Truckee Wetlands Restoration Partnership
Conceptual Design Basis Report

A report Prepared for:

Truckee River Watershed Council

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Balance Hydrologics, Inc.®

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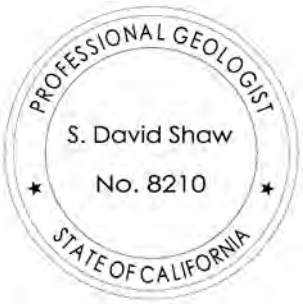

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1 INTRODUCTION

1.1 Purpose

This report presents the results of our initial field studies and hydrologic analyses of the Hilltop-Ponderosa Wetlands Complex in the Town of Truckee, California, and accompanies conceptual alternatives developed for restoration of portions of the wetland complex (**Appendix A**). The conceptual alternatives presented are focused on restoring wet meadow processes and functions and maintaining recreational and other existing land uses. The mechanism that has been established to do this is termed the 'Truckee Wetlands Restoration Partnership' (TWRP), and includes public and private landowners and agencies that manage infrastructure along Brockway Road Corridor in the Town of Truckee. Balance Hydrologics' (Balance) scope of work on this project includes a comprehensive site assessment, followed by development of a conceptual restoration plan in conjunction with Landscape Architects at L&P DesignWorks.

Earlier work was completed by Balance for the TWRP and summarized in a November 2010 letter report to Lisa Wallace (Shaw, 2010). These investigations concluded that the Hilltop-Ponderosa area was once a single connected wetland complex that discharged to the Truckee River, but has since been impacted by land uses and urban development within the Town of Truckee. Potential restoration strategies and alternatives were identified for specific areas, as well as additional focused studies for particular areas. This report outlines the findings of a more focused assessment and presents conceptual restoration designs developed through a stakeholder planning and review process. The proposed design concept is suitable for presentation to and discussion among the landowners and project partners; however, this report should always accompany the proposed designs when they are distributed.

1.2 Goals and Objectives

The goal of the hydrology and soils investigation is to evaluate the feasibility of restoring wetland and meadow processes and functions in this location. Specific restoration goals and objectives include the following:

- Restore hydrologic and ecologic continuity across the Hilltop-Ponderosa Wetlands Complex with connectivity to the Truckee River;
- Restore wet meadow conditions to impacted areas;
- Maintain hydrologic support to existing functional wetland areas;
- Maintain water supply for irrigation of the Ponderosa Golf Course Irrigation Pond
- Remove or modify historical features or watershed disturbances that have re-routed dominant streamflow patterns;
- Restore flow and saturation to previously abandoned wet meadows and wetland areas;
- Provide a sustainable trail network based on existing patterns of use;

- Engage and educate the community about local wetland resources through improved aesthetics, access and interpretive features

To evaluate the feasibility of achieving these objectives, we completed an initial assessment and detailed evaluation of site hydrology. This has included:

- An evaluation of soils and water-holding properties of soils,
- Estimates of water volumes and peak flow rates that can be expected, and
- Surface water and groundwater monitoring to evaluate the hydrologic support that may be available to seasonal wetlands and swales into the spring and early summer; the program also serves as an important site baseline for comparison against future post-project conditions.

1.3 General Technical Approach and Work Conducted

Balance's scope of work on this project includes a comprehensive site assessment, followed by development of restoration alternatives with the Truckee River Watershed Council and TWRP and selection of a preferred alternative. This report outlines the findings of our site assessment and presents conceptual restoration designs developed through a stakeholder planning and review process.

Including initial work completed in 2010, the following site-specific data, reports, and/or information have been reviewed for this project:

- Soil survey of the Tahoe National Forest area (USDA USFS, 1993);
- Geologic mapping of the Lake Tahoe Basin (Saucedo and others, 2005);
- A geotechnical investigation completed for the Hilltop Master Plan (Holdrege & Kull, 2004);
- A geotechnical investigation report for the Brockway Road Trail Project (Lumos and Associates, 2010)
- Detailed topography (1-ft contours) based on aerial photogrammetry obtained by Lumos Engineers for the Town of Truckee in the vicinity of the Brockway Trail;
- Detailed topography (1-ft contours) of the project site, based on aerial LiDAR surveys obtained by the Truckee Donner Public Utility District (TDPUD);
- Final plans for the Brockway Road Trail Project (Lumos and Associates, 2013)
- Wetland delineations covering portions of the wetland complex and surrounding areas (Garcia and Associates, 2002; Glazner, 2002; Merron, 2002; Glazner and Anderson, 2003; Juncosa, 2003; Juncosa, 2005; JBR Environmental Consultants, 2009; and TDPUD, 2010);
- Historical maps, aerial photographs, and anecdotal information provided by members of the Truckee-Donner Historical Society; and

- Golf Course Irrigation Pond water usage information provided by the Truckee Donner Recreation and Park District;

On December 13, 2012, Balance initiated a surface water- and groundwater-monitoring program by excavating several backhoe test pits and installing piezometers (shallow monitoring wells) in the pits. Continuous water level recorders were installed in each piezometer, as well as in the Ponderosa Golf Course Irrigation Pond and Irrigation Pond inflow and outflow channels. As initial restoration concepts and potential design elements were discussed among the project team, our field program and modeling scope evolved to include evaluations of watershed hydrology and peak flows according to Town of Truckee Drainage Standards. Additionally, a water balance-based model was developed in order to estimate the timing and volume of water at the site on a seasonal basis, so that the duration and magnitude of seasonal low flows, irrigation supply, and hydrologic support for downstream wetlands under a range of seasonal conditions could be evaluated.

The combined monitoring and modeling efforts allow for multiple lines of evidence that can be used in the sizing and design of channel and wetland restoration elements.

2 SETTING

2.1 Hydrography and Climate

Comprehensive site descriptions and the historical setting has been provided in an earlier Balance Hydrologics letter report (Shaw, 2010), and are briefly summarized here in order to provide context for the attached restoration plan alternatives.

The Hilltop-Ponderosa Wetland Complex is located along Brockway Road in the Town of Truckee on the south side of the Truckee River, as shown in **Figure 1**. The meadow and terrace is bounded on the south side by uplands and residential areas and on the north side by Brockway Road, Truckee Regional Park, residential housing, and a steep escarpment above the Truckee River. Surface water originates from developed springs and hillslope seeps, and precipitation, and flows from west to east across a gently sloping terrace ranging in elevation from 5,880 feet near the Hilltop Area to approximately 5,850 feet near the Ponderosa Golf Course. The Golf Course is managed by the Truckee Donner Recreation and Park District (TDRPD), which utilizes a shallow pond (the "Irrigation Pond") located at the east end of the terrace for irrigation purposes, supplementing spring-fed inflows with groundwater pumped from a nearby well. The Irrigation Pond drains through two outflow channels, across a meadow, to a relatively steep channel that routes flows north through a residential area and the Town of Truckee Corporation Yard, before discharging into the Truckee River at an elevation of 5,750 feet.

Mean annual precipitation is approximately 30 to 34 inches at this site, as recorded at the U.S. Forest Service Truckee Ranger Station in Truckee and NRCS SNOTEL Station "Truckee #2" near Bald Mountain. As is typical of the region, most precipitation falls during the winter months as snow and rain, with occasional summer thunderstorms. The contributing watershed area to this drainage is difficult to discern due to drainage modifications and undocumented storm drain configurations. To conservatively estimate peak flows at the Golf Course Irrigation Pond and Brockway Road Crossings, we have measured and established the contributing watershed area to be approximately 313 acres (0.49 square miles).

2.2 Published Geology and Soils Information

BEDROCK GEOLOGY

The Hilltop-Ponderosa Wetland Complex occupies a terrace mapped by the USDA USFS (1993) as old glacial outwash and described by Saucedo and others (2005) as poorly-sorted boulder and cobble gravel, sand and silt. These deposits overlie and are adjacent to the bedrock that forms the hills immediately south of the wetland terrace. Bedrock consists of both Prosser Creek alluvium — older and indurated (cemented) sediments ranging in size from lake bed clays to boulders — as well as olivine-latite volcanic flows which erupted from Bald Mountain to the south. There are a number of seeps and springs along the toe of the hillside to the south, perhaps emanating from the Prosser Creek alluvium, the interbedded alluvium and volcanics, or both sources. At least two of the springs have been developed for water supply, and the Tahoe Donner Public Utility District (TDPUD) currently operates a production well near one of the

springs. The elevation of the wet meadow and terrace appears to be controlled by bedrock and a mapped fault at the west end of the Hilltop Area, and by volcanic bedrock, which outcrops at the east (downstream) end of the study area just north of Estates Drive.

PUBLISHED SOILS INFORMATION

The regional soil survey (USDA USFS, 1993) shows one continuous wetland soil unit (Aquolls-Borolls) extending from near Hilltop Road to the Ponderosa Golf Course, indicating that this area was historically a single continuous wetland (see Figure 1). The Aquolls and Borolls units are very poorly drained soils which form in valley floors, swales, and drainages and consist of stratified coarse sand to clay. These soils are typically associated with wet meadow vegetation that can tolerate a high groundwater table during much of the year, primarily rushes (Carex and Juncus species), with some alder, willow, and aspen trees. The soil survey designates Aquolls-Borolls as Hydrologic Soil Group D, soils with very low infiltration rates, which may support areas of ponded water in topographic depressions. The surrounding Kyburz-Trojan soils complex is described as being relatively shallow, with depth to bedrock commonly at 34 to 38 inches, relatively low infiltration rates and rapid runoff.

Downstream, soils of the lowest terrace surface and the Truckee River floodplain are mapped as part of the Inville-Riverwash-Aquolls complex, a relatively heterogeneous mix of glacial outwash (Inville series), recent alluvium (Riverwash), and marshes (Aquolls). Consistent with the inclusion of Aquolls, a number of existing wetlands are evident through aerial photography interpretation and field observations, most notably between the Truckee River and the west end of the Tahoe-Truckee Sanitation Agency (T-TSA) ponds, and along the south bank of the Truckee River, at a point just east of the Highway 267 overpass (see Figure 1).

3 SITE INVESTIGATION

3.1 Methods

SOILS ASSESSMENT

Existing studies and published mapping do not provide information on the alluvial deposits and soil properties at a suitable resolution for wetland and channel restoration planning and design. Therefore, a site investigation was executed prior to and during the design period.

Using a backhoe, a number of trenches were excavated on December 13, 2012 to provide more accurate detail regarding soil types across the site. Three trenches (12-01 through 12-03) were excavated using a backhoe and 24-inch bucket to a depth ranging from 3.2 to 6.3 feet, as dictated by refusal in boulders and/or bedrock. In more sensitive wetland and saturated areas, borings were hand-augured to approximately 3 feet on March 5, 2013. Following review of initial groundwater monitoring data from the early portion of water year 2013[1] and development of preliminary design alternatives, we returned to the site on March 5, 2013 and hand-augured additional shallow borings. Boring and Test Pit logs are presented in **Appendix B** and locations are shown as piezometers in **Figure 2**.

