Lower Cascade Canal and Upper Grass Valley Canal Long Term Canopy Cover Study and Pond Study Report, Baseline Year 0

Banner Cascade Pipeline Project

Prepared for:
Nevada Irrigation District

Prepared by:
Stantec Consulting Services Inc.

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Sign-off Sheet

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Abbreviations

AMSL	Above Mean Sea Level
Canopy Cover Assessment	Canopy Cover Assessment via Densiometer
Canopy Cover Study	Long Term Tree Health and Canopy Cover Assessment via Densiometer
CFS	Cubic Feet Per Second
CRLF	California Red Legged Frog
DBH	Diameter at Breast Height
EIR	Environmental Impact Report
ESA	Endangered Species Act
GIS	Geographic Information Systems
GPS	Global Positioning System
LCC	Lower Cascade Canal
MMRP	Mitigation Monitoring and Reporting Program
Monitoring Plan	Ten Year Canopy Cover Study Monitoring Plan
NID	Nevada Irrigation District
Pond Study	Long Term Seep Wetland, Pond, and Associated Potential Endangered Species Act Species Habitat Study
Project	Lower Cascade- Canal Banner/Cascade Pipeline Project
Report	Lower Cascade Canal and Upper Grass Valley Canal Long Term Canopy Cover Study and Pond Study, Baseline Report-Year 0
UGVC	Upper Grass Valley Canal
Workplan	Wetland Impact Assessment Workplan

1.0 INTRODUCTION

This Lower Cascade Canal and Upper Grass Valley Canal Long Term Canopy Cover Study and Pond Study Report, Baseline Year 0 (Report) provides the baseline data for the initial monitoring year (Year 0) for the Nevada Irrigation District (NID) Lower Cascade Canal (LCC) and Upper Grass Valley Canal (UGVC) Long Term Canopy Cover Study, comprised of a Long Term Tree Health Assessment and Canopy Cover Assessment via Densiometer (Canopy Cover Study), and a Long Term Seep Wetland, Pond, and Associated Potential Endangered Species Act (ESA) Species Habitat Study (Pond Study). This Report also includes a Ten Year Monitoring Plan for each of the components listed above (Appendix C- Ten Year Canopy Cover Study Monitoring Plan, and Appendix D- Ten Year Pond Study Monitoring Plan). The Ten Year Monitoring Plans are based on, and intended to comply with, two canal flow-reduction mitigation measures included in the Final Environmental Impact Report (EIR) for the Lower Cascade- Canal Banner/Cascade Pipeline Project (Project) (NID 2006).

1.1 PROJECT DESCRIPTION

NID constructed the Banner Cascade Pipeline to ensure reliable water deliveries to the areas of Grass Valley and Nevada City, Nevada County, California. These pipelines also serve as the primary means for conveying up to approximately 95 Cubic Feet Per Second (CFS) of raw water to Grass Valley and Nevada City and to the Loma Rica and Elizabeth George Wastewater Treatment Plants (WTP) (Figure 1.1- Study Location Overview). The Banner Cascade Pipeline replaced both the LCC and the UGVC, which had reached capacity and no longer met the needs of the area.

Once the Banner Cascade Pipeline began operation in fall of 2013, the flows of the LCC and the UGVC have been gradually reduced and will continue to be kept in limited service as service lateral. With the Banner Cascade Pipeline online, flows in the LCC have reduced to a range of two to ten CFS, with a typical flow estimated to be approximately three to five CFS. Flows in the UGVC have been reduced to approximately one to two CFS. The DS Canal, another NID canal, will not experience flow reductions, and thus will act a control to base LCC and UGVC study results.

1.2 PROJECT SETTING

The LCC and the UGVC are located on Banner Mountain in Nevada County, California. The LCC begins near Pasquale Road and meanders south crossing Banner Lava Cap Road and Idaho Maryland Road, and ends at the Loma Rica WTP in Grass Valley (Figure 1.1). The UGVC branches westward to the Elizabeth George WTP at the junction of Banner Lava Cap Road and Gracie Road in Nevada City (Figure1.1). The elevation of this area ranges from approximately 3,150 to 3,325 feet (960 to1, 010 meters) Above Mean Sea Level (AMSL).

The LCC is approximately 7.4 miles long, 100 years in age, and has a maximum hydraulic capacity of approximately 45 CFS. This capacity does not meet the projected water demands of the WTPs and other uses based on Nevada County's General Plan for the area (NID 2006). The UGVC, a branch off the LCC, is approximately 0.5 mile long and has a maximum capacity of approximately 12 CFS. Prior to the operation of the Banner Cascade Pipeline, the LCC flowed at rates up to approximately 45 CFS (i.e., maximum capacity), and the UGVC diversion off the LCC flowed at rates of approximately eight CFS. The water in the LCC is diverted from Deer Creek above Scotts Flat Lake. In the past, this canal primarily served the two WTPs mentioned above. Therefore, flow in these canals was virtually year-round, except during relatively brief canal maintenance work.

The vegetation communities surrounding the canals are typical of those found in the western foothills of the northern Sierra Nevada range. There are many areas immediately adjacent to the LCC and the UGVC that are also urban (NID 2012). The overarching vegetation community present at the LCC, the UGVC, and the DS Canal can be classified as Sierrean Mixed Conifer-Hardwood Forest. This forest type is comprised of both upland and riparian species. At the LCC, the UGVC, and the DS Canal study site locations, observed upland over-story species include black oak (*Quercus kelloggii*), canyon live oak (*Quercus chrysolepis*), Douglas-fir (*Pseudotsuga menziesii*), hazelnut (Corylus cornuta), incense cedar (*Calocedrus decurrens*), Pacific madrone (*Arbutus menziesii*), Ponderosa pine (*Pinus ponderosa*), and tanoak (*Notholithocarpus densiflorus*). Upland shrub species include coyote brush (*Baccharis pilularis*), and Himalayan blackberry (*Rubus armeniacus*). Intermixed within this Sierrean Mixed Conifer-Hardwood Forest are also riparian species including bigleaf maple (*Acer macrophylum*), Pacific dogwood (*Cornus nuttallii*), gray alder (*Alnus incana*), mountain maple (*Acer glabrum*), Oregon ash (*Fraxinus latifolia*) and white alder (*Alnus rhombifolia*). Riparian shrub and herbaceous species include common cattail (*Typha latifolia*), dock species (*Rumex* spp.), Harding grass (*Phalaris aquatica*), plantain species (*Plantago* spp.) and various rushes (*Juncus* spp.). At lower elevations along the LCC, closer to the Loma Rica WTP, oak species are more common and thus fewer coniferous trees are present. In areas where urban encroachment has not occurred, vegetation communities are intact and provide suitable habitat for vegetative and wildlife species alike. Reference Appendix D for a complete list of all species observed per study site.

1.3 PROJECT PURPOSE

By keeping the canals in service, NID will preserve the canals as a historical, cultural, scenic, and recreational amenity. However, reducing the flows and water levels in these two canals will reduce the wetted perimeter in each canal and the head on the remaining wetted perimeter. This change in hydraulic conditions will reduce the amount of leakage from the canals, which has the potential to impact the environment created by canal leakage over the years (NID 2006).

Potential impacts were identified in the Project's Draft EIR that could result from the canal flow reductions (NID 2004). These include potential reduction in canopy cover due to reduced flows

and seepage that supports the growth of riparian, or wet-adapted (i.e., emergent or hydrophytic) riparian-type species (e.g., bigleaf maple, Pacific dogwood).

The impact analysis in the EIR found that the possible stress from the flow reduction could also lead to increased susceptibility to disease, parasitism, and possibly death of plants, including special status plant species. This in turn could result in loss of trees and associated shade canopy, reductions in seepage flows to ponds, and the reduction of habitat for common and special status wildlife species (i.e., California red legged frog [*Rana draytonii*]) (NID 2004).

While the dependence of riparian vegetation on flow in stream systems is generally accepted, efforts to quantify this dependence have been plagued with difficulties. The geomorphic and hydrologic characteristics of a site determine how streamflow reductions are likely to affect water availability for riparian plants (Kondolf et al. 1987). In addition, such interactions in canal systems do not appear to be verified in published literature. As such, the EIR deemed it necessary to study the potential for reduced flow to affect canal area vegetation, canopy cover, and associated seep wetlands or ponds (NID 2004).

The purpose of this Report and associated Monitoring Plan(s) (Appendices C and D) is to provide the baseline monitoring data (Year 0) for NIDs LCC and the UGVC Long Term Canopy Cover Study and Pond Study- as described in the Mitigation Monitoring and Reporting Program (MMRP) Wetland Impact Assessment Workplans (Workplan) (NID 2012) to mitigate for potential significant impacts to the environment including those potentially caused by reducing the flow in the LCC from typical rates (NID 2004). Furthermore, the Workplans describe a specific course of study to assess the magnitude, if any, of these potential environmental impacts that may result from the reduced canal leakage caused by the Banner Cascade Pipeline Project (NID 2012). This Report also provides future implementation and adaptive management monitoring strategies.

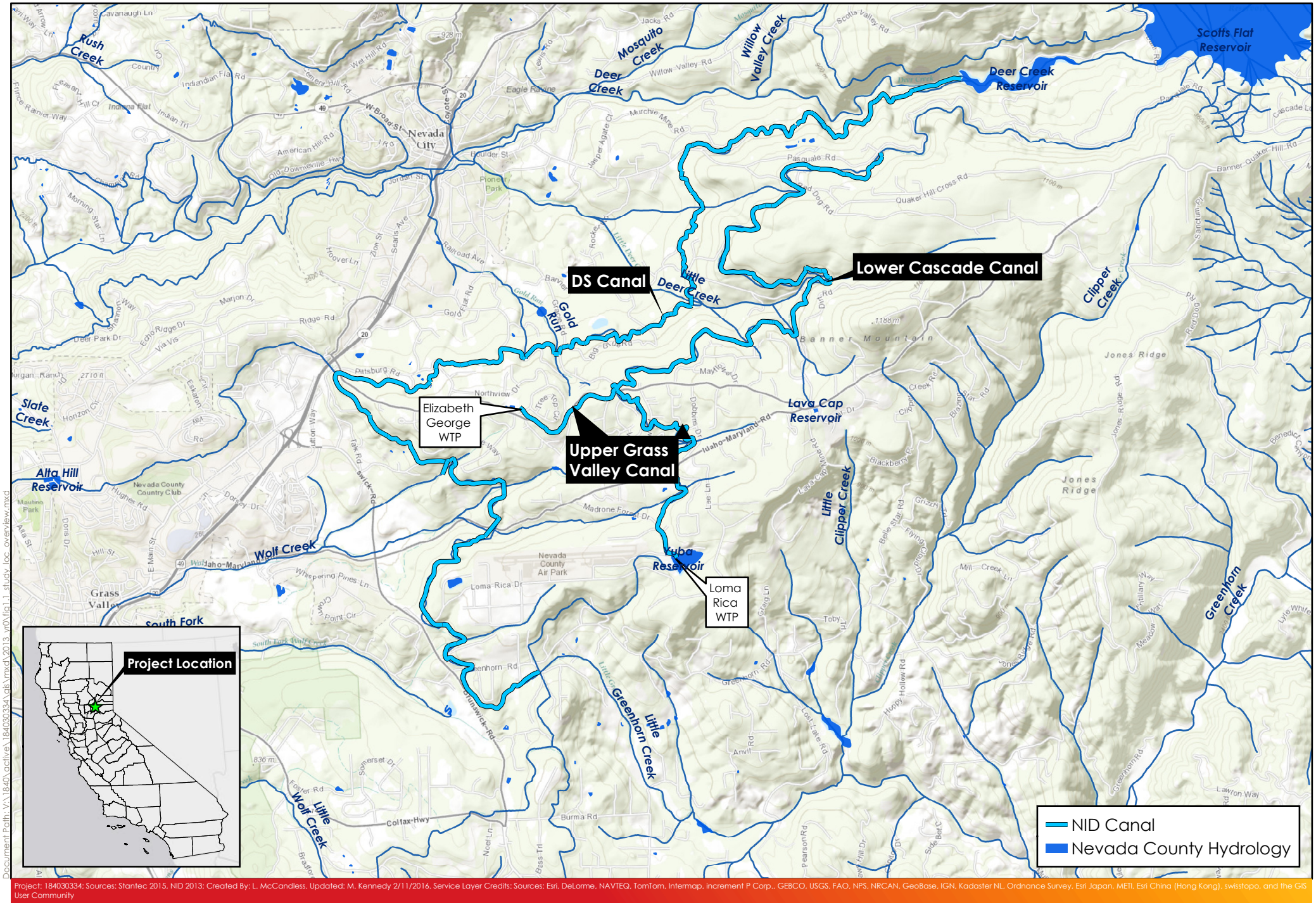

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Figure 1.1
Study Location Overview
Long Term Canopy Cover Study and Pond Study, Baseline Year O

Nevada Irrigation District, Banner Cascade Project

2.0 METHODS

Methods for the Canopy Cover Study, including the Tree Health Assessment and Canopy Cover Assessment, and the Pond Study were developed as part of the Workplans (NID 2012). These methods address flow reductions through spatial and temporal comparisons. A mixed-method qualitative and quantitative approach for documenting changes along the LCC and the UGVC as flows are reduced has been implemented for the aforementioned studies and is defined in the following section, with parameters summarized in Table 2.1 below.

Table 2.1 Methods and Parameters Summary for the Canopy Cover Study and the Pond Study

Study Type	Duration of Study (years)	Data Collection Frequency	LCC Total Study Sites	UGVC Total Study Sites	DS Canal Total Control Sites	Study Site Description(s)
Canopy Cover Study Tree Health Assessment	10	Every 2 years (Years 0, 2, 4, 6, 8, 10)	4	1	1	Approximately 20 x 10 meters
Canopy Cover Study Canopy Cover Assessment	10	Every 4 years [2] (Years 0, 4, 8, +10)	350	50	50	50 densiometer observations per mile
Pond Study (Seep Wetland, Pond, and Associated Potential ESA Species Habitat Study)	10	Every 4 years [2] (Years 0, 4, 8, +10)	2	0 [1]	1	Dependent on pond locations & accessibility

[1] No ponds were observed along canal

[2] Data Collection Frequency' was updated in table to reflect future adaptive management recommendations

2.1 CANOPY COVER STUDY METHODS

In compliance with Mitigation Measure 3.8-1 (Appendix E Mitigation Monitoring and Reporting Program Workplan), two studies were conducted as part of the overall Canopy Cover Study including- 1) Tree Health Assessment; and 2) Canopy Cover Assessment (NID 2006).

2.1.1 Tree Health Assessment

The Tree Health Assessment generally consists of the following parameters:

- Evaluating progressive changes in downstream flora patterns over time along the impacted canal areas and along comparable control sites;

- Tree Health Assessment data collection will occur within each of the appropriate study years in the late summer, typically August through September, when the trees are most water stressed, but prior to leaf shedding (i.e., abscission); and

- Surveys will be completed by a qualified Botanist or Biologist (NID 2012).

2.1.1.1 Site Selection

The canals were divided into mile markers to assess progressive downstream patterns. Study sites along the canals were identified based on overarching vegetation community composition and access. According to the Workplans (Appendix E), a minimum of four Tree health Assessment sites shall be defined along the LCC, with three sites between mile five and mile seven (lower sites), and one site between miles one and five (upper site). On the UGVC, two study sites shall be established including one site between miles zero and 0.25 (upper site) and one between miles 0.25 and 0.5 (lower site). Lastly, one control study site shall be defined on the DS Canal (NID 2012).

A total of six representative Tree Health Assessment study sites were selected (Figure 2.1 Canopy and Pond Study Areas). Representative sites were selected based on vegetation type, areas suspected of maximum leakage (e.g., unlined stretches of canal), and other associated flora that has the greatest potential to be adversely impacted by reductions in canal leakage. Each study site is approximately 20 meters in length, centered within riparian vegetation, and includes individual trees on both the downslope and upslope of the canal. Each study site is at least one meter from the downslope toe of the canal and one meter from the upslope toe of the canal[1]. The Tree Health Assessment study sites were selected in May 2013 by Stantec Biologists. In summary the six study sites are comprised of the following 1) four study sites along the LCC, 2) one study site along UGVC[2], and 3) one Control Site along DS Canal[3].

2.1.1.2 Data Collection

Baseline (Year 0) tree health data was collected by Stantec Biologists at the six study sites on September 10 and 11, 2013. At each of the six study sites, approximately 25 trees were tagged and evaluated at each for baseline tree health. Trees were located on both the downslope (approximately 75 percent of trees selected) and the upslope (approximately 25 percent). Baseline survey data was collected, recorded, and assessed by considering the following factors (Zobrist 2011):

[1] Specific dimensions were adjusted based on biological assessment of apparent canal seepage-dependent areas.
[2] Due to limited suitable study sites, only one site was established along the UGVC.
[3] Due to the varying conditions and lack of historical data along both the LCC and UGVC prior to the Banner Cascade Pipeline and the pipelines reduction in flows, certain spatial and temporal comparisons were not appropriate nor could be used in assessing the impacts of flow reductions along the canals. At the time of the study in 2013, both the LCC and UGVC were experiencing reduced flows, and therefore an upstream location on each of the canals under study could not be used as a control site where the downstream would then be considered the area of impact. Thus, one control study site was established along the DS canal.

- Presence of foliage decline or evidence of crown fading
- Color of foliage: out of season discoloration of foliage
- Evidence of disease, parasite, or insect damage
- Diameter at Breast Height (DBH)

To capture the data above, visual inspections of selected trees at the six study sites were made using the criteria listed in Table 2.2 below. Data was documented with a Trimble Series 6000 GeoXH Global Positioning System (GPS). In addition to the baseline data, monitoring data is required to continue to be collected for a total of ten years, at two year intervals. Therefore, surveys will be conducted in years 2015, 2017, 2019, 2021, and 2023.

