

Caples Spillway Channel Stabilization Plan

El Dorado Hydroelectric Project
(FERC No. 184)

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Acronyms

cfs	cubic feet per second
CDFW	California Department of Fish and Wildlife
EID or District	El Dorado Irrigation District
ERC	Project No. 184 Ecological Resources Committee
FERC	Federal Energy Regulatory Commission
LF	linear feet
sq ft	square feet
sq yds	square yards
SWRCB	State Water Resources Control Board
USFS	US Forest Service

1 Introduction

The Caples Spillway Channel Stabilization Plan (Stabilization Plan or Plan) is a requirement of the FERC Project No. 184 license¹. This Stabilization Plan presents a plan with engineering drawings and specifications for the stabilization of the spillway channel based on a 60 cfs design flow, which was developed in consultation with the USFS, SWRCB, and ERC.

Section 1 of this document describes the objectives and background leading to the development of the Stabilization Plan. Stabilization treatments are provided in Section 2, which includes Appendices B, C, and D that fully describe the Stabilization Plan design features. A maintenance, monitoring and reporting plan is provided in Section 3. References are provided in Section 4.

1.1 Objectives

This Stabilization Plan addresses stream bank erosion that may occur within the Caples Lake spillway channel during flows up to 60 cfs. The Plan addresses two key erosion areas (Upper and Lower Erosion Sites) along the half-mile length of the spill channel. The stabilization treatments presented in this Plan are designed to achieve the following objectives:

- > Stabilize the spillway channel banks to accommodate releases from the Caples Lake Auxiliary Dam up to 60 cubic feet per second (cfs)
- > Use methods to minimize site disturbance, loss of existing trees, and maintain the natural character of the area
- > Minimize use of imported materials by utilizing native materials available on-site or locally (e.g., large woody debris, willow cuttings, large cobbles) and hand tools, without the use of mechanical equipment or site grading to minimize site disturbance

The District, in consultation with the USFS, SWRCB, and ERC, determined that the measures utilized to stabilize the spillway channel should be designed to accommodate flows up to 60 cfs. This design flow is based on the District's determination that there is no operational need to release more than the currently approved 60 cfs into the spillway channel as part of normal operations. The District only utilizes the spillway to make short-term low magnitude releases in order to remove accumulated woody debris and pollen that accumulates in front of the auxiliary dam. The District plans to continue to route operational reservoir outflows through the Main Dam outlet works on Caples Creek, consistent with the current license requirements.

1.2 Background

Geomorphic investigations conducted during the Federal Energy Regulatory Commission (FERC) relicensing of the El Dorado Hydroelectric Project (Project No. 184) indicated that historic spill flows had over time resulted in incision, bank erosion, and widening of the Caples auxiliary dam spillway channel (ENTRIX 2002).

License requirements were incorporated into the October 2006 Project No. 184 FERC license to address the condition of the spillway channel, including requirements to: 1) limit spillway releases to not exceed 60 cfs, 2) investigate channel stability in the spillway channel as part of the Geomorphology Sensitive Site Investigation monitoring element, 3) monitor channel properties as a basis for evaluating changes in channel condition through the Geomorphology Continuing Evaluation of Representative Channel Areas

¹ FS 4(e) Condition No. 38, subsection 4b, SWRCB Water Quality Certification Condition No. 5, and Section 8 of Appendix A to the El Dorado Relicensing Settlement Agreement

monitoring element, 4) complete a Feasibility Study to determine whether the spillway facility can be designed to convey adaptive management pulse flows that cannot be released through the existing outlet works into the Caples Creek natural channel, and 5) develop a stabilization plan for the Caples Spillway Channel.

EID prepared a Sensitive Site Investigation/Geomorphology Monitoring Plan (Monitoring Plan; EID, 2008) in consultation with the USFS, SWRCB, ERC, and the FERC to provide a “detailed investigation of fluvial geomorphic properties” of the spillway channel. In fulfillment of the Monitoring Plan, EID conducted the following field studies that were initiated in 2007, along with hydraulic modeling, and other analyses, including:

- > Field assessments of spillway channel stability
- > Hydraulic modeling to predict velocities, depths, and shear forces on bed and banks, needed to provide a basis for developing stabilization measures
- > A test flow release over a range of flows to provide hydraulic model calibration; observations and measurements of bed/bank stability, hydraulic conditions, and to conduct empirical sediment balance/sediment transport studies