GROUNDWATER AND SURFACE WATER INVESTIGATIONS

Piezometers were installed in all backhoe-excavated trenches with screened intervals as indicated in test pit logs included in **Appendix B**. The annular space around the screen and 0.5- to 1-foot above the screen was filled with 30-mesh Monterey sand and the remaining portion of the test pit was backfilled and compacted with native soil. Native soil was also mounded around the piezometer head to prevent surface water ponding or preferential infiltration at the location of the piezometer. Piezometers generally have a 1- to 2-foot 'stickup' above the mound surface and are secured with a compression cap. All piezometers were instrumented with near-continuous water-level recorders and calibrated with periodic manual measurements. Depth-to-water measurements and specific conductance readings were carried out for calibration of the water level records.

Upon project initiation, the Irrigation Pond inflows and outflows, as well as the pond itself, were instrumented with a staff plate and near-continuous water-level recorder to monitor water levels through winter and spring snowmelt, and to relate pond drawdown to water table declines and fluctuations into spring and summer 2013. The staff plate consists of a metal graduated plate mounted on a 2x4, and a 2-inch slotted PVC pipe houses a submersible water level recorder.

[1] The term 'water year 2013' refers to the period from October 1, 2012 to September 30, 2013.

Water Balance Modeling

We developed a pre-project hydrologic response model in order to characterize the hydrologic effects of restoring meadows in this area. In particular, the model allows us to estimate the magnitude, duration and frequency of the flows that contribute water to the Irrigation Pond, where channel and wetland re-alignments are being considered. The hydrology model also allows us to evaluate the water supply available for irrigation and for release to downstream areas.

Peak-Flow Modeling

In addition to the baseflow calculations, we developed an event-based model to estimate peak runoff values for a design storm, as based on Town of Truckee Engineering Standards, which call for use of the Rational Method for watershed areas up to 320 acres. The Town provides maps and tables necessary to calculate pre-defined precipitation depths and infiltration rates. Due to the significant unknowns in watershed storm drainage conditions and total watershed area, along with the variable influences of snowmelt, this calculation is made on a preliminary basis, in order to evaluate existing culverts and channel and culvert sizing considerations.

3.5 Findings

Antecedent Conditions during the Study

Total precipitation during the early part of water year 2013, prior to initiation of the on-site monitoring program, was significantly above average, with 20.3 inches of precipitation recorded from October through December at the Truckee #2 SNOTEL site (Table 1). The remainder of the monitoring period, from January through September, 2013, however, was extremely dry, with 6.03 inches of precipitation. Several summer thunderstorms occurred during 2013, but limited to no precipitation was recorded at nearby rainfall gages.

Based on this intra-annual precipitation distribution, observed springflow to the site is considered to be representative of short-term dry conditions. Recent and long-term groundwater monitoring conducted by the California Department of Water Resources (DWR), however, indicates limited or no decline in regional groundwater levels during water year 2013, indicating that groundwater conditions during the study may also be reflective of long-term average conditions. In other words, early-season snowpack and recharge appears to have maintained groundwater conditions and spring flows at nearly-normal conditions.

Soils

Soils encountered at the site were found to be dominated by brown to dark-brown sandy and gravelly clays, with water flowing freely from cobbly and gravelly strata overlying clay. Depth to bedrock ranges from roughly 3 to 6 feet, with the shallowest bedrock found at the northeastern end of the terrace (Appendix B). These observations are consistent with those of Lumos Engineers (2010) and published geologic maps of the area, and reflect a relatively thin veneer of glacial outwash overlying a bedrock terrace or 'strath terrace.' As such, wetlands on the terrace

surface appear to be readily maintained by saturation of the thin, clay-rich overburden, with downward percolation limited by bedrock and lateral flow limited by low slopes and fine-grained soils.

GROUNDWATER AND SURFACE WATER OBSERVATIONS

All groundwater and surface water observations are compiled in the site Observer Logs, presented as **Appendix C.**

Ponderosa Golf Course Irrigation Pond

Figure 3 shows the Ponderosa golf Course Irrigation Pond hydrology during the monitoring period. Peak instantaneous flow for the period of record[2] was approximately 23.5 cfs in mid-January. As is typical of spring-supported systems, pond inflow remained fairly constant, with baseflows ranging from approximately 0.04 cubic feet per second (cfs; 18 gpm) during a cold snap in January to 0.36 cfs during peak snowmelt. Inflows during the summer months remained steady, fluctuating between 0.15 and 0.31 cfs (67 to 139 gpm) suggesting that the spring-fed ditch is perennial and the primary hydrologic support for the Wetlands Complex and Irrigation Pond

Pond outflow was mostly steady during the winter months and roughly equal to pond inflow until late April, when air temperatures rose and golf course irrigation apparently began. Pond water levels and outflow fluctuated after this period, with pond stage peaking during cool periods around 5,849.8 feet and falling to a low of approximately 5,848.4 feet during hot periods.

Pond outflow ceased in late June. Limited or no flow continued past the terrace to downstream portions of the project site.

Groundwater levels

The site was largely saturated during soils investigations and initiation of the monitoring program. **Figure 4** shows that groundwater levels were initially close to the ground surface, with maximum depth to water found in upland areas with artificial fill on the north side of the irrigation pond (Piezometer 12-02). In areas where fill was encountered, groundwater levels appeared to be maintained at or above the clay-rich native soils, at the bottom of the artificial fill layers. Relatively undisturbed meadow areas (Figure 2, Piezometer 12-03) remained saturated at the ground surface through most of the winter months.

Upon initiation of snowmelt and warmer temperatures in mid-March, groundwater levels began to decline across the meadow, while the Irrigation Pond remained full and

[2] Water year 2013 peak flow likely occurred on November 30 or December 2, 2012, prior to initiating the monitoring program.

spilling. The rates of water table decline increased significantly once water levels in the irrigation pond began to fall and surface outflows declined significantly. **Figure 5** shows this increased rate of decline beginning around April 18, 2013. Rapid declines in the Irrigation Pond water level are assumed to be a result of pumping for irrigation use, with relatively rapid recovery assumed to be from pond inflows. It is also possible that recovery was augmented by well pumping, but spring-supported appear to have been sufficient to support pond filling alone. Groundwater levels do not respond to these rapid fluctuations, reflecting the low-transmissivity nature of the soils on site.

Figure 6 shows groundwater contours and inferred groundwater flow directions during winter and summer conditions, and illustrates the influence of the Irrigation pond on local groundwater conditions. During the winter and early spring, the site is largely saturated, with groundwater flow directions mostly parallel to the axis of the meadow. Influences of the Irrigation Pond inflow ditch are apparent in winter and early spring, when the ditch conveys water across the site, draining or bypassing abandoned portions of the meadow. By summer, the ditch and irrigation pond bring water to the meadow, forming a groundwater mound above surrounding areas. The clayey and low-transmissivity nature of soils on the site maintain this mound at the ditch and pond, with very little leakage to adjacent areas.

WATER BALANCE MODELING

In order to evaluate how irrigation demand relates to meadow hydrology, as well as the potential to restore hydrologic and ecological continuity across the meadow and to the Truckee River, we have developed a water balance-based model of the pond. The governing equation of the water balance employed in this study is shown below (Gupta, 1995):

$$\Delta V = Q_{in,S} + P - E - Q_{out,S} - Q_{out,G} - Q_{out,G}$$

where:

ΔV = change in volume of water
$Q_{in,S}$ = surface water inflow
P = direct precipitation
E = evaporation
$Q_{out,S}$ = surface water outflow
$Q_{out,G}$ = subsurface water outflow
$Q_{out,G}$ = subsurface water outflow

This equation was applied to the pond on a monthly basis, with volumes expressed as average monthly flow rates. Surface water inflow was measured just upstream of the irrigation pond, and surface outflow was measured in the two outflow ditches (Figure 2). Direct precipitation is based on records maintained by the U.S. Forest Service for the Truckee Ranger Station, as reported by the California Data Exchange Center (CDEC station TKE). Evaporation is based on work conducted by the Desert Research Institute for lakes in the Middle Truckee River watershed (Huntington and McEvoy, 2011), and are

reported to be on the order of 0.2 feet in April, rising to around 0.6 feet per month in August (Huntington and McEvoy, 2011), or 4,300 to 14,000 gpd (2 to 6 gpm) across the 1.3-acre pond. Subsurface inflows and outflows are assumed to be equal and offsetting during the winter months, and negligible during the summer months, as indicated by groundwater monitoring data.

Monthly water balance calculations are summarized in **Table 1**, which includes monthly estimates of pond 'surplus' or 'deficit.' When a surplus is shown, pond inflows are greater than outflows, and when a deficit is shown, pond outflows are greater than inflows. Based on the field data collected, outflows exceed inflows during the winter months, and inflows exceed surface outflow through the summer months due to irrigation use. Irrigation use is reported by TDRPD to be on the order of 120,000 gallons per day, 6 days per week. Inflows from well pumping are not tracked and therefore not accounted for in the model, so surpluses during the summer irrigation season in the absence of outflows can be assumed to be the result of well pumping.

PEAK FLOW MODELING

Peak flow calculations were carried out according to Town of Truckee Design Standards, and indicate the 100-year flow to be approximately 430 cubic feet per second (cfs). The 10-year flow is estimated to be roughly 295 cfs. These are considered to be conservative estimates based on uncertain watershed areas, and should be refined prior to designing for infrastructure protection. The 40-foot long corrugated metal culvert (CMP) under Estates Drive is currently configured with a negative slope (i.e. the pipe exit is higher than the pipe entrance). In addition, the capacity of the culvert appears to be significantly limited. As a result, water backs up between the Estates Drive culvert and Brockway Road.

4 CONCEPTUAL RESTORATION DESIGN

4.1 Assessment Conclusions and Design Implications

Based on this site assessment, we conclude the following:

- The current meadow form appears to be dominated by a bedrock or 'strath' terrace overlain by a thin veneer of glacial outwash. Meadow hydrology is seasonal, with groundwater levels falling to more than 5 feet below the ground surface in many locations by mid-July. Late summer groundwater conditions are supported primarily by the developed springs and irrigation ditches with limited influence from the Irrigation Pond. Re-establishing surface water connections across the meadow, ditch, and pond is likely to re-establish wetland conditions across impacted meadow areas.

- Wetland restoration efforts should therefore utilize surface flow as the primary mechanism to distribute water across the meadow.