Table 2.2 Tree Health Assessment Data Collected on September 10 to 11, 2013

Assessment Type	Assessment Description	Assessment Score
Canopy Cover	Canopy cover die-back by percentage based on density and presence of foliage at the crown on the tree.	**1- None:** no canopy present, 0% **2- Sparse:** most canopy absent, 0-25% **3- Partial:** canopy 25-50% **4- Medium:** canopy 50-75% **5- Full:** canopy 75-100%
Bark Health	Bark health is assessed through the absence/ sluffing of bark on the bole and limbs of the tree.	**1- Dead:** 100% sluffing off, extensive damage **2- Poor:** decaying or dead; 75-100% bark absent from bole and limbs of tree; abundant root rot; extensive insect damage; overall discoloration and bark shape irregularities; abundant surface growth **3- Fair:** 50-75% bark absence; some root rot and insect damage; discoloration and bark shape irregularities; bark sluffing **4- Good:** 25-50% bark absence; some root or heart rot present; bark only missing from tree limbs **5- Excellent:** 0-25% bark absence. Present bark generally intact and of high vigor
Leaf Color	Leaf color is assessment based on abnormal colorations that are not typical for the species or season, uniform throughout all present foliage, etc.	**1- Normal:** no abnormalities present, color normal **0- Abnormal:** abnormal color present (e.g., spotting, insect tracks, necrotic tips, etc.)
New Growth Presence	"New growth" is any new vascular growth including leaf buds, basal sprouts, epicormic stems, and saplings.	**0- Present** **1- Not Present**

Assessment Type	Assessment Description	Assessment Score
Surface Growth Presence	Surface growth on trunk and stems includes lichen, moss, and all other normal terrestrial algal plants (i.e., non-vascular plants, bryophytes).	**0- Present** **1- Not present**
Disease	Disease includes fungal/ mold presence and other pathogens, tubers, cankers, structural decay (e.g., basal decay, irregular growth pattern of tree), root and heart rot, etc.	**0- Present** **1- Not present**
Parasites	Parasites can include, but are not limited to the presence of mistletoe, red pustules, etc.	**0- Present** **1- Not present**
Insect Infestation	Signs of insects include burrowing/ bore holes; frass, larvae or larva galleries, or insect presence; leaf notching; epicormics stems, galls, etc.	**0- Present** **1- Not present**
Overall Tree Health	Overall tree health was assessed through leaf/ foliage health and other associated physical leaf characteristics, amount of canopy foliage present, stem and bark health (e.g., decay), abnormal tree shape, and/or increased presence of disease, parasites and insect infestations. Normal seasonal variations were considered in overall health scoring.	**1- Dead Overall** **2- Poor Overall**: partial-full discoloration; severe insect damage; disease presence; tissue damage **3- Fair Overall**: partial discoloration; some insect damage, heart rot **4- Good Overall**: some discoloration **5- Excellent Overall**: no physical abnormalities

2.1.2 Canopy Cover Assessment

In addition to the Tree Health Assessment, a Canopy Cover Assessment (via Densiometer Analysis) was conducted as part of the Canopy Cover Study. Baseline cover data was collected initially and will continue to be collected in conjunction with the Tree Health Assessment data within the same ten year study period (2013 to 2023). However, according to the Workplans (Appendix E), data should be collected at a different interval, occurring every five years (i.e., 0, 4, 6, and 10) (NID 2012). Canopy Cover Assessments are intended to coincide with Tree Health Assessments, and further contribute to the mixed-method qualitative and quantitative analysis of tree health and canopy cover along the canal. Similar to Tree Health, Canopy data collection will occur within each of the appropriate study years in the late summer, typically August through September, when the trees are most water stressed, but prior to leaf shedding. Surveys will be completed by a qualified botanist or Biologist (NID 2012).[4]

[4] The Canopy Cover Assessment interval specification in the Workplan outlines five year intervals for Canopy Cover Assessments, however is contradicted with a specification to occur every two to four years (i.e., 0, 4, 6, 10). In light of on-going environmental conditions within the timeframe of tree health and canopy studies (e.g., drought), to be complimentary to the Tree Health Assessments and to increase study time and efficiency, it is recommended as an adaptive management strategy to update the Canopy Cover Assessments to occur every four years with one final assessment to conclude the study on year ten (i.e., 0, 4, 8, 10). This timing adaptive management recommendation is further detailed in the Discussion Section below.

2.1.2.1 Site Selection

The Canopy Cover Assessment sites were established along the same canal reaches as the Tree Health Assessment sites. The Canopy Cover Assessment sites do not directly correlate to the Tree Health Assessment study sites, but rather extend the entire length of each established study reach (e.g., miles zero to seven of LLC).

2.1.2.2 Data Collection

Baseline canopy cover data was collected by a Stantec Biologist on September 10, 19, 20, and 30, 2013. At each canopy cover assessment location, observations were made using a densiometer and methods described in The Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment State Water Resources Control Board Standard Operating Procedure for Measuring Canopy Cover Using a Seventeen Point Spherical Convex Densiometer and the Workplans (Burres 2010, Ode 2007; NID 2012). This method uses the Strickler modification (17-point) of a convex spherical densiometer to correct for overestimation of canopy density (thickness and consistency of plant foliage) that occurs with unmodified readings (Strickler 1959). Observations were made facing upstream, downstream, facing the right bank, and facing the left bank.

Canopy cover data was collected along approximately seven miles of the LCC, 0.5 mile of the UGVC, and along one mile of the DS Canal (Control Sites). To achieve an accurate measurement of canopy cover using a densiometer, a large sample size is recommended (approximately 400 observations) (Jennings et al. 1999). Each observation location was documented with a Trimble Series 6000 GeoXH GPS.

2.2 POND STUDY METHODS

2.2.1 Pond Study

The Pond Study (Seep Wetland, Pond and Associated Potential ESA Species Habitat Study) was conducted in compliance with MMRP Workplan Mitigation Measure 3.8-2, as defined in the Project's Final EIR (NID 2006). The Pond Study will assess whether reductions in canal flows and associated leakage will potentially result in negative impacts to sensitive habitats and species, specifically special status species such as the CRLF (NID 2012). In accordance with MMRP Workplan Mitigation Measure 3.8-2, a ten year study of potentially impacted seeps, wetlands, and ponds located adjacent to the LCC and the UGVC with an assessment of special status species habitat suitability changes over the study period shall be required.

Pond Studies shall be conducted in conjunction with the Canopy Cover Study within the same ten year study period (2013 to 2023). However, according to the Workplans, data shall be collected at a specific interval, occurring every five years (i.e., Years 0, 4, 6, and 10) (NID 2012). Pond Study data collection will occur within each of the appropriate study years in the late

summer, typically August through September, when the trees are most water stressed, but prior to leaf shedding. Surveys will be completed by a qualified Botanist or Biologist (NID 2012).

Like the Canopy Cover Assessment of the Canopy Study, the Workplan outlines five year intervals for the Pond Study; however it is contradicted with a specification to occur every two to four years (Years 0, 4, 6, 10). Similar to the Canopy Cover Assessment, it is also recommended as an adaptive management strategy to update the Pond Study to occur every four years with one final assessment to conclude the study on year ten (Years 0, 4, 8, 10). This adaptive management recommendation is further detailed in the Discussion Section below.

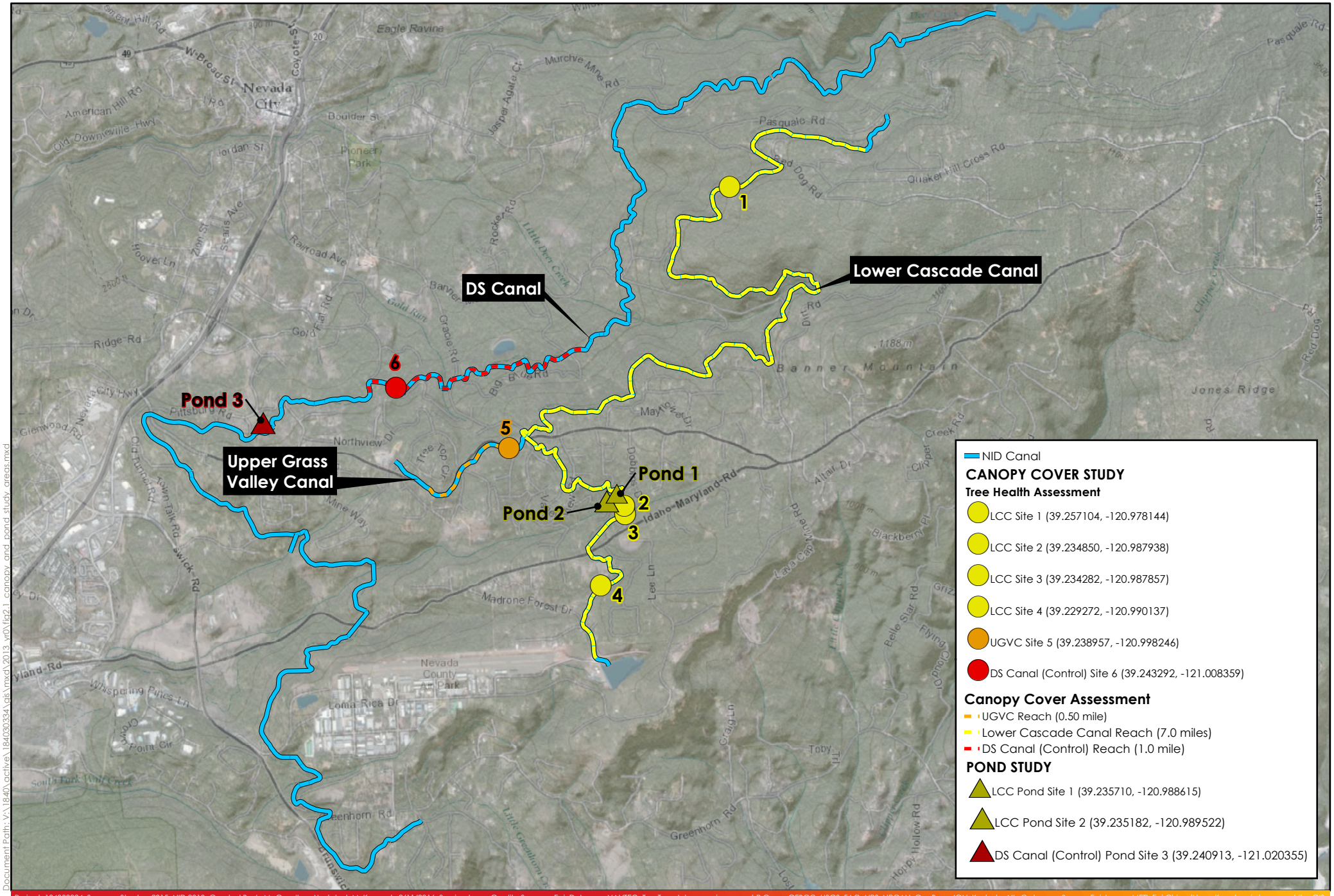
2.2.1.1 Site Selection

Ponds and/or seep wetlands that are located within 50 meters of the downslope side of the canals were targeted and assessed as part of the Pond Study. Sites were also targeted based on property access. Due to the lack of ponds/seep wetlands and access along the LCC, UGVC, and DS Canals, fewer than five seep wetlands/ ponded areas were identified, as was originally targeted by the Workplan (NID 2012). The final Pond Study sites established include two sites along the LCC (Pond 1 and Pond 2), and one control site along the DS Canal (Pond 3) (Figure 2.1). No ponds were identified along the UGVC, and therefore no study pond sites are located along the UGVC.

2.2.1.2 Data Collection

As part of the Pond Study, initial baseline wildlife and habitat suitability assessments (including overarching vegetative cover) were conducted on October 2 and November 6, 2013 by Stantec Biologists. An additional study to verify and quantify vegetation species present at the Pond Study sites was conducted on November 6, 2013 by Stantec Biologists. At each of the three Pond Study sites, the following data was collected and assessed:

- Delineation of inundated area/ soil saturation
- Hydrology pattern
- Range of water depths;
- Soil type
- Vegetation present
- Wildlife species observed
- CRLF habitat assessment
- Site photo



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1 inch = 3,142 feet

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Figure 2.1

Canopy and Pond Study Areas

Long Term Canopy Cover Study and Pond Study, Baseline Year O

Nevada Irrigation District, Banner Cascade Project

3.0 RESULTS

Data was interpreted against the backdrop of NIDs LCC and the UGVC flow rates, loss rates, and California's defined water years (i.e., October to April). LCC and the UGVC tree health, canopy, and pond data were compared with DS Canal Control Site data. In addition biological communities and habitat associated with the study sites and canals were generally evaluated for potential presence/absence of special status species. Compiled results are detailed below.

3.1 CANOPY COVER STUDY

Canopy Cover Studies are comprised of a Tree Health Assessment and a Canopy Assessment (via Densiometer). Baseline data for the Canopy Cover Studies was collected in September 2013 by Stantec Biologists. Results for both components of the Canopy Cover Study are detailed below.

3.1.1 Tree Health Assessment

Observations and baseline canopy cover data was collected in September 10-12, 2013 by Stantec Biologists. Data for each site was post-processed using GIS (Geographic Information Systems) ESRI ArcView 10.1 technologies. Geographical data and associated attribute information was compiled with tree health field collection data into a central database using Microsoft Excel.

3.1.1.1 Site 1 Lower Cascade Canal

Twenty-four riparian tree species were surveyed and tagged (tag numbers 173 to194) at study site 1 on the LCC (Appendix B- Photo Record, Photos 1- 5). Tree species surveyed include bigleaf maple, gray alder, and Pacific dogwood. Of the surveyed trees, Pacific dogwood is the dominant species. DBH for the surveyed trees ranges from one to nine inches, including multiple trunks. Overall tree health was good (score of 4), with some normal/seasonal discoloration of canopy foliage. Surface growth was present on approximately 76.2 percent of the trees. Bark health ranges between poor and fair (scores of 2 and 3), with abundant abnormal coloration and/or absence of bark and little root rot on the cambium. Possible disease was found on Pacific dogwood (tag number 185). Disease symptoms included dead-decaying bole and stems, extensive insect damage, lack of foliage, and growth of unidentified fungal organisms. Insect damage was documented on two bigleaf maples (tag numbers 182 and 192). On number 182 (Photo 3), insect burrowing holes were found on the trunk. Insect damage was isolated on the foliage on tree number 192. No parasitic presence was documented.

3.1.1.2 Site 2 Lower Cascade Canal

Twenty riparian tree species along the LCC were surveyed and tagged (tag numbers 131 to 151) at study site 2 (Appendix B- Photo Record, Photos 6-8). Species surveyed include bigleaf maple, gray alder, and Pacific dogwood. Of those selected, Pacific dogwood is the dominant species at 50 percent (ten total individuals). For all species surveyed, DBH ranges from one to 12.5 inches. The average overall tree health was categorized as fair to good (scores of 3 and 4), with two bigleaf maples (tag numbers 133 and 138) categorized as being in poor health (score of 2). Surface growth was present on approximately 65.0 percent of the trees surveyed. Bark health ranges between poor and fair (score of 2 and 3). Possible disease was found on one gray alder (tag number 144), and two Pacific dogwoods (tag numbers 149 and 150). Disease symptoms on the aforementioned trees include abnormal discoloration of the foliage and bark spotting. At study site 2, no presence of parasites or insect infestation was observed on the surveyed tree species.

3.1.1.3 Site 3 Lower Cascade Canal

Twenty-one riparian tree species along the LCC were surveyed and tagged (tag numbers 152 to 172) at study site 3 (Appendix B- Photo Record, Photos 9-11). Species surveyed include bigleaf maple, gray alder, and Pacific dogwood. The dominant species at study site 3 is bigleaf maple. DBH of the trees surveyed at study site 3 ranges from one to 21.0 inches. Overall tree health was fair to good (scores of 3 to 4). However, there was one bigleaf maple (tag number 158) that was in poor overall health (score of 2), with extensive mortality of tree limbs and dead foliage at the crown of the canopy. Another bigleaf maple (tag number 163) was found to be mostly dead, still standing, with unidentified white fungal bodies on the bark, and thus also in poor overall health (score of 2). Surface growth was present on approximately 85.7 percent of the total trees surveyed. Bark health ranged from poor to fair (scores of 2 to 3); however, four trees were categorized as having poor bark health (score of 2). Insect infestation was observed on a Pacific dogwood (tag number 159). Insect damage was concentrated on the foliage, while no parasites or other disease were observed on tree species surveyed at study site 3.

3.1.1.4 Site 4 Lower Cascade Canal

Eighteen riparian tree species along the LCC were surveyed and tagged (tag numbers 106 to123) at study site 4 (Appendix B- Photo Record, Photos 12-15). Species surveyed include bigleaf maple, gray alder, and Oregon ash. The dominant tree species present at study site 4 is bigleaf maple. For all species, the DBH ranges from one to seven inches. Overall tree health is good to excellent (scores of 4 to 5). Bark health for the trees surveyed at site 4 is fair (score of 3). Surface growth was present on approximately 11.1 percent of the total trees surveyed. One insect infestation was observed on a bigleaf maple surveyed (tag number 108). Infestation was concentrated on the foliage and was minimal. No parasite or disease was observed on the tree species surveyed at study site 4.

3.1.1.5 Site 5 Upper Grass Valley Canal

Eight riparian trees were surveyed and tagged (tag numbers 98 to105) along the one UGVC study site, site 5 (Appendix B- Photo Record, Photos 16-18). Species surveyed include bigleaf maple, Pacific dogwood and white alder. Among the tree species surveyed at study site 5, Pacific dogwood and white alder are the co-dominant species present. For all tree species surveyed, the DBH ranges from two to ten inches. On average, overall tree health was fair (score of 3). However, three trees were categorized as being in poor overall health (score of 2). Of the eight trees surveyed at study site 5, 87.5 percent have surface growth present. Bark health was poor (score of 2); including some presence of root rot on the inner cambium, as well as few bark discolorations/abnormal growth patterns. Disease was observed on one upslope white alder (tag number 104). Insect infestation was observed on three Pacific dogwoods (tag numbers 98, 99, and 102). Insect infestation is concentrated on the foliage for these trees. No parasites were documented on surveyed tree species at study site 5 on the UGVC.

3.1.1.6 Site 6 DS Canal (Control Site)

Twenty-two trees were surveyed and tagged (tag numbers 75 to 96) at study site 6 along the DS Canal, the Control Site (Appendix B- Photo Record, Photos 19-22). Species surveyed include bigleaf maple, Pacific dogwood, and white alder. Pacific dogwood is the dominant tree species present at study site 6, with an overall cover of 64 percent. For all species surveyed the DBH ranges from one to 78 inches. Overall tree health was fair to good (scores of 3 to 4); however one white alder was found to be mostly dead (score of 1). Bark health was variable for the surveyed trees, however is on average poor to fair (score of 2 to 3). New growth was present on 86.4 percent and surface growth was observed on only three trees surveyed (13.6 percent). Insect infestations were found on 15 of the 22 trees surveyed (68.2 percent). Infestations were concentrated to the foliage, with bark burrows being minimal. No observations of disease or parasites were observed at study site 6 along the DS Canal.

3.1.1.7 Tree Health Assessment Results Summary

The following analysis and results summarize the overall baseline (Year 0) tree health findings for each site along the LCC, the UGVC, and the DS Canal (Control Site) (Table 3.1).

