.

1. At the upstream and downstream boundaries of each pool, glide or riffle, temporarily place rebar pins into the bed at locations that are 5, 25, 45, 65, and 85 percent of the width of the channel. Stretch measuring tapes between the rebar pins to create transects for use in defining a grid over the entire active bed area of each morphological unit, where “active bed area” is defined as the parts of the pool, glide or riffle which are submerged at typical summer flow levels. When flow rates or bed material precludes the use of rebar pins, tapes were tied off around boulders or cobbles or a single tape along the bank was used.

2. The goal is to collect a stratified random sample of 80 to 150 points. Since transect lengths will vary with each segment, the next step is to calculate the interval length between sampling points needed to collect the necessary number of samples.

3. Walking alongside a tape, when reaching the pre-selected sampling point, collect a sample by reaching into the water with face averted and retrieving the first particle touched on the channel bed. Using a ruler, the sample is measured along its intermediate axis and classified as fine sediment (< 4 mm), coarse sediment (gravel, cobble, boulder), bedrock, large organic debris (sizeable enough to provide local habitat value, or anthropogenic in origin (construction materials, trash).

4. The sizes of all coarse particles are measured along their intermediate axis. Following the widespread adaptation of the standard Wolman (1954) criteria, each particle is classified within standard metric size categories which vary as the square root of 2 (e.g., 4 mm to 5.6 mm, 5.6 mm to 8 mm, 8 mm to 11.3 mm, 11.3 mm to 16 mm, and so on up to large boulder sizes). Results may be expressed either as a frequency distribution or by the equivalent size of specified percentiles: the 16^{th}, 50^{th} and 84^{th} percentiles (D-16, D-50, D-84) are most commonly used in stream habitat analysis.

5. Careful quality control is needed to optimize the quality of particle size data and minimize variance in estimates collected by different observers. New observers are trained by experienced staff and their performance is monitored in the field as data collection proceeds. For example, confirming that sampling occurs at the correct interval and that particle size is measured along the intermediate axis.

6. The percent of the bed covered by fine sediment is the percent of sampling points within the pool, glide or riffle at which fine material was encountered during the bed census when measuring directly below the sampling point.

2.5 Cross-section Surveys

Cross-sections were surveyed with an auto level at approximately 2-foot intervals within the channel and at slope breaks along the banks. All bed elevations were recorded to the nearest 0.01-foot. Sequential repeated surveys recorded pool fill and scour. Surveys were conducted in general accordance with the methods described by Harrelson and others (1994). To facilitate comparison with potential future surveys, cross-sections within each reach were correlated to the same arbitrary vertical datum, and cross-section endpoints were established using rebar labeled with aluminum tags.

2.6 Photography

Photo points were added to the monitoring program during the 2011 surveys to provide a baseline for repeatable comparisons during future monitoring efforts. Photo points were established at or near the cross-section locations or, in the case of the MTHR site, at locations where erosion and sedimentation may occur in the future.

3. RESULTS

3.1 Hydrology

To provide context for the results of our bed conditions monitoring, we briefly summarize snowpack and annual streamflow conditions in the Middle Truckee River for water years 2010 and 2011. In Figure 2 we present the snow-water equivalent precipitation values as measured at the Central Sierra Snow Lab in Soda Springs, California for both years, and in Figure 3 we present daily mean flow at the USGS Truckee River gage near Truckee California (USGS 10338000). The Truckee River near Truckee gage is located downstream of Lake Tahoe and upstream from the Donner Creek, Trout Creek, Prosser Creek, and Little Truckee River tributaries. We note that Donner Lake, Prosser Creek Reservoir, and Boca Reservoir are managed reservoirs and releases vary.

Water year 2010 was characterized by near-average snowpack and streamflow conditions. The snow-pack at the Central Sierra Snow Lab held just slightly above-average water content into the spring (Figure 2), while daily mean flow for the Truckee River was below the long-term average. The maximum daily mean flow of 880 cubic feet per second (cfs) occurred on June 4, 2010. The peak instantaneous streamflow was 1060 cfs on June 6, 2010. The recurrence interval for this level of flow is approximately 2 years[2].

Water year 2011 was a high-runoff year due to the above-average snowpack (Figure 2), resulting in more numerous and higher peak flows than in WY 2010 (Figure 3). The peak instantaneous streamflow was 1840 cfs on October 24, 2010, with an estimated recurrence interval of 2.7 years. The maximum daily mean flow was 951 cfs on June 15, 2011. In addition, there was a long duration of sustained high flows this year. In particular, daily mean flows at the Truckee gage exceeded 500 cfs for more than a month (June 6 to July 8, 2011), compared to only 8 consecutive days above 500 cfs during WY 2010.

3.2 Reconnaissance

Appendix A includes observations and photographs taken during the reconnaissance-level channel investigation. The goals of this effort were to develop a qualitative baseline record of conditions in Trout Creek, Alder Creek and the main stem Truckee River and to identify potential sediment sources that could be addressed through TMDL implementation or other sediment control strategies. The channel walks were also conducted to identify suitable long-

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[2] Based on 40 years of record at USGS station 1033800. Calculations do not account for changes in regulation and diversion upstream of the station.

term bed monitoring sites—locations that would likely show representative responses to conditions and changes in the watershed.

3.2.1 Trout Creek

Trout Creek was evaluated from downstream of the Tahoe Donner subdivision to upstream of downtown Truckee. This particular reach was targeted under the assumption that impacts and changes in land use in the largely suburbanized upper watershed would be reflected by channel bed conditions in downstream reaches. As indicated by the field observations in Appendix A, Trout Creek is a relatively-steep stream through this reach. Channel morphology is step-pool dominated, with pools typically controlled by glacial till (large boulders and cobble), and to a limited extent, by large wood. Stream banks and channel elevations were largely stable through this reach, with limited immediate sources of fine sediment. It should be noted, however, that drainage from portions of Euer Valley Road and an aggregate quarry just upstream of highway Interstate 80 (I-80) appear to flow directly into the stream channel, causing significant erosion and sediment transport to the stream bed.

3.2.2 Alder Creek

Alder Creek was evaluated from downstream of the Tahoe Donner subdivision to upstream of Highway 89. This particular reach was also targeted in hopes of evaluating bed conditions downstream of Tahoe Donner, as well as potential influences of drainage from Alder Creek Drive. Channel morphology is variable throughout this area, with alternating wood- and beaver-controlled step pools. Beavers have made widespread channel modifications upstream of the Schussing Way crossing, with extensive pools and multi-channel systems. Downstream of this area, the channel form alternates between riffle-pool sequences and wood-controlled step pools. In contrast to Trout Creek, we noted a number of unstable and failing banks in this reach, mostly where the stream is eroding into glacial outwash terraces. Alder Creek Drive drainage infrastructure appears to provide a direct conduit for road sand to the channel.

3.3.3 Truckee River

Channel reconnaissance on the Truckee River focused on the Truckee Canyon reach, from Glenshire Drive to Floriston, and was conducted via kayak during releases from Prosser and Boca Reservoirs. This reach is largely confined within the youngest glacial outwash features, including large boulders that are rarely transported by modern flows. These boulder riffles are interpreted to be remnants of Pleistocene glacial outburst floods ('jokulhlaups' of Birkeland, 1964) and are considered to be immobile at nearly all modern flood flows. The boulder riffles are separated by lower-gradient gravel and cobble reaches that exhibit a more dynamic riffle-and-pool morphology. Channel migration throughout much of this section is limited by both glacial deposits and infrastructure, such as the Union Pacific Railroad and I-80 crossings. The railroad maintenance roads and embankments do not appear to be maintained for sediment and erosion control; in many places, the railroad is essentially built within the channel, with dry ravel and exposed sediment readily available for transport and deposition.

The gravel-cobble reaches appear to be more dynamic than the boulder riffles and follow a somewhat predictable form (i.e. riffle-pool-glide), so these reaches should be more comparable to each other, and should also respond more readily to changes in land use and watershed management. For these reasons, we targeted these more mobile and dynamic reaches for bed conditions surveys.

3.3 Bed Conditions Surveys

Bed condition survey results are presented below for each of the three reaches surveyed on the Middle Truckee River reaches. For each reach, we discuss the geomorphic maps developed in 2010 and 2011 and any changes in channel and bed conditions we inferred from those maps. We then outline bed material grain-size distributions as statistical values developed from pebble count data and percent of bed cover by fines. Finally, for each reach, we provide plots of cross-section data and photos. Since cross-sections were only collected during 2011, the data presented herein are provided primarily as baseline information, for comparison to future conditions.

3.3.1 San Francisco Fly Casting Club (MTFC)

Fieldwork was conducted at the MTFC reach on September 16, 2010 at a streamflow of approximately 113 cfs, and on September 21, 2011 at a flow of approximately 115 cfs.

3.3.1.1 Sketch map

Figures 4 and 5 present the 2010 and 2011 sketch maps of the pool-glide-gravel riffle sequence at the MTFC reach, with the latter map annotated to highlight observed geomorphic changes. Upstream of the mapped sequence is a boulder riffle, where a pebble count was added during the 2011 field visits. Downstream, the mapped reach transitions to a deep forced pool in a left bend.

Generally we observed little to no change within the MTFC reach in 2011. The gravel riffle was unchanged and we observed no significant change in the location of the thalweg between Stations 0 and 200 feet. We also detected little to no change through the glide (Stations 240 to 360 feet). Our maps indicate some shift in the location of large boulders, however, we believe this is a mapping error, rather than real change, because the elevated streamflows during water year 2011 still do not appear to have been large enough to cause movement of large boulders. We did observe mats of submerged milfoil growing on the uniform substrate at Stations 360 and 420 feet in 2011 that we did not observe in 2010. Small mounds or bars of sand and gravel were trapped in the lee of these mats in late summer. Grain-size data, however, indicate that the sand fraction was actually lower in 2011.

3.3.1.2 Pebble Counts

Tables 1 and 2 present the results of the pebble counts for the 2010 and 2011 site visits, respectively. In comparing the particle-size measurements across years, we observe four main trends: 1) The pool appears to have coarsened; 2) The glide appears to have become finer; 3) The gravel riffle does not appear to have changed substantially; and 4) The percent of the streambed covered by fines (sand-size and finer) at the MTFC reach was lower in 2011.

3.3.1.3 Cross-section surveys

Cross-section survey locations are shown in Figures 6 to 9. Cross-section 1, at station 162 feet, crosses the upstream pool unit (Figure 6). Cross-section 2, at station 234 feet, crosses the pool-glide transition unit (Figure 7). Cross-section 3, at station 324 feet, crosses the glide-riffle transition unit (Figure 8). Cross-section 4, at station 451 feet, crosses the downstream riffle-pool unit (Figure 9).

3.3.1.4 Photo-Documentation

Figure 10 presents four photos of the MTFC study reach. These photos are presented as a reference baseline and are intended to demonstrate photo points for future monitoring efforts. Photographs from these locations will facilitate qualitative analysis of changes to the stream bed and banks and assessments of bank vegetation.

Photo 1 looks across cross-section 1 from the right bank at the upstream pool at station 162 feet. Photo 2 looks across the pool glide transition at cross-section 2 from the right bank at station 234 feet. Photo 3 looks across cross-section 3from the right bank at the glide riffle transition at station 324 feet. Photo 4 looks across cross-section 4 from the right bank at the downstream riffle unit at station 451 feet.

3.3.2 Horseshoe Bend (MTHB)

Fieldwork was conducted at the MTHB reach on September 20, 2011 at a streamflow of approximately 210 cfs, and on September 21 at a flow of approximately 115 cfs.

3.3.2.1 Sketch map

Figures 11 and 12 present the 2010 and 2011 sketch maps of the riffle-pool-glide- riffle sequence at the MTHB reach, with the latter map annotated to highlight observed geomorphic changes. The upstream riffle on the sketch map was not included in the pebble count, and may be under the influence of hydraulic conditions associated with the I-80 Bridge. As with the other reaches surveyed, very large boulders are considered to be immobile at all but the highest flows.

Generally, we observed little to no change from 2010 to 2011 in the location and extent of channel facies along most of the Horseshoe Bend reach. The "flooded riffle"[3] at the upstream end of the study reach (station 0 to 50 feet) appears to have been maintained in place, and we observed no significant change in the location of the thalweg between stations 0 and 200 feet. The glide (stations 340 to 600 feet) was also nearly identical to 2010; however, we observed thalweg development through the glide. At station 345 feet, we observed mats of submerged milfoil in 2011 that we did not observe in 2010. Small mounds or bars of sand and gravel were trapped in the lee of the mats; however, as at the other monitoring sites, the grain size data indicate an overall reduction in the sand-fraction of the bed. Overall, the bed, banks, and riparian vegetation through this reach appear to have remained fairly stable through the sustained high flows of 2011.

3.3.2.2 Pebble counts

Tables 1 and 2 present the results of the pebble counts for the 2010 and 2011 site visits, respectively. In comparing the particle-size measurements across years, we observe three main trends: 1) The D16 value is slightly finer; 2) The coarse fraction in the riffle unit appears to have coarsened; and 3) Despite decrease in D16 values throughout the MTHB reach, and the new mat

[3] Due to flow releases from upstream reservoirs, flow conditions during the study are higher than would be normal under late-summer or early-fall low-flows in an unregulated system. Thus, we have interpreted bed features at MTHB and the other study reaches based on bed topography, rather than solely on water velocities, turbulence and other indicators commonly used under unregulated low-flow conditions.

of milfoils at the head of the glide, the fine fraction (the percent of the bed covered by sand and finer material) is universally lower after the flows of 2011.

3.3.2.3 Cross-sections

Cross-section locations are shown on Figures 13 to 16. Cross-section 1, at Station 55 feet, is located in the upstream riffle unit (Figure 13). Cross-section 2, at Station 402 feet, crosses the glide unit (Figure 14). Cross-section 3, at station 667 feet, crosses the glide-riffle transition unit (Figure 15). Cross-section 4, at station 667 feet crosses the downstream riffle unit (Figure 16).

3.3.2.4 Photo-documentation

Figure 17 presents four photos of the MTHB study reach. These photos are presented as a reference baseline and are intended to demonstrate photo points for future monitoring efforts. Photographs from these locations will facilitate qualitative analysis of changes to the stream bed and banks and assessments of bank vegetation.

Photo 1 looks across cross-section 1 from the left bank at the upstream riffle at station 55 feet. Photo 2 looks across the glide unit at cross-section 2 from the left bank at station 402. Photo 3 looks across cross-section 3 from the left bank at the glide riffle transition at station 667. Photo 4 looks across cross-section 4 from the left bank at the downstream riffle unit at station 769.

3.3.3 Hirschdale Road Bridge (MTHR)

Fieldwork was conducted at the MTHR reach on September 7 and 22, 2010 at streamflows of approximately 200 cfs, on September 20 at flows of approximately 210 cfs, and on September 21 at flows of approximately 115 cfs.

3.3.3.1 Sketch map

Figures 18 and 19 present the 2010 and 2011 sketch maps of the riffle-pool-glide- riffle sequence at the MTHR reach, with the latter map annotated to highlight observed geomorphic changes. The upstream riffle on the sketch map was not included in the pebble count. As with the other reaches surveyed, very large material is considered to be immobile at all but the highest flows.

Generally, we observed more macro-scale changes in morphology at MTHR than at the MTFC and MTHB sites. The upstream riffle between stations 400 and 600 feet did not change noticeably with the exception of woody debris deposited on the left bank bar. Other than this addition, the left bar on the bank from stations 220 to 640 feet[4] appears unchanged, and willows on the banks appear to have survived high flows during 2011.

The large pool between stations 140 and 340 feet does appear to have changed in 2011: 1) the tail of the pool has retreated upstream, due to filling-in at the downstream end; 2) a mat of milfoil has developed on the left bank; 3) a secondary pool appears to have formed at the tail end of the pool; and 4) the stormwater channel at station 200 feet on the right bank appears to have washed out and eroded.

The glide between stations 0 and 140 feet also changed in 2011. There is a new deposit of fine silts and sands on the right bank. Additionally, the large log on the left bank is still present and appears to have induced scouring of the bed and bank, forming a deeper, broader pool.

3.3.3.2 Pebble counts

Tables 1 and 2 present the results of the pebble counts for the 2010 and 2011 site visits, respectively. During both 2010 and 2011, the pool was too deep to collect grain size data using a modified Wolman count, and data were only collected at the riffle and glide units. In comparing the particle-size measurements across years, we observe three main trends: 1) The glide unit coarsened slightly; 2) The riffle unit appears to have become finer; and 3) Despite a general fining of the riffle reach, the fine fraction (sand-size and finer) at MTHB was lower in 2011.

3.3.3.3 Cross-sections

Cross-section locations are shown in Figures 20 to 22. Cross-section 1, at station 499 feet, is located in the riffle unit (Figure 20). Cross-section 2, at station 130 feet, crosses the pool-glide transition (Figure 21). Cross-section 3, at station 50 feet, crosses the glide unit (Figure 22)

3.3.3.4 Photo-documentation

Figure 23 presents three photos of the study reach, to be used as a reference baseline. These photos are presented as a reference baseline and are intended to demonstrate photo points for future monitoring efforts.

[4] Note that the stationing at MTHR increases downstream to upstream, opposite to the stationing at MTFC and MTHR.

Photo 1 looks upstream from station 150 feet along the right bank of the glide and pool units. Photo 2 looks downstream from station 560 feet at the pool and glide units. Photo 3 looks upstream from station 560 feet toward the riffle unit.