- Soil stratigraphy in the Wetland Terrace Complex consists of historical wetland soils (silty loam) overlying clays, with artificial fill present in portions of the site, north of the Irrigation Pond and south of Estates Drive. Removal of fill and exposure of historical wetland soils is anticipated to be a suitable wetland restoration approach in these areas.

- Water year 2013 has been characterized by very little precipitation after December. Results of the groundwater and surface-water monitoring program, however, indicate that spring-supported flows to the meadow and Irrigation Pond remain fairly steady, on the order of 0.2 to 0.3 cfs during the summer months. This supply may decline during very dry periods.

- Groundwater monitoring in the vicinity of the Irrigation Pond reflects a disturbed meadow system. During the winter months, saturation is relatively widespread, except for areas bypassed or drained by ditches, most notably west of the Irrigation Pond. During the summer months, the ditch and the pond hold water at elevations above the surrounding shallow groundwater table.

- Fluctuating water levels in the pond do not readily transmit across the meadow; therefore, restored meadow hydrology is not likely to be adversely affected by continued operation and short-term water level fluctuations in the Irrigation Pond.

- Water balance calculations reflect a condition in which pond inflows were on the order of 150,000 gpd during the irrigation season, sufficient to meet the golf course irrigation demand of 120,000 gpd. After consideration of evaporation from the pond, surplus water of approximately 10-15 gpm is available to support

downstream hydrology, rather than the roughly 100 gpm that would be available without irrigation demands.

4.2 Design Layout and Elements

Appendix A includes conceptual design drawings for four areas.

TDLT PARCEL (SOUTHWEST OF BROCKWAY ROAD, SHEET L-1.1)

The Truckee Donner Land Trust Parcel is located southwest of Brockway Road and north of the Winter Creek Subdivision, where the wetland crosses the terrace. The primary feature on this site is a constructed ditch that conveys water from developed springs, across Brockway Road to the Irrigation Pond. In order to reverse impacts associated with this feature, we propose blocking the ditch to disperse flows across the meadow surface and creating a formal walking path along the margin of the wetland and connects with the Palisades Drive commercial area.

Immediately upstream of the Brockway Road crossing, additional ditches are currently in place to convey water to the culverts under Brockway Road and Estates Drive. These culverts are undersized and with a negative slope (i.e. in the upstream direction). As a result, water collects on the TDLT property in lower portions toward the center of the meadow, maintaining saturation and ponding in the wetland. Conceptual restoration plans include an alternative culvert location under Brockway Road that would eliminate the need for the two culverts and more effectively convey water down the meadow (shown in Appendix A, Sheet L-1.2). Potential benefits of a culvert in this location are limited to effective draining of the meadow, while potential impacts include wetland dewatering. Therefore, in keeping with the objective of limiting disturbance to existing functional ecosystems, we do not recommend pursuing this alternative culvert location as a design element, due to the alterations to meadow hydrology that may result on the upstream side of the road.

PONDEROSA GOLF COURSE IRRIGATION POND (BETWEEN BROCKWAY ROAD AND ESTATES DRIVE, SHEET L-1.2)

The Irrigation Pond inflow ditch and adjacent areas are among the most heavily disturbed areas of the historical Hilltop-Ponderosa Wet Meadow Complex. Meadow restoration in this area will consist of filling the irrigation ditch to disperse flows across the former meadow surface. The meadow surface will be restored and expanded through relocation of parking areas, and the meadow will transition gradually into the irrigation pond. The pond will be reconfigured with more gradual side slopes and deeper central areas to increase storage volume. Removal of the existing chain link fence around the pond and establishment of formal trails will provide access and a park-like setting for nearby residents while limiting multiple informal access points and haphazard trail development.

CHANNELS AND SWALES TO THE TRUCKEE RIVER (NORTH OF ESTATES DRIVE, SHEETS L-1.3 AND L-1.4)

When outflow from the Irrigation Pond is sufficient for water to leave the terrace and flow toward the Truckee River, water first passes under Estates Drive, flows across a

maintenance road before flowing into a detention basin upslope of the former Town of Truckee Corporation Yard. Both the road crossing and the detention basin should be modified to better accommodate flows, and eliminate overflows into basins operated by T-TSA. Proposed modifications include installation of culverts under the maintenance road to convey flows from upstream swales to the detention basins. The detention basin will operate such that flows will rise and drain using a riser pipe. The pipe will outfall to arestored swale and riparian corridor through the former corporation yard, replacing the existing ditch and culvert system.

Downstream, given the existing infrastructure and need to protect the T-TSA basins, we anticipate utilizing existing culverts and pipes to convey flows down the embankment from the corporation yard to the Truckee River floodplain. An existing concrete ditch which receives flow from these culverts and crosses the floodplain will be removed. In its place, flow dispersal log and rock structures will be designed to spread water on the floodplain surface.

4.3 Design Criteria

CRITICAL ELEVATIONS FOR DESIGN

The conceptual alternatives presented in Appendix A intend to maintain and protect existing infrastructure associated with Brockway Road, Ponderosa Golf Course, and adjacent properties. Upstream project limits and project details are selected based on this existing infrastructure, with constraints imposed by the Brockway Road culvert, the Estates Drive culvert, the Irrigation Pond, and meadow elevations below the golf course. Finally, we identified existing infrastructure and culverts in the vicinity of the former Town of Truckee Corporation Yard, the Legacy Trail, and the Truckee River to guide the development of channel restoration plans between the Irrigation Pond and the Truckee River. Elevations for these features have not been surveyed, but provide the basis for design in areas immediately upstream and downstream.

HYDROLOGIC SUPPORT FOR EXISTING IRRIGATION USE AND DOWNSTREAM WETLANDS

The water balance analysis described in Section 3 of this report has been carried out with the goal of understanding how wetland hydrology is affected by use of the pond for irrigation, and vice versa. We have also used the model to evaluate the potential for increased evaporation and evapotranspirative demand that may result from restoring the meadow and increasing wetland saturation and ponding. Conceptual restoration plans include a roughly 3-fold increase in saturated or ponded areas, and may result in an additional 7 to 16 gpm of demand on the springflow source. As such, the volume of water available to flow to downstream areas may be reduced by approximately 10 percent. This reduction would likely be offset by increased water storage in currently dewatered portions of the meadow, with slow release of water later into the year. As a result, we expect no discernable changes in flow rates to downstream areas during the summer months.

Well yields from the Golf Course Well have not been evaluated as part of this study, but if well pumping is a viable alternative to support irrigation demand, increased

evapotranspiration rates may be easily offset. Increased use of alternative water sources would also aid in the restoration of flows to support downstream areas.

4.4 Design Constraints

Identification of site-specific constraints is a critical step to help establish restoration feasibility and a basis for design. Based on the hydrologic assessment outlined above, we have identified the following site constraints. The proposed conceptual plan attempts to address, mitigate for, minimize or outright avoid these constraints, but it should be noted that not all constraints can be avoided.

HYDROLOGY

Spring development and historical and modern land uses have fundamentally altered the hydrology of the system. Portions of the meadow are much wetter than would have occurred prior to European settlement, while other areas have been dewatered or filled. While the hydrology of the meadow is now better understood, it is not clear exactly what the historical hydrology was prior to development of springs, irrigation pond and ditches. Finally, it should be recognized that the existing wetlands on site are somewhat functional; designs have been developed to avoid direct or indirect impacts to existing functional habitat, focusing on enhancement of impaired areas.

INFRASTRUCTURE AND HUMAN USE

The proposed design concepts have been developed under the assumption that much of the existing infrastructure will remain. As such we have incorporated existing informal walking trails into the restoration design elements, and propose retaining existing culverts under Estates Drive and Brockway Road, as well as a number of culverts in the vicinity of the Former Town of Truckee Corporation Yard and the Truckee River Legacy Trail. Finally, the upstream (east) limit of the project is established outside of the Palisades Drive Commercial area and infrastructure associated with the TDPUD's Southside Well.

PROPERTY OWNERSHIP

The conceptual designs presented include design elements on multiple properties. Approval and implementation of these elements will require close coordination with all stakeholders or property owners. Existing conservation easements and constructed mitigation wetlands will be avoided, with the exception of the recently-constructed wetland which mitigates for impacts associated with the Brockway Trail. This wetland has been incorporated into the restoration design, in consultation with the Town of Truckee and Lahontan Regional Water Board staff.

4.5 Design Opportunities

WATER AVAILABILITY

Unlike many wetland restoration endeavors, this particular project includes a perennial source of surface water flow. Beyond the constraints listed above, a great deal of

habitat and water quality benefit can be gained simply by distributing perennial water to previously impacted portions of the meadow.

5 Limitations

This report was prepared in general accordance with the accepted standard of practice in surface-water and groundwater hydrology existing in Northern California and the Sierra Nevada for projects of similar scale at the time the investigations were performed. No other warranties, expressed or implied, are made.

As is customary, we note that readers should recognize that interpretation and evaluation of subsurface conditions and physical factors affecting the hydrologic context of any site is a difficult and inexact art. Judgments leading to conclusions and recommendations are generally made with an incomplete knowledge of the conditions present. More extensive or extended studies, including additional hydrologic baseline monitoring, can reduce the inherent uncertainties associated with such studies. We note, in particular, that many factors affect local and regional ground-water levels. If the client wishes to further reduce the uncertainty beyond the level associated with this study, Balance should be notified for additional consultation.

We have used standard environmental information such as precipitation, topographic mapping, and soil mapping, in our analyses and approaches without verification or modification, in conformance with local custom. New information or changes in regulatory guidance could influence the plans or recommendations, perhaps fundamentally. As updated information becomes available, the interpretations and recommendations contained in this report may warrant change. To aid in revisions, we ask that readers or reviewers advise us of new plans, conditions, or data of which they are aware.

Concepts, findings and interpretations contained in this report are intended for the exclusive use of the Truckee River Watershed Council under the conditions presently prevailing except where noted otherwise. Their use beyond the boundaries of the site could lead to environmental or structural damage, and/or to noncompliance with water-quality policies, regulations or permits. Data developed or used in this report were collected and interpreted solely for developing an understanding of the hydrologic context at the site as an aid to conceptual planning and channel and wetland restoration design. They should not be used for other purposes without great care, updating, review of sampling and analytical methods used, and consultation with Balance staff familiar with the site. In particular, Balance Hydrologics, Inc. should be consulted prior to applying the contents of this report to geotechnical or facility design, routine wetland management, sale or exchange of land, or for other purposes not specifically cited in this report.

Finally, we ask once again that readers who have additional pertinent information, who observed changed conditions, or who may note material errors should contact us with their findings at the earliest possible date, so that timely changes may be made.