Table 3.1 Results Summary of Baseline Tree Health Assessments

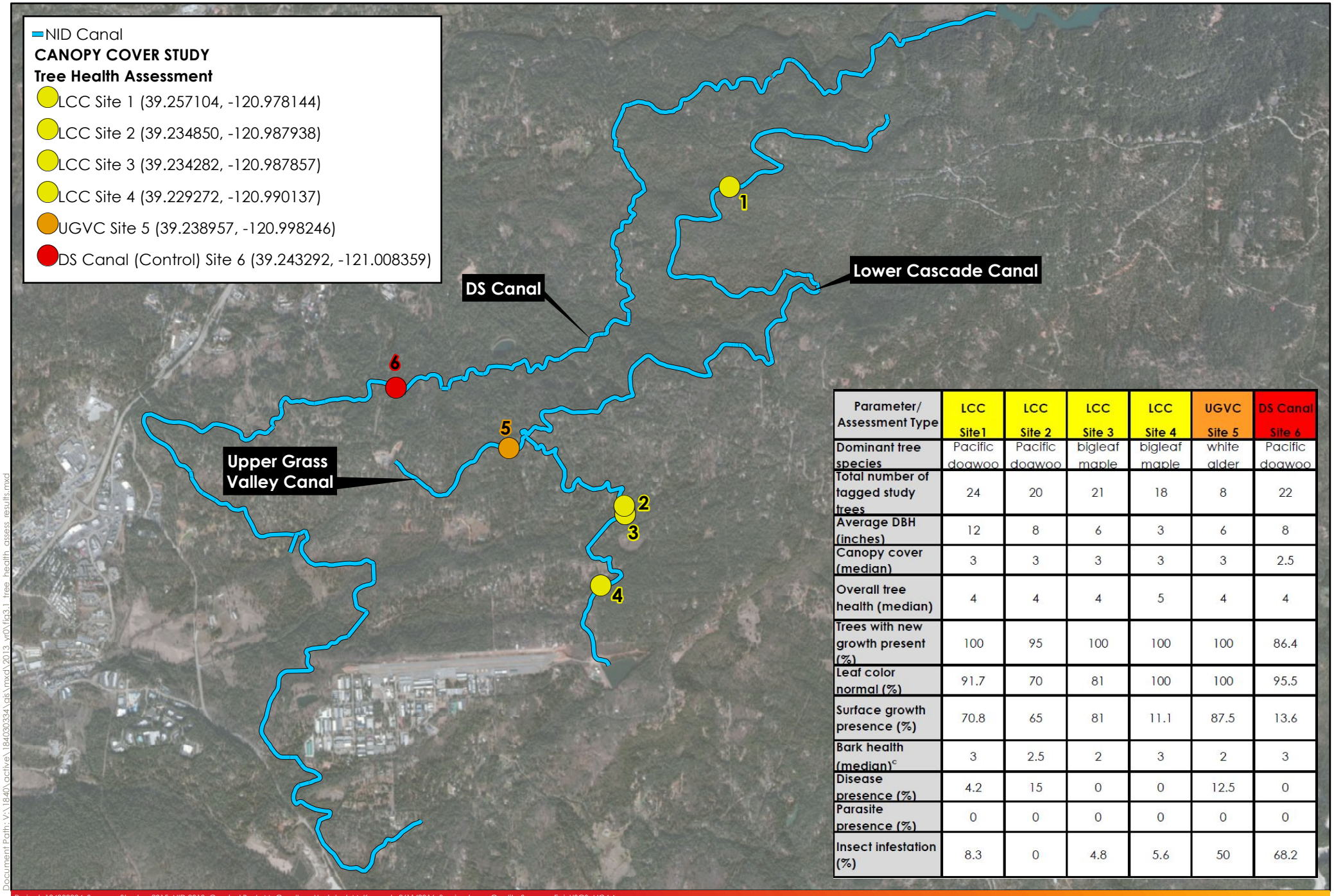
Assessment	Site 1 LCC	Site 2 LCC	Site 3 LCC	Site 4 LCC	Site 5 UGVC	Site 6 DS Canal (Control Site)
Total Trees Surveyed	24	20	21	18	8	22
Dominant Species	Pacific dogwood	Pacific dogwood	bigleaf maple	bigleaf maple	white alder	Pacific dogwood
DBH (minimum inches)	1.0	1.0	1.0	1.0	2.0	1.0
DBH (maximum inches)	9.0	12.5	21.0	7.0	10.0	10.0
Canopy Cover[1]	Sparse-Partial (2.5)	Sparse-Partial (2.6)	Sparse-Partial (2.5)	Sparse-Partial (2.9)	Sparse-Partial (2.3)	Sparse-Partial (2.3)
Bark Health[1]	Poor-Fair (2.6)	Poor-Fair (2.5)	Poor-Fair (2.2)	Fair (3.0)	Poor (2.0)	Poor-Fair (2.4)
Abnormal Leaf Color	90.5%	70.0%	81.0%	100.0%	100.0%	95.5%
New Growth Presence	100.0%	95.2%	100.0%	100.0%	100.0%	86.4%
Surface Growth Presence	76.2%	65.0%	85.7%	11.1%	87.5%	13.6%
Disease Presence	4.8%	14.3%	0%	0%	12.5%	0%
Parasite Presence	0%	0%	0%	0%	0%	0%
Insect Presence	9.5%	0%	4.8%	5.6%	37.5%	68.2%
Overall Tree Health[1]	Good (4.1)	Fair-Good (3.95)	Fair-Good (3.7)	Good-Excellent (4.6)	Fair (3.1)	Fair-Good (3.5)

[1]Average of all survey values

Canopy Cover: 1- None (0%); 2- Sparse (0-25%); 3- Partial (25-50%); 4- Medium (50-75%); 5- Full (75-100%)

Bark Health: 1- Dead (100%); 2- Poor (75-100%); 3- Fair (50-75%); 4- Good (25-50%); 5- Excellent (0-25%)

Tree Health: 1- Dead; 2- Poor; 3- Fair; 4- Good; 5- Excellent



Parameter/ Assessment Type	LCC Site1	LCC Site 2	LCC Site 3	LCC Site 4	UGVC Site 5	DS Canal Site 6
Dominant tree species	Pacific dogwoo	Pacific dogwoo	bigleaf maple	bigleaf maple	white alder	Pacific dogwoo
Total number of tagged study trees	24	20	21	18	8	22
Average DBH (inches)	12	8	6	3	6	8
Canopy cover (median)	3	3	3	3	3	2.5
Overall tree health (median)	4	4	4	5	4	4
Trees with new growth present (%)	100	95	100	100	100	86.4
Leaf color normal (%)	91.7	70	81	100	100	95.5
Surface growth presence (%)	70.8	65	81	11.1	87.5	13.6
Bark health (median)[c]	3	2.5	2	3	2	3
Disease presence (%)	4.2	15	0	0	12.5	0
Parasite presence (%)	0	0	0	0	0	0
Insect infestation (%)	8.3	0	4.8	5.6	50	68.2

Stantec

0 3,600 Feet

1 inch = 3,142 feet

Nevada

Figure 3.1
Tree Health Assessment Results
Long Term Canopy Cover Study and Pond Study, Baseline Year O

Nevada Irrigation District, Banner Cascade Project

3.1.1 Canopy Cover Assessment

Observations and baseline canopy cover data was collected on September 10, 19, 20, and 30 2013 by a Stantec Biologist. Canopy cover data was collected using a densiometer following the methods described in The Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment State Water Resources Control Board Standard Operating Procedure for Measuring Canopy Cover Using a Seventeen Point Spherical Convex Densiometer (Burres 2010, Ode 2007). Canopy cover data and the location for each site was collected using sub-meter Trimble GPS, and post-processing was performed using GIS (Geographic Information Systems) ESRI ArcView 10.1 technologies. Data collection and canopy density percentages were calculated based on methods and formulas described in Use of the Densiometer to Estimate Density of Forest Canopy on Permanent Sample Plots (Strickler 1959). The following results analysis averages and summarizes the overall canopy cover data collected based on densiometer readings along each canal reach.

3.1.1.1 Lower Cascade Canal

Approximately seven miles of the LCC was sampled for canopy cover (Figure 3.2 Canopy Cover Assessment Results). A total of 351 canopy cover observation points were identified and assessed. Canopies on the LCC were full to partially full for the riparian tree species surveyed. The average percent density of canopy cover along seven miles of the LCC was approximately 83.2 percent. The minimum canopy cover measured was 33.5 percent and the maximum was 100 percent.

3.1.1.2 Upper Grass Valley Canal

Approximately 0.5 mile of the UGVC was surveyed to assess canopy cover (Figure 3.2). A total of 24 canopy cover observation points were identified and assessed. Canopies on the UGVC were full to partially full for the riparian tree species surveyed. The average percent density of canopy cover along 0.5 miles of the UGVC was approximately 89.4 percent. The minimum canopy cover measured was 71.0 percent and the maximum was 100 percent.

3.1.1.3 DS Canal (Control Site)

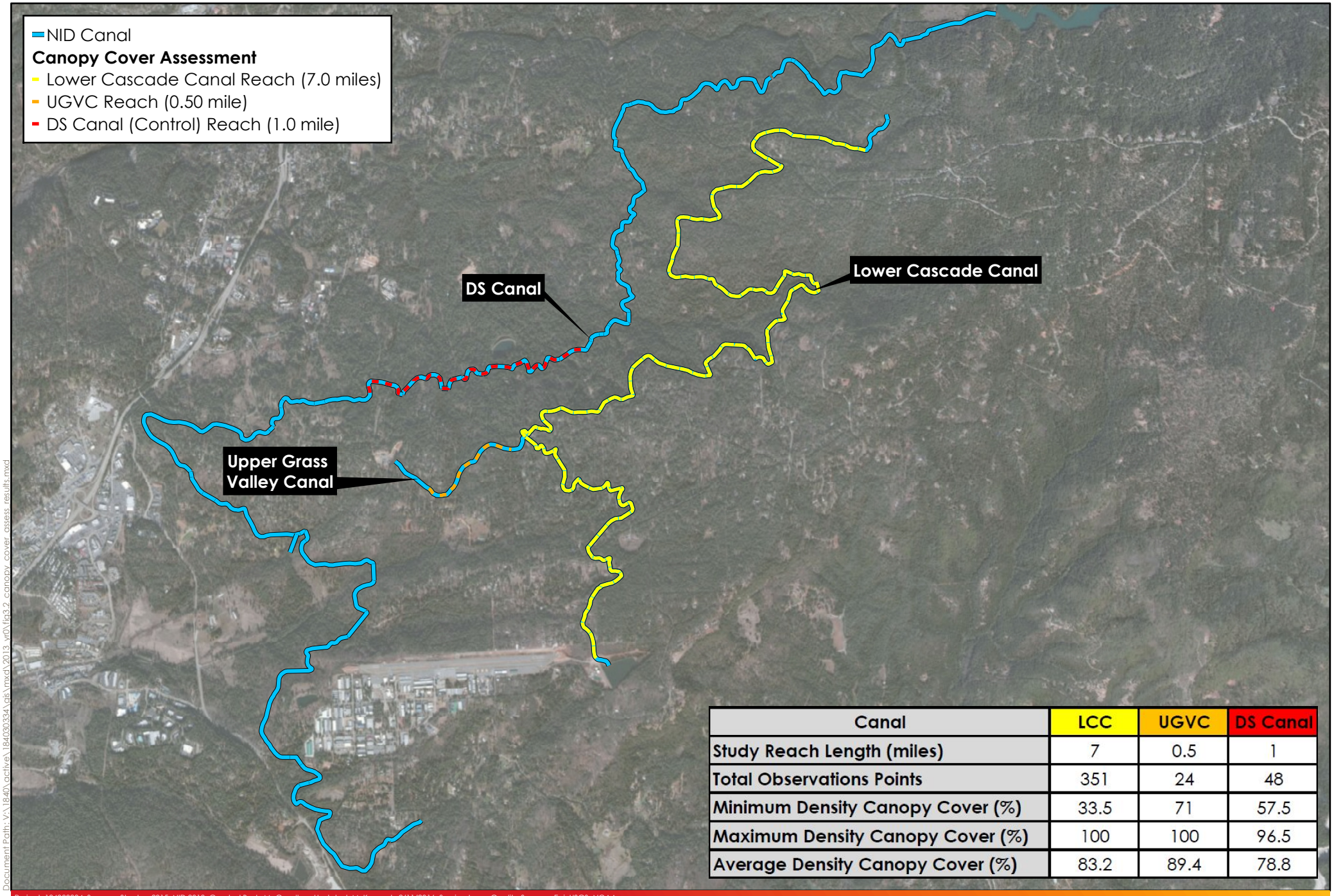
Approximately one mile of the DS Canal (Control Site) was surveyed to assess canopy cover and serve as a control (Figure 3.2). A total of 48 canopy cover observation points, or individual canopies, were identified and assessed. Canopies on the DS Canal were full to partially full for the riparian tree species surveyed. The average percent density of canopy cover along one mile of the DS Canal was approximately 78.8 percent. The minimum canopy cover measured was 57.5 percent and the maximum was 96.5 percent.

3.1.1.4 Canopy Cover Assessment Results Summary

The following analysis and results summarize the overall baseline (Year 0) canopy cover findings for each site along the LCC, the UGVC, and the DS Canal (Control Site) (Table 3.2).

Table 3.2 Summary of Baseline Canopy Cover Assessment Results

Canal	LCC	UGVC	DS Canal
Study Reach Length (miles)	7.0	0.50	1.0
Total Observations Points	351	24	48
Minimum Density Canopy Cover (%)	33.5	71	57.5
Maximum Density Canopy Cover (%)	100	100	96.5
Average Density Canopy Cover (%)	83.2	89.4	78.8



Canal	LCC	UGVC	DS Canal
Study Reach Length (miles)	7	0.5	1
Total Observations Points	351	24	48
Minimum Density Canopy Cover (%)	33.5	71	57.5
Maximum Density Canopy Cover (%)	100	100	96.5
Average Density Canopy Cover (%)	83.2	89.4	78.8

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Project: 184030334; Sources: Stantec 2015, NID 2013; Created By: L. McCandless. Updated: M. Kennedy 2/11/2016. Service Layer Credits: Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

N

Stantec

0 3,600 Feet

1 inch = 3,142 feet

Nevada

Figure 3.2
Canopy Cover Assessment Results
Long Term Canopy Cover Study and Pond Study, Baseline Year O

Nevada Irrigation District, Banner Cascade Project

3.2 POND STUDY RESULTS

Pond Studies were comprised of collecting inundation, soil saturation and type, water depth, vegetation present, and special status species habitat assessments. During Year 0, data collected serves as the baseline conditions at the Pond Study sites. These sites include two sites on the LCC and one along the DS Canal (Figure 3.3 Pond Study Results). No sites were identified along the UGVC. Baseline data for the Pond Study was collected on October 2 and November 6, 2013. Results, including vegetative cover, wildlife, and special status species, for the Pond Study are summarized below.

3.2.1 Pond 1 Results

At Pond 1 on the LCC, the majority of the vegetation lies around the perimeter of the pond, with little vegetation encroaching into the pond (less than 5 percent cover). There are scattered common cattails within the pond on the southwestern pond edge. Incense cedar is the dominant over-story species (74 percent cover). There are many ornamental groundcover and vining species, from the residential area to the north, encroaching into the vicinity of the pond. Emergent vegetation was also present, but not abundant or constraining. The associated pond habitat appears to be intact and healthy, thus able to support both native plant populations and wildlife species.

Soil color was assessed and quantified as a 10 YR 6/4, light yellowish brown (i.e., hydric) using methods described in the Soil Survey Field and Laboratory Methods Manual and the Munsell Soil Color Charts (MSCC 2000, USDA 2009).

Pond 1 is estimated to be 25 by 40 feet in size (1,000 square feet). The estimated visual maximum depth of the pond 1 is 4 feet.

Pond 1 is supplied with purchased water from April 15 through October. Due to the water flowing directly into Pond 1 via the canal, the pond is perennial and likely has consistent and steady water levels. According to the LCC and the UGVC Canopy and Workplans (NID 2012), if the habitat assessment data indicate that the habitat at Pond 1 is clearly maintained by water from sources other than leakage, then only the baseline data would need to be collected and subsequent studies can be suspended; however Pond 1 may provide habitat for sensitive species (i.e., CRLF, western pond turtle), so it is recommended monitoring is continued. Further information regarding the Pond Study future monitoring and adaptive management is detailed in the Discussion Section.

3.2.2 Pond 2 Results

At Pond 2 on the Lower Cascade Canal most vegetation lies around the perimeter of the pond, with little vegetation encroaching into the pond (less than 10 percent cover). Incense cedar is the dominant overstory species (85 percent cover), while Himalayan blackberry is dominant

within the understory (15 percent cover). There are many ornamental groundcover species from the residential area to the north encroaching into the vicinity of the pond. Emergent vegetation is present at Pond 2, but not abundant or constraining. The habitat appears to be intact and healthy, and able to support both native plant populations and wildlife species.

Soil color was assessed and quantified as a 5 YR 5/3 light reddish brown (i.e., hydric) using methods described in the Soil Survey Field and Laboratory Methods Manual and the Munsell Soil Color Charts (MSCC 2000, USDA 2009).

Pond 2 is estimated to be 50 by 60 feet in size (3,000 square feet). The estimated visual maximum depth of the pond 2 is 4 feet.

Pond 2 is located next to/below Pond 1 along the LCC and is supplied with purchased water from April 15 through October 15 from the LCC. Pond 2 is connected to Pond 1 and receives water from Pond 1. This consistent supply of water in Pond 2 allows for its perennial state and likely permits steady water levels throughout the year (per. Comm. Matt Halvorson, NID). According to the LCC and the UGVC Canopy and Workplans (NID 2012), if the habitat assessment data indicate the habitat in the ponds are clearly maintained by water from sources other than leakage, then only the baseline data need be collected and subsequent studies can be suspended; however Pond 2 may provide habitat for sensitive species (i.e., CRLF, western pond turtle), so it is recommended it continue to be monitored. Further information regarding Pond Study future monitoring and adaptive management is detailed in the Discussion Section below.

3.2.3 Pond 3 Results

Pond 3 on the DS Canal is the Control Site for the study. On the eastern side on Pond 3, there is sparse vegetation, primarily dominated in the understory by Himalayan blackberry, and other non-native perennial herbs (Table 3.3). Mountain maple is dominant in the overstory (85 percent cover). The vegetation on the eastern portion of the pond is sparse and primarily dominated by non-natives. On the western portion of the pond, the water levels are deeper, supporting more wetland species such as common cattail in the understory (15 percent cover) and incense cedar in the overstory (10 percent cover). Watermarks were visible near the woody vegetation line on north facing pond banks.

Soil color was assessed and quantified as a be 5 YR 5/6 yellowish red (i.e., hydric) using methods described in the Soil Survey Field and Laboratory Methods Manual and the Munsell Soil Color Charts (MSCC 2000, USDA 2009).

Pond study site 3 is estimated to be 25 by 50 feet in size (1,250 square feet). The estimated maximum depth of the pond 2 is 4 feet.

There is a water service on the parcel that Pond 3 is located on along DS Canal that purchases water through the irrigation season of April 15 through October 15. No water is purchased

through the winter months; however the water service could potentially leak by some residual water due to canal flows being up higher than normal winter flows (per. Comm. Matt Halvorson). Pond 3 may be supplied by water purchased through the water service, and therefore would result in more consistent and steady water levels in the pond. According to the LCC and the UGVC Canopy and Workplans (NID 2012), if the habitat assessment data indicate the wetlands and/or ponds in the study do not have potential special status species habitat, or that habitat is clearly maintained by water from sources other than leakage, then only the baseline data need be collected and subsequent studies can be suspended. The water levels of Pond 3 may be maintained through sources other than leakage; however it may provide habitat for sensitive species, so it is recommended that it continue to be monitored. Further information regarding Pond Study future monitoring and adaptive management is detailed in the Discussion Section 4.2.