A main objective of the spillway channel stability assessment was to characterize existing geomorphic conditions along the entire length of the spill channel, including identification of locations that are unstable and subject to bank erosion. A field survey of the spillway channel was performed in September 2007, which included:

- > Assessment of channel morphology including identification of channel geomorphology, locations and photo-documentation of head cuts, bank erosion, and large wood debris jams
- > Longitudinal bed profile survey from Caples auxiliary dam to Caples Creek
- > Cross-section surveys at identified erosion areas
- > Sediment composition assessment of bed and banks at cross-sections within identified erosion areas

Test flow releases were conducted in 2009 to provide observations of bed/bank stability, conduct empirical sediment balance/sediment transport studies, and allow for hydraulic model calibration. The results of the field assessment of channel stability and test flow releases are documented in the Caples Spillway Channel Sensitive Site Investigation Project 184 Geomorphology Monitoring report (ENTRIX, 2010). That assessment distinguished two geomorphic reaches based on channel type: 1) an upper cascade channel type, and 2) a lower pool-riffle channel type. The upper 2,200 ft of the spillway channel is predominantly a cascade channel type with a gradient of 8.7 percent. Cascade channel types occur on steep gradients, are straight and narrowly confined by valley walls, with longitudinally and laterally disorganized coarse bed material, that are typically cobbles and boulders. The lowermost 850 ft of the spillway channel is a pool-riffle channel type with a gradient of 0.9 percent. The channel laterally oscillates (meander pattern), with an associated sequence of bar-pool-riffle.

Two sites with bank instability and erosion were identified in the report, one within the cascade channel reach, and one within the pool-riffle reach, which were subsequently identified as the “Upper” and “Lower” erosion sites. Smaller areas of isolated erosion were also observed throughout the spillway channel, but they did not represent a potential for substantial recruitment of sediment and did not exceed a minimum criteria of 20 linear ft of bank erosion used for mapping unstable eroding sites. The hydraulic model itself was not prepared at that time because it was necessary to determine what the maximum design flow capacity was needed for the development of the Stabilization Plan.

Several tasks were identified as precursors to determining the maximum design flow capacity and development of the Stabilization Plan:

- > Completing geomorphology studies of Caples Creek to determine the appropriate pulse flow releases required to meet resource objectives

- > Measuring the outlet capacity of the Caples Lake Main Dam to determine if required pulse flow releases could be conveyed through the outlet works
- > Completing the Caples Feasibility Study to determine whether the Caples Spillway Facility can be designed to convey adaptive management pulse flows that cannot be released through the existing outlet works into the Caples Creek natural channel in a manner that addresses resource concerns

The geomorphic monitoring of Caples Creek was completed in 2010 and the monitoring results and pulse flow recommendations were published in 2011 (Cardno Entrix, 2011). The outlet capacity of Caples Lake Main Dam was measured during pulse flow releases in 2010. The results of these two efforts found that the pulse flows currently required by the Project No. 184 license as well as the pulse flows recommended based on the results of geomorphologic monitoring can be conveyed through the existing Caples Lake Main Dam outlet works. In response to these findings, the District prepared a proposal requesting USFS, SWRCB, and ERC approval to close-out the Feasibility Study; the USFS, SWRCB, ERC, and FERC approved the proposal to suspend the requirement to prepare the Feasibility Study (FERC 2014).

Because it was not necessary to convey adaptive management pulse flows in the spillway channel, the District evaluated the operational needs to help define a maximum design flow capacity for the Caples spillway channel. Based on operational experience, the District determined there is no operational need to release more than the currently approved 60 cfs into the spillway channel as part of normal operations. As such, the District presented a framework for the development of the Stabilization Plan to the USFS, SWRCB, and ERC in October 2012. The framework included the following elements:

- > Continue to route operational reservoir releases through the Main Dam outlet works on Caples Creek, consistent with the current license requirements
- > Stabilize the spillway channel up to 60 cfs using biotechnical measures to minimize site disturbance and maintain the natural channel character of the area
- > Develop and present a proposal to modify Caples target lake levels, under certain circumstances, to further reduce likelihood of uncontrolled spill events
- > Continue to monitor spillway channel conditions as part of the Geomorphology Continuing Evaluation of Representative Channel Areas, consistent with adaptive management program principles

No objections to this framework were noted at the October 2012 meeting and the District proceeded with the development of the hydraulic model and Stabilization Plan consistent with the framework. In April 2013, the USFS, SWRCB, and ERC requested to revisit the framework for the development of the Stabilization Plan. The District presented the framework again in May 2013. During this discussion, the USFS, SWRCB, and ERC requested that the hydraulic model developed for the Geomorphology Sensitive Site Investigation for the Caples spillway channel evaluate hydraulic conditions at flows of 250 cfs and 600 cfs and requested a site visit to better understand the stage-discharge relationship of the spillway channel. The District agreed to rerun the hydraulic model to simulate conditions for discharges ranging between 4 cfs to 600 cfs based on requests from the USFS, SWRCB, and ERC. The District also conducted a site visit with representatives from interested parties in July 2013 to review the modeling results and describe potential stabilization measures.