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TABLES

Table 1. Ponderosa Golf Course Irrigation Pond Hydrology, Truckee Wetlands Restoration Partnership, Truckee, California

	INFLOW				OUTFLOW									
	Inflow from ditch[1]		Direct Precipitation[2]		Pond outflow[1]		Estimated evaporation from pond[3]			Estimated Irrigation Use[4]			Surplus or Deficit[5]	
	gpm	*gpd*	*inches*	*gpd*	*gpm*	*gpd*	*ft*	*gpm*	*gpd*	*gpd*	*days/wk*	*gpm*	*gpm*	*gpd*
October	*80*	*115,200*	1.58	1,799	*nm*	*nm*	0.45	4.2	*6,092*	120,000	6	70	5.9	*8,521*
November	*121*	*174,493*	6.05	7,118	*nm*	*nm*	0.31	2.9	*4,241*	0	0	0	118.4	*170,482*
December	120	172,800	7.33	8,346	nm	*nm*	0.22	2.1	*2,989*	0	0	0	118.1	*170,080*
January	206	297,285	0.48	547	224	*323,136*	0.13	1.2	*1,708*	0	0	0	-19.1	*-27,541*
February	63	90,478	0.13	164	58	*84,015*	0.08	0.8	*1,139*	0	0	0	3.7	*5,329*
March	130	187,419	1.47	1,674	135	*193,882*	0.11	1.0	*1,509*	0	0	0	-5.5	*-7,917*
April	94	135,717	0.51	600	108	*155,105*	0.17	1.6	*2,306*	120,000	6	70	-84.9	*-122,320*
May	103	148,643	1.78	2,027	40	*58,164*	0.29	2.8	*4,014*	120,000	6	70	-9.8	*-14,115*
June	121	174,493	0.45	529	13	*19,388*	0.41	3.9	*5,665*	120,000	6	70	33.9	*48,812*
July	108	155,105	0.03	34	*0*	*0*	0.56	5.3	*7,600*	120,000	6	70	32.5	*46,861*
August	*81*	*116,329*	0.01	11	*0*	*0*	0.59	5.6	*8,113*	120,000	6	70	5.3	*7,571*
September	*126*	*180,956*	0.85	1,000	*0*	*0*	0.53	5.0	*7,259*	120,000	6	70	50.8	*73,084*

[1]As measured during water year 2013 on a near-continuous basis, or estimated where shown in italics.

[2]As reported by the California Data Exchange Center (CDEC) for station TKE (Truckee Ranger Station).

[3]Evaporation is estimated based on mean monthly evporation for Prosser Reservoir, Boca Reservoir, Martis Reservoir, and Donner Lake, as reported by Huntington and McEvoy (2011)

[4]As communicated verbally by Mike Steven (TDRPD) to Jeannette Halderman (TRWC) on May 3, 2013.

[5]When a surplus is shown, pond inflows are greater than outflows, and when a deficit is shown, pond outflows are greater than inflows.

Groundwater inflows and outflows are assumed to be equal, such that net groundwater gains or losses from the pond are assumed to be negligible.

nm = not measured, assumed to be negligible

FIGURES

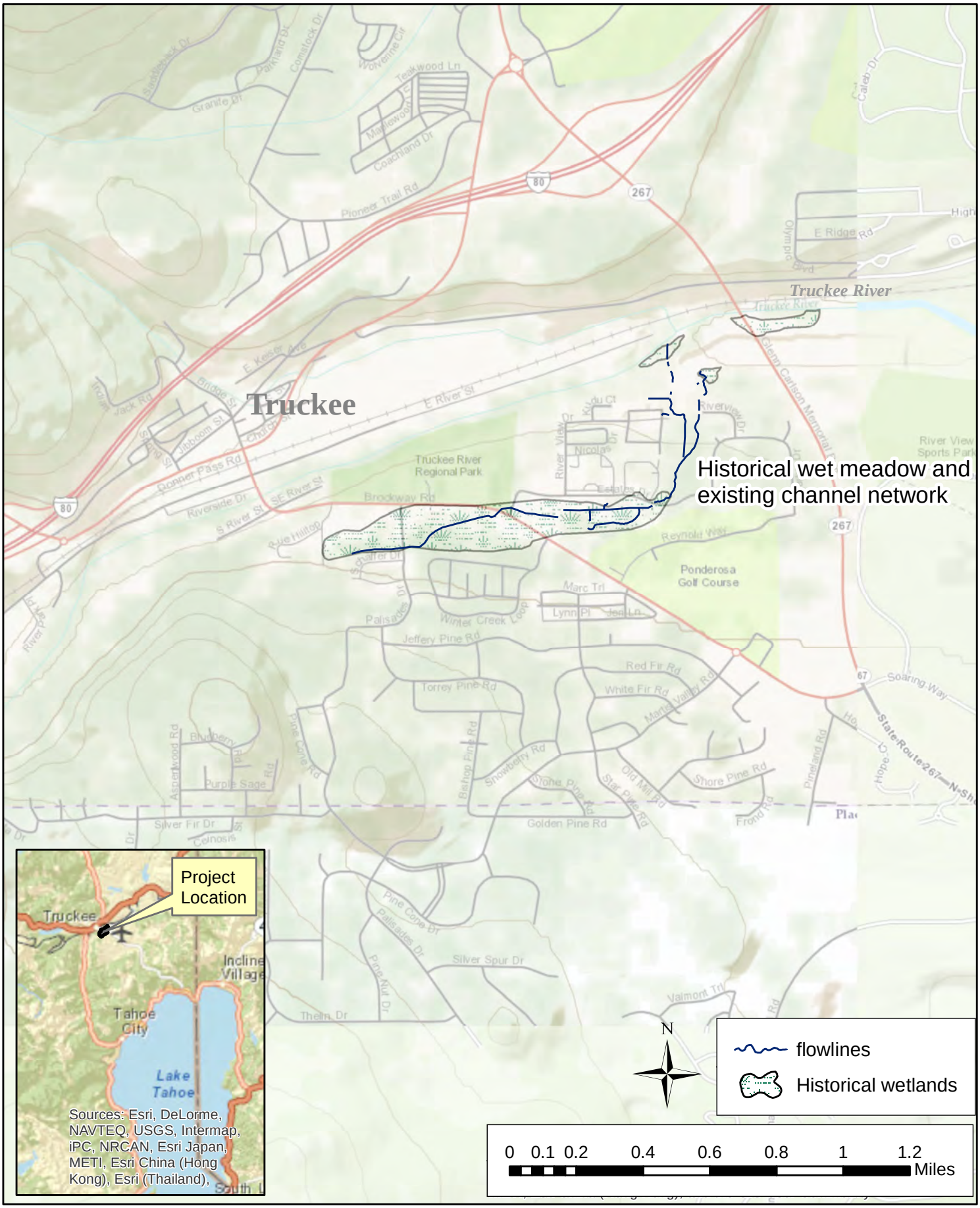

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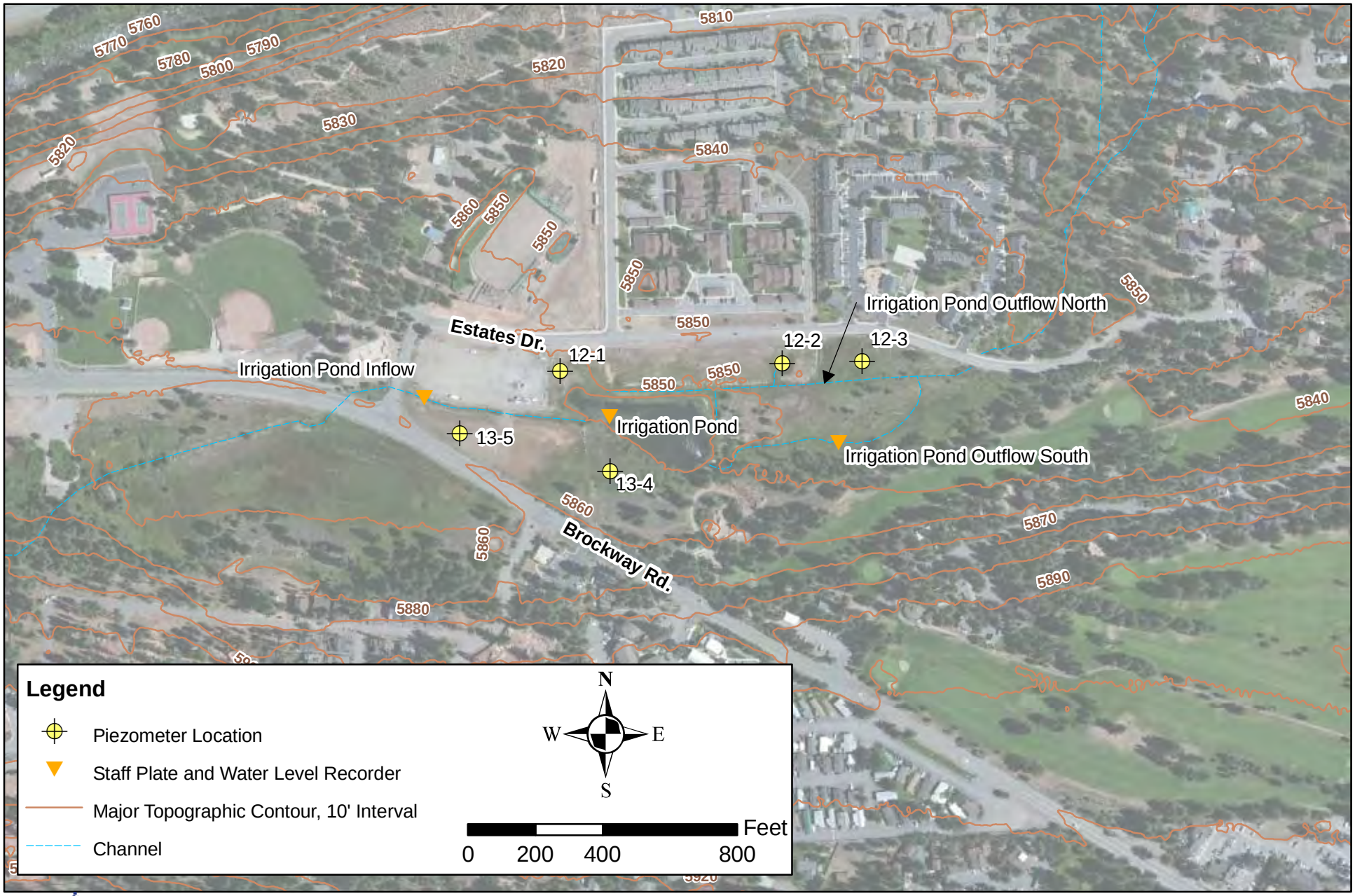
Figure 1. Project Location, Truckee Wetlands Restoration Partnership, Truckee, California