4. DISCUSSION

4.1 Reconnaissance

Our reconnaissance of Trout Creek indicates that the channel is largely stable through the study reach (See Appendix A); however, drainage from Euer Valley Road and the aggregate quarry just upstream of Highway I-80 is likely a significant source of erosion. These sediment sources should be evaluated in more detail in order to consider potential mitigation options. Bed sedimentation indicators such as V-star and pebble counts are anticipated to reflect localized conditions, rather than effects of watershed management activities in upstream areas. If these are to be used to monitor long-term and watershed-wide changes, a large number of representative reaches should be used.

Alder Creek is largely controlled by streamwood and beaver-controlled step pools in the upper portions of the watershed. Downstream and immediately upstream of Schussing Way, we observed a number of bank failures. As on Trout Creek, these sediment sources should be evaluated in more detail in order to consider potential mitigation options. The relatively dynamic and unstable nature of this reach also precludes the application of V-star and pebble-counts as long term monitoring methods.

In general, the Middle Truckee River through the reconnaissance reach (See Appendix A) is stable. The channel slope and location is largely controlled by the dominant sediment: in many places remnant material from Pleistocene glacial outburst floods. In addition to sediment sources throughout the watershed and identified in the TMDL, Highway I-80 and the Union Pacific Railroad cross or run adjacent to the creek and have nearly immediate hydrologic connectivity to the channel in many locations. These locations are potential point sources for fine sediment and Best Management Practices (BMPs) could be targeted in these areas to limit the amount of fine sediment entering the Truckee River.

4.2 Hydrology

During WY 2011, precipitation in the Middle Truckee River watershed was above-average, runoff was also above-average, and we expect that sediment loads were also elevated as a result. This study, together with flow and sediment transport monitoring reported separately (Hastings and Shaw, 2011; Hastings and Shaw, 2012), serves to: a) establish baseline conditions against which to compare the effectiveness of erosion control and watershed management measures implemented upstream to reduce fine sediment loading; and b) provide initial comparisons of changes in bed conditions in WY 2010 and WY 2011at several representative reaches.

WY 2011 streamflow appears to have caused changes in bed texture at each of the reaches evaluated. Beds coarsened at nearly all locations and the sand fraction of the bed was reduced. Less sand may also result from recent measures taken within the Middle Truckee River watershed to reduce fine sediment loading. However, this conclusion is preliminary and additional monitoring will be required to assess if this reduction is being sustained.

4.3 Pebble Counts

Figure 24 summarizes the percentage of fines on the bed for each unit within each reach. Based on the pebble count data, there was much less sand and silt on the bed in 2011 than in 2010. We hypothesize that higher and longer-duration flows through the Middle Truckee in WY 2011 mobilized and flushed fines from these reaches. The generally higher baseflow through Summer 2011 may also have contributed to the reduction of fines on the bed and limited settling of suspended sediment from upstream sources.

4.4 Sketch Maps

The Middle Truckee River has a history of repeated glaciation, most recently in the late Pleistocene. Glaciers moved large amounts of material from surrounding peaks to the valleys where it was deposited as till and glacial outwash. Consequently, there is an ample supply of large cobble-boulder material through these reaches that was deposited under much higher flow conditions. We do not expect this “very large” fraction of the bed to move frequently, and also anticipate that the river is largely controlled by many of these features. As a result, relatively little change is apparent between geomorphic maps developed in 2010 and 2011. The addition of cross-section surveys to this long-term monitoring program will help identify changes in bed topography that may not be detectable through mapping alone.

The Hirschdale Road site (MTHR) experienced the most macro-scale shifts in bed texture, but it is difficult to tell whether there was net gain or loss of sediment through this reach between the 2010 and 2011 surveys. It is also important to note that the percent of the bed covered by fines decreased at MTHR, indicating that the geomorphic changes at this reach may be associated with gravel, rather than sand and fine sediment carried in suspension. This station is also downstream of the mouth of the Little Truckee River, and Boca and Stampede Reservoirs, and may be influenced by flows from the Little Truckee River and the “sediment-starved” waters released from those impoundments

Generally, we observed more milfoil mats at all sites during the 2011 site visits. These features should be monitored to see if they persist in the same locations and grow from year-to-year. Milfoil appears to have a tendency to alter local hydraulics, inducing sedimentation within the mat and immediately downstream. Grain size data, however, do not indicate an increase in the sand fraction between the 2010 and 2011 bed surveys.

As we understand it, the Town of Truckee will be installing sediment transport monitoring stations near the USGS Truckee River near Truckee station and on the Truckee River at Boca Bridge, between MTHB and MTHR. These stations will provide valuable information on sediment transport on the Truckee River and will allow for comparison of sediment transport rates and timing to conditions on the streambed.

5. CONCLUSIONS AND RECOMMENDATIONS

We recommend that streamflow and sediment transport measurements be continued and that a long-term physical monitoring plan be established. Continued repeated data collection including pebble counts, sketch maps, topographic surveys, and photography will better identify trends in fine sediment loading and transport, and better detect the potential effects of mitigation measures taken in the basin. Annual monitoring will provide the highest fidelity record, and facilitate a more detailed evaluation of the effects of annual variation in the hydrology and hydraulics of the Middle Truckee River and better differentiation of annual-scale changes from long-term fine sediment reduction trends and improvement of aquatic habitat.

6. REFERENCES

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Wolman, M.G., 1954, A method of sampling coarse river-bed material: Transactions, American Geophysical Union, v. 35, p. 951-956

TABLES

Table 1. Summary of particle-size measurements for 2010.

Stream	Site	Water Year [2]	Sample Size	Proportion of bed area occupied by: Cobbles (>45mm)	Sand (<4mm)	Bedrock	Organics	Artifacts	D-size [1]: D-16	D-50	D-84
Middle Truckee River	MTFC Pool	2010	127	0.62	0.21	0.00	0.02	0.00	36.0	142.0	581.8
	MTFC Glide	2010	120	0.41	0.26	0.00	0.01	0.00	16.0	52.3	136.4
	MTFC Riffle	2010	131	0.18	0.18	0.00	0.02	0.00	12.1	28.5	51.5
	MTFC All			**0.40**	**0.22**	**0.00**	**0.02**	**0.00**	**21.4**	**74.3**	**256.6**
	MTHB Pool	2010	140	0.22	0.02	0.00	0.04	0.00	16.6	31.0	66.9
	MTHB Glide	2010	63	0.27	0.25	0.00	0.00	0.00	14.1	26.9	103.5
	MTHB Riffle	2010	105	0.68	0.08	0.00	0.02	0.00	30.8	79.2	154.9
	MTHB All			**0.39**	**0.12**	**0.00**	**0.02**	**0.00**	**20.5**	**45.7**	**108.4**
	MTHR Pool	2010	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	MTHR Glide	2010	103	0.25	0.02	0.00	0.08	0.00	17.0	35.9	78.5
	MTHR Riffle	2010	109	0.66	0.19	0.00	0.00	0.00	35.1	130.8	310.8
	MTHR All			**0.46**	**0.11**	**0.00**	**0.04**	**0.00**	**26.1**	**83.4**	**194.7**
		Mean for pools		*0.42*	*0.12*	*0.00*	*0.03*	*0.00*	***26.28***	***86.52***	***324.35***
		Mean for glides		*0.31*	*0.18*	*0.00*	*0.03*	*0.00*	***15.70***	***38.37***	***106.13***
		Mean for riffles		*0.50*	*0.15*	*0.00*	*0.01*	*0.00*	***26.01***	***79.49***	***172.41***

Table 2. Summary of particle-size measurements for 2011.

Stream	Site	Water Year [2]	Sample Size	Proportion of bed area occupied by: Cobbles (>45mm)	Sand (<4mm)	Bedrock	Organics	Artifacts	D-size [1]: D-16	D-50	D-84
Middle Truckee River	MTFC Pool	2011	97	0.75	0.09	0.00	0.00	0.00	41.8	190.2	636.7
	MTFC Glide	2011	115	0.38	0.13	0.00	0.01	0.00	10.8	40.5	129.2
	MTFC Riffle	2011	101	0.15	0.07	0.00	0.04	0.00	16.4	30.6	46.0
	MTFC Boulder Riffle [3]	2011	97	0.81	0.03	0.00	0.00	0.00	45.4	133.7	331.6
	MTFC All [4]	----		**0.43**	**0.10**	**0.00**	**0.02**	**0.00**	**23.0**	**87.1**	**270.7**
	MTHB Pool	2011	100	0.29	0.01	0.00	0.00	0.00	11.3	31.8	59.2
	MTHB Glide	2011	119	0.18	0.11	0.00	0.03	0.00	8.6	22.0	65.2
	MTHB Riffle	2011	114	0.74	0.04	0.00	0.00	0.00	24.6	89.4	195.6
	MTHB All	----		**0.40**	**0.05**	**0.00**	**0.01**	**0.00**	**14.8**	**47.7**	**106.6**
	MTHR Pool	2011	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	MTHR Glide	2011	97	0.32	0.01	0.00	0.01	0.00	20.5	34.9	60.4
	MTHR Riffle	2011	115	0.65	0.01	0.00	0.01	0.00	17.2	81.8	195.7
	MTHR All			**0.49**	**0.01**	**0.00**	**0.01**	**0.00**	**18.9**	**58.4**	**128.0**
		Mean for pools		*0.52*	*0.05*	*0.00*	*0.00*	*0.00*	***26.53***	***111.00***	***347.96***
		Mean for glides		*0.30*	*0.08*	*0.00*	*0.01*	*0.00*	***13.31***	***32.46***	***84.91***
		Mean for riffles		*0.51*	*0.04*	*0.00*	*0.02*	*0.00*	***19.42***	***67.25***	***145.76***

Notes:

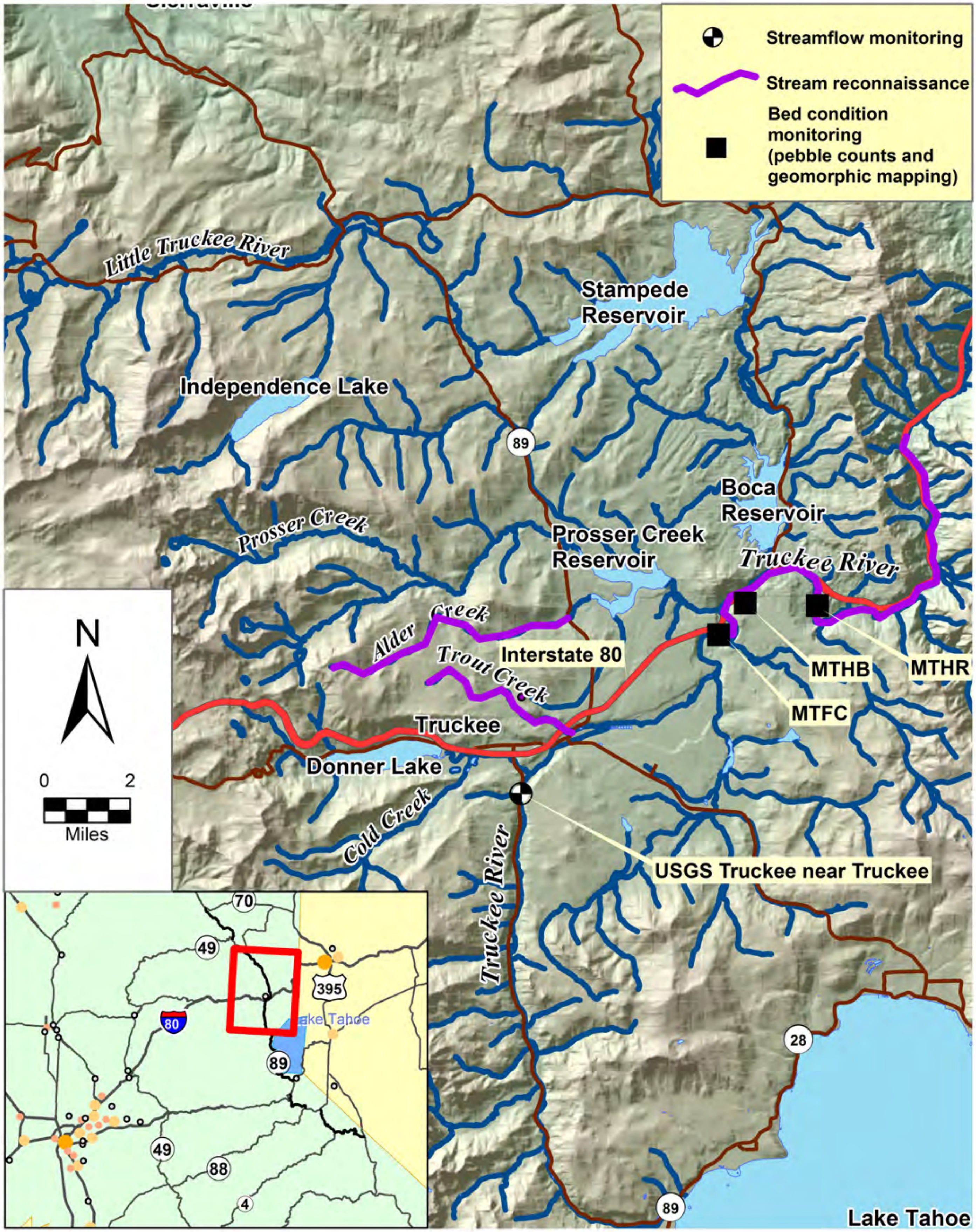
[1] Size greater than 4 mm of the 10th, 16th, 50th, 84th, and 90th percentiles of material covering the bed.
All particle sizes are for the intermediate ('b') axis, or about the size of sieve on which a particle of this size would be retained.

[2] Surveys are typically conducted during the summer of the water year.

[3] Not measured in 2010

[4] Excluding Boulder Riffle for consistent comparison to 2010

FIGURES



Balance Hydrologics, Inc.

210011 monitoring.mxd

Figure 1. Monitoring locations, Middle Truckee River TDML evaluation, Nevada County, California