Following the site visit in July 2013, the District prepared the Caples Spillway Channel Stabilization Plan (EID, 2013) that presented plans to address bank erosion that may occur within the Caples Lake spillway channel for releases up to 60 cfs. The stabilization treatments presented in the plan were designed to achieve the following objectives:

- > Stabilize the spillway channel banks to accommodate releases from the Caples Lake Auxiliary Dam up to 60 cubic feet per second (cfs)
- > Utilize stabilization means and methods that minimize site disturbance, loss of existing trees, and maintains the natural character of the area
- > Rely on native materials available on-site

The components of the Stabilization Plan, including the approach; implementation and maintenance; and reporting and consultation were also included in the plan. The District provided the draft plan to the USFS, SWRCB, and ERC for review and consideration in August 2013. In August 2014, the SWRCB and USFS provided comments on the draft Plan and requested an evaluation of alternatives for stabilization at three flow levels (60, 120, and 250 cfs) including a rationale for the stabilization approach for each flow level and supporting hydraulic modeling in order to determine the appropriate level of mitigation necessary to stabilize the spillway channel.

To support the alternatives analysis, the District performed an updated spillway erosion assessment in October 2015 to re-check bank stability conditions for comparison with 2007 survey results. The survey collected data rating stream channel and bank stability conditions using the Bank Erosion Hazard Index (BEHI) field inventory data sheet (Rosgen 1996) to assess potential for contributing to bank erosion. Results were very similar to those from the 2007 survey. Most of the spillway channel had BEHI rating of either “very low” or “low risk” of bank erosion, other than the Upper and Lower Erosion Sites. The results of this assessment are included in the Caples Spillway Channel Stabilization Plan Design Alternatives Documentation Report (EID, 2016).

In October 2016, the District completed the alternatives analysis requested by the SWRCB and USFS and documented the results in the Caples Spillway Channel Stabilization Plan Design Alternatives Documentation Report (EID, 2016). The Design Alternatives Documentation Report presented design plans for three stabilization alternatives corresponding to design flows at 60, 120, and 250 cfs, and analyzed how each of the alternatives addressed the design objectives for stabilization. The Design Alternatives Documentation Report provided the rationale for the Stabilization Plan alternatives, including criteria and references from the technical literature supporting the proposed stabilization treatments. Various hydraulic analyses were performed to screen and select from a range of stabilization measures and to inform the site-specific stabilization designs. The different treatments were compared for various metrics including effectiveness, disturbance, maintenance, durability, lifecycle, blending, constructability, permitting, and estimated cost. The design alternatives were presented to the ERC at a meeting held on October 13, 2016, and the Design Alternatives Documentation Report was posted on the District’s website on October 24, 2016 for USFS, SWRCB, and ERC review and consideration. The District requested approval of the design alternative that utilizes vegetative treatments provided for the 60 cfs design flow because this design alternative:

- > Reduces erosion not only at 60 cfs, but also at higher flows 120 cfs and 250 cfs ;
 - 60 cfs = 50 – 80% reduction²
 - 120 cfs = 24 – 79% reduction
 - 250 cfs = 34 – 92% reduction
- > Can be completed by hand crews with the least amount of ground disturbance with no tree removal
- > Blends well with existing environment
- > Provides an indefinite life cycle once vegetation is established;
- > Straightforward environmental review and permitting processes; and
- > Lowest construction cost

CDFW, SWRCB, and USFS provided comments (February 1, 2017, February 14, 2017, and February 15, 2017, respectively) on the Design Alternatives Documentation Report. The District, with assistance from Cardno, responded to all questions and comments (EID April 20, 2017), and requested

² This is the range of erosion reductions achieved from the minimum to the maximum, depending upon the site-specific bank stabilization locale, compared to existing erosion rates.