C:\Projects\210028 location map.mxd



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W:\Projects\210028 GIS\Figure2.mxd

Figure 2. Surface water and groundwater monitoring locations, Truckee Wetlands Restoration Partnership, Truckee, California

Basemap Source: ESRI

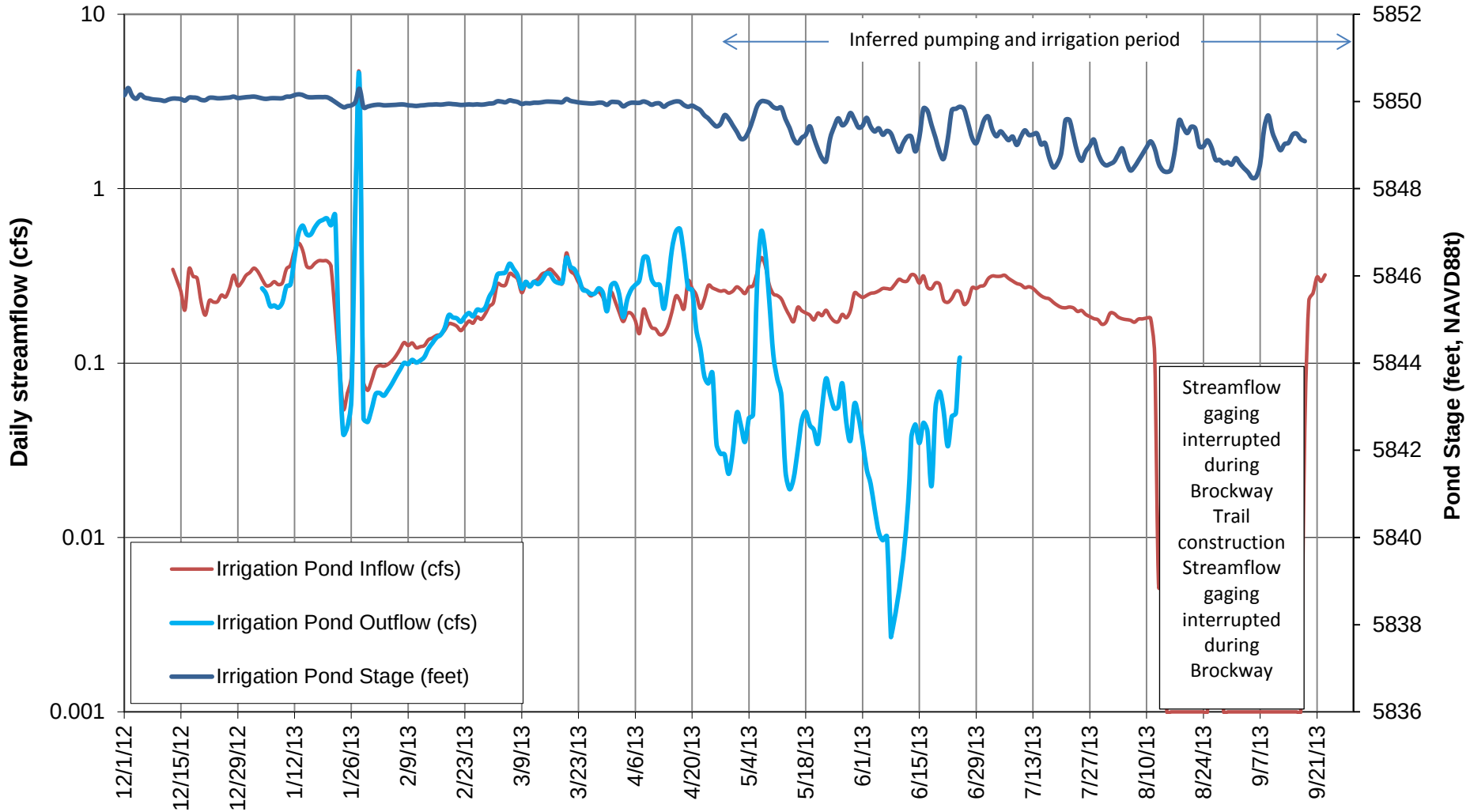

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Figure 3. Irrigation Pond daily stage, inflow, and outflow, Truckee Wetlands Restoration Partnership, Truckee, California, water year 2013.

Pond outflow was approximately equal to inflow until pond water levels began to fluctuate in late April.

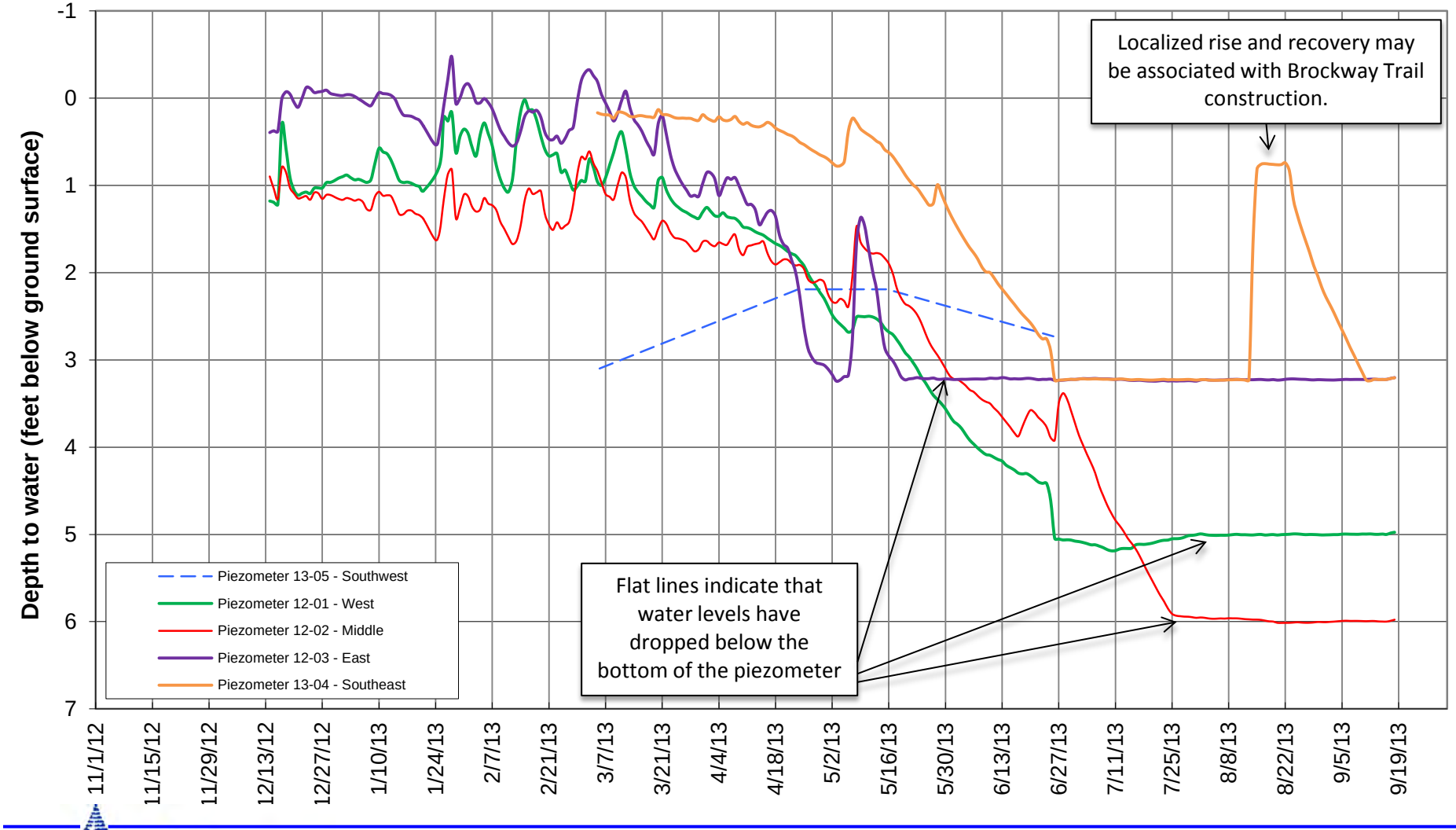

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Figure 4. **Depth to groundwater**
Truckee Wetlands Restoration Partnership, Truckee, California, water year 2013.
Groundwater levels were initially close to the surface, especially in relatively undisturbed meadow areas. Groundwater levels declined upon the onset of warmer temperatures and snowmelt, with more rapid declines in late April and early May