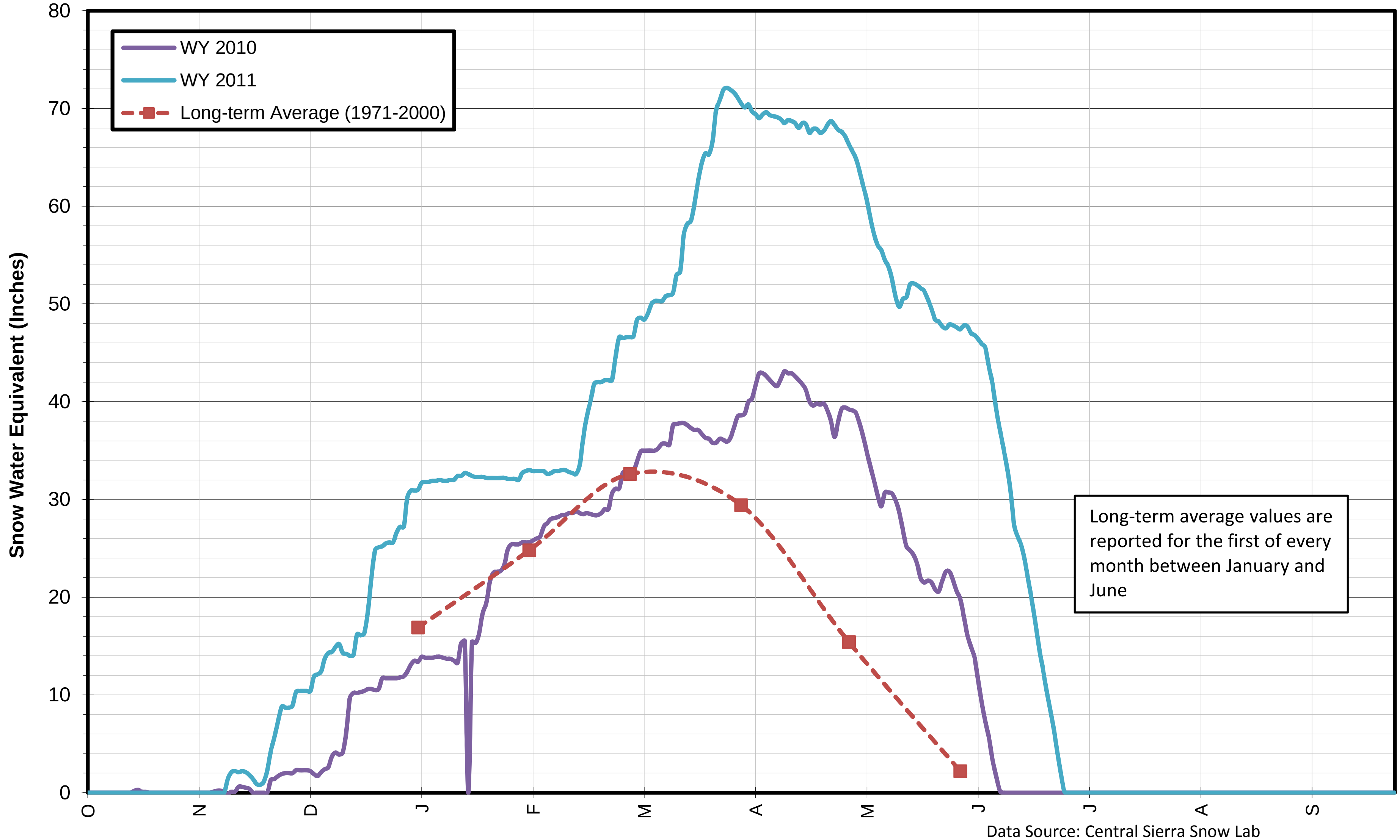
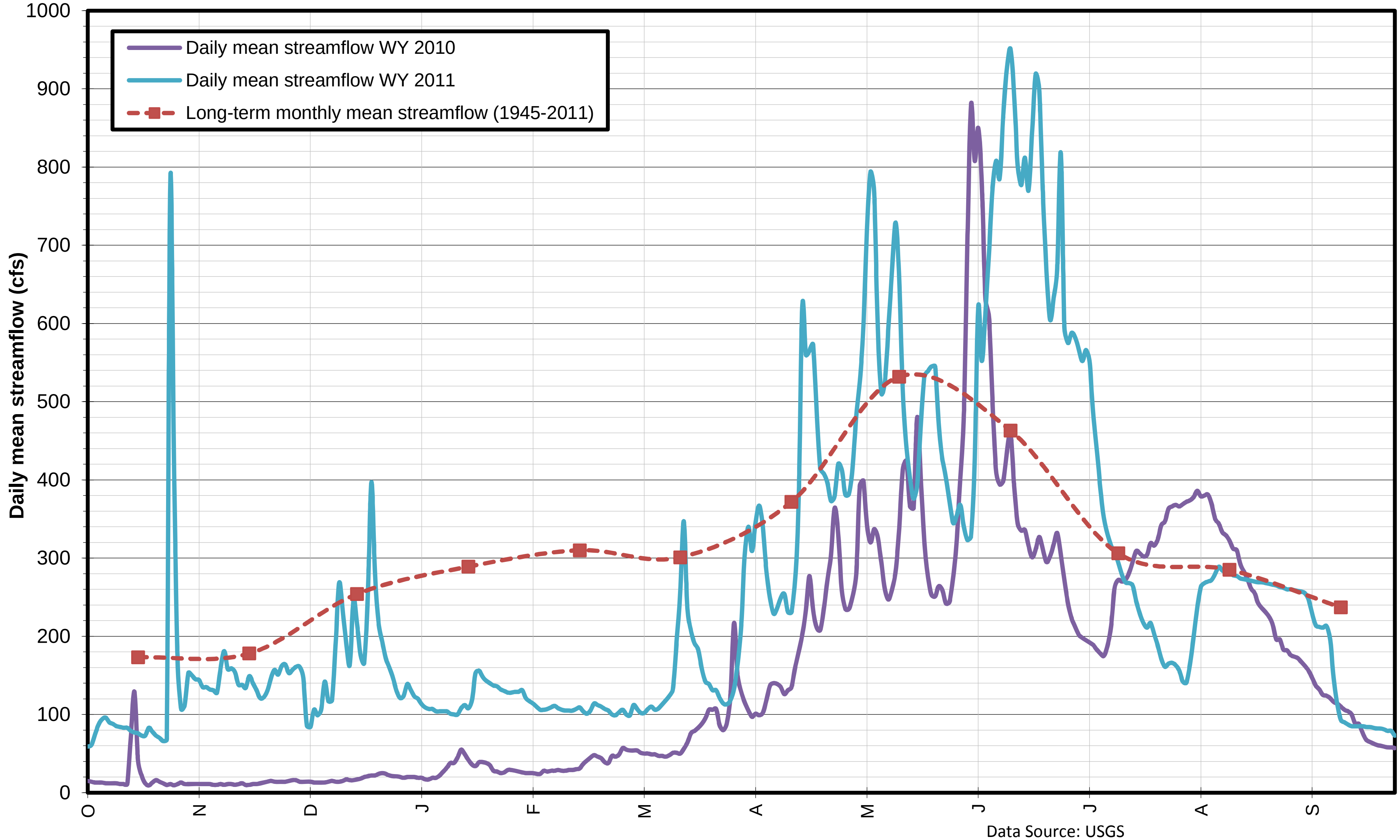
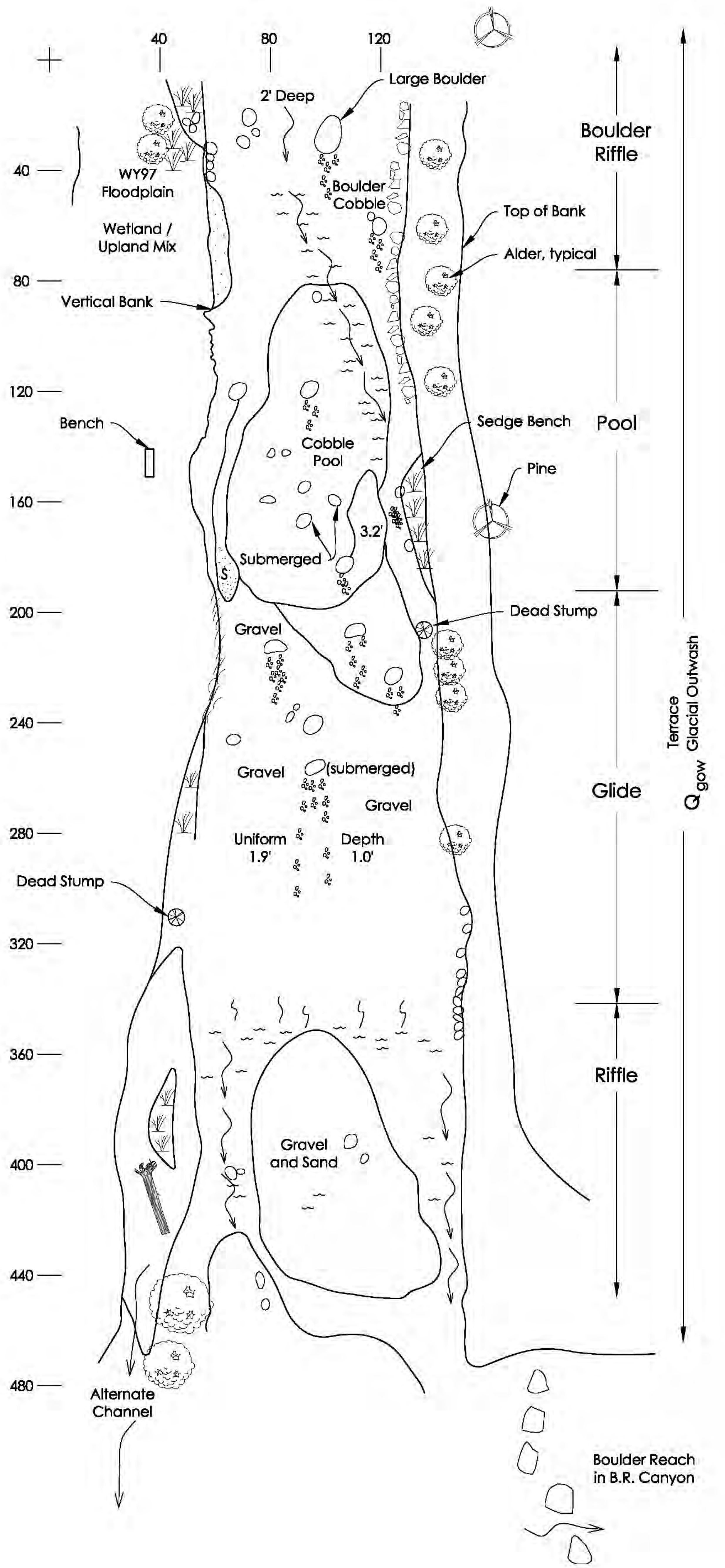


Figure 2. Snow-water equivalent precipitation, Central Sierra Snow Lab, Soda Springs, California, water years 2010 and 2011 as compared to long-term average. The Snow Lab is located approximately 11 miles west of Truckee, California at 6,950 feet elevation.



Balance Hydrologics, Inc.

Figure 3. **Daily mean streamflow, USGS gage, Truckee River near Truckee (USGS 10338000). Water years 2010 and 2011 as compared to long-term monthly average.** The Truckee River near Truckee gage is located two miles south of Truckee, California, upstream of the confluence with Donner Creek.



All units in feet.

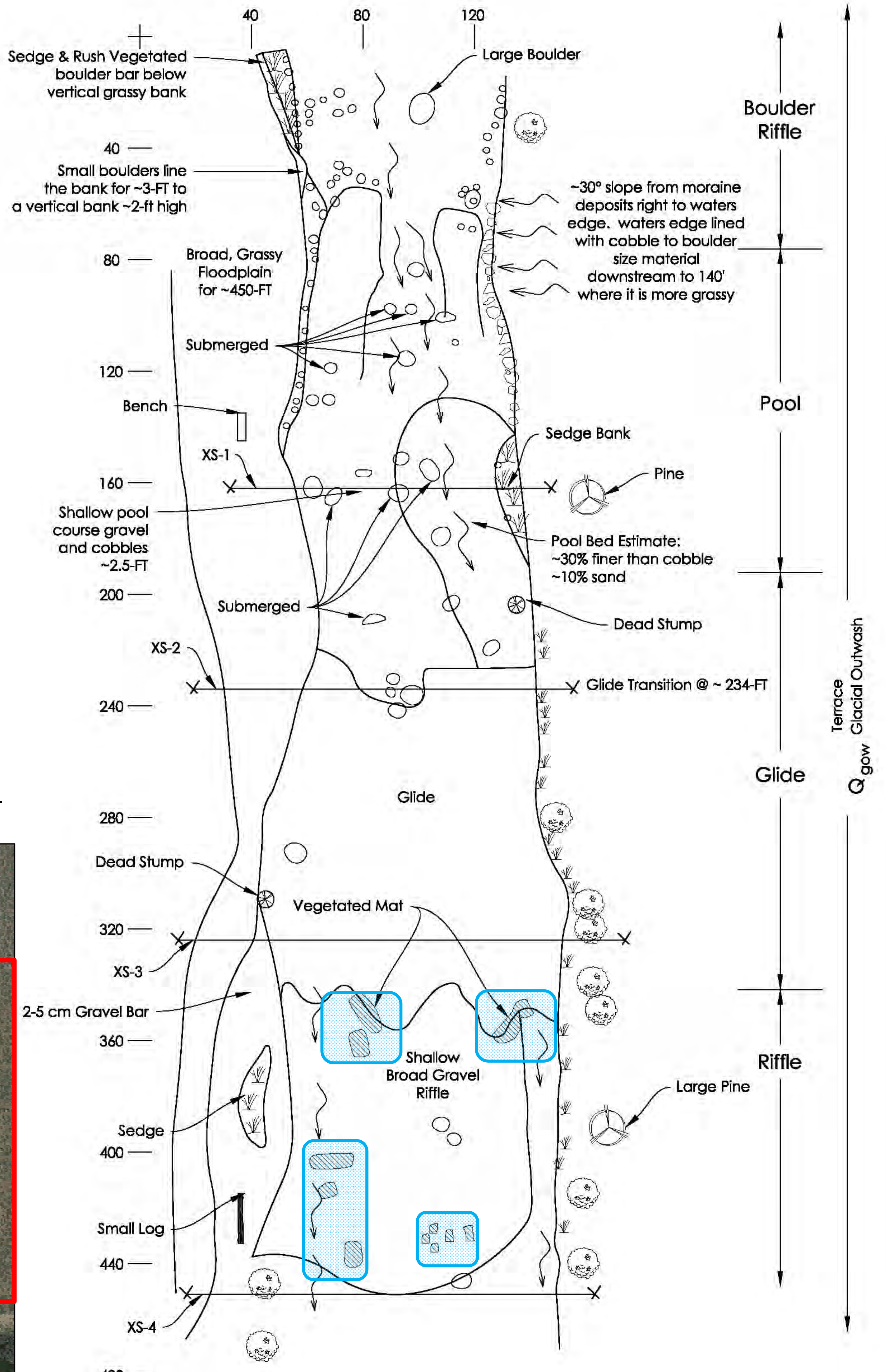
Balance Hydrologics, Inc.

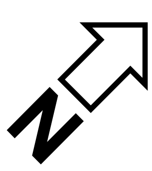
Figure 4 **.**

Digitized sketch map of summer 2010 conditions, San Francisco Fly Casting Club, Middle Truckee River, Nevada County, California

210011 Digitized Map Figures

Source: Image: Google Earth, Mapping: Balance Hydrologics





All units in feet.

Areas of detected change between 2010 and 2011

Balance Hydrologics, Inc.

Figure 5
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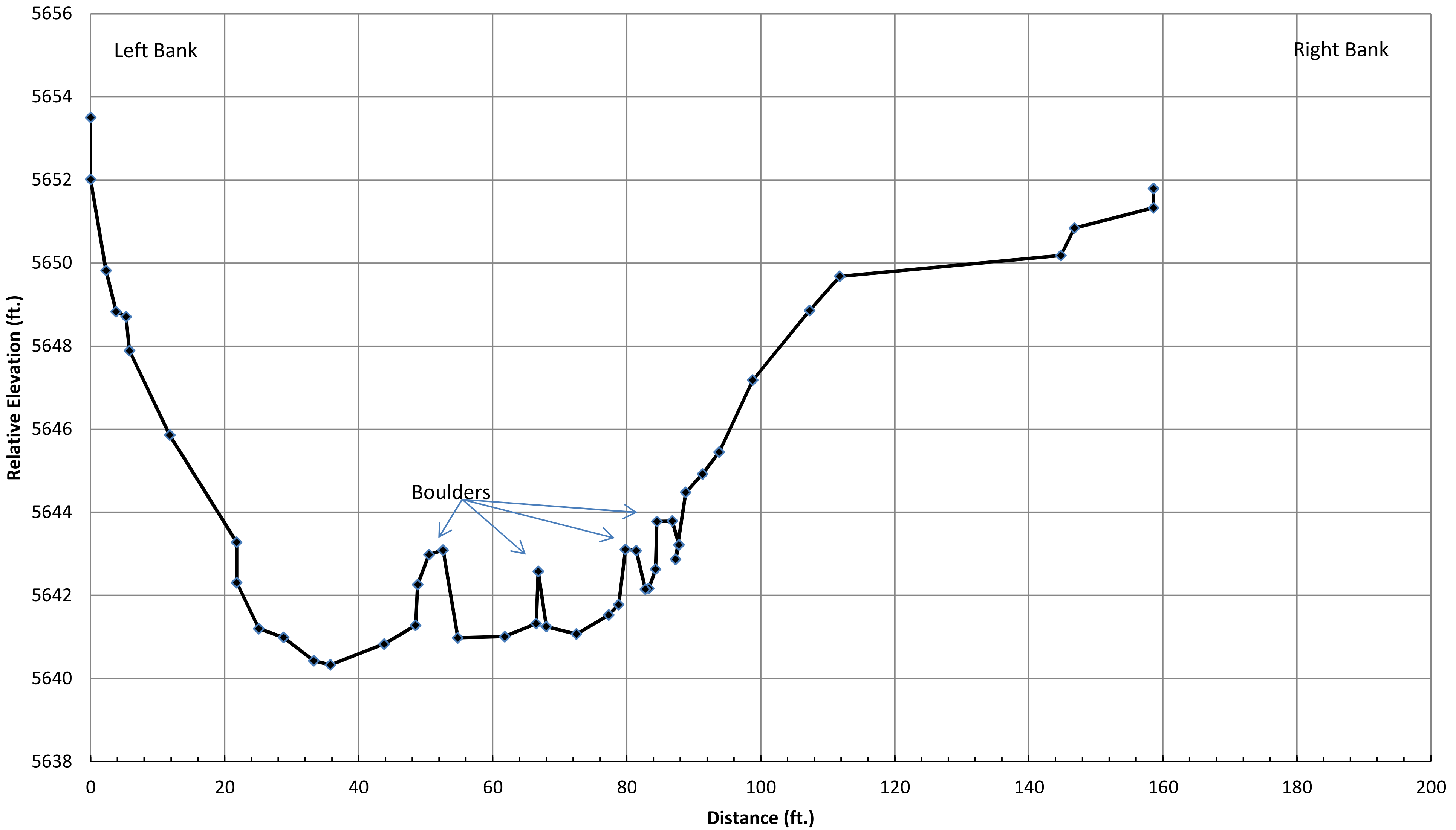
Digitized sketch map of summer 2011 conditions, San Francisco Fly Casting Club, Middle Truckee River, Nevada County, California. Changes between summer 2010 and summer 2011 annotated in blue.