SWRCB, USFS, and ERC approval for the 60 cfs design stabilization alternative. CDFW approved the 60 cfs design alternative in its February 1, 2017 comments provided the design does not require an amendment to the FERC license to modify minimum lake-level targets for Caples Lake. The SWRCB (June 13, 2017) and USFS (June 14, 2017) provided conditional approval for the 60 cfs stabilization alternative pending certain revisions to the final plans. Specific to the stabilization measures, the SWRCB identified two locations in the Upper Erosion Site where it was requested that the District consult with SWRCB, USFS, and CDFW to determine appropriate stabilization methods to be included in the final Plan for review and approval. The District conducted a field tour for the SWRCB, USFS, and ERC in July 2017 to discuss proposed stabilization methods for these two sites. The stabilization measures discussed during the field tour have been incorporated into this Stabilization Plan along with revisions addressing the other conditions for approval. Appendix A provides the letters with conditions of approval from the CDFW, SWRCB, and USFS. Section 2.1 of this Stabilization Plan provides additional detail on the revisions made to the design plans to address the conditions of approval.

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2 Stabilization Plan

Erosion along the Caples Spillway channel occurs due to two related processes; hydraulic erosion by flow impingement on the bank face mostly concentrated at the bank toe, which may be followed by geotechnical erosion due to over-steepening of the bank face that can result in partial bank failure. As documented in the Design Alternatives Documentation Report (EID, 2016), vegetative treatments were found to provide substantial erosion reductions relative to existing conditions, by both reducing hydraulic erosion (impingement on the bank face) and by forestalling geotechnical bank failures. The percent erosion reduction from existing conditions using vegetation methods for stabilization was determined to be a 50 to 80 percent reduction at a 60 cfs flow (EID 2016).

This Stabilization Plan addresses bank stabilization at the Upper and Lower Erosion Sites for the 60 cfs design flow predominantly using vegetative methods. There are two site-specific locales within the Upper Erosion Site where biotechnical methods are prescribed using a combination of rock-and-log stabilization measures with vegetative treatments.

2.1 Stabilization Plan Revisions Made in Response to Comments

The CDFW (February 1, 2017), SWRCB (June 13, 2017) and USFS (June 14, 2017) provided conditional approval for the 60 cfs stabilization alternative pending incorporation of certain clarifications and revisions into this Plan. Appendix A provides the correspondence with conditions of approval from CDFW, SWRCB, and USFS. The engineering plans included in the Design Alternatives Documentation Report (EID, 2016) were updated with the provision of greater detail for the design features, along with those revisions made to address the conditions of approval. Changes made to the Plan in response to comments for conditional approvals are as follows:

- > Modified this Stabilization Plan to remove the development of a proposal to modify minimum lake-level targets for Caples Lake
- > Added stabilizations treatments at two locations at the Upper Erosion Site not previously addressed in the updated stabilization plans. Both sites were inspected in the field with the USFS, SWRCB, and ERC (July 2017) and proposed stabilization treatments were discussed. The stabilization treatments at both sites will be field-fit, with the use of hand tools only.
 - 85 linear feet along the right bank (stations 2+45 to 3+30) incorporates a log and rock toe revetment with plantings of willow stakes. Logs will be obtained from downed wood currently in the channel, and rock will be imported via helicopter.
 - 48 linear feet along the right bank (stations +60 to 1+08) incorporates a rock toe with interspersed plantings of willow stakes. The bank overhang will be shaved back in order to place the rock toe. Rock will be imported via helicopter.
- > Removed the description of conditions in the monitoring plan under which future stabilization site maintenance activities would or would not be implemented in response to bank instability
- > Changed the absolute vegetation cover success criteria in the monitoring plan, which is to be determined at the end of Year 5 monitoring from 50% to 75%. Cover will be assessed during each of the first 5 years of monitoring following planting and additionally, after Year 5 monitoring concurrent with the monitoring performed under the Geomorphology Continuing Evaluation of Representative Channel Areas monitoring that is conducted every 5 years.
- > Included field observations of bank stability and fixed photo-monitoring sites in the monitoring plan

- > Added a statement that if willow establishment perpetually fails at certain locations in the spillway channel, EID will consult with the State Water Board, USFS, and CDFW to determine appropriate actions to stabilize the locations using other methods, including non-vegetative methods.
- > Added a statement that if, during the term of the FERC license, monitoring identifies significant levels of erosion (e.g., geotechnical failures or erosion rates comparable to current conditions) despite achieving vegetation success criteria, EID shall consult with the SWRCB, USFS, and CDFW on actions to reduce erosion or redefine vegetation success criteria.
- > Incorporated vertical willow bundles into the design at a treatment site in the Lower Erosion Site.