3.2.4 Pond Study Vegetative Cover

The three pond assessment study sites on the LCC and the DS Canal (Ponds 1, 2, and 3) are vegetated predominantly with an over-story of incense cedar and Pondera pine, as well as a mosaic of both native and non-native annual and perennial grasses and forbs in the under-story. In addition, there are many ornamental species (i.e., non-native species) present at the Pond Study sties, as the sites are within proximity to rural developed landscapes. Specifically, the combined averages of vegetation cover nativity for Ponds 1, 2, 3 are as follows- 1) 15 percent non-native, 2) 19 percent invasive/ noxious weed, and 3) 66 percent native. For further details specific to vegetation communities, reference the Biological Setting Section above. Table 3.3 below details plant species observed on November 6, 2013 at the three pond assessment sites and the percent of each species within the over-story and understory of the vegetation community. Note that additional annual and perennial grasses and forb species may be present at each pond assessment site; however, due to the timing of field studies (i.e., October and November 2013), some early and mid-bloom period species may have been senescent and not identifiable.

Table 3.3 Quantified Over-Story and Under-Story Vegetation Cover Present at the cover Pond Study Sites

common name	*Scientific name*	LCC Pond 1		LCC Pond 2		DS Canal Pond 3 (Control Site)	
		Understory %	Over-story %	Understory %	Over-story %	Understory %	Over-story %
Brazilian waterweed	*Egeria densa*			1			
common cattail	*Typha latifolia*	4		1		15	
common ladyfern	*Athyrium filix-femina*	5					
common sheep sorrel	Rumex acetosella			1			

common name	*Scientific name*	LCC Pond 1		LCC Pond 2		DS Canal Pond 3 (Control Site)	
		Understory %	Over-story %	Understory %	Over-story %	Understory %	Over-story %
cutleaf blackberry	*Rubus laciantus*	4		2			
dandelion species	*Agoseris* spp.					1	
dock species	*Rumex* spp.					3	
Harding grass	*Phalaris aquatica*					3	
hedgenettle species	*Stachys* sp.	1				1	
Himalayan blackberry	*Rubus aermeniacus*			15		9	
honeysuckle species	*Lonicera* sp.	2	1	2			
incense cedar	*Calocedrus decurrens*		74		85		10
mountain grape	*Berberis aquifolium*	1					
mountain maple	*Acer glabrum*		5				85
navarretia species	*Navarretia* sp.					1	
Oregon ash	*Fraxinus latifolia*		4				
Pacific madrone	*Arbutus menziesii*				4		
plantain species	*Plantago* spp.					4	
poison hemlock	*Conium maculatum*	2				3	
Ponderosa pine	*Pinus ponderosa*				9		5
quaking aspen	*Populus tremuloides*		1				
quillwort species	*Isoetes* sp.					1	
rush species	*Juncus* spp.					9	
sorrel species	*Oxalis* sp.			1			
water parsnip	*Berula erecta*					2	
ornamentals [1]	–	5	15	10	2		
thatch	–	1		1		5	
inundation	–	73		65		33	
bare ground	–	2		2		10	

[1] Ornamentals include non-native, decorative species in both/over-story documented on basis of cover, not by individual species.

3.2.5 Pond Study Special Status Species

All sites within the Pond Study on the Lower Cascade Canal and the DS Canal (Figure 3.3) were all assessed for sensitive and/or special status species and their associated habitat, specifically the California red-legged frog (CRLF). Depending on the presence of sensitive species and habitat, ponds may be removed from future monitoring (NID 2012); however, all pond assessment study sites were found to have marginal potential suitable CRLF habitat. Note: No presence of bullfrogs was observed at the pond study sites.

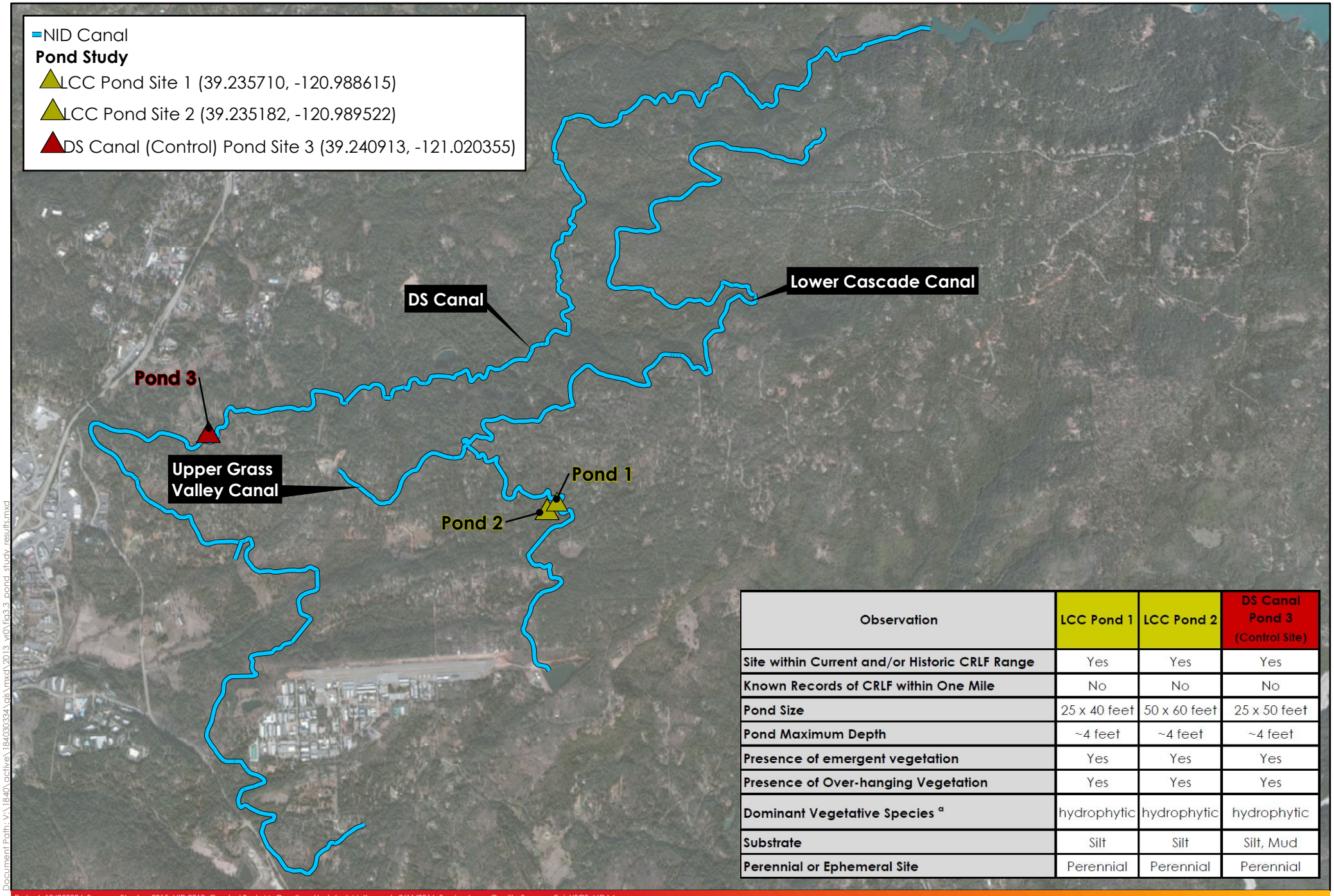
3.2.6 Pond Study Results Summary

The following analysis and results summarize the overall baseline (Year 0) pond study findings for each site along the LCC, and the DS Canal (Control Site) (Table 3.4).

Table 3.4 Pond Study Results Summary

Observation	LCC Pond 1	LCC Pond 2	DS Canal Pond 3 (Control Site)
Site within Current and/or Historic CRLF Range	Yes	Yes	Yes
Known Records of CRLF within One Mile	No	No	No
Pond Size	25 x 40 feet	50 x 60 feet	25 x 50 feet
Pond Maximum Depth	~4 feet	~4 feet	~4 feet
Presence of emergent vegetation	Yes	Yes	Yes
Presence of Over-hanging Vegetation	Yes	Yes	Yes
Dominant Vegetative Species [1]	hydrophytic	hydrophytic	hydrophytic
Substrate	Silt	Silt	Silt, Mud
Perennial or Ephemeral Site	Perennial	Perennial	Perennial

[1] Reference Section 1.3 Biological Setting, and Table 3.3 Over-Story and Under-Story Vegetation Cover for specific dominant vegetation species present at each site



Observation	LCC Pond 1	LCC Pond 2	DS Canal Pond 3 (Control Site)
Site within Current and/or Historic CRLF Range	Yes	Yes	Yes
Known Records of CRLF within One Mile	No	No	No
Pond Size	25 x 40 feet	50 x 60 feet	25 x 50 feet
Pond Maximum Depth	~4 feet	~4 feet	~4 feet
Presence of emergent vegetation	Yes	Yes	Yes
Presence of Over-hanging Vegetation	Yes	Yes	Yes
Dominant Vegetative Species [a]	hydrophytic	hydrophytic	hydrophytic
Substrate	Silt	Silt	Silt, Mud
Perennial or Ephemeral Site	Perennial	Perennial	Perennial

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Project: 184030334; Sources: Stantec 2015, NID 2013; Created By: L. McCandless. Updated: M. Kennedy 2/11/2016. Service Layer Credits: Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

N

Stantec

0 3,800 Feet

1 inch = 3,188 feet

Nevada

Figure 3.3
Pond Study Results
Long Term Canopy Cover Study and Pond Study, Baseline Year O

Nevada Irrigation District, Banner Cascade Project

4.0 DISCUSSION

This Report provides the baseline data (Year 0) for the Nevada Irrigation District (NID) Lower Cascade Canal (LCC) and Upper Grass Valley Canal (UGVC) long term Canopy Cover Study, comprised of a Tree Health Assessment and Canopy Cover Assessment, and the long term Seep Wetland, Pond and Associated Potential ESA Species Habitat Study (Pond Study). This Report also includes a Ten Year Monitoring Plan for each of the components listed above (Appendix C Ten Year Canopy Cover Study Monitoring Plan, and Appendix D Ten Year Pond Study Monitoring Plan). The Monitoring Plans are based on, and intended to comply with, two canal flow-reduction mitigation measures included in the Final Environmental Impact Report (EIR) for the Lower Cascade-Canal Banner/Cascade Pipeline Project (Project) (NID 2006). The purpose of the Discussion Section is to provide conclusions, considerations, and recommendations relevant to the baseline studies conducted during Year 0 (2013) of aforementioned long term study.

4.1 CANOPY COVER STUDY DISCUSSION

The Canopy Cover Study is comprised of the Tree Health Assessment and the Canopy Cover Assessment (via Densiometer Analysis). For the purpose of collecting baseline data (Year 0, 2013) riparian tree species were only evaluated within the selected study sites. However, it is recommended that for the Canopy Cover Study, general assessments of upland species present at the sites are summarized (for future discussion), as many upland species within these vegetation communities have become accustomed to a wetted environment. In addition, it is recommended that comparative considerations for future years (i.e., comparing Year 0 with Year 2) are assessed as needed. These can include, but are not limited to, natural variation assessments, cumulative and sequential impacts evaluation, relevant considerations of threshold and latent effects, and abiotic and biotic conditions (e.g., climatic variability, drought, plant and pest invasive species increases, site aspect, etc.).

4.1.1 Tree Health Assessment

Tree Health Assessment data was collected on September 10 and 11, 2013 and represents the baseline data (Year 0) for informing adaptive management measures within the Ten Year Canopy Cover Monitoring Plan (Appendix C). A total of 113 trees were tagged for the Tree Health Assessment. Overarching dominant species tagged include Pacific dogwood, bigleaf maple, and white alder. Overall tree health was good at all sites; however study site 4 along the LCC scored an excellent. All trees at study sites along the LCC and the UGVC exhibited normal variations in foliage color, and minimal disease and parasitism. At the DS Canal Control Site (study site 6), although the general health of trees was good during baseline data collections (Year 0, 2013), many of the trees displayed less new growth, more frequent canopy die-back, and a high percentage of insect infestation in comparison to trees assessed on the LCC and the UGVC. It is recommended that if fair general conditions persist at the DS Canal Control Site in comparison to the good to excellent conditions at the LCC and the UGVC (which are

experiencing decreased flows in the canals) during Year 2 Tree Health Assessments (2015), then an overall comparative analysis should be implemented within the monitoring report documenting final results. Additionally, it is recommended if a tree species scores below good and has the presence of insects, parasites, new growth, etc. then attribute data is collected (i.e., type of insects, sap, if tree species is deciduous and losing foliage, surface growth type, etc.); as these factors can be indicative of types of tree stressors. Decreases in tree health will be evaluated and addressed as needed.

Moving forward, additional data will be collected every two years for eight more years (2015-2023; Years 2, 4, 6, 8, 10) in the late summer (August-September); thus comprising five more studies to complete the monitoring requirements developed to comply with Mitigation Measure 3.8-1 defined in the Final EIR for the Lower Cascade Canal – Banner/Cascade Pipeline Project (Appendix E)(NID 2006). Baseline data will be compiled and compared with subsequent data from future study years.

4.1.2 Canopy Cover Assessment

Canopy Cover Assessment data was collected on September 10, 19, 20, 30, 2013 and represents the baseline data (Year 0) for informing adaptive management measures within the Ten Year Canopy Cover Study Monitoring Plan (Appendix C). A total of 423 combined observation points of riparian canopy cover were collected on the LCC, the UGVC, and the DS Canal. The study reach sizes for the canals are as follows- LCC seven miles, UGVC 0.5 mile, and DS Canal one mile. The average canopy cover of riparian tree species along each reach are follows- LCC: 83.2 percent; UGVC; 89.4 percent; and DS Canal: 78.8 percent.

Additional data will be collected in future years to complete the monitoring requirements developed to comply with Mitigation Measure 3.8-1 defined in the Final EIR for the Lower Cascade Canal – Banner/Cascade Pipeline Project (NID 2006). The Canopy Cover Assessment interval specification in the Workplan outlines five year intervals for canopy assessments; however it is contradicted with a specification to occur every two to four years (Years 0, 4, 6, 10). In light of on-going changing environmental conditions (i.e., drought/ lack of precipitation, climatic variability) within the timeframe of Canopy Cover Assessments, and to further be complimentary to the Tree Health Assessments timeframe (increasing overall efficiency and study viability), it is recommended as an adaptive management strategy to update the Canopy Cover Assessments to occur every four years with one final assessment to conclude the study on Year ten (Years 0, 4, 8, 10). This timing adaptive management recommendation is included in the Ten Year Canopy Cover Study Monitoring Plan (Appendix C).

4.2 POND STUDY DISCUSSION

Seep Wetland, Pond and Associated Potential ESA Species Habitat Study (Pond Study) was conducted in compliance with Mitigation Measure 3.8-2. In future survey years, the Pond Study will assesses whether reductions in canal flows and associated leakage will potentially result in

the negative impacts to sensitive habitats and species, specifically special status species such as CRLF (NID 2012). Like the Canopy Cover Study, it is recommended that the Pond Study also assesses present upland species at the sites and evaluates habitat and pond health including species, as many upland species within these vegetation communities have become accustomed to a wetted environment. In addition it is recommended that comparative considerations for future years are assessed as needed. These can include cumulative and sequential impacts evaluation, relevant considerations of threshold and latent effects, and abiotic and biotic conditions (e.g., climatic variability, drought, etc.).

4.2.1 Pond Study

Pond assessment data was collected on October 2 and November 6,, 2013 by Stantec Biologists. Additional data will be collected in future years to complete the long-term monitoring plan developed to comply with Mitigation Measure 3.8-2 defined in the Final EIR for the Lower Cascade Canal – Banner/Cascade Pipeline Project (NID 2006).

LCC pond study site 1 is estimated to be 1,000 square feet. The estimated maximum depth of the pond 1 is 4 feet. LCC pond 2 is estimated at 3,000 square feet, and the estimated maximum depth of the pond 2 is 4 feet. DS Canal pond 3 is estimated at 1,250 square feet, and the estimated maximum depth of the pond 2 is 4 feet. All surveyed ponds have emergent/ hydrophytic vegetation present and hydric soils. Native species are dominant, while non-native species often include Himalayan blackberry and Harding grass. In light that the assessed ponds receive water from other sources during the irrigated season (April to October); habitat is subsequently intact and in fair health. According to the LCC and the UGVC Canopy and Workplans (NID 2012), if the habitat assessment data indicates that the habitat at any of the ponds is clearly maintained by water from sources other than leakage, then only the baseline data would need to be collected and subsequent studies can be suspended. However, all assessed ponds may provide habitat for sensitive species (i.e., CRLF, western pond turtle), so it is recommended the Pond Study continue.

As part of the Ten Year Pond Study Monitoring Plan, it is further recommended that pond and habitat health evaluations continue to include assessment of pond water levels, soil inundation, and the proportion of native to non-native species in both the over-story and under-story canopies. It is recommended that adaptive management strategies are applied, as needed, to manage invasive noxious weeds and maintain habitat integrity. Baseline data will be compiled and compared with subsequent data from future study years. Cover classes for all plant species at each pond assessment study site are also to be summarized.

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APPENDICES

Appendix A OBSERVED VEGETATION & WILDLIFE SPECIES

Vegetation and wildlife species observed during Canopy Cover Studies, including Tree Health Assessments and Canopy Cover Assessments, and during Pond Studies at all study sites on the LCC, UGVC, and the DS Canal on September 10-11, 19, 20, and 30, October 2, and November 6, 2013, Nevada County, California.