210011 Digitized Map Figures

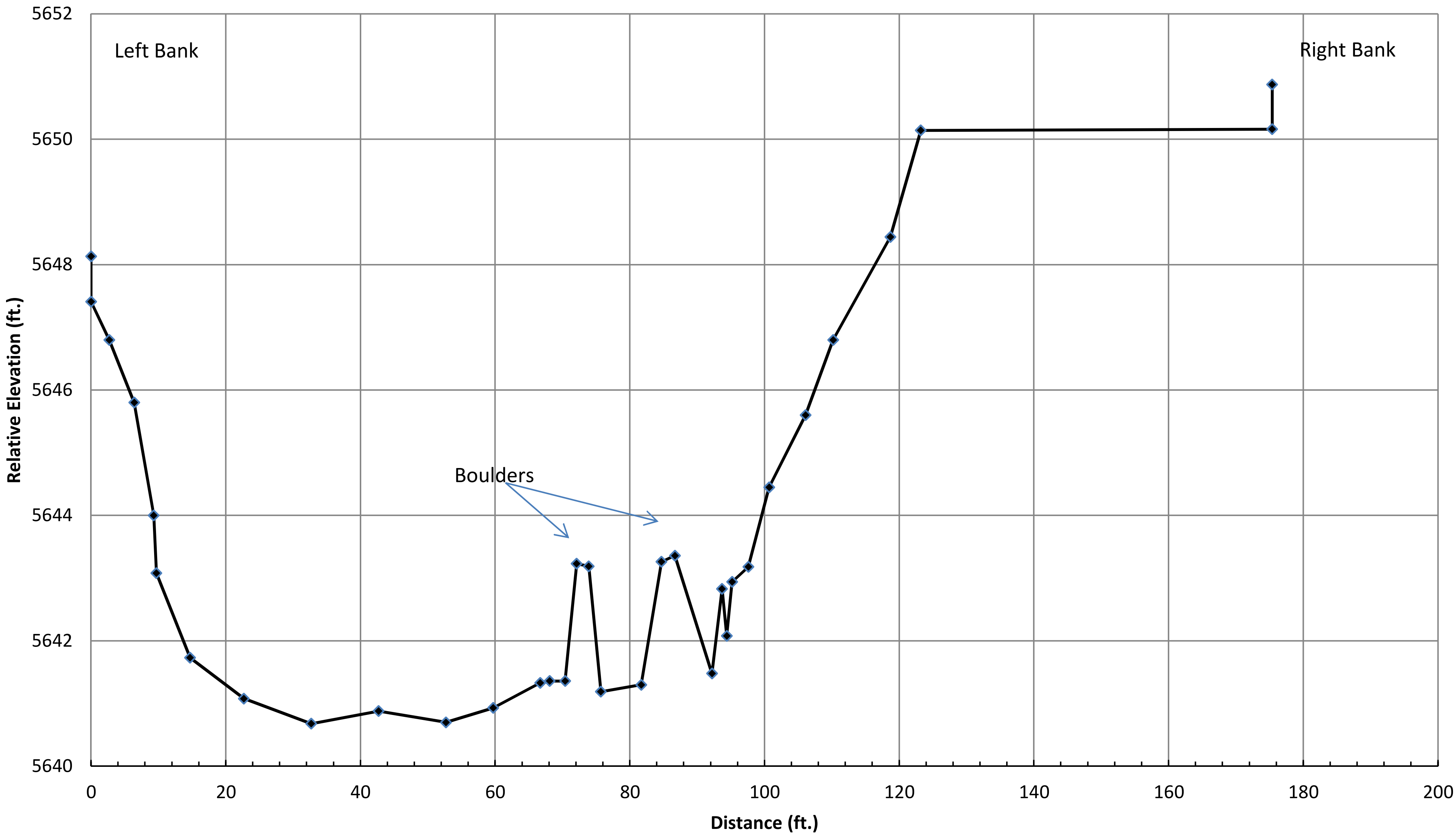
Source: Image: Google Earth, Mapping: Balance Hydrologics



Source: Balance Hydrologics Survey

Balance Hydrologics, Inc.

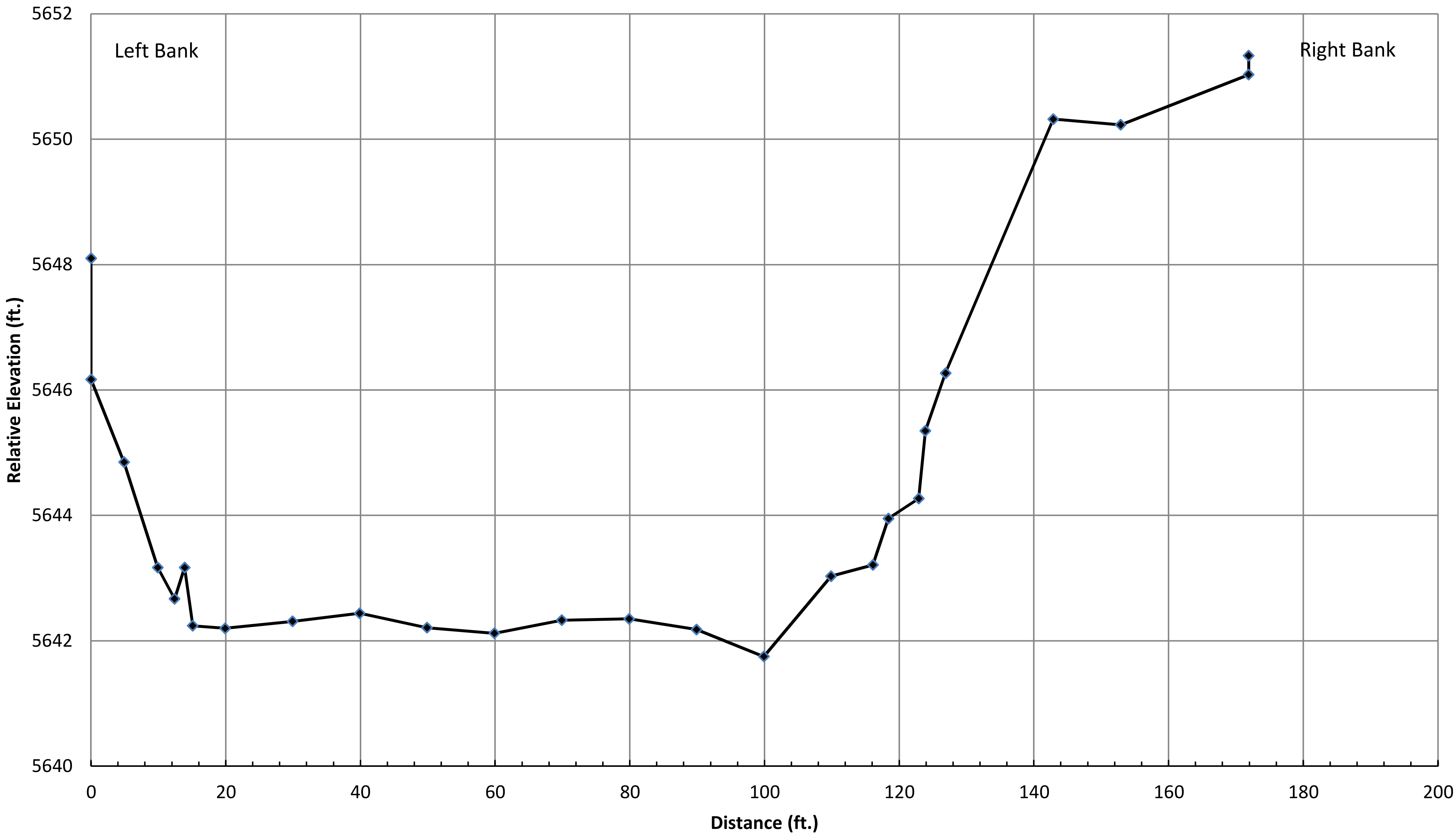
Figure 6. Cross-section 1 at the San Francisco Fly Casting Club (MTFC), Middle Truckee River, Nevada County, California.



Source: Balance Hydrologics Survey

Balance Hydrologics, Inc.

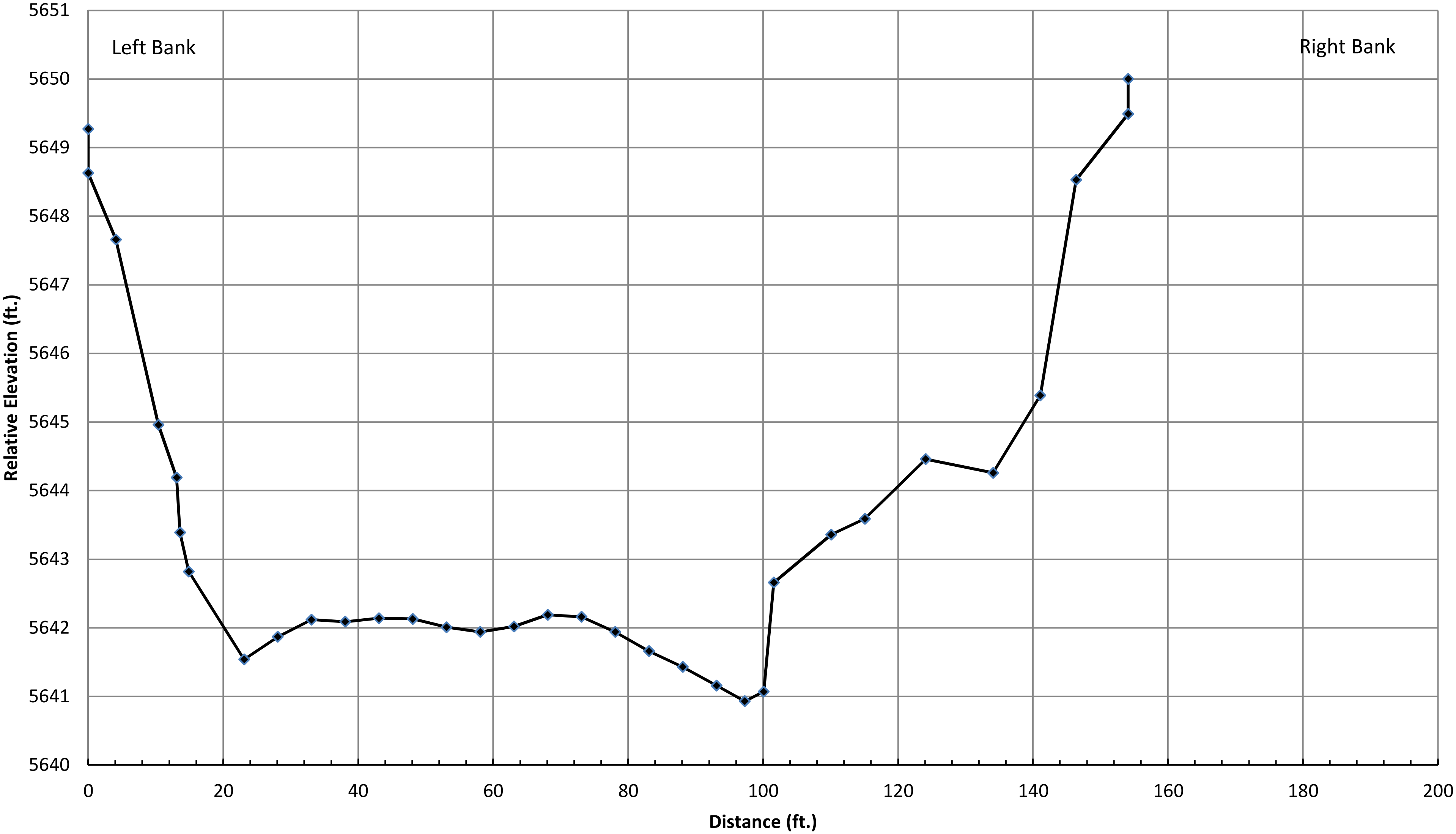
Figure 7. Cross-section 2 at the San Francisco Fly Casting Club (MTFC), Middle Truckee River, Nevada County, California.



Source: Balance Hydrologics Survey

Balance Hydrologics, Inc.

Figure 8. Cross-section 3 at the San Francisco Fly Casting Club (MTFC), Middle Truckee River, Nevada County, California.



Source: Balance Hydrologics Survey

Balance Hydrologics, Inc.

Figure 9. Cross-section 4 at the San Francisco Fly Casting Club (MTFC), Middle Truckee River, Nevada County, California.

Cross-section 162

Cross-section 234

Cross-section 324

Cross-section 451

Balance Hydrologics, Inc.

Figure 10. **2011 photo points at the San Francisco Fly Casting Club (MTFC) site, Middle Truckee River, Nevada County, California.**

file name Bed Conditions Photodoc

Source: Balance Hydrologics

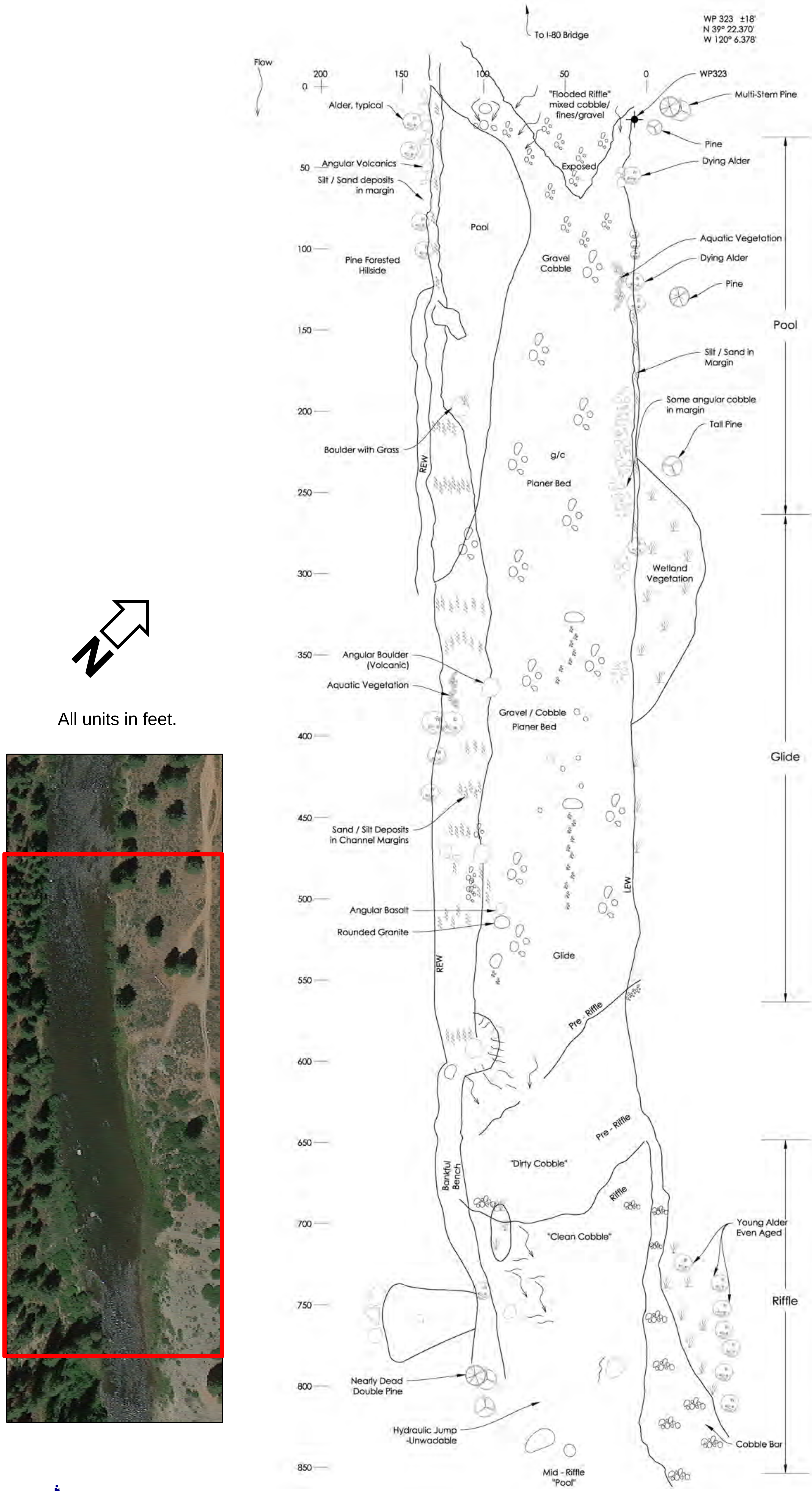
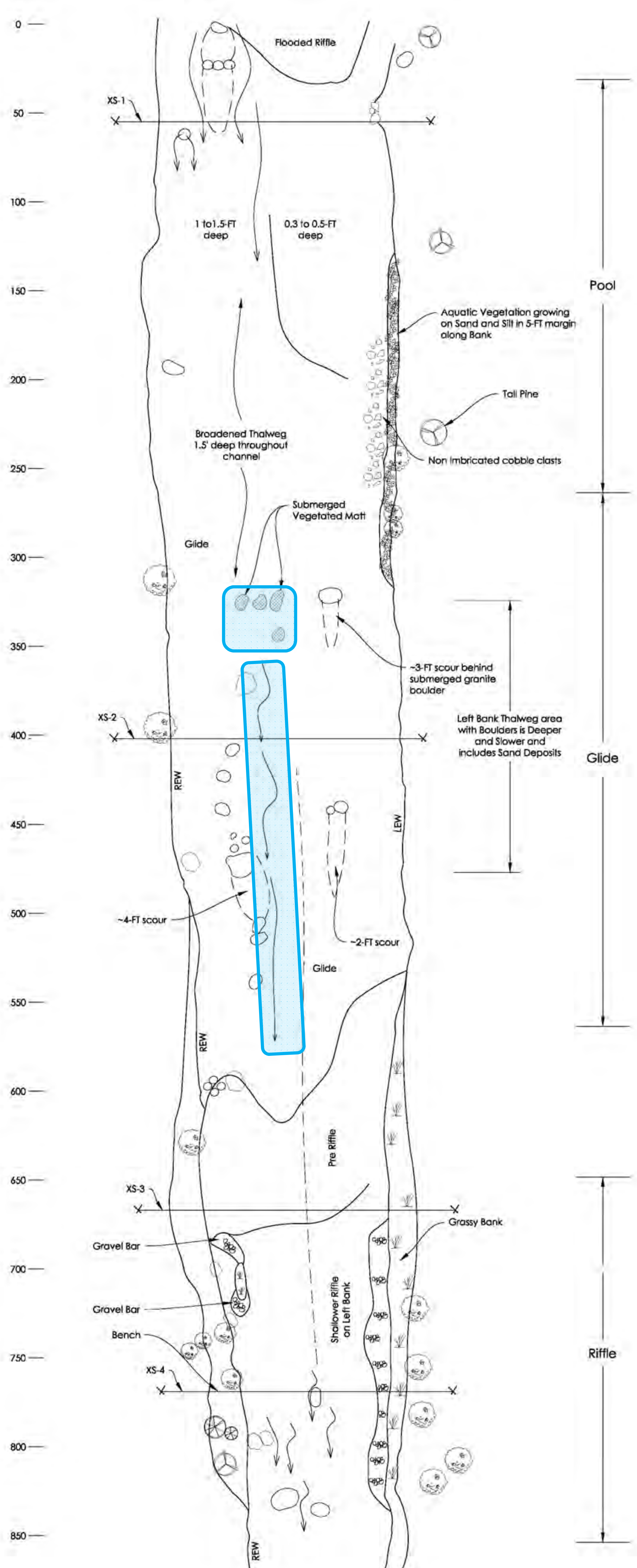


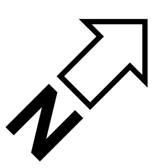
Figure 11 . **Digitized sketch map of summer 2010 conditions, Horseshoe Bend, Middle Truckee River, Nevada County, California**

Balance Hydrologics, Inc.