2.2 Stabilization Plan Overview

The Stabilization Plan location maps and engineering drawings are provided in Appendix B. Specified treatment areas are identified to distinguish and group stabilization treatments areas on the plan set. Typical cross-sections are shown. The design plans include a detail sheet showing vegetative and wood/rock toe revetment installation specifications. Specifications for vegetative installations that include live stakes with coir logs, live stakes/pole plantings, and willow fascines, are also included on the detail sheet. Table 2-1 provides a summary of the Upper Erosion Site stabilization treatments and Table 2-2 provides a summary of the Lower Erosion Site stabilization treatments.

A Vegetative Treatment Photo Log is provided in Appendix C and Vegetation Installation Details are provided in Appendix D. Ground photos of the Upper and Lower Erosion Sites are annotated to depict the location of vegetation installations proposed in the Stabilization Plans in Appendix C. EID will install vegetative stabilization treatments in each of the erosion areas as shown in the design plans (Appendix B), following the implementation techniques outlined in Appendix D. The design plans provide a guide for installation of the treatments; some field-fit adjustments may be necessary to accommodate site-specific conditions and to ensure stabilization measures perform as expected.

All stabilization treatments will be implemented using hand tools only, including rock and log toe revetments, and fit to field conditions. Materials staging areas and access routes for the Upper and Lower Erosion Sites are identified in the design plans. Coir logs, imported rock (only required for specific locations in the Upper Erosion Site), and plant materials will either be delivered to the sites using helicopter and/or by foot access from the Lake Margaret trail. A portion of the foot access to the Upper Erosion Site takes off from the Lake Margaret trail via “cross-country” off-trail travel, which is predominantly over open bedrock terrain. Helicopter delivery areas are specified in the design plans; staging for the delivery of these materials may occur from the Lake Margaret trailhead parking area, the auxiliary dam public parking area, or other approved areas located along Highway 88 in proximity to the project site.

EID plans to implement the vegetative stabilization treatments in the fall or spring/early summer, depending on weather conditions. The preferred timing of the planting is either in the fall when willows have gone dormant or in spring/early summer before the willow buds start to break. For a fall installation, non-vegetative treatments (e.g., coir logs, rock toe revetments) may be constructed in the summer so these activities can be completed prior to willow dormancy in the fall.

Table 2-1. Summary of Upper Erosion Site Stabilization Treatments

Treatment Area	Begin STA	End STA	Length	Bank
U1	Live Stakes			
STA:	3+25	3+55	30	Left
U2	Live Stakes and Poles			
STA:	3+17	3+57	40	Right
U3	Log and Rock Toe Revetment with Live Stakes and Poles			
STA:	2+45	3+30	85	Right
U4	Live Stakes and Poles			
STA:	2+58	2+72	14	Right
U5	Live Stakes and Poles, Willow Fascines, Coir Logs			
STA:	2+46	1+39	107	Right
U6	Live Stakes and Poles, Coir Log			
STA:	1+25	1+87	62	Left
U7	Rock Toe with Willow Stakes			
STA:	+60	1+08	48	Right
U8	Live Stakes and Poles, Willow Fascines			
STA:	+1	+64	63	Right
U9	Live Stakes and Poles			
STA:	+12	+48	36	Left

Table 2-2. Summary of Lower Erosion Site Stabilization Treatments

Treatment Area	Begin STA	End STA	Length	Bank
L1	Live Stakes and Poles, Coir Logs			
STA:	7+74	8+48	74	Right
L2	Remove Smaller Logs from Debris Jam to Clear Channel			
STA:	7+38	7+74	36	Right
L3	Live Stakes and Poles, Coir Logs			
STA:	7+02	7+38	36	Right
L4	Live Stakes and Poles			
STA:	5+91	6+48	57	Right
L5	Willow Fascines, Coir Logs, Live Stakes			
STA:	5+04	5+91	87	Right
L6	Live Stakes and Poles, Vertical Willow Bundles, Coir Logs			
STA:	6+23	7+25	102	Left
L7	Live Stakes and Poles, Willow Fascines			
STA:	4+13	5+20	107	Left
L8	Live Stakes and Poles			
STA:	4+15	5+04	89	Right

2.2.1 Willow Harvest

Prior to harvesting willow materials, a qualified ecologist will identify suitable willows that could be used for source material for the pole plantings and the fascines. The ecologist will also flag the locations of each stabilization treatment within each erosion area. All willow cuttings are anticipated to be collected from along Caples Creek, including in the vicinity of Caples Meadow, or Kirkwood Creek, located downstream of the spillway channel. Willow cutting source materials may also be collected from other locations in close proximity to the project area.