Common name	*Scientific name*	Lifeform	Nativity	Site Observed								
				Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Pond 1	Pond 2	Pond 3
Plants												
Brazilian waterweed	*Egeria densa*	Perennial herb	Non-native invasive							x		x
bigleaf maple	*Acer macrophylum*	Tree	Native	x	x	x	x	x	x			
black oak	*Quercus kelloggii*	Tree	Native									
canyon live oak	*Quercus chrysolepis*	Tree	Native									
common cattail	*Typha latifolia*	Perennial herb	Native								x	x
common ladyfern	*Athyrium filix-femina*	Fern	Native								x	
common sheep sorrel	*Rumex acetosella*	Perennial herb	Non-native invasive							x		
coyote brush	*Baccharis pilularis*	Shrub	native									
cutleaf blackberry	*Rubus laciantus*	Shrub	Non-native							x	x	
dandelion species	*Agoseris* spp.	Perennial herb	Native									x
dock species	*Rumex* spp.	Perennial herb	Non-native									x
Douglas-fir	*Pseudotsuga menziesii*	Tree	Native									
gray alder	*Alnus incana*	Tree	Native		x	x						
Harding grass	*Phalaris aquatica*	Perennial grass	Non-native invasive									x
hedgenettle species	*Stachys* sp.	Perennial herb	Native								x	x
Himalayan blackberry	*Rubus aermeniacus*	Shrub	Non-native invasive							x		x
honeysuckle species	*Lonicera* sp.	Vine	Native							x	x	
incense cedar	*Calocedrus decurrens*	Tree	Native							x	x	x
mountain grape	*Berberis aquifolium*	Shrub	Native								x	
mountain maple	*Acer glabrum*	Tree	Native							x	x	x
navarretia species	*Navarretia* spp.	Annual herb	Native								x	
Oregon ash	*Fraxinus latifolia*	Tree	Native				x				x	
Pacific dogwood	*Cornus nutallii*	Tree	Native	x	x	x		x	x			
Pacific madrone	*Arbutus menziesii*	Tree	Native							x		
plantain species	*Plantago* sp.	Perennial herb	Non-native							x		x
poison hemlock	*Conium maculatum*	Perennial herb	Non-native invasive								x	x
Ponderosa Pine	*Pinus ponderosa*	Tree	Native							x		x

Appendix A Observed Vegetation & Wildlife Species
October 1, 2013

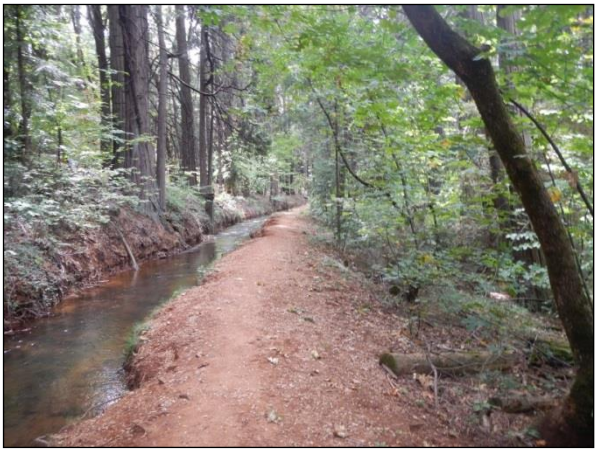
Common name	*Scientific name*	Lifeform	Nativity	Site Observed								
				Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Pond 1	Pond 2	Pond 3
quaking aspen	*Populus tremuloides*	Tree	Native								x	
quillwort species	*Isoetes* sp.	Fern	Native									x
rush species	*Juncus* spp.	Perennial grass	Native									x
sorrel	*Oxalis* sp.	Perennial herb	Non-native							x		
tanoak	*Notholithocarpus densiflorus*	Tree	Native				x					
water parsnip	*Berula erecta*	Perennial herb	Native									x
white alder	*Alnus rhombifolia*	Tree	Native	x		x		x	x			
Wildlife												
black-capped chickadee	*Poecile atricapillus*	–	–									x
northern flicker	*Colaptes auratus*	–	–							x	x	
Pacific tree frog	*Pseudacris regilla*	–	–								x	
Steller's jay	*Cyanocitta stelleri*	–	–							x	x	
Western scrub jay	*Aphelocoma californica*	–	–									x

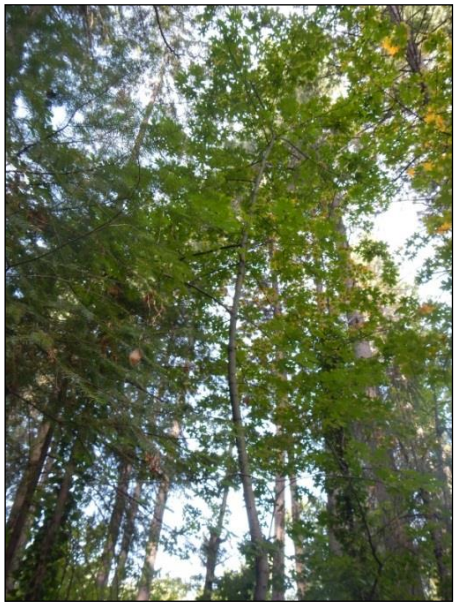
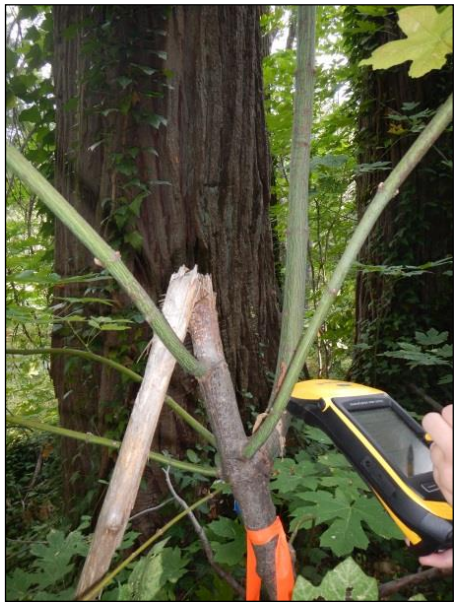
Study Sites: LCC- Sites 1 to 4, Pond 1 and 2; UGVC- Site 5; DS Canal (Control Site) - Site 6, Pond 3;

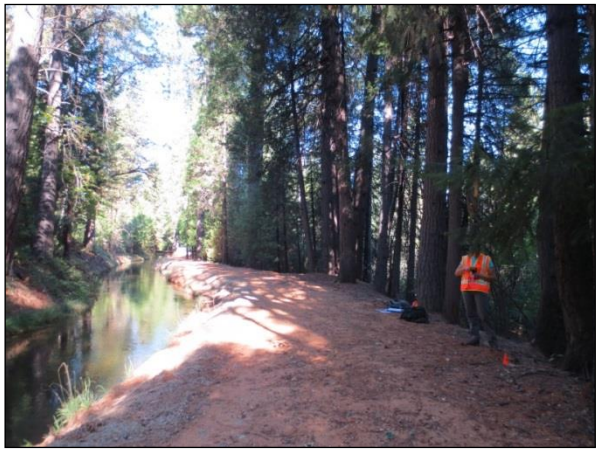
Appendix B PHOTO RECORD

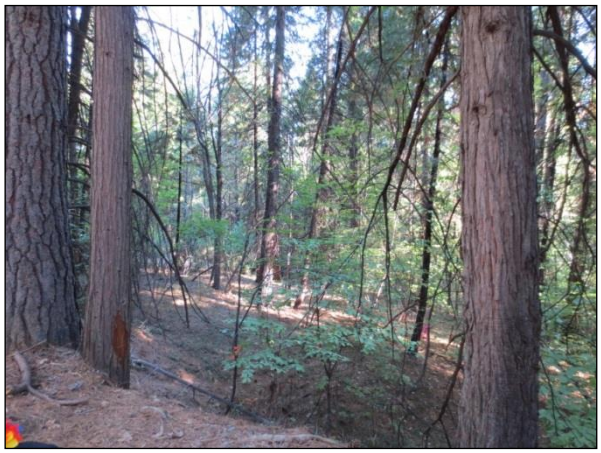
The following Photo Record is documentation of the baseline conditions (Year 0) of the Banner Cascade Riparian Canopy Cover and Pond Studies conducted in fall 2013 (September to November), Nevada County, California.

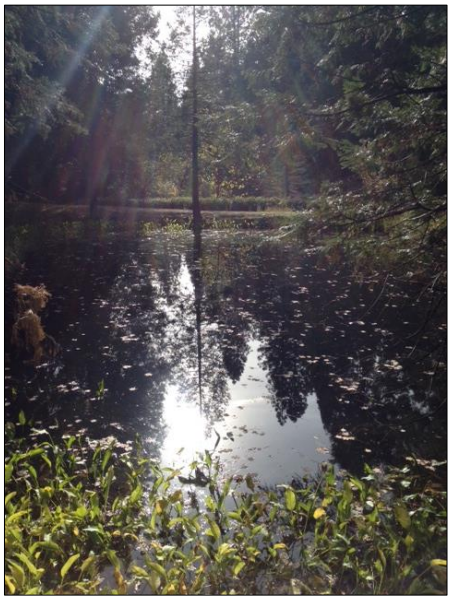
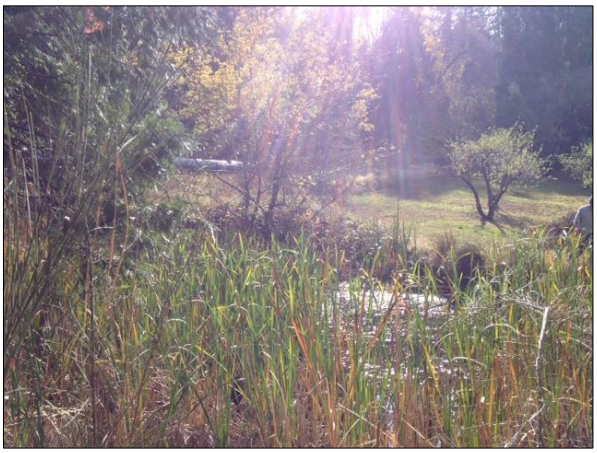
<table>
<tr><th colspan="2">Photos 1-4: Lower Cascade Canal Site 1</th></tr>
<tr><td>1
  </td><td>2
  </td></tr>
<tr><td>Lower Cascade Canal, study site 1 access. Southwest aspect / facing downstream.</td><td>Lower Cascade Canal, study site 1 access. Northeast aspect/ facing upstream.</td></tr>
<tr><td>3
  </td><td>4
  </td></tr>
<tr><td>Lower Cascade Canal, study site 1. Bigleaf Maple, tree #182.</td><td>Lower Cascade Canal, study site 1. Pacific mountain dogwood, tree #188.</td></tr>
</table>

Photos 5-6: Lower Cascade Canal Site 2	
5 	6 
Lower Cascade Canal, study site 2. At study site access point, northwest aspect, facing upstream.	Lower Cascade Canal, study site 2. At study site access point, south aspect, facing downstream.
Photos 7-8: Lower Cascade Canal Site 3	
7 	8 
Lower Cascade Canal, study site 3. At study site access point, north aspect, facing upstream.	Lower Cascade Canal, study site 3. At study site access point, southwest aspect, facing downstream.

Photos 9-12: Lower Cascade Canal Site 4	
9 	10 
Lower Cascade Canal, study site 4. At study site access point, north aspect, facing upstream.	Lower Cascade Canal, study site 4. At study site access point, southwest aspect, facing downstream.
11 	12 
Lower Cascade Canal, study site 4. Bigleaf maple, tree #109	Lower Cascade Canal, study site 4. Bigleaf maple, tree #122

Photos 13-14: Upper Grass Valley Canal Site	
13 	14 
Upper Grass Valley Canal study site. At study site access point, east aspect, facing upstream.	Upper Grass Valley Canal study site. At study site access point, west aspect, facing downstream.
Photos 15-18: DS Canal Control Site	
15 	16 
DS Canal study site (Control Site). At study site access point, east aspect, facing upstream	DS Canal study site (Control Site). At study site access point, west aspect, facing downstream.

17 	18 
DS Canal study site (Control Site). South aspect, facing downslope.	DS Canal Control study site. North aspect, on the downslope side, adjacent to Pacific mountain dogwood tree #80.
Photos 19-20: Lower Cascade Canal, Pond 1	
19 	20 
Lower Cascade Canal, Pond 1, located off lower Spring Road. Northeast facing aspect.	Lower Cascade Canal, Pond 1, located off lower Spring Road. Southwest facing aspect.

Photos 21-22: Lower Cascade Canal, Pond 2	
21 	22 
Lower Cascade Canal, Pond 2, located off upper Spring Road. South facing aspect.	Lower Cascade Canal, Pond 2, located off upper Spring Road. North facing aspect.
Photos 23-24: DS Canal Control Site, Pond 3	
23 	24 
DS Canal Pond 3 (Control Site), located off Pittsburg Mine Road. West facing aspect.	DS Canal Pond 3 (Control Site), located off Pittsburg Mine Road. Northeast facing aspect.

Appendix C TEN YEAR CANOPY COVER STUDY MONITORING PLAN

The purpose of the Ten Year Canopy Cover Study Monitoring Plan (Monitoring Plan) is to summarize and detail requirements for the future monitoring efforts for the Canopy Cover Study and to comply with Mitigation Measure 3.8-1 defined in the Final EIR for the Lower Cascade Canal- Banner/Cascade Pipeline Project (NID 2006). The Canopy Cover Study is comprised of the Tree Health Assessment Study and the Canopy Cover Assessment for the Lower Cascade Canal (LCC), and Upper Grass Valley Canal (UGVC), and DS canal (Control Site). The Monitoring Plan is specific to a study timeline and data collection methods which are detailed below.

C.1 STUDY TIMELINE

- Tree Health Assessments - Data will be collected every two years for eight more years (2015-2023; years 2, 4, 6, 8, 10) in the late summer (August to September).
- Canopy Cover Assessments - Data will be collected every four years with one final assessment to conclude the study on year 10 (i.e., 0, 4, 8, and 10), in the late summer (August to September) and concurrent with the Tree Health Assessments.

Table C.1 Summary of Canopy Cover Study Assessments and Monitoring Year

Canopy Cover Study	Study Year					
	2013- Year 0 [1]	2015- Year 2	2017- Year 4	2019- Year 6	2021- Year 8	2023- Year 10
Tree Health Assessment	x	x	x	x	x	x
Canopy Cover Assessment	x		x		x	x

[1] Year 0 baseline studies were completed in 2013.

C.2 STUDY LOCATIONS

The following locations are the Canopy Cover study sites comprising the Tree Health Assessments and the Canopy Cover Assessments for this Ten Year Canopy Cover Study Monitoring.

C.2.1 Tree Health Assessment

- Lower Cascade Canal
  - Site 1: 39.257104, -120.978144
  - Site 2: 39.234850, -120.987938

  - Site 3: Latitude 39.234282, Longitude -120.987857
  - Site 4: Latitude 39.229272, Longitude -120.990137
- Upper Grass Valley Canal
  - Site 5: Latitude 39.238957, Longitude -120.9982466
- DS Canal (Control Site)
  - Site 6: Latitude 39.243292, Longitude -121.008359

C.2.2 Canopy Cover Assessment

Table C.2 Canopy Cover Assessment study reaches, location, and size.

Canal	LCC	UGVC	DS Canal
Canal Sample Size (miles)	7	0.5	1
Total Observations Points	351	24	48

C.3 STUDY DATA COLLECTION

C.3.1 Tree Health Assessments

Data should be recorded and assessed considering the following factors (Zobrist 2011):

- Presence of foliage decline or evidence of crown fading;
- Color of foliage: out of season discoloration of foliage; and
- Evidence of disease, parasite, or insect damage.

To capture the data above, visual inspections of each tagged tree at each of the six Tree Health Assessment sites should be made using the criteria listed below. Each tree should be assigned a score for each category or criteria using the datasheets included in this Appendix.

Table C.3 Tree Health Assessment Data Criteria

Assessment Type	Assessment Description	Assessment Score
Canopy Cover	Canopy cover die-back by percentage based on density and presence of foliage at the crown on the tree.	**1- None:** no canopy present, 0% **2- Sparse:** most canopy absent, 0-25% **3- Partial:** canopy 25-50% **4- Medium:** canopy 50-75% **5- Full:** canopy 75-100%
Bark Health	Bark health is assessed through the absence/ sluffing of bark on the bole and limbs of the tree.	**1- Dead:** 100% sluffing off, extensive damage **2- Poor:** decaying or dead; 75-100% bark absent from bole and limbs of tree; abundant root rot; extensive insect damage; overall discoloration and bark shape irregularities; abundant surface growth **3- Fair:** 50-75% bark absence; some root rot and insect damage; discoloration and bark shape irregularities; bark sluffing **4- Good:** 25-50% bark absence; some root or heart rot present; bark only missing from tree limbs **5- Excellent:** 0-25% bark absence. Present bark generally intact and of high vigor
Leaf Color	Leaf color is assessment based on abnormal colorations that are not typical for the species or season, uniform throughout all present foliage, etc.	**1- Normal:** no abnormalities present, color normal **0- Abnormal:** abnormal color present (e.g., spotting, insect tracks, necrotic tips, etc.)
New Growth Presence	"New growth" is any new vascular growth including leaf buds, basal sprouts, epicormic stems, and saplings.	**0- Present** **1- Not Present**
Surface Growth Presence	Surface growth on trunk and stems includes lichen, moss, and all other normal terrestrial algal plants (i.e., non-vascular plants, bryophytes).	**0- Present** **1- Not present**
Disease	Disease includes fungal/ mold presence and other pathogens, tubers, cankers, structural decay (e.g., basal decay, irregular growth pattern of tree), root and heart rot, etc.	**0- Present** **1- Not present**
Parasites	Parasites can include, but are not limited to the presence of mistletoe, red pustules, etc.	**0- Present** **1- Not present**
Insect Infestation	Signs of insects include burrowing/ bore holes; frass, larvae or larva galleries, or insect presence; leaf notching; epicormics stems, galls, etc.	**0- Present** **1- Not present**

Assessment Type	Assessment Description	Assessment Score
Overall Tree Health	Overall tree health was assessed through leaf/ foliage health and other associated physical leaf characteristics, amount of canopy foliage present, stem and bark health (e.g., decay), abnormal tree shape, and/or increased presence of disease, parasites and insect infestations. Normal seasonal variations were considered in overall health scoring.	**1- Dead Overall** **2- Poor Overall**: partial-full discoloration; severe insect damage; disease presence; tissue damage **3- Fair Overall**: partial discoloration; some insect damage, heart rot **4- Good Overall**: some discoloration **5- Excellent Overall**: no physical abnormalities

C.3.2 Canopy Cover Assessment

The Canopy Cover Study- Canopy Cover Assessment data will be collected along each canal study reach using a densiometer following the methods described in The Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment State Water Resources Control Board Standard Operating Procedure for Measuring Canopy Cover Using a Seventeen Point Spherical Convex Densiometer (Burres 2010, Ode 2007); as well as in the LCC and the UGVC Long Term Canopy Cover Study and Pond Study (Year 0). Data for each site will be collected on the datasheet provided below and using sub-meter Trimble GPS and post-processed using GIS. Analysis will average the overall canopy cover data collected based on densiometer readings along each canal reach. Results were then synthesized from the canopy cover data. Data collection and canopy density percentages will be calculated based on methods and formulas described in Use of the Densiometer to Estimate Density of Forest Canopy on Permanent Sample Plots (Strickler 1959).

C.4 STUDY REPORTING

Reporting at the end of each study year will be in the form of an Interim Technical Memorandum (Memo), and will be drafted to summarize the Canopy Cover Studies (i.e., Tree Health and Canopy Assessment data and results) for that year. The data for the study year will also be discussed in conjunction with California's water year data and NID LCC and the UGVC flow data. Each Memo will include adaptive management recommendations, if necessary. NID is not required to adhere to any interim recommendations but may want to take them into consideration when reducing or limiting flow that may have canopy impacts, should they be documented. On the last year of study (i.e., year 10, 2023) a Final Report will be compiled summarizing data collection methods, results, analysis as well as make findings and recommendations.