210011 Digitized Map Figures

Source: Image: Google Earth, Mapping: Balance Hydrologics





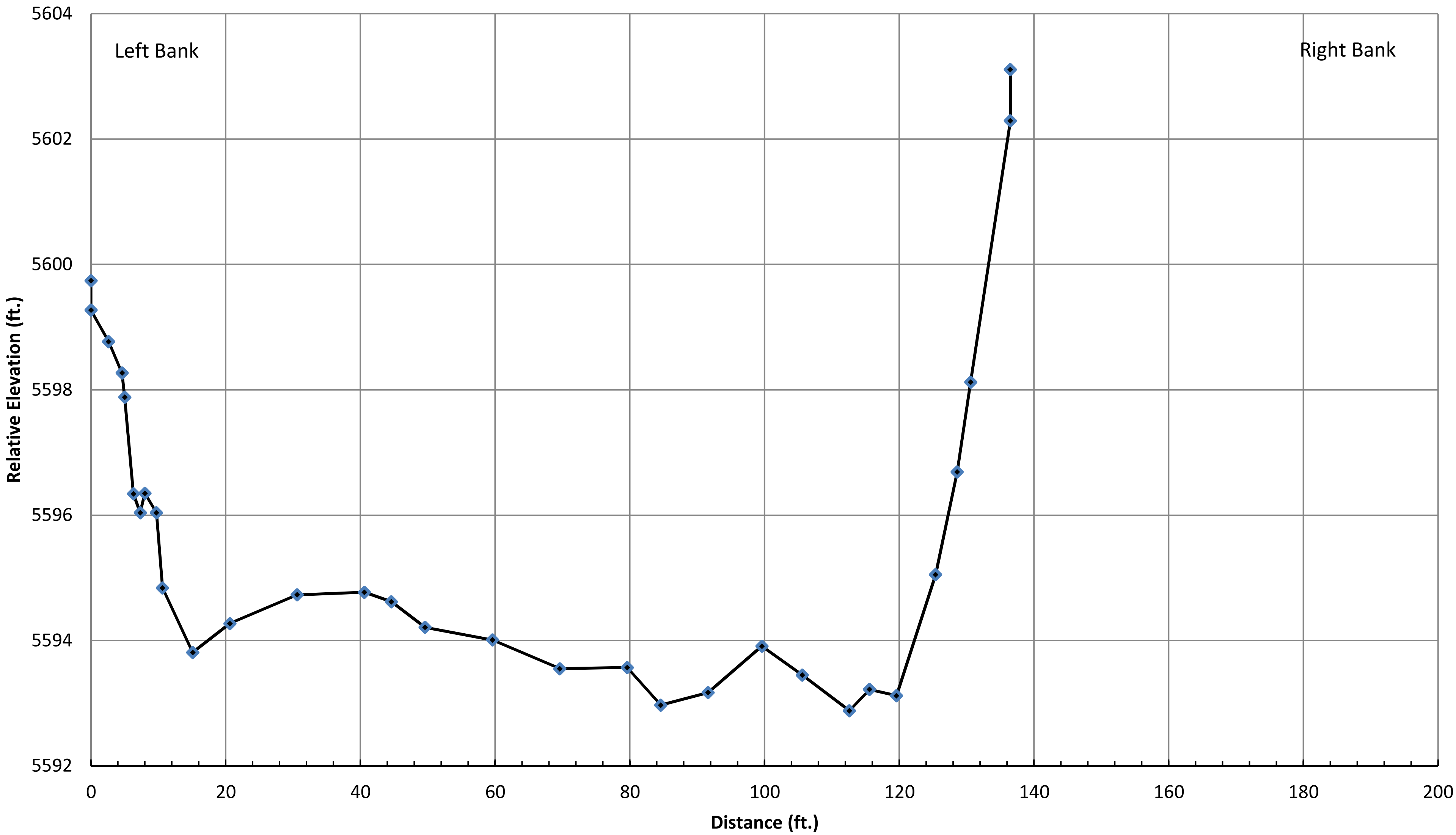
All units in feet.

Areas of detected change between 2010 and 2011

Balance Hydrologics, Inc.

Figure 12 . **Digitized sketch map of summer 2011 conditions, Horseshoe Bend, Middle Truckee River, Nevada County, California.**
Changes between summer 2010 and summer 2011 annotated in blue.

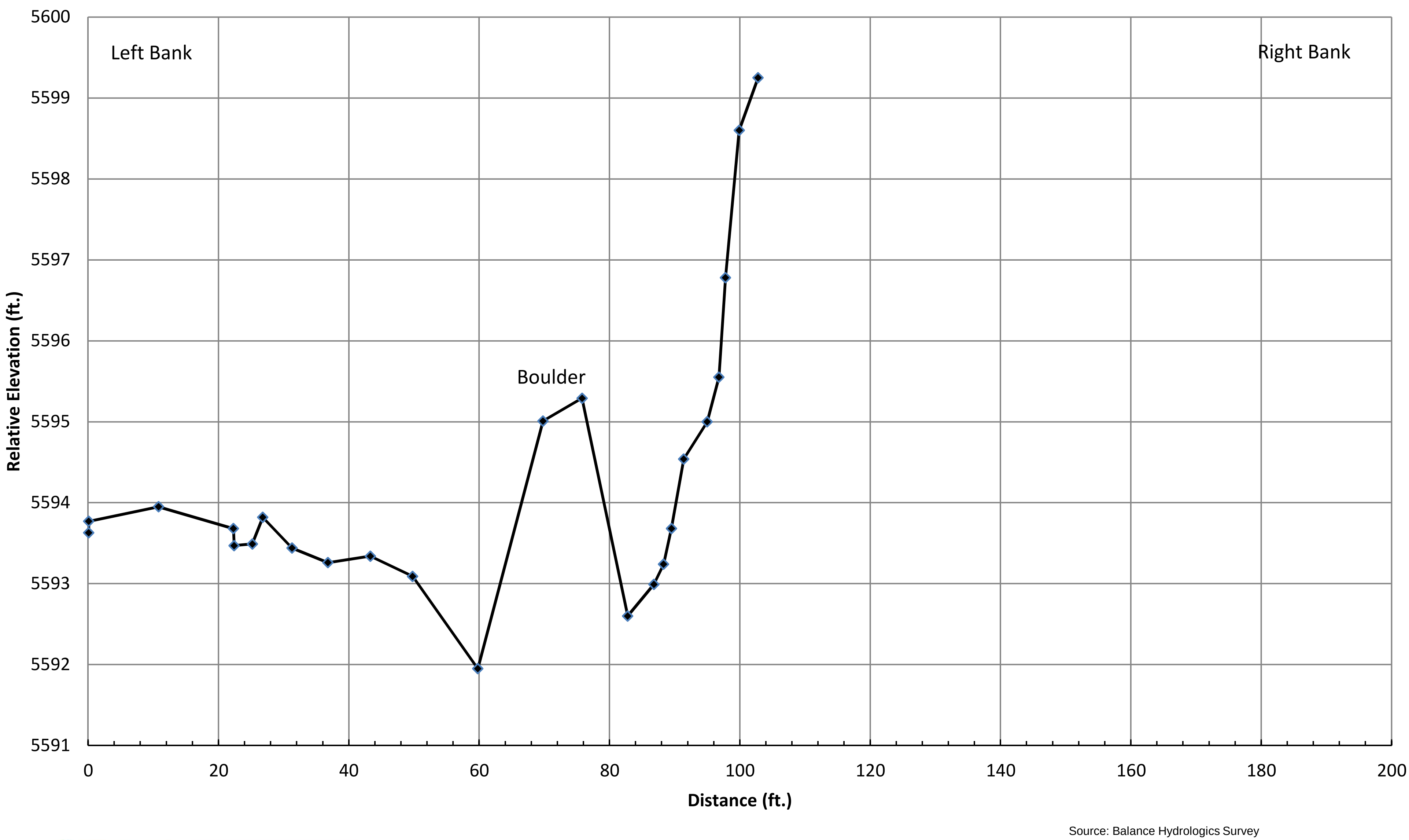
Source: Image: Google Earth, Mapping: Balance Hydrologics



Source: Balance Hydrologics Survey

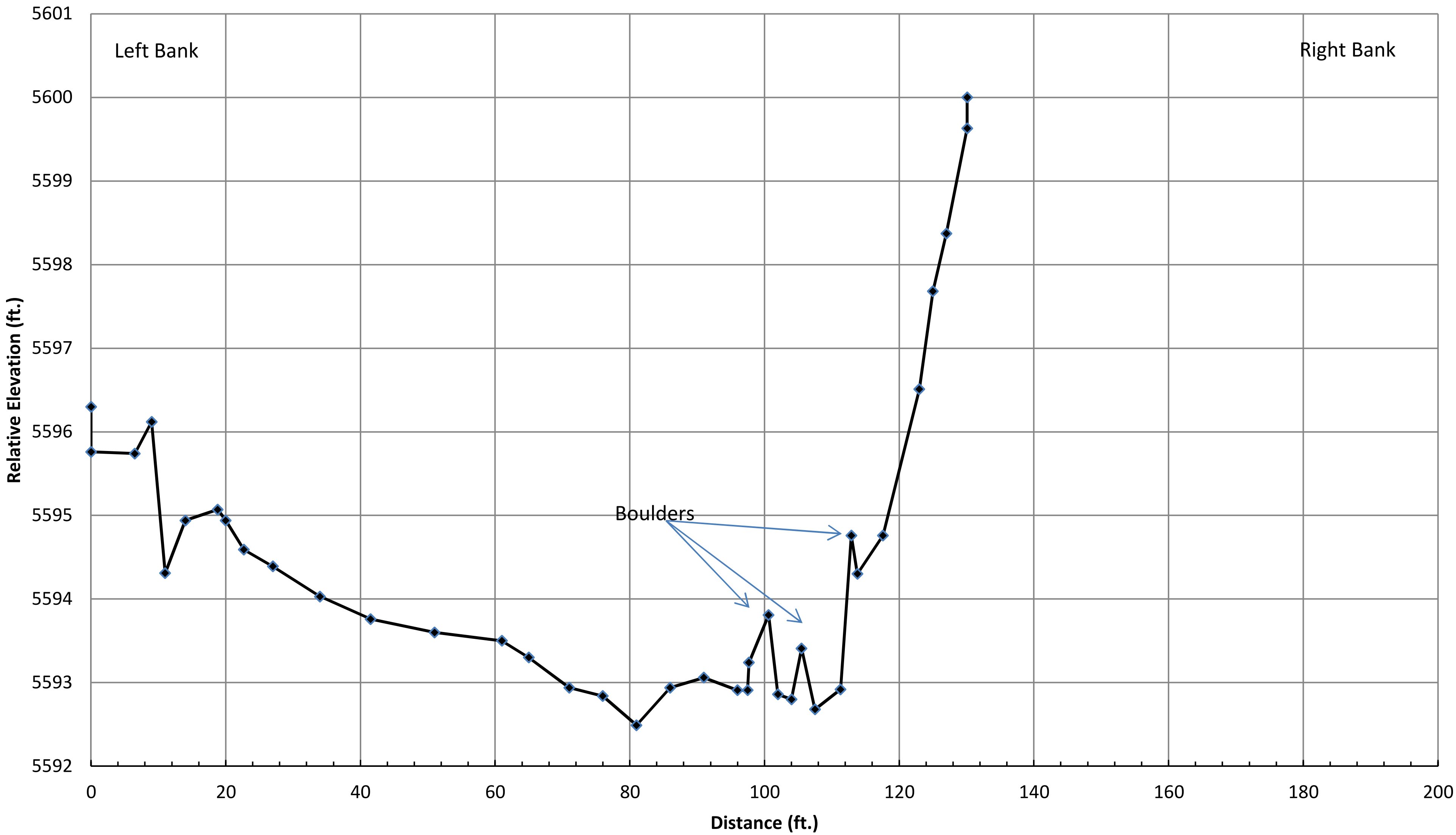
Balance Hydrologics, Inc.

Figure 13. Cross-section 1 at Horseshoe Bend (MTHB), Middle Truckee River, Nevada County, California.



Balance Hydrologics, Inc.

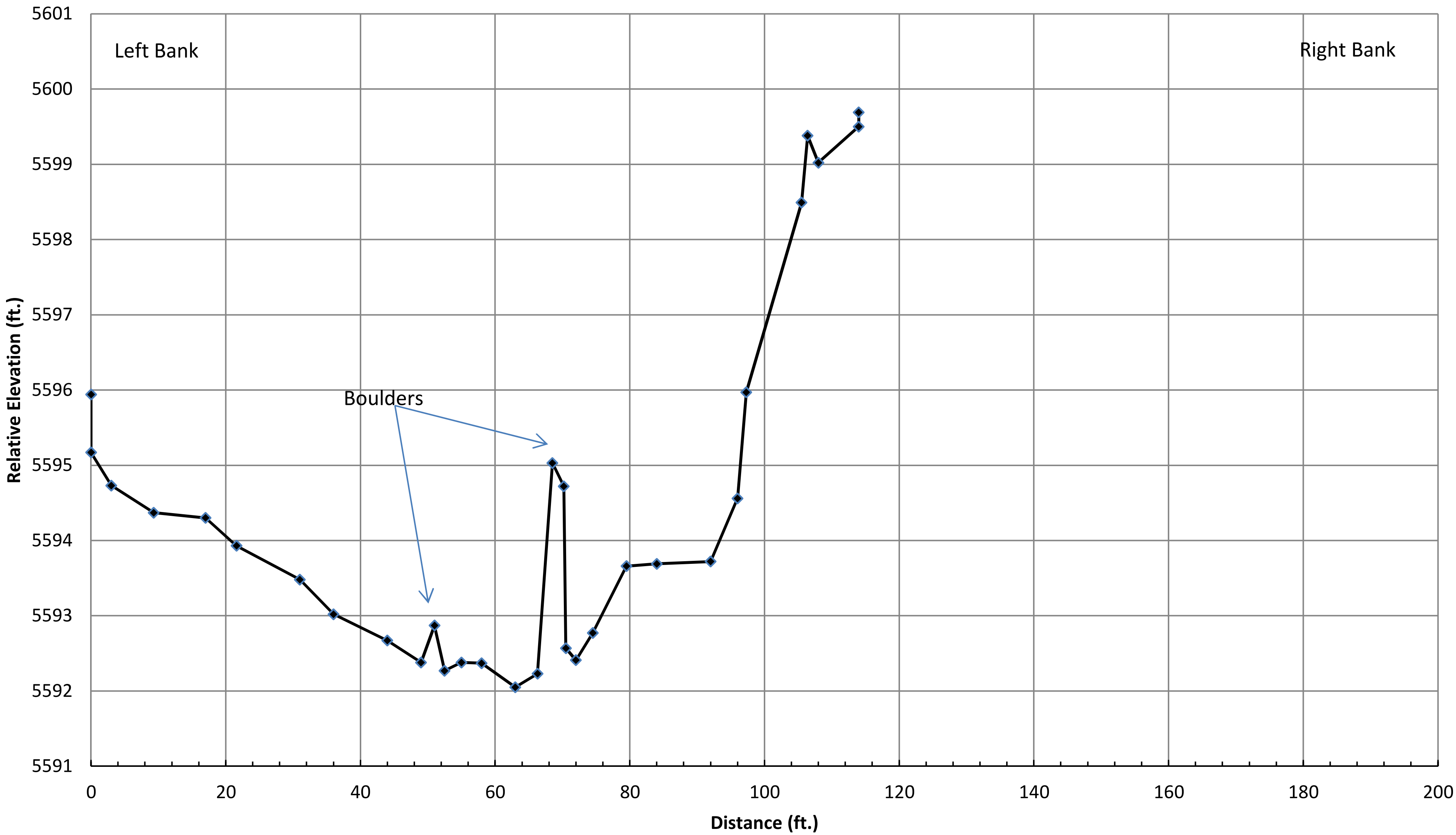
Figure 14. Cross-section 2 at Horseshoe Bend (MTHB), Middle Truckee River, Nevada County, California.



Source: Balance Hydrologics Survey

Balance Hydrologics, Inc.