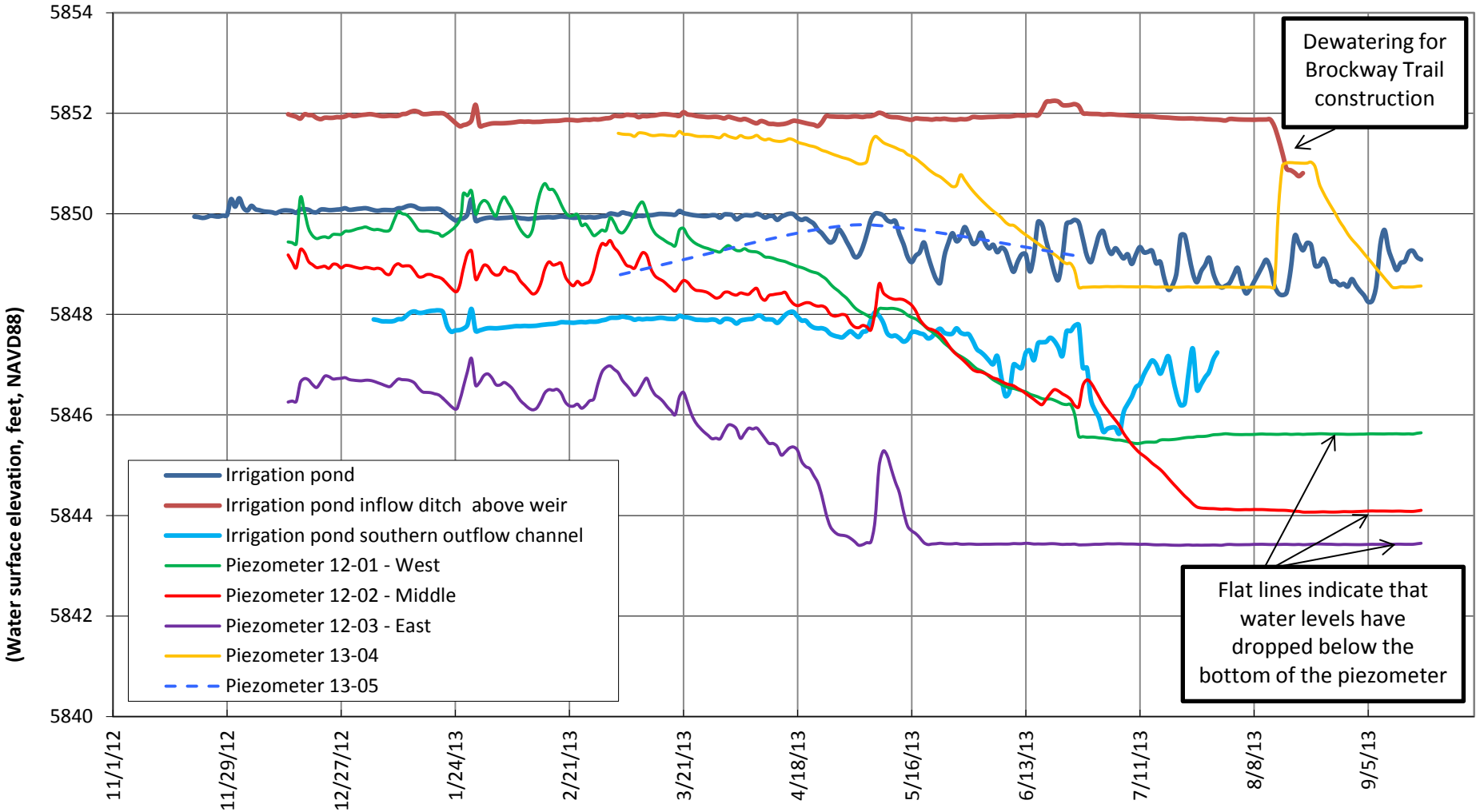

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Figure 5. Surface water and groundwater elevations, Truckee Wetlands Restoration Partnership, Truckee, California, water year 2013.

Relative elevations imply a groundwater gradient from west to east, down the axis of the meadow. Groundwater levels do not appear to be affected by short-term variations in Irrigation Pond levels.

APPENDICES

APPENDIX A

Conceptual Wetland Restoration Design

200' 400' 800'

SCALE IS APPROXIMATE

Project:

TRUCKEE WETLAND RESTORATION PARTNERSHIP

Site:

BROCKWAY ROAD
TOWN OF TRUCKEE, CALIFORNIA

Balance Hydrologics, Inc.
12020 Donner Pass Road, Suite B1
Truckee, CA 96161
530.550.9776

TruckeeRiverWatershedCouncil

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INDEX SHEET

Stamp:

LICENCED LANDSCAPE ARCHITECT
ROBIE W. LITCHFIELD LIC. # 4197
Signature
03-31-12
Renewal Date
20 Nov 2013
Date
STATE OF CALIFORNIA

Drawn By: RWL
Checked By: RWL
Drawing Date: 11.18.13

Revisions:

Rev.	Date	Remarks

INDEX
SHEET
Scale : 1" = 200' APPROX.
Sheet No:
L-1.0
4 OF 5

MATCHLINE - SEE SHEET L-1.2

PROPOSED BOULDER DISSIPATERS - TYP. UTILIZE EX. BOULDERS

PROPOSED WETLAND INTERPRETIVE KIOSK AND OBSERVATION POINT - PER TRUCKEE DONNER LAND TRUST - SET ON DETENTION BASIN BERM

FILL EXISITING DITCHES TO DISPERSE WATER ACROSS AND REVITALIZE HISTORIC WETLAND - TYPICAL

LOG DIVERSION STRUCTURES TO DISPERSE FLOWS

PROPOSED WALKING CIRCUIT 4' WIDE SOFT SURFACE WALKING PATH - TO BE LOCATED IN UPLAND - UTILIZE EXISTING TRAILS AS FEASIBLE

EXISTING DETENTION BASIN

PROPOSED PATH FROM CLUSTER BOX PARKING TO INTERPRETIVE POINT

EXISTING CLUSTER BOX PARKING

BROCKWAY ROAD

WINTERHAVEN

5062

NOTE: PARCEL LINES AND PHOTO IMAGE ARE APPROXIMATE AND ARE INTENDED TO PROVIDE CONTEXT ONLY

50' 100' 200'

Project:

TRUCKEE WETLAND RESTORATION PARTNERSHIP

Site:
BROCKWAY ROAD
TOWN OF TRUCKEE, CALIFORNIA

Balance Hydrologics, Inc.
12020 Donner Pass Road, Suite B1
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CONCEPTUAL DESIGN
TDLT PARCEL

Stamp:

LICENSED LANDSCAPE ARCHITECT
LITCHFIELD, RUBEN
Signature
03-31-12
Renewal Date
27 Jan 2014
Date
STATE OF CALIFORNIA

Drawn By:RWL
Checked By:RWL
Drawing Date: 1.22.14

Revisions:

Rev.	Date	Remarks

CONCEPTUAL DESIGN

TDLT PARCEL

Scale : 1" = 50'

Sheet No:
L-1.1
2 OF 5

LOW IMPACT DEVELOPMENT STORMWATER MANAGEMENT FEATURES THROUGH CENTER ISLAND AND AROUND PARKING LOT EDGES - TO DRAIN INTO GRASSY AREA TO THE EAST

IMPROVED AUTO PARKING APPROX. 100 SPACES

REGIONAL PARK

ESTATES DRIVE

EQUESTRIAN STADIUM

GRADING /RECONTOURING WILL BE REQUIRED TO MEET PROPOSED RESTORED WETLAND GRADES AND PARKING LOT GRADES

TRUCKEE SENIOR LIVING

TRAILER PARKING - APPROXIMATELY 13 SPACES

DIFFUSE FLOW ACROSS RESTORED WETLAND, PRESERVETRUCKEE PINES MITIGATION SITE - TYP.

INSTALL CURB AND GUTTER, BOULDER BOLLARDS AND PLANTING TO PROTECT RESTORED WETLAND FROM DRIVERS - MAY INCLUDE PARALLEL PARKING

RESTORED WETLAND/ STORMWATER MANAGEMENT FEATURE

PATH AROUND POND - 3' WIDE- AT GRADE, ELEVATED DECK/PUNCHEON, OR FLOW CONTROL BERM - AS CONDITIONS WARRANT - WILL VARY UPON LOCATION

DECOMMISSION OLD TRAILS AND ESTABLISH ONE MAIN PATH ACROSS PROJECT AREA FROM ESTATES TO BROCKWAY

RESOURCES INTERPRETIV E

LID/SMP INTERPRETIVE

8+26

8+00

8+10

STATION 8+10

8+48

10+00

RESTORED WETLAND

11+00

12+00

13+00

14+00

14+34

STORMWATER AND SNOW STORAGE BASIN

POND FRINGE/ EMERGENT VEGETATION; 1'-2' DEEP - TYPICAL

OPEN WATER - +/- 6' DEEP

POND +/- 5851 ELEV NATURALIZED

REMOVE SPOILS PILE AND EXPAND POND CAPACITY - UTILIZE MATERIALS AS FILL FOR WETLAND RESTORATION TRANSPLANT TREES TO UPLAND REACHES, LOCATIONS TO BE DETERMINED

EX. POND INLET

RESTORED WETLAND

NEW FLOW CONTROL WEIR

EX. FLOW CONTROL WEIR, TO BE REMOVED, PUMP LOCATION TO BE PRESERVED

ALT. CULVERT CROSSING

LOG DIVERSION STRUCTURE

DIFFUSE FLOW ACROSS RESTORED WETLAND -

FILL EXISTING DITCHES TO MATCH EXISTING GRADE - TYP.

6" SCH 80 PVC BY-PASS PIPES PER LUMOS 100% DWGS - TYP

IVESIA PROTECTION AREA

WILDIFE INTERPRETIVE

NOTE: EXISTING FENCE TO BE REMOVED

EXISTING UPLAND

BIKE PATH MITIGATION AREA INCORPORATED INTO EXPANDED POND

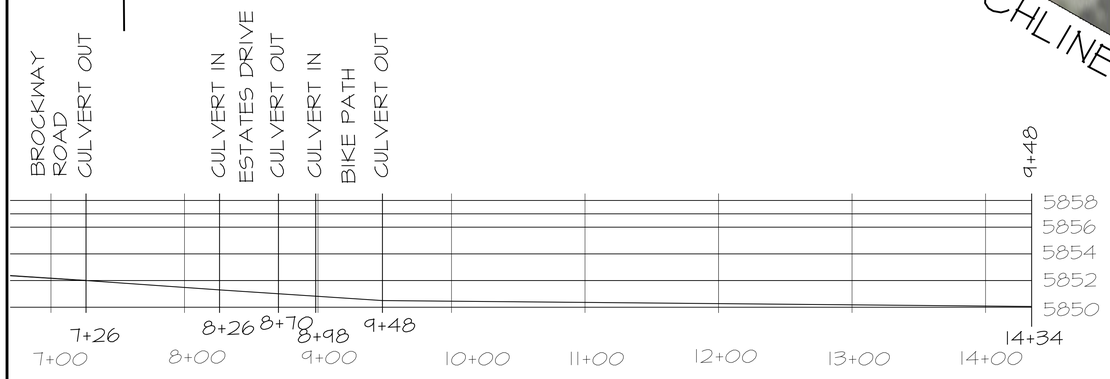
PIPE AND GRAVEL PASS THROUGH PER LUMOS DWGS - TYP.