TREE HEALTH ASSESSMENT DATASHEET

PROJECT	CLIENT	DATE	OBSERVER(S)	DATA ENTRY
WEATHER		PROJECT LOCATION		
		SITE NAME AND LOCATION		
NOTES				

TREE #	SPECIES	DBH	EASTING	NORTHING	PHOTO NUMBERS/DESCRIPTIONS
LEAVES: SIGNS OF DECLINE IN CONDITION/COLOR			BARK TO STEM CONDITION		SIGNS OF DISEASE/PARASITES/INSECT INFESTATION
TREE #	SPECIES	DBH	EASTING	NORTHING	PHOTO NUMBERS/DESCRIPTIONS
LEAVES: SIGNS OF DECLINE IN CONDITION/COLOR			BARK TO STEM CONDITION		SIGNS OF DISEASE/PARASITES/INSECT INFESTATION
TREE #	SPECIES	DBH	EASTING	NORTHING	PHOTO NUMBERS/DESCRIPTIONS
LEAVES: SIGNS OF DECLINE IN CONDITION/COLOR			BARK TO STEM CONDITION		SIGNS OF DISEASE/PARASITES/INSECT INFESTATION
TREE #	SPECIES	DBH	EASTING	NORTHING	PHOTO NUMBERS/DESCRIPTIONS
LEAVES: SIGNS OF DECLINE IN CONDITION/COLOR			BARK TO STEM CONDITION		SIGNS OF DISEASE/PARASITES/INSECT INFESTATIO
TREE #	SPECIES	DBH	EASTING	NORTHING	PHOTO NUMBERS/DESCRIPTIONS
LEAVES: SIGNS OF DECLINE IN CONDITION/COLOR			BARK TO STEM CONDITION		SIGNS OF DISEASE/PARASITES/INSECT INFESTATION

CANOPY COVER DATASHEET

PROJECT	DATE	OBSERVER(S)	DATA ENTRY
WEATHER	PROJECT LOCATION		
	SITE NAME AND LOCATION		
NOTES			

DATA POINT #	UPSTREAM	DOWNSTREAM	FACING LEFT BANK	FACING RIGHT BANK

Appendix D TEN YEAR POND STUDY MONITORING PLAN

The purpose of the Ten Year Pond Study Monitoring Plan (Monitoring Plan) is to summarize and detail requirements for the future monitoring efforts for the Pond Studies and to comply with Mitigation Measure 3.8-2 defined in the Final EIR for the Lower Cascade Canal- Banner/Cascade Pipeline Project (NID 2006). The Pond Study is located on the Lower Cascade Canal (LCC), and Upper Grass Valley Canal (UGVC), and DS canal (Control Site). The Monitoring Plan is specific to a study timeline and data collection methods which are detailed below.

D.1 STUDY TIMELINE

Data will be collected every four years with one final assessment to conclude the study on year 10 (i.e., 0, 4, 8, and 10), in the late summer (August to September). Data collection will also be collected concurrently with the Canopy Cover Study.

Table D.1 Summary of Pond Studies and Monitoring Year

Pond Study (all sites)	Study Year					
	2013- Year 0 [1]	2015- Year 2	2017- Year 4	2019- Year 6	2021- Year 8	2023- Year 10
	x		x		x	x

[1] Year 0 baseline studies were completed in 2013.

D.2 STUDY LOCATIONS

The following locations are the Pond Study sites for this Ten Year Pond Study Monitoring.

- LCC Pond 1: 39.235710, -120.988615
- LCC Pond 2: 39.235182, -120.989522
- DS Canal (Control Site) Pond 3: 39.240913, -121.020355

D.3 STUDY DATA COLLECTION

As part of the Pond Study, wildlife and habitat suitability studies (including overarching vegetative cover) will be collected. Specifically, at each of the three Pond Study sites, the following data will be collected and assessed:

- Delineation of inundated area (mapped with Trimble GPS);
- Hydrology patterns;
- Area soil saturation;

- Range of water depths;
- Soil type (MSCC 2000);
- Vegetation present;
- Wildlife species observed;
- CRLF habitat assessment (USFWS 2005); and
- Site photos.

Each pond assessment will include a GPS delineation, and information on hydrology, soils and vegetation, in accordance with U.S. Army Corps of Engineers Guidelines for Wetland Delineations (Environmental Library 1987). Each pond study site should be assessed for the presence of potential California red legged frog (CRLF) habitat, and other associated special status species, based on the Revised Guidance on Site Assessments and Field Surveys for the CRLF (USFWS 2005). Data will be recorded on the attached datasheet.

D.4 STUDY REPORTING

Reporting at the end of each study year will be in the form of an Interim Technical Memorandum (Memo), and will be drafted to summarize the Pond Studies for that year. The Memo will also include Canopy Cover Study results as well. The data for the study year will also be discussed in conjunction with California's water year data and NID LCC and the UGVC flow data. Each Memo will include adaptive management recommendations, if necessary. On the last year of study (i.e., Year 10, 2023) a Final Report will be compiled summarizing data collection methods, results, analysis as well as make findings and recommendations.

POND ASSESSMENT DATASHEET

PROJECT	DATE	OBSERVER(S)	DATA ENTRY
WEATHER	PROJECT LOCATION		
	SITE NAME AND LOCATION		
NOTES			
AREA OF INUNDATION	CALIFORNIA RED-LEGGED FROG HABITAT ASSESSMENT 1. Is this site within the current or historic range of the CRLF? 2. Are there known records of CRLF with 1 mile of site?		
AREA OF SOIL SATURATION	POND CHARACTERISTICS: SIZE:		
RANGE OF WATER DEPTHS	MAXIMUM DEPTH: VEGETATION: EMERGENT, OVERHANGING, DOMINANT SPECIES:		
SOIL TYPE	SUBSTRATE:		
VEGEATION PRESENT	PERENNIAL OR EPHEMERAL: IF EPHEMERAL, DATE IT GOES DRY: OTHER HABITAT CHARACTERISTICS, SPECIES OBSERVATIONS, DRAWINGS, COMMENTS:		
WILDLIFE SPECIES OBSERVED			

Appendix E MITIGATION MONITORING AND REPORTING PROGRAM WORKPLAN

Nevada Irrigation District Banner Cascade Pipeline Project

Mitigation Measures 3.8-1 and 3.8-2 Compliance

Lower Cascade Canal and Upper Grass Valley Canal Canopy and Wetland Impact Assessment Workplans

Prepared for: Nevada Irrigation District

November 30, 2012

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1.0 Introduction

This Nevada Irrigation District (NID) Lower Cascade Canal (LCC) and Upper Grass Valley Canal (UGVC) Canopy Cover/Riparian Tree and Seep/Wetland Study Workplan is based on, and intended to comply with, two canal flow-reduction mitigation measures included in the Lower Cascade Canal-Banner/Cascade Pipeline Project Environmental Impact Report (EIR) (Jones & Stokes, 2007). This draft workplan was reviewed by canal preservation specific stakeholders (Nevada County Save Our Historic Canals) and will be submitted to the United States Fish and Wildlife Service (USFWS) and California Department of Fish and Game (CDFG) for input. Based on agency input, a final workplan will be posted on the NID website and implemented.

2.0 Background

2.1 PROJECT NEED

The LCC and UGVC are critical links in NID's water system conveying untreated, raw water to irrigation customers and to the Loma Rica and Elizabeth George water treatment plants (WTPs) serving Grass Valley and Nevada City, respectively. The LCC and UCVC are located on Banner Mountain in Nevada County (Figure 1). The LCC is approximately 7.4 miles long, over 100 years old, and has a maximum hydraulic capacity of approximately 45 cubic feet per second (cfs), which does not meet the projected water demands of the WTPs and other uses served by this canal based on Nevada County's General Plan for the area (Jones & Stokes, 2007). The UGVC

Photo 1:
Mixed Coniferous Forrest along Lower Cascade Canal above Gracie Road

branching off the LCC to serve the Nevada City area is approximately 0.5 mile long and has a maximum capacity of approximately 12 cfs.

NID needed to replace the LCC and UGVC to continue to provide reliable water deliveries to the Grass Valley/Nevada City area. To address this need, NID constructed the Banner Cascade Pipeline to serve as the primary means (in place of the canals) for conveying up to approximately 95 cfs of raw water to the Grass Valley/Nevada City area, including to the WTPs. The Banner Cascade Pipeline has been installed; however, it is not yet in operation. (Figure 2)

Once the Banner Cascade Pipeline begins operation the LCC and UGVC will be kept in limited service as service lateral. Specifically, LCC flows will reduce to approximately 3 cfs during the core winter months (December through March) and approximately 5 cfs during the primarily irrigation season (April through November). UGVC flows are projected to reduce to approximately 1 cfs to 2 cfs. By keeping the canals in service, NID will preserve the canals as a historical, cultural, scenic, and recreational amenity. However, reducing the flows and water levels in these two canals will reduce the wetted perimeter in each canal and the head on the remaining wetted perimeter. This change in hydraulic conditions will reduce the amount of leakage from the canals, which has the potential to impact the environment created by canal leakage over the years (Jones & Stokes, 2007).

Since the publication of the EIR, NID has conducted several studies to assess if there is a relationship between canal flow and well levels. In general, NID has found a lack of correlation between the canal flows and well depth. In addition, the canal water isotopes are distinct from the well water isotopes, indicating their sources are distinct (NID, 2012). However, there have been no studies to date on the relationship between riparian habitat and flows.

Figure 1
Project Vicinity

Stantec

NID Lower Cascade Canal Riparian and Wetland Study Workplan

Project: 184030334; Sources: Stantec, 2012; NID 2012; ESRI, 2011; Created By: K. Smith

2.2 IMPACT ANALYSIS SUMMARY

Potential impacts were identified in the Lower Cascade Canal-Banner/Cascade Pipeline Project Final EIR (Jones & Stokes, 2007) that could result from the canal flow reductions. These included potential reduction in canopy cover due to reduced flows and seepage that supports the growth of mesic, or wet-adapted, riparian-type species as well as possible upland species that have become accustomed to a wetted environment. This impact was described in the EIR as follows:

- **Impact 3.8.1: Flow reduction in the LCC could result in impacts to vegetation (including special status plants) and wildlife habitat.**

Specifically, potential water stress to mesic species such as western dogwood (*Cornus nutallii*) and big leaf maple (*Acer macrophyllum*) were identified. Other species, such as incense cedar (*Calocedrus decurrens*), madrone (*Arbutus mensiesii*), black oak (*Quercus kelloggii*), canyon live oak (*Quercus chrysolepis*), and ponderosa pines (*Pinus ponderosa*) were identified in the EIR as species that are either flexible with respect to water regimes or require dry, well drained soils.

The impact analysis in the EIR found that the possible stress from the flow reduction could lead to increased susceptibility to disease, parasitism, and possibly death of plants, including special status plant species. This in turn could result in loss of habitat for common and special status wildlife species.

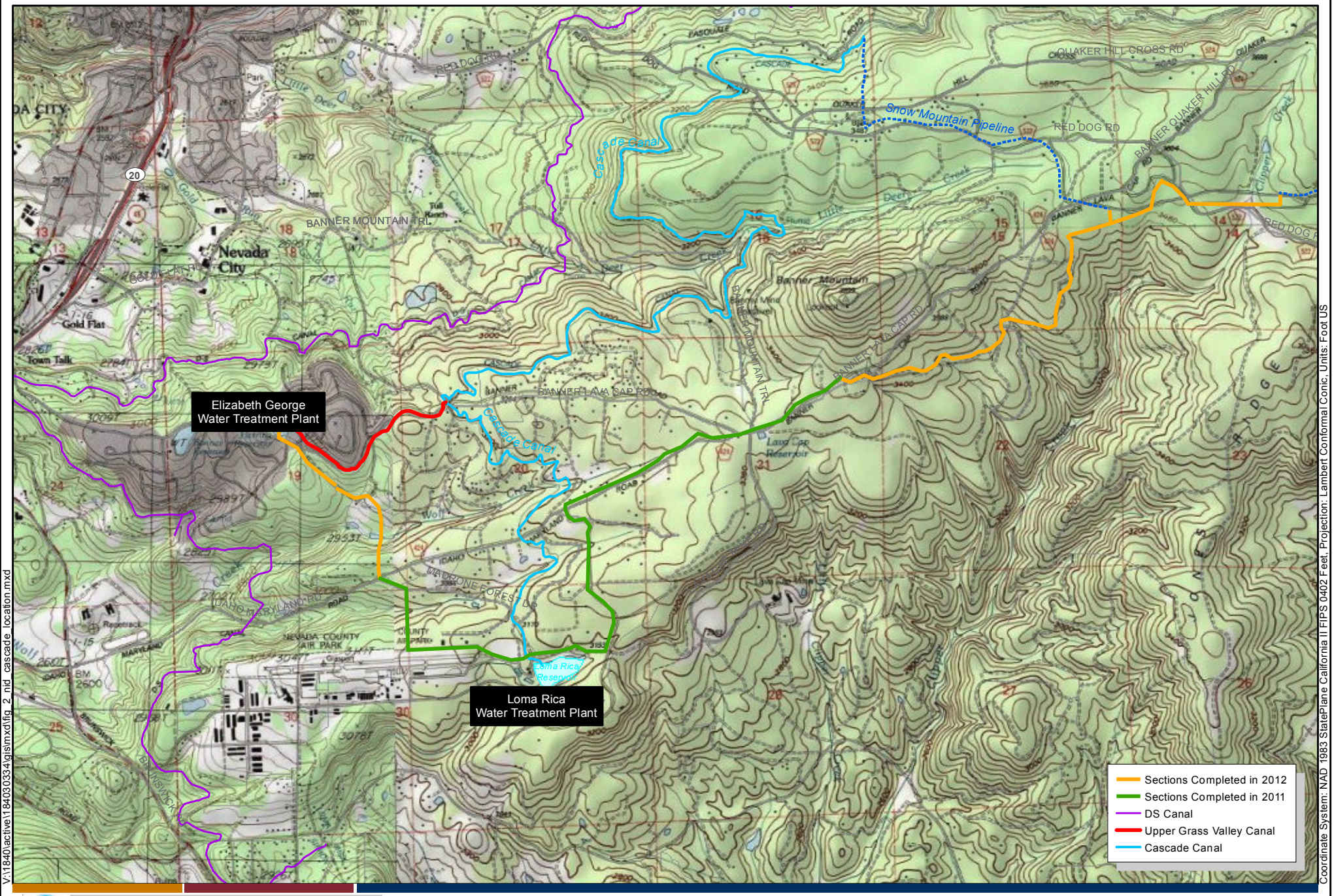
While the dependence of riparian vegetation on flow in stream systems is generally accepted, efforts to quantify this dependence have been plagued with difficulties. The geomorphic and hydrologic characteristics of a site determine how streamflow reductions are likely to affect water availability for riparian plants (Kondolf *et al.*, 1987). In addition, such interactions in canal systems do not appear to be documented in published literature. As such, the EIR deemed it necessary to study the potential for reduced flow to affect canal area vegetation/canopy cover (and associated seep wetlands or ponds) (Jones & Stokes, 2007).

The EIR identified an additional canal flow reduction-related potential impact,

- **Impact 3.8-3: Loss or Disturbance of Special-Status Species Using Ponds and Seeps**

According to the EIR, there are several ponds adjacent to the LCC that may or may not be supported by water seepage from the canal (Jones & Stokes, 2007). The hydrology study in the EIR indicated that some water from the canal potentially reaches ponds in the surrounding area at times. The influence of the canal on adjacent water bodies is seasonal, with a higher influence in dry seasons and a negligible influence in wet seasons. The means by which canal water reaches these ponds has not been studied. Possible means include permitted water diversion from the canals by the pond owners, direct seepage from the canal, groundwater levels augmented by canal seepage, and surface and/or subsurface runoff of canal water used for irrigation purposes. Water sources, such as canals, that persist into dry seasons can be critical for the breeding success of California red-legged frogs (CRLF), a federally listed species. Because there is potential to affect a federally listed species, this impact was considered significant and required the implementation of a mitigation measure to assess the impacts of flow reductions on potential CRLF habitat, including seeps and ponds.

The following workplans describe a course of study to assess the magnitude, if any, of some environmental impacts that may result from the reduced canal leakage caused by the Banner Cascade Pipeline Project. Specifically, the following workplans are intended to address Impact 3.8-1 and Impact 3.8-3 and their associated Mitigation Measures as outlined in the Mitigation Monitoring and Reporting Program (MMRP) of the Lower Cascade Canal-Banner/Cascade Pipeline Project Final EIR (Jones & Stokes, 2007). These mitigation measures are described in the Regulatory Setting section below and the complete text for these mitigation measures is included in Appendix A of this report.



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Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet, Projection: Lambert Conformal Conic, Units: Foot US

NEVADA IRRIGATION DISTRICT
NEVADA COUNTY – PLACER COUNTY
GRASS VALLEY, CALIFORNIA

0 4,000 Feet

Figure 2
Banner Cascade Pipeline and Lower Cascade Canal Location

Stantec

NID Lower Cascade Canal Riparian and Wetland Study Workplan

Project: 184030334; Sources: Stantec, 2012; NID 2012; ESRI, 2011; Created By: K. Smith

2.3 REGULATORY SETTING

The Lower Cascade Canal – Banner/Cascade Pipeline Project Final EIR was completed by NID in 2007 (Jones & Stokes, 2007). A Mitigation Monitoring and Reporting Program was developed to mitigate for potential significant impacts to the environment, including those potentially caused by reducing the flow in the LCC from typical rates of approximately 45 cfs to approximately 3 to 5 cfs, and in the UGVC from 12 cfs to 1 cfs to 2 cfs. The specific concern was that lowering canal flows could reduce seepage from the canal, and thereby reduce established flora and fauna dependent on canal seepage. The potential environmental impacts could take the form of 1) loss of trees and associated shade canopy, and/or 2) reductions in seepage flows to ponds and marshy environs that have some potential to be habitat for CRLF. The specific EIR mitigation measures being addressed herein are:

- *Mitigation Measures 3.81: Prepare and Implement Long-Term Monitoring Program.* The following Canopy Cover Study was developed to satisfy this requirement of the EIR.
- *Mitigation Measure 3.82: Prepare and Implement a Mitigation and Monitoring Program to Determine Impacts to Adjacent Seeps and Ponds.* The following Seep Wetland, Pond and Associated Potential Endangered Species Act (ESA) Species Habitat Study was developed to satisfy this requirement of the EIR.

2.4 PHYSICAL SETTING

The LCC is located in the Nevada City and Grass Valley, California, area (Figure 2). The LCC begins near Pasquale Road and meanders south crossing Banner Lava Cap Road and Idaho Maryland Road, and eventually ends at the Loma Rica WTP in Grass Valley. The elevation of the area ranges from 3,325 feet to 3,150 feet. The natural habitat in the area of the canal is defined primarily as mixed

Photo 2:
Mixed Coniferous Forest with mesic species such as white alder, dogwood, Himalayan blackberry and wild red raspberry on the downslope.

coniferous/hardwood forest and is dominated by ponderosa pine, douglas fir, incense cedar, black oak, madrone, and some canyon live oak in the overstory. Understory species include big leaf maple, white alder (*Alnus rhombifolia*), and western dogwood. In areas along the canal with a shrub layer, the primary species are ncludeswestern chokeberry (*Prunus virginiana demissa*), Himalayan blackberry (*Rubus discolor*), and wild raspberry (*Rubus ideaus*). At the lower elevations, closer to the Loma Rica WTP, there are more oaks and fewer coniferous trees, indicative of a lower elevation and drier ecology (Appendix B, Photo 3). Additional representative photos are included in the preliminary photo log (Appendix B).