Figure 15. Cross-section 3 at Horseshoe Bend (MTHB), Middle Truckee River, Nevada County, California.



Source: Balance Hydrologics Survey

Balance Hydrologics, Inc.

Figure 16. Cross-section 4 at Horseshoe Bend (MTHB), Middle Truckee River, Nevada County, California.

Cross-section 55

Cross-section 402

Cross-section 667

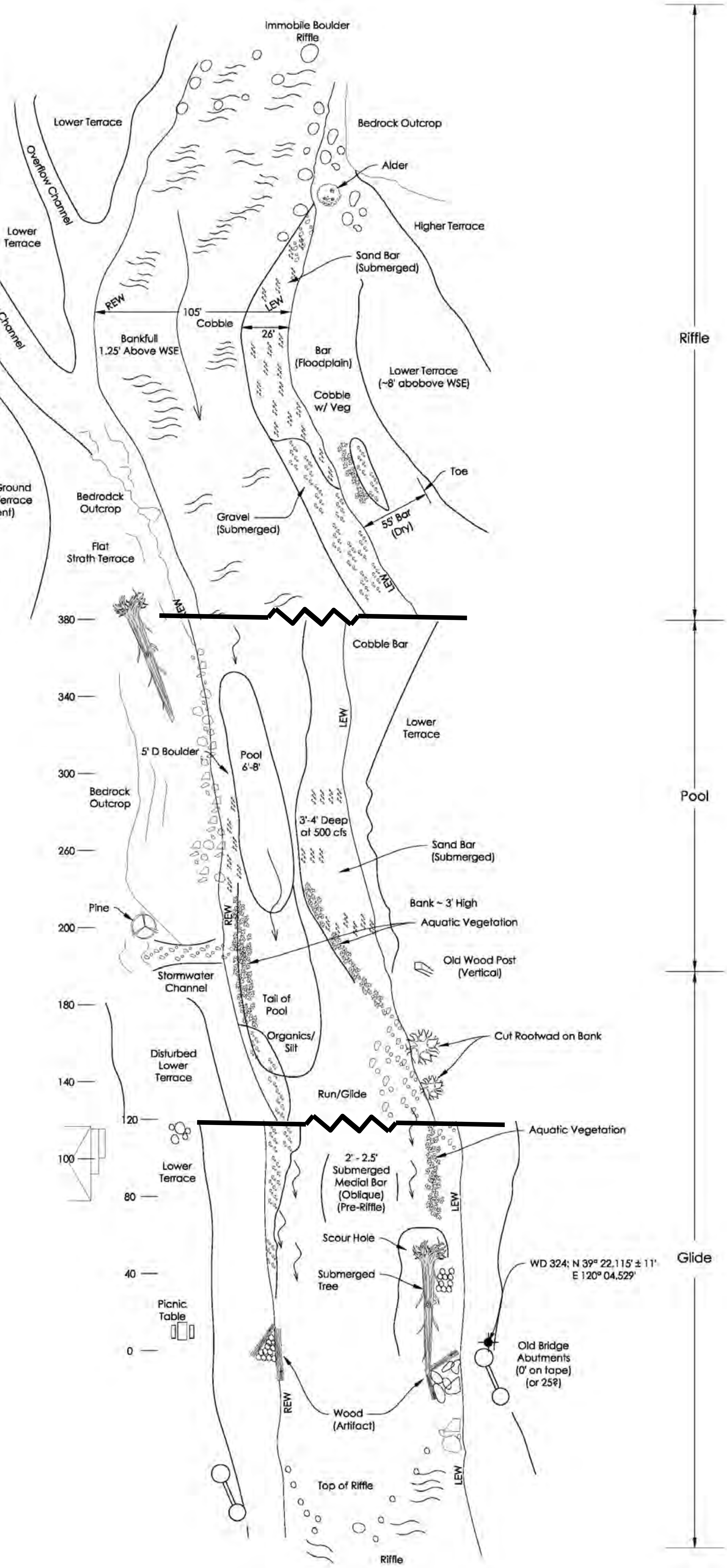
Cross-section 769

Balance Hydrologics, Inc.

Figure 17. **2011 photo points, at the Horseshoe Bend (MTHB) site, Middle Truckee River, Nevada County, California.**

file name Bed Conditions Photodoc

Source: Balance Hydrologics



Balance Hydrologics, Inc.

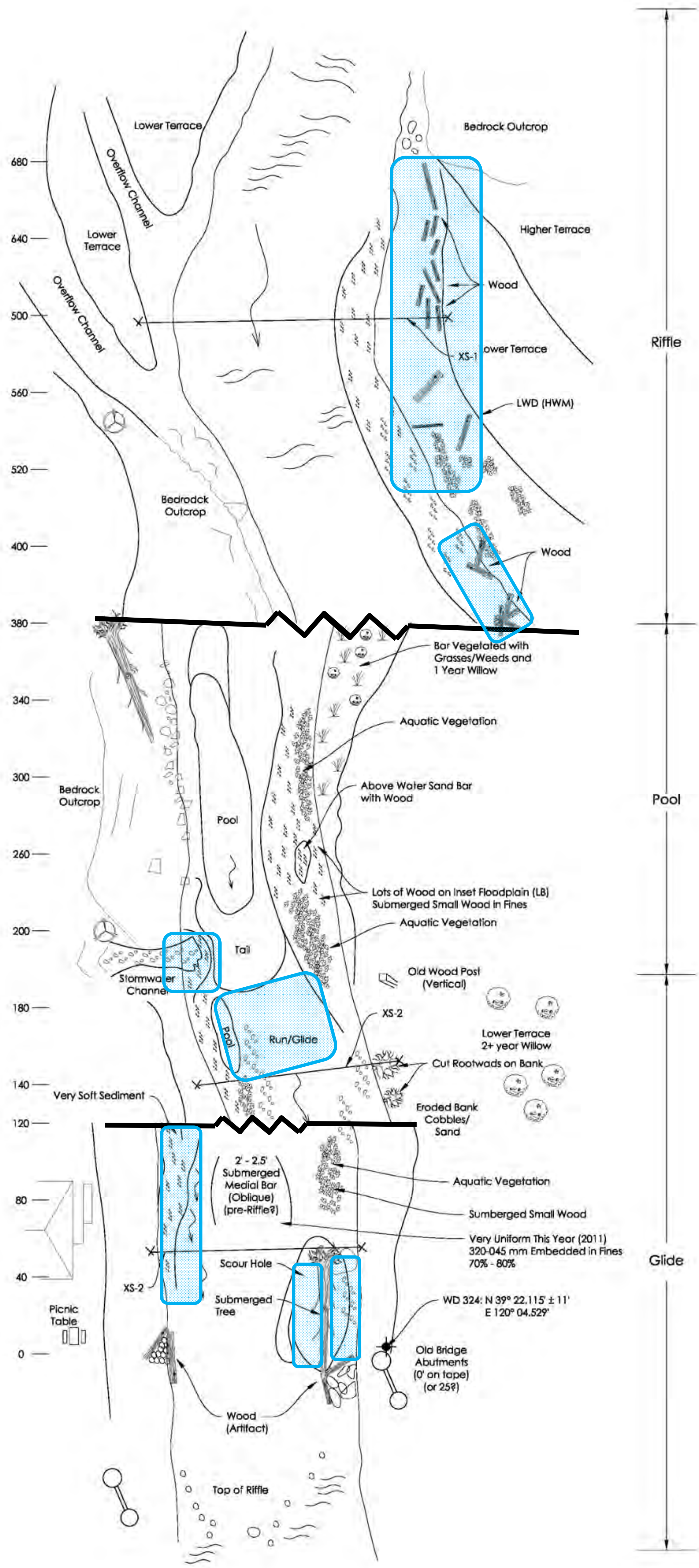
Figure 18 . **Digitized sketch map of summer 2010 conditions at Hirschdale Road, Middle Truckee River, Nevada County, California.**
Note that Hirschdale Road Reach was sketched on three separate sheets. Long profile distances have been correlated, but the separate sketches not shifted and rotated. Sketches are separated by dividing lines.

210011 Digitized Map Figures

Source: Image: Google Earth, Mapping: Balance Hydrologics

N

All units in feet.

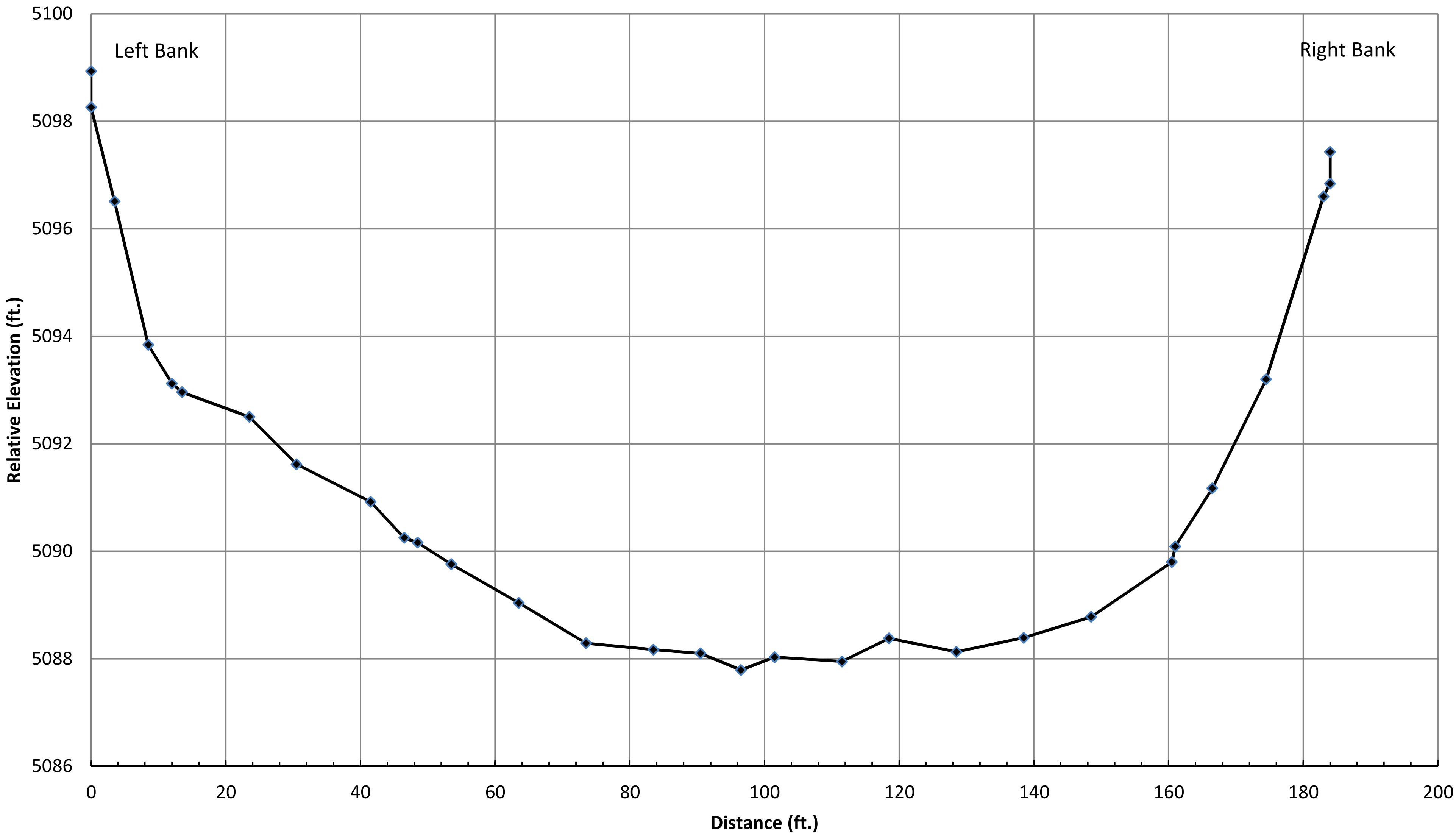


Areas of detected change between 2010 and 2011

Balance Hydrologics, Inc.

Figure 19 . Digitized sketch map of summer 2011 conditions at Hirschdale Road, Middle Truckee River, Nevada County, California. Changes between summer 2010 and summer 2011 annotated in blue. Note that Hirschdale Road Reach was sketched on three separate sheets. Long profile distances have been correlated, but the separate sketches not shifted and rotated. Sketches are separated by dividing lines.

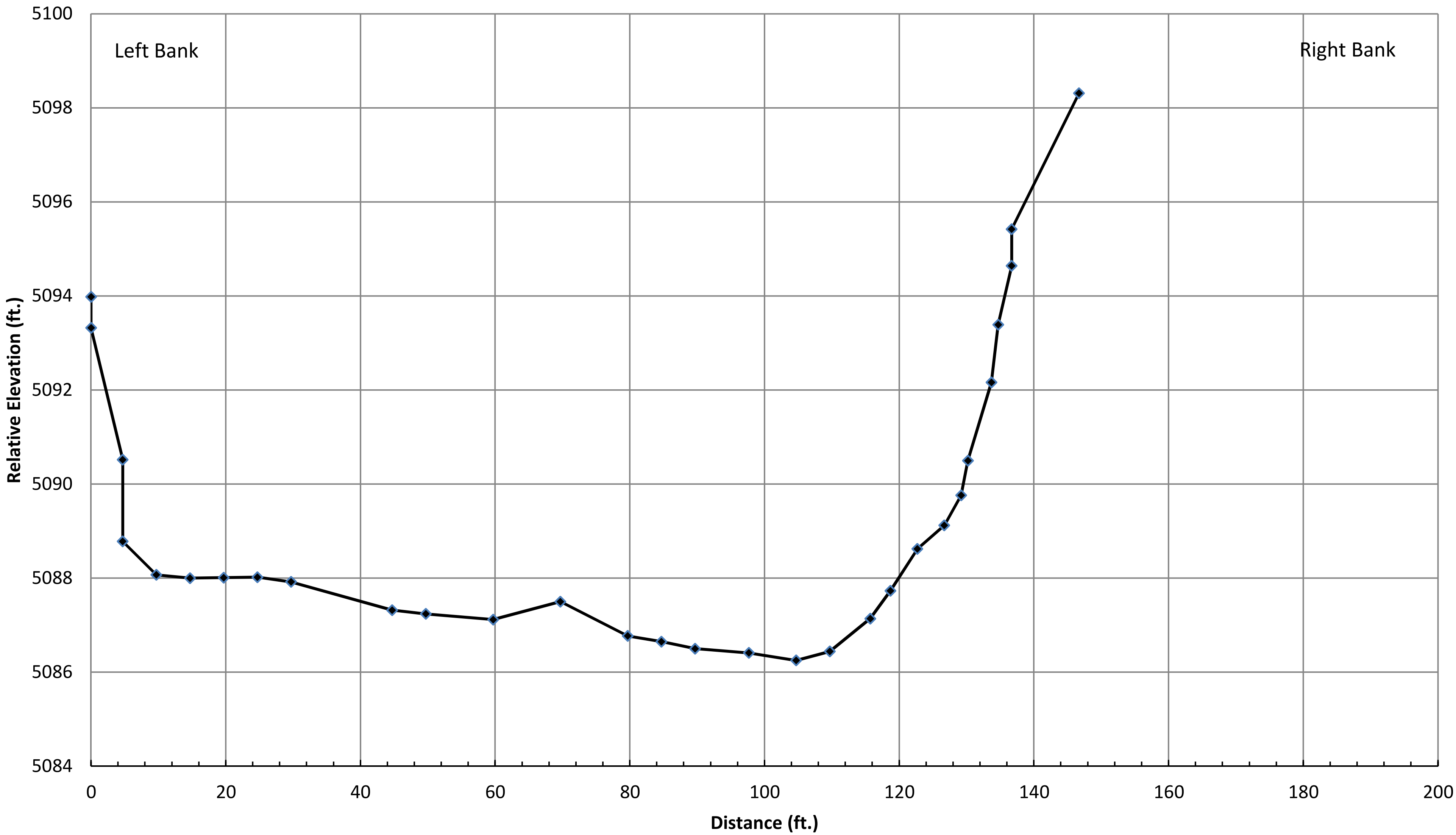
Source: Image: Google Earth, Mapping: Balance Hydrologics



Source: Balance Hydrologics Survey

Balance Hydrologics, Inc.