BROCKWAY ROAD

WETLAND RESTORATION INTERPRETIVE SIGNS - 3X5 GRAPHICS ON RAISED PLATFORMS FOR SEATING, FISHING, BIRD WATCHING, VIEWING, ETC

TRAILS INTERPRETIVE

SWALE PROFILE STATIONS - SEE EXISTING SWALE PROFILE FOR FULL VIEW



MATCHLINE - SEE SHEET L-1.1

MATCHLINE - SEE SHEET L-1.3

NOTE: PARCEL LINES AND PHOTO IMAGE ARE APPROXIMATE AND ARE INTENDED TO PROVIDE CONTEXT ONLY

50' 100' 200'

Project:

TRUCKEE WETLAND RESTORATION PARTNERSHIP

Site:

BROCKWAY ROAD
TOWN OF TRUCKEE, CALIFORNIA

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12020 Donner Pass Road, Suite B1
Truckee, CA 96161
530.550.9776

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CONCEPTUAL DESIGN PONDEROSA POND

Stamp:

Drawn By: RWL
Checked By: rwl
Drawing Date: 1.22.14

Revisions:

Rev.	Date	Remarks

CONCEPTUAL DESIGN

PONDEROSA POND

Scale : 1" = 50'

Sheet No:

L-1.2

3 of 5

NOTE: PARCEL LINES AND PHOTO IMAGE ARE APPROXIMATE AND ARE INTENDED TO PROVIDE CONTEXT ONLY

50' 100' 200'

Project:

TRUCKEE WETLAND RESTORATION PARTNERSHIP

Site:

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CHANNEL TO THE TRUCKEE RIVER

Stamp:

LICENCED LANDSCAPE ARCHITECT
ROBIN W. LITCHFIELD LIC# 4197
Signature
03-31-12
Renewal Date
27 Jan 2014
Date
STATE OF CALIFORNIA

Drawn By: RWL
Checked By: XXX
Drawing Date: 1.22.14

Revisions:

Rev.	Date	Remarks

CONCEPTUAL DESIGN

CHANNEL TO TR (north)

Scale : 1" = 100'

Sheet No:

L-1.4

4 OF 5

MATCHLINE - SEE SHEET L-1.4

MATCHLINE - SEE SHEET L-1.2

NOTE: PARCEL LINES AND PHOTO IMAGE ARE APPROXIMATE AND ARE INTENDED TO PROVIDE CONTEXT ONLY

50' 100' 200'

Project:

TRUCKEE WETLAND RESTORATION PARTNERSHIP

Site:
BROCKWAY ROAD
TOWN OF TRUCKEE, CALIFORNIA

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CHANNEL TO THE TRUCKEE RIVER

Stamp:

LICENCED LANDSCAPE ARCHITECT
ROBERT W. LITCHFIELD, LIC. #4197
Signature
03-31-12
Renewal Date
27 Jan 2014
Date
STATE OF CALIFORNIA

Drawn By:RWL
Checked By:BALANCE
Drawing Date: 1.22.14

Revisions:

Rev.	Date	Remarks

CONCEPTUAL DESIGN

CHANNEL TO TR (south)

Scale : 1" = 50'

Sheet No:
L-1.3
4 OF 5

APPENDIX B

Test Pit Logs

Appendix B

Test Pit Logs

Soils in all trenches were logged in detail using ASTM soil logging standards. Each soil type has a Unified Soil Classification System (USCS) identifier, such as CH or ML. Solid lines indicate changes in USCS type. At each change in soil type is a complete soil description, the components of which follow:

> Hardness or density, moisture content, color, MAJOR CONSTITUENT, minor constituents with adjectives such as "with," "few" or "trace", sand and gravel grain sizes where appropriate, other associated textural or constituent descriptors.

The following abbreviations are occasionally employed within the test pit logs:

c	coarse
corr.	corrected
dk.	dark
f	fine
freq.	frequent
gr.	gravel
lt.	light
m	medium
qtz	quartz
sa.	sand
SS	sandstone
tr.	trace
w/	with

Where the constituents or appearance of a soil changed, without changing the USCS, only the pertinent changes are described. Within the soil descriptions, soil color is occasionally described using the Munsell Soil Color convention (i.e.: Hue Value/Chroma). Samples where collected and retained are indicated, as are notes on water observed during excavation. Well construction is also described on each log form in the indicated column.

Balance Hydrologics, Inc.

LOG OF ~~BORING~~ TEST PIT

Project	TRUCKEE WETLAND		Boring No.
Number	210028		12-01
Total Depth	6.3 ft		
Sheet	1	of 1	

DATE: 12/13/12

Depth	Sample Type	Recovery	Blows/6"	USCS	Description	Graphic Log	*	**	Remarks	Well Construction
1				GW	0-1.5' LIGHT BROWN CLAY w/ ROUNDED COBBLE; ROOT DEPTH ~4"				WP571 2.7' stickup	
					FILL					
2				OH	1.5-3.5 3.0; DARK BROWN ORGANIC HORIZON (HISTOSOL?), SOME CLAY					
	2.2'				▽ WATER POURING INTO HOLE AT ~3' (ON TOP OF HARDER LAYER)				5' LENGHT SLOTTED PVC (.020) PACKED w/ #30 SAND.	
3										
4					3.5-6.3 ROUNDED COBBLE/GRAVEL IN CLAY MATRIX					
				CL	LIGHT BROWN LEAN CLAY					
5					MOIST; (WATER APPEARS TO BE FLOWING ON TOP					
6										
					6.3 REFUSAL ON BEDROCK					
7										

841 Folger Avenue
Berkeley, CA 94710-2800

**

Logged by	D. SHAW
Drafted by	
Supervised by	

Balance Hydrologics, Inc.

LOG OF ~~BORING~~ TEST PIT

Project	TRUCKEE WETLANDS
Number	210028
Total Depth	5.5 ft
Sheet	1 of 1

Boring No. 12-02

DATE: 12/13/12

Depth	Sample Type	Recovery	Blows/6"	USCS	Description	Graphic Log	*	**	Remarks	Well Construction
1				GW	0-1.5 BROWN SANDY LOAM / COBBLY CLAY (DRY)				WP 572 2.0' STICKUP	
2				CH	1.5-2.5 DARK GRAY CLAY W/ COBBLE SOME GLEYING				UPON EXCAVATING FURTHER TO NORTH, LOTS OF WATER ENTERING PIT AT 1' DEPTH, FROM GRAVELLY	
3				CL	2.5-5.5 ORANGE-BROWN MOTTLED CLAY W/ ROUNDED COBBLE (GLACIAL OUTWASH)				5' LENGTH SLOTTED PVC PACKED W/ #30 SAND	
4										
5										
6					5.5 REFUSAL ON BEDROCK					

841 Folger Avenue
Berkeley, CA 94710-2800

**

Logged by	D. SHAW
Drafted by	
Supervised by	

Balance Hydrologics, Inc.

LOG OF ~~BORING~~ TEST PIT

Project	TRUCKEE WETLANDS	Boring No.
Number	210028	
Total Depth	3.2 FT	12-03
Sheet	1 of 1	

DATE: 12/13/12

Depth	Sample Type	Recovery	Blows/6"	USCS	Description	Graphic Log	*	**	Remarks	Well Construction
									WP 573	
1	0.5'			OH	0-0.9' ORGANIC DARK BROWN CLAY LOAM, MOIST				3.0' BLANK RISER (stickup = 1.8')	
2	1.5'			GW	0.9-3.2' YELLOW BROWN GRAVELLY COBBLY LOAM, SOME CLAY WATER FLOWING IN COBBLY LAYERS SOME BOULDERS				2.0' SLOTTED PVC PACKED W/ #30 SAND	
3					3.2' REFUSAL IN BEDROCK					
4										
5										

841 Folger Avenue
Berkeley, CA 94710-2800

**

Logged by	D. SHAW
Drafted by	
Supervised by	

Balance Hydrologics, Inc.

Log of Boring

Project Number	210028 13-04
Total Depth	3.45
Sheet	1 of 1

Boring No. 13-04

Hand auger 4" bit

Depth (ft)	Sample Type	Recovery	USCS	Description	Remarks	Well Construction
2				Sandy, loam, w/ gravels and some clay gravel in sandy clay sand, clay w/ gravel	native soil Monterey #30 sand	
4					cap drilled w/ holes to drain	
6				SCLT 116@ 1.6°C very low	stick up = 1.8'	
8					ponded water on surface in western wetland	
10				difficult augering many attempts to get deeper than 3' cobbles / boulders?		
12						
14						
16						
18						
20						
22						
24						
26						
28						

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Logged by	BKH
Drafted by	BKH
Supervised by	

Balance Hydrologics, Inc.

LOG OF BORING

		Boring No.
Project	210028	
Number	13-05	13-05
Total Depth	3.30	
Sheet	1 of 1	

Depth	Sample Type	Recovery	Blows/6"	USCS	Description	Graphic Log	*	**	Remarks	Well Construction
					Hand auger 4" bit					
1					clay					
2					clay w/ gravels					
3	3.3'				water filling borehole					
					difficult augering conditions attempted 9- boreholes refusal < 3.5'					

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**

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Supervised by	

APPENDIX C

Site Observer Log

Table C1. Surface water monitoring observations, Truckee Wetlands Restoration Partnership, Truckee, California, WY 2013

Site Conditions				Streamflow				Water Quality Observations				High-Water Marks		Remarks
Date/Time (mm/dd/yr)	Observer(s)	Stage (staff plate) (feet)	Hydrograph (R/F/S/B)	Measured Discharge (cfs)	Estimated Discharge (cfs)	Instrument Used (AA/PY/B)	Estimated Accuracy (e/g/f/p)	Water Temperature (oC)	Specific Conductance at field temp. (µmhos/cm)	Specific Conductance at 25C (at 25 oC)	Additional Samples	Estimated stage at staff plate (feet)	Inferred dates? (mm/dd/yr)	
Ponderosa Golf Course Pond Inflow (weir)														
11/15/12 16:00	cs	--	--	--	--	PY	--	5.0	120	197	--	--	--	Measured flow at Estates Drive culvert outflow; no staff plate installed at time of measurement
12/13/12 17:04	ds, cs	1.33	R	0.27	--	B	g	2.2	111	197	--	--	--	Installed v-notch weir and levellogger+staff plate
12/14/12 10:15	ds	1.35			--			1.5	72	129	--	--	--	
1/4/13 13:45	bkh	1.31	S	0.28	--	B	g	4.2	113	189	--	--	--	Snow on banks but not affecting stage; cold nights and melting snow during day--diurnal flux expected
3/5/13 12:15	bkh	1.31	S		--	--	--	3.9	111	188	--	--	--	Water clear, weir board slightly bowing outward; reinforced with a couple boulders.
3/14/13 17:45	bkh	1.345	S	0.29	--	B	g	8.3	130	195	--	--	--	Warm, sunny, snowmelt runoff; abundant algae in pool behind weir, higher stages may require alternative methods of flow measurement
3/20/13 10:30	bkh	1.45	S	0.48	--	B	g	4.2	180	302	--	--	--	Rain overnight; clearing with more rain/snow forcasted for afternoon; water clear;
4/23/13 14:00	ds	1.13	F	--	0.26	--	f				--	--	--	Most of flow is under weir; plugged back of weir with clay, stage rising
4/23/13 18:30	ds	1.29	R	0.28	--	B	g	7.6	256	392	--	1.36	4/4/2013	Stage recovered, weir in working order; flow appears to be constant
5/15/13 15:00	cs, bkh	1.22	S	0.14	--	B	e	9.8	148	214	--	1.35	4/29/2013	Sunny, warm, windy, weir losing flow under weir; plugged weir with clay, stage rose from 1.16 to 1.22; conducted flow measurements before (0.09 cfs) and after (0.14 cfs); Surveyed in the staff plate and notch today.
6/25/13 16:05	ds	1.44	f?	0.207	--	B	--	6.5	132	204	--	--	--	Some precipitation in last few days. Construciton happening near channel.
7/31/13 15:45	ds	1.22	B	0.142	--	B	--	8.7	140	201	--	--	--	Water clear, weir in good condition, no leaks, downloaded.
												--	--	
Ponderosa Golf Course Pond														
11/15/12 15:45	cs	3.42	S	--	--	--	--	--	--	--	--	--	--	Installed staff plate + levellogger in pond, west end
1/4/13 15:00	bkh	3.55	ICE	--	--	--	--	--	--	--	--	--	--	Pond frozen, stage reading with ice/snow
3/20/13 10:40	bkh	3.57	S	--	--	--	--	--	--	--	--	--	--	Elevated water surface, increased runoff from ditch; adjacent wetland areas saturated or ponded in small locations
4/23/13 15:00	ds	3.19	S	--	--	--	--	14.1	161	207	--	--	--	Downloaded levelogger;
5/15/13 14:00	bkh, cs	2.66	S	--	--	--	--		--	--	--	--	--	Surveyed in staff plate; no outflow
6/25/13 16:34	ds	3.41		--	--	--	--	12.4	159.0		--	--	--	
7/31/13 16:20	ds	2.18		--	--	--	--		--	--	--	--	--	
9/18/13 0:00	bkh	2.66		--	--	--	--	18.9	194.0	221.0	--	--	--	Downloaded.