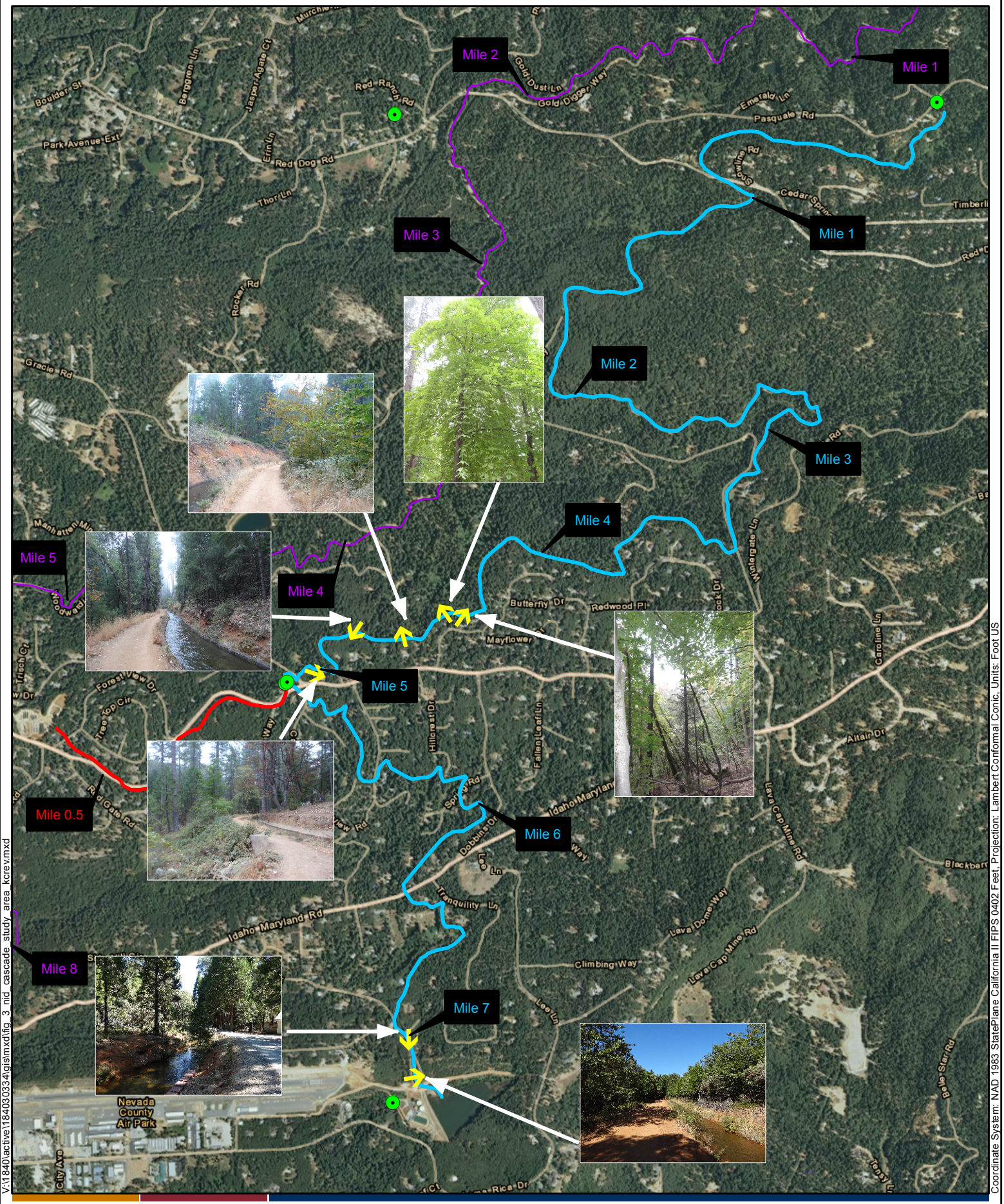
2.5 HYDROLOGY

The LCC water is diverted from Deer Creek above Scotts Flat Lake. This diversion primarily serves the two WTPs. Therefore, flow in these canals is virtually year-round, except during relatively brief canal maintenance work. The LCC presently flows at rates up to approximately 45 cfs. The project will reduce this flow to 2 cfs to 10 cfs, with a typical flow estimated to be approximately 3 to 5 cfs. The UGVC diversion off the LCC presently flows at rates of approximately 8 cfs. Once water is redirected to the Banner Cascade Pipe, UGVC flows will reduce approximately 1 cfs to 2 cfs.

3.0 Proposed Studies

The studies proposed below are intended to provide 1) baseline information necessary to comply with the EIR Mitigation Measures 3.8-1 and 3.8-2, (2) a science-based rationale to quantify potential riparian canopy cover loss, and 3) sufficient information to determine whether reductions in canal flows constitute a “take” of CRLF under the Federal ESA as a result of loss of frog habitat created by canal leakage.

NID will contact the owners of candidate study sites (both potentially impacted sites and control sites) for the studies. The studies will include sites for which NID has obtained a “right of entry” from the landowner or can obtain a visual observation from outside of the property.



0 3,000 Feet

Figure 3
Proposed Riparian and Wetland Study Area
NID Lower Cascade Canal Riparian and Wetland Study Workplan

Stantec

Project: 184030334; Sources: Stantec, 2012; NID 2012; ESRI, 2011; Created By: Kimberly Clyma

3.1 METHODS RATIONAL

In general, methods for addressing flow reductions include spatial and temporal comparisons consider : 1) upstream versus downstream conditions (not feasible on LCC or UGVC because the entire length of the canals will have reduced flows), 2) progressive changes in downstream environmental patterns (in impacted areas and non-impacted “control” areas), or 3) differently regulated waterways (i.e. similar canals not experiencing flow reductions). Temporal comparisons consider 1) environmental conditions before and after flow reduction, and 2) sequential post-flow alteration conditions (Braatne *et al.,* 2008).

These approaches have limitations due to lack of historical data and varying conditions along both canals prior to the scheduled reduction in flows. To address these limitations, Braatne *et al.* (2008) recommend multiple study approaches to provide more confident interpretations of ecological impacts. Because the entire LCC and UGVC will experience reduced flows, upstream (control area) vs. downstream (impact area) assessments cannot be conducted. Other spatial and temporal methods can be used, including methods that include a reference (or “control”) site and a test (or “impact”) site.

Table 1 below summarizes the study design developed to facilitate Mitigation Measure 3.8.1 and 3.8.2 compliance and the work plan details are included in the sections below. In general, NID proposes a mixed method qualitative and quantitative approach to documenting potential riparian changes along Banner Cascade Canal as flows are reduced.

Table 1: Study Design and Sampling Effort Overview.

Study Name	Duration of Study	Data Collection Frequency	Number of LCC Study sites		Number of UGVC Study Sites		Number of Reference Sites (and locations)	Control Site Types	Study Reach Dimensions (meters [m])	Notes
			Upstream (Miles 1-5)	Downstream (Miles 5-7)	Upstream (Miles 0-0.5)	Downstream (Miles .5-2)				
Canopy cover										
Tree Health Assessment	10 yrs	Required - every 2 yrs (0,2,4,6,8, & 10 yrs)	1	3	1	1	1 (DS Canal)	Reference Canal (DS) & Temporal Data from Year zero	~ 20 m long by a minimum of 1 m wide (preferably 5 m, depending on access)	Sites to be centered on areas with mesic vegetation, (i.e. dogwoods and maples). downslope of the canal
Densiometer Canopy Cover Assessment	10 yrs	Years 0, 4, 6, 10 (selected to generally coincide with tree health assessment years)	250 (densitometer observations)	100 (densiom. obs)	25 (densiom. obs)	75 (densiom. obs)	50 (DS Canal) (densiom. obs)	Reference Canal (DS) & Temporal Data from Year zero	~ 50 observations per mile	
Seep Wetland, Pond and Associated Special Status Species Study										
Wetland Mapping	10 yrs	Years 0, 4, 6, 10 (selected to generally coincide with tree health assessment years)	5	2	2	1	1	Reference Canal (DS) & Temporal Data from Year zero		If the habitat assessment data indicate the wetlands and/or ponds in the study do not have potential special status species habitat, or that habitat is clearly maintained by water from sources other than leakage, then only the baseline data need be collected and subsequent studies can be suspended.
CRLF, WTP, and CA Black Rail Habitat Assessment	10 yrs	Years 0, 4, 6, 10 (selected to generally coincide with tree health assessment years)	5	2	2	1	1	Reference Canal (DS) & Temporal Data from Year zero		If the habitat assessment data indicate the wetlands and/or ponds in the study do not have potential special status species habitat, or that habitat is clearly maintained by water from sources other than leakage, then only the baseline data need be collected and subsequent studies can be suspended.

Table 2

Study Methods Considered, Yet Determined Inadequate or Inappropriate for Riparian Change Documentation

Study Name	Duration of Study	Data Collection Frequency	Number of LCC Study sites		Number of UGVC Study Sites		Number of Reference Sites (and locations)	Control Site Types	Study Reach Dimensions (meters [m])	Notes
			Upstream (Miles 1-5)	Downstream (Miles 5-7)	Upstream (Miles 0-0.5)	Downstream (Miles .5-2)				
Aerial Photo Canopy Cover Assessment	10 yrs	Every 5 years (0,5,&10 yrs)	1	1	1	1	1 (DS Canal)	Reference Canal (DS) & Temporal Data from Year 0	Length of canal with 100 m buffer (200 m corridor)	Aerial photography analysis is considered to yield marginal data due to shadow effects in the photographs and shadow effects of the overstory on the potentially impacted understory. Therefore, NID does not propose conducting this type of study.
Optional Tree Ring Study	10 yrs	Once (Year 10)	1 (tree)	2 (trees)	1 (tree)	1 (tree)	1 (tree)	Reference Canal (DS) & Historic data recorded in tree rings	Number of samples = number of individual tress to be cut (final number TBD)	

4.0 Canopy Cover Study (Mitigation Measure 3.8.1)

In order to comply with Mitigation Measure 3.8.1 and assess the impacts, if any, of canal flow reductions on canopy cover, two studies will be conducted:

- **Tree Health Assessment**
- **Canopy Cover Assessment via Densitometer Analysis**

Note: Tree ring and Aerial photography methods were considered but discarded as too limited due to conifer shadows (See Table 2 and Appendix D).

4.1 TREE HEALTH ASSESSMENT

As required in the mitigation and monitoring and reporting program, tree health assessments will be conducted at study years 0, 2, 4, 6, 8, and 10. The assessments will be made by qualified botanists and will consist of evaluating the health of the trees in both control areas and potentially impacted areas. Assessments will include evidence of disease, evidence of parasite and insect damage, and loss of canopy. The tree health assessments are similar to, and complementary to, the separate canopy cover assessments which will occur in study years 0, 5, and 10.

4.1.1 Site Selection and Monitoring Effort

The tree health assessment study sites will be selected based on an initial assessment of vegetation along the canals and similar control sites not impacted by the Banner Cascade Pipeline Project (e.g., similar sites along NID's DS Canal). The sites along the LCC and UGVC will be selected based on vegetation type, areas of maximum leakage, and associated flora that have the greatest potential to be adversely impacted by reductions in canal leakage. Additionally, sites near the ends of the canals will be selected because in these areas the residual flows proposed by NID will be at a minimum, thus leakage will be at a minimum.

As noted, the tree health assessment monitoring effort will consist of six field surveys in study years 0, 2, 4, 6, 8 and 10 after the initial site selection process. The assessments will be conducted by qualified botanists and consist of several tasks including:

- A record of the types, numbers, sizes, and approximate locations for each tree on site.
- A photographic record of tree appearance under similar late summer/early autumn "pre-rain" conditions when water stress on the trees and their photosynthetic surfaces should be most evident.
- A visual inspection of tree leaves, needles, bark, etc. for signs of disease, parasites, and/or insect infestation, with a photographic record being made of the observations appropriate. Again, water stress impacts from reduced canal leakage should be most evident towards the end of the dry season.
- An assessment of canopy cover at each site under comparable seasonal conditions from year-to-year, e.g., specifically before deciduous species begin the process of shedding their leaves.

Options for canopy cover assessments are discussed in the following section on the Canopy Cover Study work plan. The evaluations of canopy cover conducted every two years as part of the tree health assessment work plan will be compatible with and complimentary to the specific canopy cover assessments (Section 4.2).

The tree health assessment monitoring effort will consist of 1) evaluating progressive changes in downstream flora patterns over time along the impacted canals and along comparable control canals (e.g., NIDs DS Canal), and 2) evaluating overall temporal changes in flora along the impacted canals compared to control canals over the 10 year study period. To complete these evaluations in a rational manner, the involved canals will be broken into segments (see Figure 3) and study sites will be identified within these segments, as described below.

- **Progressive Downstream Comparisons:** In order to assess progressive downstream patterns, the LCC and UGVC have been divided into mile markers downstream study sites, with the upper-most sites affected less than the lower sites due to progressive

canal losses and resultant reduced flows downstream. As such, the study entails more downstream study sites (i.e. LCC mile 5 to mile 7, UGVC miles 0.25 to 0.5) than upstream sites (i.e. LCC mile 0 to miles 5, UGVC mile 0 to mile 0.25). The final site selection will be based on a detailed site survey; however, a minimum of four tree health and densitometer study sites will be defined between LCC mile 5 to mile 7 (three sites) and UGVC mile 0.25 to mile 0.5 (one site). Two additional sites (one on each canal) will be defined between LCC mile 0 to mile 5 and UGVC mile 0 to mile 0.25.

Photo 3:
Lower Cascade Canal Mile 6 (as Identified in Figure 3)

Study sites will be 20 meters in length and centered on areas with mesic vegetation, such as maples and dogwoods. Other tree species within these mesic species study areas will also be included in the data collection. The study area width will depend on access, and will be no less than one meter (but preferably 5 meters) from the downslope toe of the canal levee. Actual study site dimensions may be adjusted based on a qualified biologist's assessment of apparent canal seepage-dependent areas.

- **Differentially Regulated Canals - Reference Site Comparison**: In order to reduce the confounding effect of natural variation in flora caused by factors other than reduced canal flows, the LCC and UGVC study sites, will be evaluated relative to a comparable canal study site not impacted by reduced canal flows (e.g., NID's DS Canal located somewhat parallel to the LCC) (see Figure 3). Study sites along this reference or "control" canal will be selected for their similarity to the LCC and UGVC study sites (i.e., reference canal sites with maples and dogwoods). The reference/control sites will have dimensions similar to the LCC and UGVC study sites, with actual study site dimensions being adjusted based on a qualified biologist's assessment of site-specific conditions.

Results from the foregoing studies will be presented as a report on progressive changes in flora (focused on trees) along the LCC and UGVC over the 10 year study period as a function position along each canal. Changes reported will be interpreted as to whether canal flow reductions were the probable cause based on reference to any changes in flora documented at the control sites.

4.1.2 Data Collection Methods

Tree health data collection will occur during the same season each study year, preferably summer when the trees are the most water stressed. Data will be collected every two years for 10 years total. At each of the six study sites (defined above), tree health will be assessed by an International Society of Arboriculture (ISA) certified arborist. A target number of 25 trees will be tagged within each study reach. Trees will be tagged on both the upslope (25 percent of the sample effort) and downslope (75 percent of the sample effort) of the canal (if access is granted by landowners). Trees will be photographed and tree health will be determined by looking at the following factors (Zorbrist 2011):

Photo 4:
Healthy foliage.

1. Pattern of foliage decline - Evidence of uniform crown fading;

2. Color of foliage – Out of season discoloration of foliage;

3. Evidence of wood-boring insects - Piles of wood dust in bark crevices;

4. Bark and stem condition – evidence of fungal fruit bodies on tree stems.

Notes (including photographs) on environmental conditions in the area will be documented.

4.2 CANOPY COVER ASSESSMENT – DENSIOMETER ANALYSIS

4.2.1 Site Selection and Sampling Effort

The canopy cover assessment are not required every two years; however, the survey dates were selected to coincide with the tree health assessment dates so that they would occur simultaneously and contribute to the mix-method qualitative and quantitative analysis of tree health and canopy cover along the canal. As such the canopy cover assessment will occur every five years (year 0, 4, 6 and 10). According to Jennings *et. al* 1999, accurate use of a densitometer requires a very large sample size (approximately 400 observations); therefore, a minimum of 50 observations per mile will be collected, with emphasis on the downstream reaches (i.e., LCC mile 5 to mile 7 and LGVC mile 0.25 to mile 0.5). To the extent feasible, the study sites will coincide with the Tree Heath Assessment study sites. The observation locations will be documented with a GPS so that repeat observations will be made at the same sites. If GPS reception is limited in areas, pin flags will be set.

4.2.2 Data Collection Methods

At each data collection location, observations will be made facing north, west, south, and east at each of the 50 locations per mile. Observation data collection will follow the State Water Quality Control Board Surface Water Ambient Monitoring Protocol for Physical Habitat Riparian Canopy Cover Assessments (Ode, 2007). This method uses the Strickler modification (17-point) of a convex spherical densiometer to correct for overestimation of canopy density (thickness and consistency of plant foliage) that occurs with unmodified readings (Strickler, 1959). The standard operating procedure for this type of canopy cover measurement is described in detail in Appendix C of this workplan.

Note: Aerial photography methods were considered by NID (Appendix D) and determined inappropriate for canopy assessment at this location due to conifer shadowing.

4.3 DATA ANALYSIS AND INTERPRETATION

Canopy Cover data will be interpreted against the backdrop of NID LCC and UGVC flow rates, loss rates, and California's defined water years. LCC and UGVC tree health, canopy, and wetland/seep data will be compared with DS Canal control site data. In accordance with the

Mitigation Measure 3.8-1, “Loss of cover for reasons other than those that might be related to a reduction of flow shall be noted and discounted”.

4.3.1 Considerations

Although a multi-pronged approach has been developed to provide for a robust study, it should be cautioned that with respect to comparative studies, responses are correlative in nature and some effects may not be caused by the flow reductions (Braatne *et al.*, 2008). This was also acknowledged in Mitigation Measure 3.8.1, “*Surrounding land use changes and water year types will be taken into account*” (Jones & Stokes, 2007). According to the literature, the following factors should be considered: natural variation, cumulative and sequential impacts, threshold effects, and latent effects (Braatne *et al.*, 2008).

Braatne *et al.* (2008) described these confounding considerations as follows:

- **Natural Variation:** Riparian zones are naturally dynamic reflecting flows and vary seasonally across years (White *et al.*, 2005). Droughts lead to natural declines in riparian biota (Tyree *et al.*, 1994). Following particular wet or dry years or multiple-year wet and dry cycle aquatic and riparian populations naturally experience episodes of decline and recovery. These form the baseline upon which flow reductions must be compared or placed in context (Braatne et al, 2008).