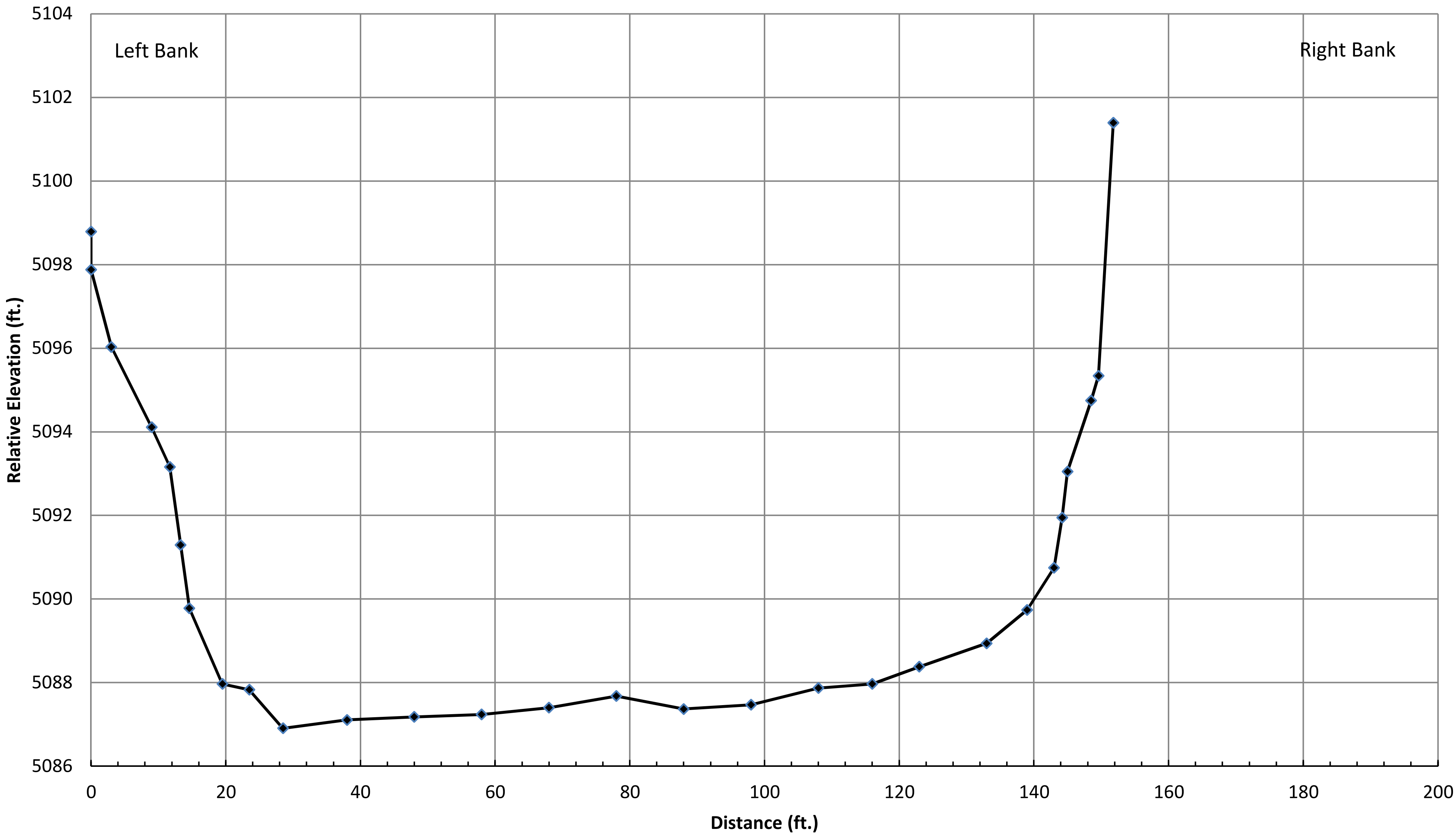
Figure 20. Cross-section 1 at Hirschdale Road (MTHR), Middle Truckee River, Nevada County, California.



Source: Balance Hydrologics Survey

Balance Hydrologics, Inc.

Figure 21. **Cross-section 2 at Hirschdale Road (MTHR), Middle Truckee River, Nevada County, California.**



Source: Balance Hydrologics Survey

Balance Hydrologics, Inc.

Figure 22. **Cross-section 3 at Hirschdale Road (MTHR), Middle Truckee River, Nevada County, California.**

Looking Upstream, Right Bank near Cross-section 2

Looking Downstream, Right Bank near Cross-section 1

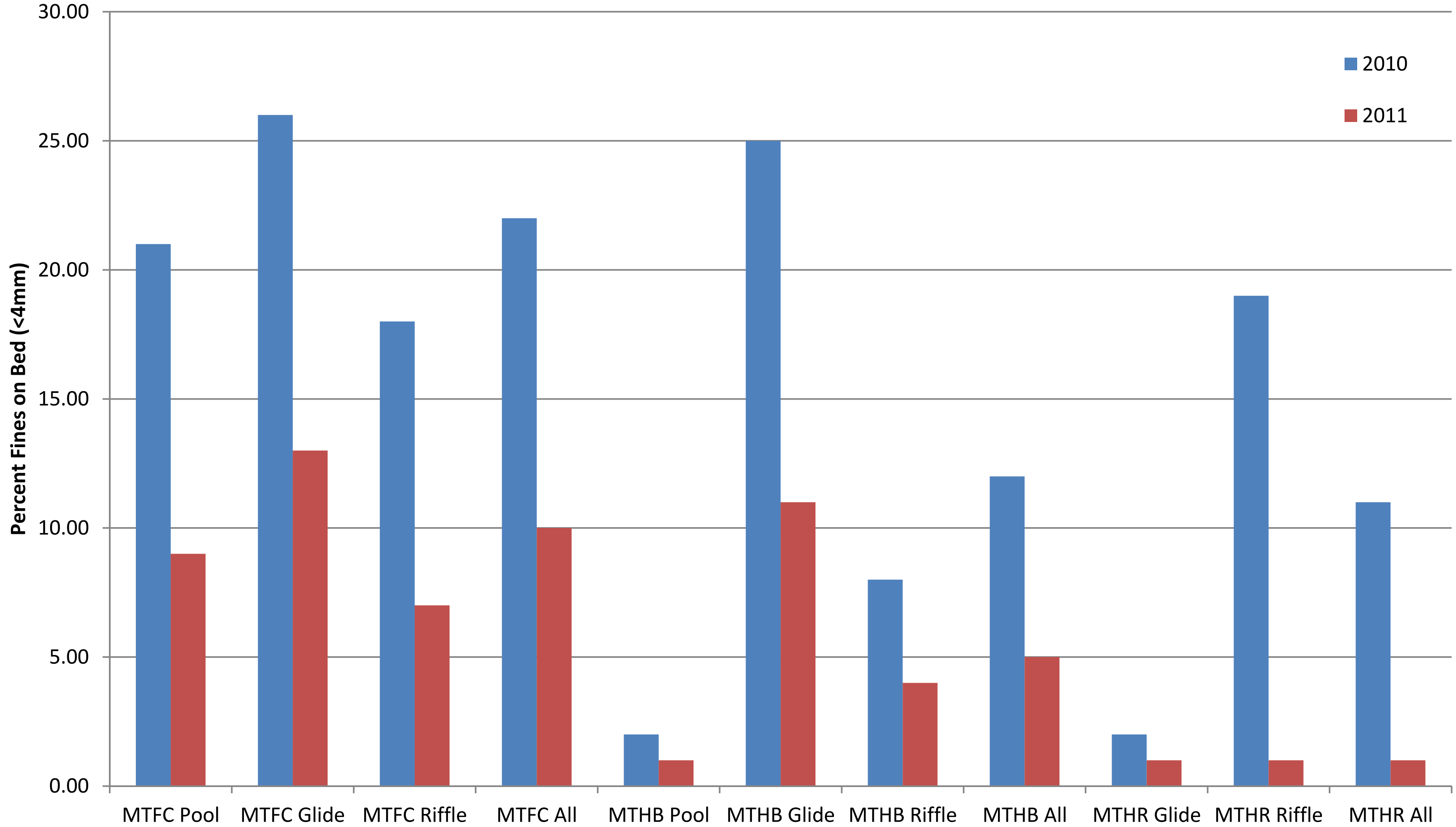
Looking Upstream, Right Bank near Cross-section 1

Balance Hydrologics, Inc.

file name Bed Conditions Photodoc

Figure 23. **2011 photo points at the Hirschdale Road (MTHR) site, Middle Truckee River, Nevada County, California.**

Source: Balance Hydrologics



Source: Balance Hydrologics

Balance Hydrologics, Inc.

Figure 24. Comparison of percent fines on the bed (<4mm) between 2010 and 2011 bed surveys. Middle Truckee River TMDL, Truckee River, Nevada County California. Note that fewer fines were observed on the bed at every unit within all three reaches during the 2011 pebble counts compared to the 2010 pebble counts.

210011 2010 Middle Truckee pebble counts

APPENDICES

APPENDIX A
Middle Truckee TMDL Assessment and Monitoring, Balance Hydrologics Stream Reconnaissance

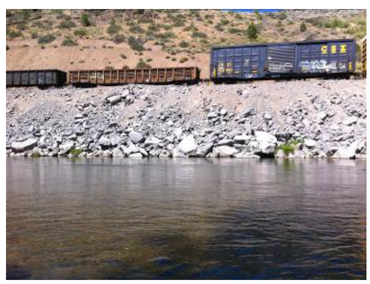
APPENDIX A

Middle Truckee TMDL Assessment and Monitoring
Balance Hydrologics Stream Reconnaissance
Truckee River, Trout Creek, Alder Creek
Nevada County, California

Truckee River: Glenshire Bridge to Hirschdale
August 27, 2010
Staff: David Shaw
Weather: sunny, warm 85 degrees
Flow conditions: 492 cfs at Boca Bridge (USGS #10344505)

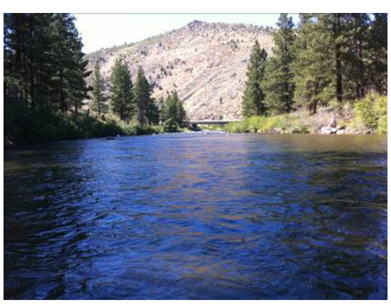
WP282

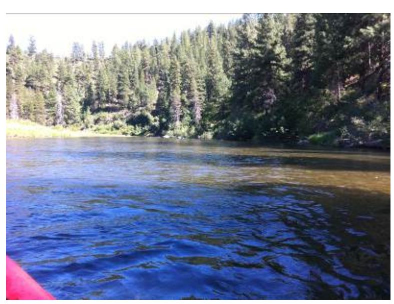
- San Francisco Fly Casting Club (SFFCC)
- RR Track on left bank, dry ravel directly into channel
- Large pool, relatively shallow, fine sediment on bottom seems to increase here compared to upstream locations.


WP283

- Long shallow pool downstream of I-80 Bridge, downstream of Prosser Cr. Confluence
- Good access off of I-80, easy to monument
- Pool is shallow and long, straight, with somewhat significant fines accumulation
- Maximum depth in scour holes around boulders in glide


Upstream view


Downstream view

WP284
Pool-Glide-Riffle just upstream of Hirschdale Road Bridge
Quite Deep

Truckee River: Hirschdale to Floriston
September 2, 2010
Staff: David Shaw and Brian Hastings
Weather: sunny, warm 85 degrees
Flow conditions: 495 cfs at Boca Bridge (USGS #10344505)

WP294

- Put-in: Downstream of Boca Bridge and Little Truckee River confluence
- GPS waypoint #295 (base of boulder riffle)
- Steep riffle (Immobile) under I-80 bridge leads to deep pool and bedrock constricted channel
- Additional riffle (mobile)
- Abundant fines in riffle/glide with noticeable algae.
- Right bank boulders form scour holes
- Pools are turbid, visibility less than 2 feet
- Fallen pine across river, cut at rootwad.

WP295

- Near Hinton, T18N, R17E, Section 34
- Gravel pit occupies the area on right bank, which is heavily disturbed;
- Boulders appear pushed into river, abundant fines associated with erosion of right bank
- Deposition of fines noticeable in eddies or slow water environs
- Abundant submerged aquatic vegetation (algae)
- Private property signs on both banks, 1,000 feet upstream from Hirschdale Bridge
- Railroad impinges on left bank

WP296

- Near Hirschdale
- Riffle at Hirschdale Bridge is constricted by bridge—giant center bar d/s of bridge resultant of constriction in high flows
- U/S of this riffle is a riffle/pool/glide sequence that may be ideal for monitoring!
- Abundant fines in pool and eddies, turbid with visibility only 2-3 feet.
- Access: Hirschdale exit on I-80, drive to Hirschdale bridge.

WP297

- Juniper Creek Confluence
- Estimated flow from Juniper Creek: 0.5-1.0 cfs
- Bar immediately upstream of confluence suggests flows from Juniper are influencing hydraulics and deposition in the Truckee River (active bar, uniform 1-yr old willows)
- Medium gravels with algae growth at this reach
- Juniper Ck is steep tributary with significant fan/delta deposit at its mouth (D50 > 256 mm)

WP298

- Downstream of Juniper Creek
- Four (4) riffles downstream of Juniper confluence are well defined and close together
- Initially, ample floodplain on right bank—then left bank suggesting Juniper moves significant material into the Truckee [gravel to small cobble]
- USGS maps suggest high flows occupy backwater channel behind left bank floodplain/bar
- Union Pacific RR is ~800 ft to the north; no man-made constrictions in this reach

WP299

- First bedrock constriction d/s of Juniper Creek
- T18N, R17E, Section 35
- Potential monitoring location in pool/riffle sequence
- Located at d/s end of large left bank floodplain and gravel beach
- [how far downstream does Juniper ck influence morphology]
- Riffles are CLEAN, pools have moderate to high visibility > 3 ft, minimal algae
- Riffle is mostly composed of large gravels, very mobile.
- Access: Hirschdale Road, across bridge, may need to cross RR on foot.
- Pool may be too deep to wade, bring wetsuit and snorkel

Truckee Canyon (per USGS map name)
Steep reach
Series of Class II and one Class 3 rapid
Bedrock confined reach

WP300

- Truckee Canyon (Sections 35/36 boundary)
- Martis Fire zone
- Valley widens with giant center bar bifurcating flow
- Thalweg river left
- Potential monitoring site: long riffle with deep (5ft) pool at bend
- Algae noticeable on bed again here
- Access: Campsite accessible by 4WD from Iceland Road

WP300

- Truckee River Wildlife Area
- T18N, R17E, Section 36
- Two small tributaries enter from right bank (unnamed, Casey Canyon)
- Left bank, 10-ft high eroding bank (fines)
- Riffle around bifurcated bar, clean gravels, no algae, visibility 3-4 ft in pools
- Left bank artificial fill from RR
- Limited Access
- Artificial constriction (riprap,rebar) generating small riffle roughly 400 ft d/s of this point

Between Casey Canyon and Gray Creek
Good riffle/pool/glide sequence after artificial constriction riffle
Access limited

WP302

- Gray Creek confluence
- RR crossing at confluence influences channel morphology
- Gray Creek is very steep tributary with large fan/delta deposit at mouth
- Estimated flow: 10-20 cfs
- Gravel-cobble-boulder material at mouth
- Sediment may have been heavily influenced by Martis Fire

WP303

- Truckee River near Iceland
- T18N, R18E, Section 31
- Steep reach with continuous Class II rapids
- Riffles too steep and swift to wade safely
- Banks have abundant willows (15-20 ft high)
- Difficult to identify a monitoring site between Gray and Bronco Creeks
- Bronco Creek Confluence
- RR constricts channel on right bank, abundant fines
- Could not identify confluence (may be dry?)
- Very steep reach with Class II rapids, deep pools

Truckee River at JAWS (class IV rapid)
T18N, R18E, Section 30
(Take out)

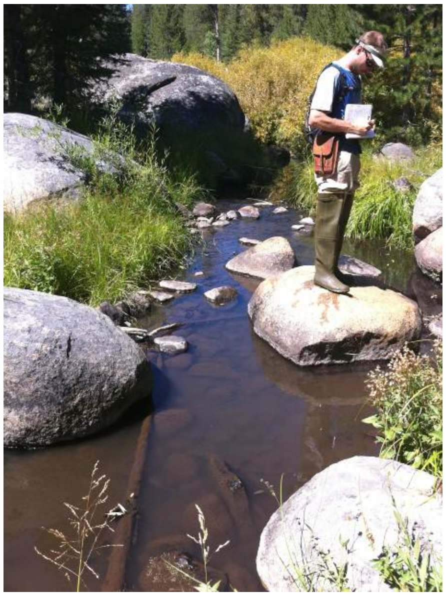
Trout Creek, Lausanne Way to Jibboom Sreet (downstream of Tahoe Donner)
September 3, 2010
Staff: David Shaw and Brian Hastings

WP304

- Channel is narrow through a steep meadow with grassy banks and willow/alder riparian cover
- Step pool morphology with channel width of ~4 to 5 feet
- Cobble-boulder substrate with abundant algae, some fines in pools, mostly gravels
- Water is slightly turbid

WP305

- Riparian corridor opens up to meadow, with deep pools (~3-ft deep)
- Beaver are present and active, with multiple well-developed side channels
- Glacial erratics present throughout meadow



WP306

- Large pool formed by erratic under a fallen tree
- Pool is 3' deep
- Extensive milfoil mat covering bottom of pool.
- Pool discharges over small riffle into a second pool with large boulders. Second pool is covered by fines and gravel. 8" fish are present

WP307

- Several pools present between boulders, most pools have abundant milfoil, complicating measurement of fine sediment

WP308

- Power line corridor
- Active bank erosion, and abundant gravels in pools
- Localized erosion may be influencing substrate downstream from here.