Table C1. Surface water monitoring observations, Truckee Wetlands Restoration Partnership, Truckee, California, WY 2013

Site Conditions				Streamflow				Water Quality Observations				High-Water Marks		Remarks
Date/Time (mm/dd/yr)	Observer(s)	Stage (staff plate) (feet)	Hydrograph (R/F/S/B)	Measured Discharge (cfs)	Estimated Discharge (cfs)	Instrument Used (AA/PY/B)	Estimated Accuracy (e/g/f/p)	Water Temperature (oC)	Specific Conductance at field temp. (µmhos/cm)	Specific Conductance at 25C (at 25 oC)	Additional Samples	Estimated stage at staff plate (feet)	Inferred dates? (mm/dd/yr)	
Ponderosa Golf Course Pond Outlet (South Ditch)														
1/4/13 12:15	bkh	7.27	S	--	0.30	visual	p	-1.4	99	192	--	--	--	Installed staff plate + levelogger approximately 100 feet downstream of pond outlet
4/23/13 15:15	ds	6.90	B	--	0.01	visual	p	17.6	236	277	--	--	--	Water ponded at staff plate, but min or now flow in channel; download
5/15/15 14:15	bkh, cs	dry	--	--	--	--	--	--	--	--	--	7.1	--	HWM is an algae line; south ditch appears to be more dry than North Ditch.
6/25/13 16:50	ds	7.10	--	--	--	--	--	12.6	170	223		--	--	
7/31/13 16:50	bkh	dry	--	--	--	--	--	--	--	--	--	--	--	Outlet is dry.
9/18/13 17:19	BKH	dry	--	--	--	--	--	--	--	--	--	--	--	Outlet is dry.
Ponderosa Golf Course Pond Outlet (North Ditch)														
1/4/13 12:30	bkh	--	--	--	**0.25**	visual	p	-0.4	98	186	--	--	--	Most of channel covered in snow+ice;
5/15/13 14:30	bkh, cs	--	--	--	**wet**	visual	e	--	--	--	--	--	--	Wet soils, but no flow

Notes:
1) ds = Dave Shaw, bkh = Brian Hastings, cs = Collin Strasenburgh
2) -- is not applicable
3) Stage is an arbitrary datum, measured in decimal feet
4) Hydrograph abreviations, R=rising, F=falling, S=Steady, B=Baseflow
5) Instrument used: PY: pygmy meter, AA: standard meter, B: bucket and stopwatch
6) Estimated accuracy: e= excellent (+/- 2%); g = good (+/- 5%); f = fair (+/- 8%); p = poor (> 10%)

Table C2. Groundwater monitoring observations, Truckee Wetlands Restoration Partnership
Truckee, California, WY 2013

Site Conditions					Water Quality Observations			Remarks
Date/Time	Observer	Top-of-casing to water (ft)	Depth to water (ft, bgs)	Water Surface Elevation NGVD/NAVD)	Temperature (°C)	Specific Conductance (at field temp.) (µS/cm)	Specific Conductance (at 25 °C)	
Piezometer 12-01 - West								
Depth to bottom =	8.00 *ft btoc*							Installed 12/13/12
Total Stickup =	2.93 *ft above gs*							
Elevation =	5853.55 *ft*							
12/14/12 13:53	ds	-4.09	1.16	5849.46	0.2	81	151	Installed levellogger
1/4/2013 14:20	bkh	-3.89	0.96	5849.66	3.9	104	176	Sunny, 30 deg with some melting snow near channel; very cold nights, surface hoar present on snow surface.
4/23/2013 15:45	ds	-4.75	1.82	5848.80	7.6	256	392	
5/15/2013 14:00	bkh, cs	-5.59	2.66	5847.96	7.4	391	602	Stratified, bottom is 696 at 25 deg C. mud at bottom burying LL
6/25/2013 17:30	ds	dry	dry	--	--	--	#VALUE!	Levelogger buried in sediment, cleaned.
7/31/2013 16:25	bkh	-7.95	5.02	5845.60	9.5	629	890	Downloaded.
9/18/2013 16:50	bkh	-8.41	5.48	5845.14				Mucky water at bottom of well, downloaded.
Piezometer 12-02 - Middle								
Depth to bottom =	7.50 *ft btoc*							Installed 12/13/12
Total Stickup =	1.50 *ft above gs*							
Elevation =	5851.58 *ft*							
12/14/12 14:05	ds	-2.25	0.75	5849.33	0.7	81	150	Installed levellogger
1/4/2013 14:30	bkh	-2.70	1.20	5848.88	3.9	154	261	Snow covering piezometer; stratified: 204 uS at 4.3 deg C at max depth
4/23/2013 15:40	ds	-3.44	1.94	5848.14	9.0	756	1115	Definite transition from snowmelt infiltration to older groundwater
5/15/2013 14:05	bkh, cs	-3.33	1.83	5848.25	10.8	236	332	Stratified, 1271 uS at 25 deg C at bottom of well;
6/25/2013 17:20	ds	dry	--	--	--	--	--	Well is dry.
7/31/2013 16:35	ds	dry	--	--	12.8	65	86	Mud at bottom, water could be stagnant in bottom of piezo.
9/18/2013 16:50	bkh	dry	--	--	--	--	--	Mud ponded in bottom of well, downloaded.
Piezometer 12-03 - East								
Depth to bottom =	*ft btoc*							Installed 12/13/12
Total Stickup =	1.80 *ft above gs*							
Ground Elevation =	5848.45 *ft*							
12/14/12 14:25	ds	-2.11	0.31	5846.34	1.5	72	129	Installed levelogger
1/4/2013 14:45	bkh	-1.8	0.00	5846.65	0.0	--	--	Water frozen in piezo; depth to ice reported; piezo was buried in snow.
4/23/2013 15:30	ds	-3.83	2.03	5844.62	7.3	472	729	Downloaded
5/15/2013 14:20	bkh, cs	-4.70	2.90	5843.75	7.2	305	472	no stratification
6/25/2013 17:10	ds	dry	dry	--	--	--	--	Well is dry.
7/31/2013 16:42	bkh	dry	dry	--	--	--	--	Well is dry.
9/18/2013 18:15	bkh	dry	dry	--	--	--	--	Well is dry.

Table C2. Groundwater monitoring observations, Truckee Wetlands Restoration Partnership
Truckee, California, WY 2013

Site Conditions					Water Quality Observations			Remarks
Date/Time	Observer	Top-of-casing to water (ft)	Depth to water (ft, bgs)	Water Surface Elevation NGVD/NAVD)	Temperature (°C)	Specific Conductance (at field temp.) (µS/cm)	Specific Conductance (at 25 °C)	
Piezometer 13-04 - Southeast								
Depth to bottom		*ft btoc*						
Total stickup		1.80 *ft above gs*						
Ground elevation		5853.57 *ft*						
3/5/13 11:00	bkh	-1.90	0.10	5851.67	1.6	116	209	Installed piezometer south of pond, east of boulder fence; difficult auger conditions, final depth 3.45 ft bgs; ground free of snow, some standing water, subsurface conditions saturated, sandy loams with gravel and clay; instrumented with levelogger (hourly) begin at 12:00
4/23/2013 14:30	ds	-2.29	0.49	5851.28	8.7	144	214	Slightly stratified, 300 uS @ 25 C at depth.
5/15/2013 13:55	bkh, cs	-2.46	0.66	5851.11	7.2	200	310	No stratification, meadow verdant
6/25/2013 16:25	cs	dry	--	--	--	--	--	Well is dry.
7/31/2013 16:12	bkh	dry	--	--	--	--	--	Construction on bike trail, meadow is very dry, brown vegetation, some flowering species.
9/18/2013 17:20	bkh	4.63	--	--	13.1	246	319	Downloaded.
Piezometer 13-05 - Southwest								
Depth to bottom		*ft btoc*						
Total stick up		1.40 *ft above gs*						
Ground elevation		5853.29 *ft*						
3/5/13 12:20	bkh	-4.50	3.10	5848.79	3.9	904	1531	Installed piezometer, difficult conditions to auger, clay with sand transitioned to dry gravelly sand and loams; final depth: 3.30 ft bgs. Mostly dry, some water beginning to fill bottom of piezo.
4/23/2013 14:15	ds	-3.59	2.19	5849.70	9.4	117	171	Appears to be a transition from ground water to fresher water?
5/15/2013 13:45	bkh, cs	-3.59	2.19	5849.70	10.3	2040	2905	Stratified, 4,000 uS at 25 deg C at bottom of well;
6/25/2013 16:20	cs	-4.13	2.73	5849.16	14.0	1773	2260	Very little water in casing, no LL installed.
7/31/2013 0:00	bkh	dry	--	--	--	--	--	Well is dry.
9/18/2013 17:40	bkh	-4.53	--	--	18.2	5000	5740	

Notes:
1) ds is David Shaw; bkh is Brian Hastings; cs is Collin Strasenburgh
2) NR is not recorded, -- is not applicable
3) Water surface elevationsare based on ground surface elevations indicated on digital elevation models (DEM) provided by the USFS
4) btoc=below top of casing; bgs=below ground surface

Specific conductance: Measured in micromhos/cm in field using a YSI30 hand-held meter; then adjusted to 25degC by equation (1.8813774452 - [0.050433063928 * field temp] + [0.00058561144042 * field temp^2]) * Field specific conductance