- **Cumulative and Sequential Impacts:** On the LCC and UGVC cumulative impacts are not particularly confounding because the primary flow impact will be solely due to flow management. However, canopy loss could occur as a result of rehabilitation and maintenance activities along the canals which may necessitate the removal of trees in order to ensure berm integrity or to allow maintenance along the berms. Such canopy loss did not require mitigation, according to Mitigation Measure 3.8.1 and could cause confounding results in the GIS analysis of canopy cover. NID will need to document any trees removed as a result of bank instability and incorporate such data into the canopy study.

- **Threshold Effects:** In riparian plants, water stress due to instream flow reduction may have a minor impact until the xylem cavitation threshold is reached which can lead to

abrupt mortality (Tyree et al, 1994). Thus, threshold effects reflect nonlinear ecosystem dynamics that confound analyses.

- **Latent Effects:** Latent effects are those in which the timing of a response is delayed, thus complicating temporal comparisons. For example, the impact of flow reduction may focus on adult tree health, but the real impact could be lowered recruitment, a factor that may not be identified for years, depending on each tree's life cycle.

Considering the confounding effects of the foregoing factors, results should be interpreted in context and with consideration of the multiple study approaches described above, defined flow rates in the canal, and water years during the study period.

4.4 REPORTING

4.4.1 Interim Technical Memorandums

At the end of each monitoring period (study years 0, 2,4 ,6,8, and 10), a technical memorandum will be drafted to summarize the data collected and the tree health and canopy cover trend (increasing or decreasing) observed in both the impact and reference/control areas. Each technical memorandum will include adaptive management recommendations, if necessary. These could include changes in study work plan, canal flow recommendations, and/or early canopy loss compensation recommendations. NID is not required to adhere to any interim recommendations but may want to use them to reduce or limit flow related canopy impacts, should they be documented.

4.4.2 Final Report

The tree health and canopy cover data will be analyzed over the 10 year study. The data will be assessed in conjunction with California's water year data and NID LCC and UGVC flow data. In addition, the findings will be compared with the reference sites on the DS Canal. The report will include a summary of the data collection methods, results, analysis as well as make findings and recommendations.

4.4.2.1 Adaptive Management and Mitigation

According to the EIR and MMRP (Jones & Stokes, 2007), if canopy loss is documented, the canopy cover replacement standards likely to be implemented are presented below in Table 2 and are adapted from the El Dorado County General Plan (El Dorado County, 1996). Nevada County currently does not have canopy cover replacement standards. It should be noted that if canopy loss is primarily riparian (mesic) species due to canal flow reductions, then replacement trees should be more upland species so that they can survive under reduced canal flow conditions. The final report will include recommendations for compliance with the canopy replacement standards in the project MMRP (Table 2, below).

Table 2. Canopy Replacement Standards

Existing Canopy Cover	Canopy Cover to be Retained or Replaced
80 - 100 percent	60 percent of existing canopy
60 - 79 percent	70 percent of existing canopy
40 - 59 percent	80 percent of existing canopy
20 - 39 percent	85 percent of existing canopy
19 percent or less	90 percent of existing canopy

This mitigation measure is not intended to be applied to rehabilitation and maintenance activities along the canals which may necessitate the removal of trees in order to ensure berm integrity or to allow maintenance along the berms.

5.0 Seep Wetland, Pond and Associated Potential ESA Species Habitat Study (Mitigation Measure 3.8.2)

The purpose of this study is to assess whether reductions in canal flows and associated leakage negatively affect seeps, wetlands, or ponds and whether documented changes could result in impacts to special status species. To complete this assessment, a 10 year study of potentially impacted seeps, wetlands, and ponds located adjacent to the LCC and UGVC is proposed along with an assessment of special status species habitat suitability changes over this study period. A good faith effort by NID will be conducted to gain access to potential study sites on private property; however, the ultimate decision for access lies with the property owner.

5.1 SITE SELECTION AND SAMPLING EFFORT

A qualified wetland and wildlife biologist will conduct a site visit to survey the LCC and UGVC. This survey can be conducted in conjunction with the Canopy Cover Tree Health Assessment site selection effort (described in Section 4.1.1 above). During the site selection survey, NID will also take into account stakeholder recommendations. Ponds and/or seeps that are located near to and downslope of the canal will be marked with Trimble GPS. If seeps or ponds extend outside the NID easement, data collection will be observational only (from the canal) or right of entries will be sought by NID prior to initiating the data collection. Pictures will be taken of seeps and ponds, and species will be recorded to the extent feasible.

A target total of 5 seep, wetland, or ponded areas (one on UGVC and four on LCC) will be selected to be included in the ten year study. In addition, two control sites will be assessed on the DS Canal.

5.2 DATA COLLECTION METHODS

Seeps, wetlands and ponds that are within 50 meters of the downslope side of the canals will be assessed where access is permitted. Data will be collected during years 0, 4, 6, and 10 (coinciding with the tree canopy cover studies described above). Wetland, seep, and, pond data will be collected to the extent feasible during each monitoring effort. Data to be collected include:

- Area of inundation,
- Area soil saturation,
- Range of water depths,
- Soil type, Vegetation present,
- Wildlife species observed.

Each wetland assessment will include a GPS delineation, and information on hydrology, soils, and vegetation, in accordance with U.S. Army Corps of Engineers Guidelines for Wetland Delineations (Environmental Laboratory, 1987) as updated for the intermountain west. Each assessment will also include representative digital images of the site.

Each downslope pond or emergent wetland (up to five) within 50 meters of the canal, to which access is granted, will also be assessed for potential CRLF habitat. If fewer than five potential CRLF pond or wetland sites are encountered, then fewer will be assessed. CRLF habitat suitability determinations will be based on USFWS criteria. Suitable habitat for CRLF generally includes slow moving or ponded waters with emergent vegetation. No protocol level studies are required as a part of this mitigation measure.

If no special-status species are found at any one feature, that feature will be removed from the monitoring list.

5.3 DATA ANALYSIS AND INTERPRETATION

Seep wetland and special status species habitat data will be assessed over the 10 year study period to quantify the presence or absence of impacts of reduced flows on seep wetlands. In an attempt to clarify confounding factors such as differential water years and weather conditions, data will be compared to two reference areas on the DS Canal, where no systematic flow reduction are planned to occur.

Note: The same cautionary notes regarding data variability and interpretation outlined in Section 4.3 apply here.

5.4 REPORTING

5.4.1 Interim Technical Memorandums

At the end of each monitoring period (each 2 years), a short technical memorandum will be drafted to summarize the data collected and the seep, wetland, and ESA species habitat suitability trend (increasing or decreasing). The interim technical memorandums will include adaptive management recommendations, if necessary. These could include flow recommendations and/or ESA consultation recommendations. With the exception of ESA consultation recommendations, NID is not required to adhere to any interim recommendations but may want to use them to reduce or limit the flow related impacts, if they occur.

5.4.2 Final Report

The seep wetland, pond, and ESA species habitat suitability data will be analyzed over the 10 year study. The data will be assessed in conjunction with California's water year data and NID LCC and UGVC flow data. In addition, the findings will be compared with the reference site on the DS Canal. The report will include a summary of the data collection methods, results, analysis and findings and recommendations.

If triggered by the findings, the final report will also include the following mitigation application:

In accordance with the Project FEIR and MMRP: "To the extent that a feature's water level does decline after project implementation, irrigation water service may be obtained to restore pre-project water levels, as the canals will remain as service lateral."

6.0 Literature Cited

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Appendix A – Mitigation Monitoring And Reporting Program EIR MMRP – Measures 3.8-1 and 3.8-2.

The following information is from the NID MMRP (NID, 1999)

Mitigation Measure 3.8-1: Prepare and Implement a Long-Term Monitoring Program.

Since scientific information on this issue is sparse, a mitigation and monitoring program will be developed to monitor impacts to vegetation surrounding the canals. This plan will be a 10 year monitoring plan and will be a separate document. It will include identification of the existing environment and inspections by botanists every two years to identify signs of death, disease, and parasitism on selected trees as compared to trees in the general surrounding area (both uphill and downhill). After five years and 10 years, botanists will review aerial photographs to identify loss of canopy cover. Loss of cover for reasons other than those that might be related to a reduction of flow shall be noted and discounted. This can be completed by several methods including visual, dot grid, line-intercept, or digital image analysis. Each method utilizes standard comparison images with designated canopy cover categories. These are superimposed on aerial photography and analyzed to obtain an estimate of the existing canopy cover. Using a densitometer in the field is another method to calculate canopy cover. Surrounding land use changes and water year types will be taken into account. The vegetation monitoring and mitigation plan will be developed through consultation with CDFG. Replacement standards will be developed based on canopy cover that is lost as a result of disease, parasitism, and/or water stress caused directly from the reduced flow in the canal. Canopy cover replacement standards likely to be implemented are presented below in table form and are adapted from the El Dorado General Plan as Nevada County does not currently outline such standards (El Dorado County, 1996). For existing canopies that are 19 percent or less in coverage, following disturbance of any kind, 90 percent of that original canopy cover must be retained (see Table 3.8-4).

Table 3.8-4. Canopy Replacement Standards

Existing Canopy Cover	Canopy Cover to be Retained or Replaced
80 - 100 percent	60 percent of existing canopy
60 - 79 percent	70 percent of existing canopy
40 - 59 percent	80 percent of existing canopy
20 - 39 percent	85 percent of existing canopy
19 percent or less	90 percent of existing canopy

This mitigation measure is not intended to be applied to rehabilitation and maintenance activities along the canals which may necessitate the removal of trees in order to ensure berm integrity or to allow maintenance along the berms.

Mitigation Measure 3.8-2: Prepare and Implement a Mitigation and Monitoring Program to Determine Impacts to Adjacent Seeps and Ponds

Since there is little information on the impact on adjacent ponds and seeps as a result of decreased flow in the canals, a mitigation and monitoring program will be developed to monitor these areas. The plan could be developed as a portion of the plan described in Mitigation Measure 3.8-1 or could be a separate document. The plan will include baseline information from seeps and ponds adjacent to the canal where property access has been granted. Baseline information should include water depth, area of inundation, vegetation present, and wildlife species observed. Photographs of each monitored area should be taken. The plan should include which habitats will be monitored (this will depend on which landowners will allow access), the frequency and duration of monitoring, the monitoring methods, how the results of the monitoring will be summarized, and what mitigation will be implemented if impacts to special-status species are substantial. If it is determined that Section 7 consultation is necessary for impacts to CRLF, this plan would be developed for the frog in consultation with USFWS during this process. If no special-status species are found at any one feature, that

feature will be removed from the monitoring list. To the extent that a feature's water level does decline after project implementation, irrigation water service may be obtained to restore pre-project water levels, as the canals will remain as service lateral.

Appendix B – Preliminary Photo Log (LCC)

Example photos of Cascade Canal –lower end

White alder downhill of Canal

White alder downhill of Canal

Alder growing in canal

Alder growing in canal

Spike rush

Willow sp and Alder growing next to canal.

Looking north from southern most end of canal (before treatment plant)

Looking south from off of Madrone Forest Drive

Looking North from near Madrone Forest Drive – denser canopy of conifers.

Could not continue North on the Canal due to No Trespassing/Private Property signs.

Alders along Canal near intersection of Banner Lava Cap Road and Gracie Road (on the Cascade Canal Trail – public access)

Alders downhill from Canal

Dogwood downhill from Canal in same area as previous two pictures

Canopy opening

Appendix C – State Water Resource Control Board Densiometer Canopy Cover Data Collection Procedure

Standard Operating Procedure (SOP) 4.9.1.1

Measuring Canopy Cover Using a Seventeen Point Spherical Convex Densiometer

Erick Burres

1.0 INTRODUCTION

Riparian canopy cover over a stream is important not only in its role in moderating stream temperatures through shading, but also as an indicator of conditions that control bank stability and the potential for inputs of coarse and fine particulate organic material. Organic inputs from riparian vegetation become food for stream organisms and structure to create and maintain complex channel habitat. Determining a stream's integrity is done by assessing the biota and physical habitats. Estimation of canopy cover contributes to this assessment. This method (Ode 2007) uses the Strickler modification (17-point) of a convex spherical densiometer to correct for overestimation of canopy density (thickness and consistency of plant foliage) that occurs with unmodified readings (Strickler 1959).

2.0 EQUIPMENT

17-point modified convex spherical densitometer (Strickler 1959).
(Mounting the densiometer onto a tripod for stabilization while reading measurements is optional.)

3.0 PROCEDURE

Densiometer measurements are taken at 0.3 m (1 ft) above the water surface, rather than at waist level, to avoid errors because people differ in height; avoid errors from standing in water of varying depths; and to include low overhanging vegetation more consistently in the estimates of cover.

Keep the densiometer level using the round bubble level found in the densiometers lower right-hand corner.

Hold the densiometer far enough away from your body so that your head is just outside the grid (12-18" away) and 0.3 m (1 foot) above the water surface with your face just below the apex of the "V" as if it was being reflected within the densiometers mirrored surface, see Figure 1. Concentrate on the 17 points of grid intersection on the densiometer that lie within the taped "V" area.

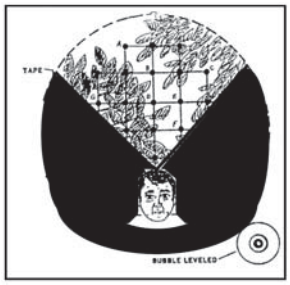

Figure 1 Schematic of modified convex spherical canopy densiometer (modified from Mulvey et al., 1992).

In the example shown in Figure 1, 11 of the 17 intersections show canopy cover, giving a densiometer reading of 11. Note proper positioning with the bubble leveled and face below the apex of the "V."

Each point represents an area of canopy opening (sky...) or canopy cover (vegetation…). Count the number of canopy covered points. Take and record four 17-point readings. These are all taken from the center of each transect (transect = wetted width): a) facing upstream, b) facing downstream, c) facing the left bank, d) facing the right bank, see figure 2.

Figure 2 Obtaining Densiometer Readings

facing upstream facing downstream facing the left bank facing the right bank

If the reflection of a tree or high branch or leaf overlies any of the 17 intersection points, that particular intersection is counted as having cover. For each of the four measurement points, record the number of intersection points (maximum=17) that have vegetation covering them

4.0 REFERENCE

C.D.P.R. 2004 SOP Number: FSOT.002.01, STANDARD OPERATING PROCEDURE Instructions for the Calibration and Use of a Spherical Densiometer. California Department of Pesticide Regulation, Environmental Monitoring Branch. 4pp

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Bioassessments in California. State Water Resources Control Board, Surface Water Ambient Monitoring Program. 48pp.

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Appendix D – Alternative Study Methods Assessed and Determined Inadequate or Infeasible

TREE HEALTH - TREE RING STUDY

The method described below was considered and not included in the study methodology because it entails removal of mature trees and removing cores from tree trunks is expected to cause tree death. Loss of trees is the concern prompting the study. Accordingly, a tree ring study is not recommended unless NID determines the alternate methods are not sufficient.

This additional study was considered as a supplement to the tree health assessment study as a means of providing additional information to complement and verify the results of the proposed study. The goal would be to relate tree growth rates (i.e., tree ring widths) to canal flows, both historic and under reduced flow conditions. The advantage of tree ring data is that the tree growth response to historical canal flows is recorded in woody tissue, creating a record that spans the lifetime of the tree (Stromberg and Patten, 1990). To collect these data, a small subset of mature maples and dogwoods would be cut down at the end of this study and their tree ring widths would be analyzed relative to historical and reduced canal flow rates.

CANOPY COVER ASSESSMENT – AERIAL PHOTOGRAPHY ANALYSIS

The method described below was considered and determined inadequate because the trees to be studies are understory trees in a mixed coniferous forest and therefore any changes among them would be masked by the shadows of the conifers.

Site Selection and Sampling Effort

Aerial photography could be used to estimate canopy cover along the length of the LCC and UGVC. The study area will extend 100 meters on either side of the canal. The DS Canal will be utilized as a reference site. Aerial photographs will be examined at the beginning of the study (2012) and then at 5 years (2017) and 10 years (2022). Aerial photograph comparisons will be made from publically available photographs, targeting where feasible, data from similar seasons. The sites for specific canopy cover assessments will be selected based on where canal leakage appears to have the greatest impact on adjacent trees.

Data Collection Methods

A visual analysis of selected canopy cover assessment sites will be used with GIS to determine changes in canopy cover between study year 0, 5, and 10. Visual assessments can be made

by using a crown density scale method (Moessner, 1949; Husch *et al.* 1982). This method consists of a series of standard squares containing black dots that cover from 5 percent to 95 percent of the area (see Figure 4). The level of cover on this scale that most resembles the canopy cover seen on the aerial photograph is then selected (Jennings et. al 1999).

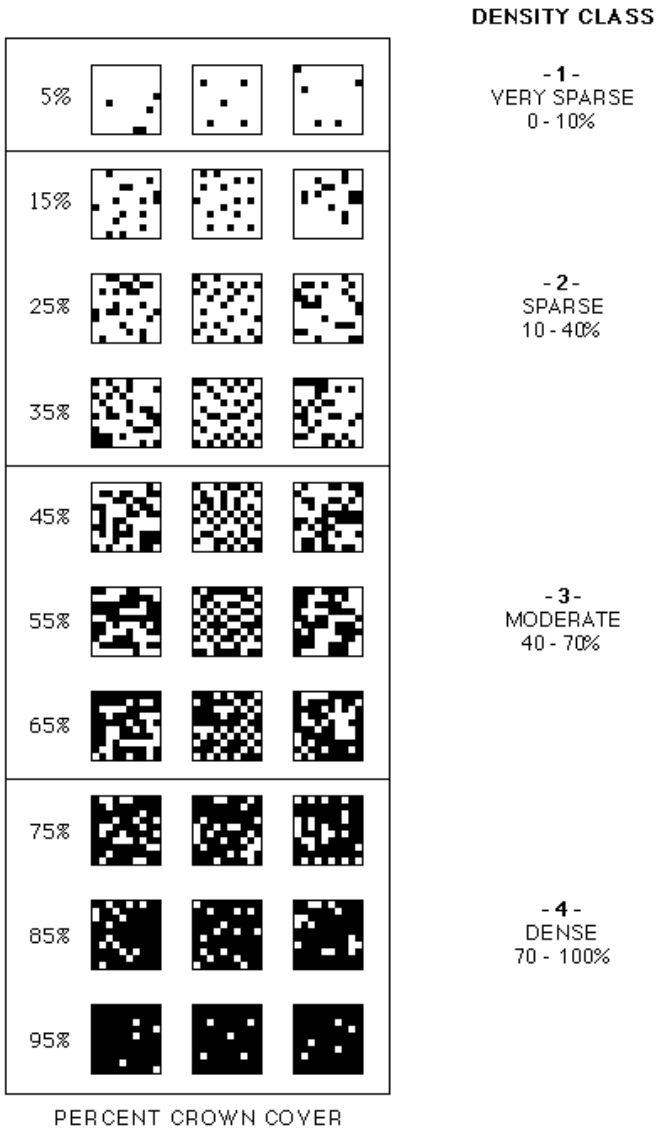

Figure 4: Example Crown Density Scale used for estimating density of forest canopy from aerial photography (Paine, 1981).