WP309

- Confluence with tributary, under power lines
- Power line maintenance road and construction of road appears to have disturbed meadows, exposed soil still present

WP310

- Road crossing
- 10-ft CMP culvert
- 1.5-ft drop at culvert outfall, with plunge pool. Pool is scoured to a cobble substrate
- Culvert inlet is constricted by boulders and wood, slightly collapsed at inlet, apparently from traffic loads over road.
- Culvert outfall hydraulics appear to affect channel form in a number of downstream pools

WP311

- Thick riparian vegetation, mostly alders
- Channel has riffle-pool morphology, alternating with step pools, with cobble as dominant substrate. Banks are eroding, apparently in equilibrium with channel form and bar development, appears to be vertically stable.
- Maximum pool depth is ~0.5-ft

WP313

- Coyote Moon Golf Course
- Large wood jam in channel, no sediment stored behind jam
- Significant wood, forming step pools with boulders
- Pools are relatively small, compared to other reaches

WP314

- Water clear, minimal fine sediment
- Pools are small, too small for V* or pebble counts

WP315

- Rebar with cap at pine tree noted (is this an established cross-section?)
- Thick willow and aspen riparian cover helping form a step-pool channel form, with roots establishing pool drops

WP316

- Pool roughly 20’ downstream of golf course bridge

August 28, 2010
Staff: David Shaw
Power lines to Jibboom St
Weather: sunny, warm 80 degrees
Flow estimated at 0.5 cfs

WP293

- Gravel pit and runoff spills to channel, offering continuous hydrologic connection between quarry and stream channel



WP292

- Left bank tributary confluence, fine sediment deposited at mouth of trib
- Depositional area: multiple channels

WP291

- Boulder-lined step pools with steep right bank and dry ravel above andesitic bedrock
- Occupied van encampment on left bank above channel
- Estimated V* = 10 percent of pool is filled with fine sediment


WP288

- Plane bed, pool appears to be entirely filled with fine andesitic gravel

WP289

- Long pool, roughly 10 percent of bed is covered with fines

WP287

- Mouth of I-80 culvert (8.5-ft CMP)
- 24-inch CMP discharging from right bank, immediately downstream of I-80 culvert outfall.

WP286

- Long pool immediately downstream of I-80 culvert
- Morphology through this reach is entirely constrained by hard infrastructure, with graded banks and reinforced channel
- 3 to 4-inch fish are present in pool

WP285

- Between I-80 and Jibboom St
- Small path from right bank to channel
- Channel consists of boulder-cobble step pools with significant fines accumulated on bed
- Evidence of runoff from road and road sand entering channel

Alder Creek, Tahoe Donner Campground to Highway 89
Staff: David Shaw
Estimated streamflow = 0.75 cfs

WP271
- Channel bifurcates into multiple channels across meadow system
- Cobble-gravel bed with thin cover of fines;
- Relatively recent forest thinning on right bank behind hillside
- Trees were cut to within 100 ft of channel

WP272
- Pool appears to be significantly filled with fines

WP273
- Beaver-dammed pool at head of wet meadow
- Significant fines covering channel bed

WP274
- Beaver activity forcing water out onto Emigrant Trail; maintenance will likely be required

WP275
- Confluence area with Carpenter Valley Branch
- Beaver still present but not as heavily disturbed

WP276
- Boulder-cobble reach, narrow riparian corridor

WP277

- Single-thread channel, limited beaver activity
- Right bank failure with trail at top of bank
  - Height = 8 ft
  - Length = 60 ft
  - Boulder-cobble in silt matrix
- Forest management (thinning) to within ~20 ft of channel)
- This is a potential reveg / stabilization project

WP278

- Pool-riffle sequence downstream of bank failure, transitions into boulder-cobble step pool reach

WP279

- Cobble-boulder controlled pool
- Several fish present, ~5-6-in
- Maximum depth is 2.5 to 3 feet
- Fine sediment covering bottom of pool

WP280

- Upstream end of pool-riffle sequence which continues for several hundred feet downstream to approximately trail crossing near Schussing Way

WP281

- Headcut in meadow

WP270

- Storm drain inlet on Alder Creek Road
- Road sand is visible on ditch bed
- This is similar to storm drainage at intersection of Alder Cr Rd and Schussing Way

WP268

- Flooded meadow upstream of beaver dams

WP267

- Gravel road stream crossing in beaver dammed pool

WP266

- Multiple channels

WP265

- Right bank failure
    - Height = 8 ft
    - Length = 25 feet
- Failure is in 6 feet of alluvium over silty-clay

WP263

- Representative steep cobble riffle

WP262

- Upstream end of right bank failure

WP261

- Downstream end right bank failure

WP260

- Boulder and cobble-controlled pool (see sketch)

WP259

- ‘Double-boulder Pool’
- Pool formed by debris jam on cobble grade control.
    - Max depth = 2’
- Large rhyolitic boulders on right bank

- Sand and cobble bed, approximately 1-in of sand deposited on gravels

WP257
- Downstream end of right bank failure
- Estimated bank failure length: 80 ft.
- Bank failure height: 10 ft.
- Failure is in sub-rounded cobble in gravel and sand matrix, fining upward to silty matrix near top of bank. Interpreted to be glacial outwash.

WP256
- Blown out beaver dam
- Willow and pine roots are maintaining channel grade where dam has failed
- Downstream end of burn piles on either side of channel

WP255
- Cobble and boulder controlled pool
    - ~75-ft long
    - 12-ft wide
    - 3-ft deep

WP254
- Beaver dammed pool with log jam on dam
- Riffle-pool morphology seems to be absent

WP253
- Cobble riffle with little to no sand or finer on bed

WP252

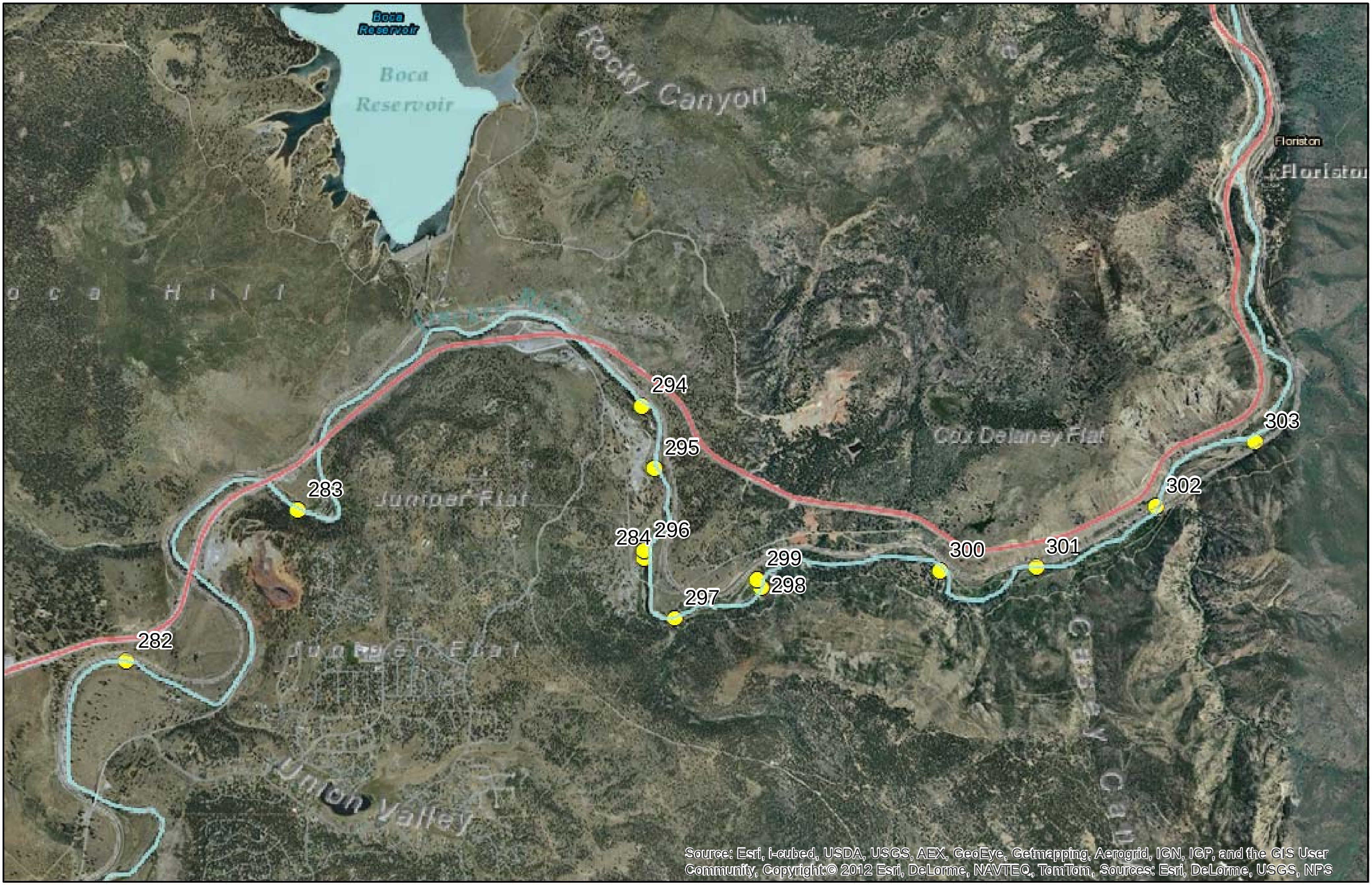
- Step pool morphology, with riffles
- Plunge pool is ~10’ long x 8’ wide, with cobble riffle downstream
- Abundant wood, some log jams appear to have been cleared (attempted to be cleared) as evidenced by fresh saw cuts

WP250

- Bedrock in channel, extensive large wood

WP251

- Right bank slope failure at soil/bedrock interface
- Boulder cobble bed downstream of slope failure, with 75-ft wide boulder and cobble floodplain
- Discontinuous bedrock outcrop\
- Extensive beaver activity



Balance Hydrologics, Inc.

Figure A1. Truckee River reconnaissance observation locations
Middle Truckee River TMDL Assessment and Monitoring
Nevada County, California

0 2,000 4,000 Feet

N

210011 Figure A1 Truckee recon points.mxd

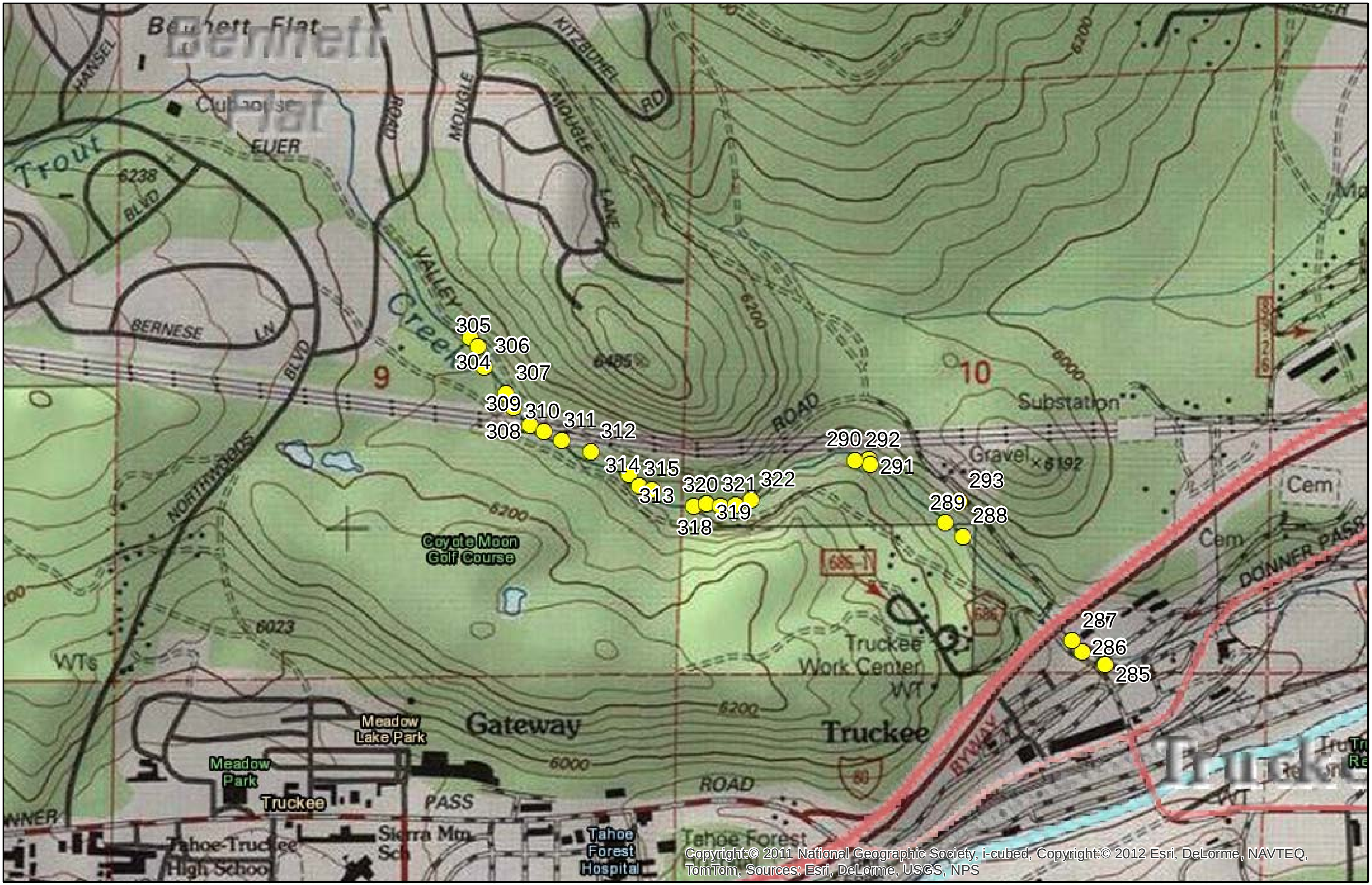


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Figure A2. Trout Creek reconnaissance observation locations
Middle Truckee River TMDL Assessment and Monitoring
Nevada County, California

0 750 1,500 Feet

N

210011 Figure A1 Truckee recon points.mxd

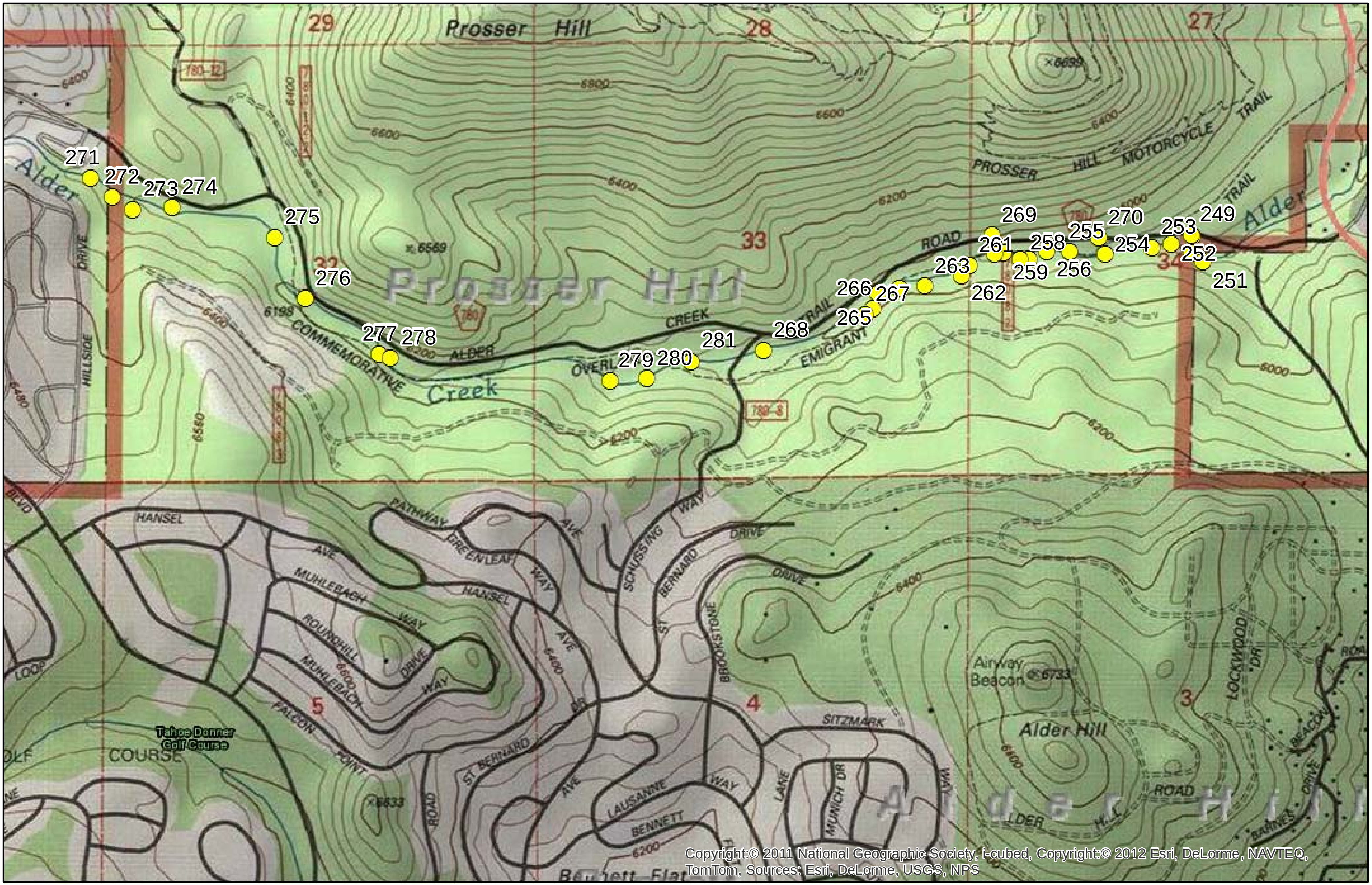

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Figure A3. Alder Creek reconnaissance observation locations
Middle Truckee River TMDL Assessment and Monitoring
Nevada County, California

0 1,000 2,000 Feet

N

210011 Figure A3 Alder Cr recon points.mxd