There are long-term riparian vegetation monitoring sites located in the Caples Creek meadow area. These monitoring sites include photopoints along Caples Creek as part of the Project No. 184 Riparian Recruitment Monitoring Plan and transects across Caples Creek as part of the Project No. 184 Riparian Species Composition Monitoring Plan. Figure 1 depicts the location of the monitoring photopoints and transects as well as the approximate area where willow harvest would occur. Willow harvest will not occur in the immediate vicinity of the riparian monitoring photopoints and transects.



Figure 1. Potential willow harvest source areas (purple) in Caples Meadow and near Kirkwood Creek

Based on the proposed stabilization treatments, at least 900 willow cuttings will be required for the pole plantings, at least 800 4-ft cuttings will be required to assemble the willow fascines, and about 130 7-ft cuttings to assemble 26 bundles for vertical bundle plantings (oriented perpendicular to the bank slope). Planting will occur as soon as possible following collection.

Willow cuttings will either be directly planted as poles or used as stakes or in fascines. The willow material will only be obtained from healthy willow individuals, as described in Appendix D. Detailed methods for gathering the willow cuttings, including specifications for stem diameters and lengths for pole plantings and fascines; cutting, preparing, and storing poles; and installing the different stabilization treatments are provided in Appendix D.

2.3 Material Quantities

Material quantities for the Upper and Lower Erosion Sites are identified in Table 2-3 and Table 2-4, respectively. The tables break down the square feet of vegetation staking area, number of vegetation stakes, number, and linear feet of willow fascines, linear feet of coir logs, and the volume of estimated rock by size class needed. There is 1,280 sq ft of vegetation staking requiring approximately 445 willow poles for the Upper Erosion Site. Approximately 1,565 sq ft requiring approximately 524 willow poles for the Lower Erosion Site. Ten willow fascines are proposed for the Upper Erosion Site totaling 160 linear feet of fascine material. For the Lower Erosion Site there are 37 fascines, of which 26 are willow bundles to be installed perpendicular to the slope contour at treatment area L6. The total length of willow fascines for the Lower Erosion Site is 390 linear ft. For the Upper Erosion Site 175 linear ft of coir logs are proposed, and for the Lower Erosion Site 285 linear ft of coir logs are proposed. Rock volume for the Upper Erosion Site totals 6 cu yds of cobble (2.5 to 11-inch) and 13.5 cu yds of boulders (18-inch diameter). No rock treatments are needed for the Lower Erosion Site.

No standing live trees will require removal at the Lower Erosion Site. At the Upper Erosion Site Treatment Area U7 there is one small pine tree (<0.5 ft diameter) that will be removed when the deeply undercut bank overhang is shaved back in order to expose the bank face for installation of a rock toe revetment (see Vegetative Treatment Photo Log in Appendix C).

Table 2-3. Summary of Approximate Material Quantities Upper Erosion Site

Area	Vegetation Sq Ft	Vegetation Number of Stakes	Willow Fascines Number of Each and (LF)	Coir Logs LF	Rock CY	
					Cobble	Boulder
U1	75	25	-	-	-	-
U2	50	17	-	-	-	-
U3	170	57	-	-	4.5	10.5
U4	25	9	-	110	-	-
U5	280	94	6 (100)	-	-	-
U6	230	77	-	65	-	-
U7	0*	15	-	0	1.5	3.0
U8	200	67	4 (60)	-	-	-
U9	250	84	-	-	-	-
Total	1,280	445	10 (160)	175	6	13.5

* Willow stakes to be planted as feasible within boulder toe interstitial spaces

Table 2-4. Summary of Approximate Material Quantities Lower Erosion Site

Area	Vegetation Sq Ft	Vegetation Number of Stakes	Willow Fascines Number of Each and (LF)	Coir Logs LF
L1	150	50	-	75
L2*	-	-	-	-
L3	40	14	-	25
L4	250	84	-	-
L5	230	77	4 (80 LF)	80
L6	380	127	**26 (195 LF)	105
L7	330	110	7 (115 LF)	-
L8	185	62	-	-
Total	1,565	524	37 (390 LF)	285

* L2 is a partial removal of a woody debris jam, does not include revegetation

** Willow bundles to be installed perpendicular to slope contour (i.e., vertical bundles)

3 Maintenance, Monitoring, and Reporting

Monitoring and maintenance activities will be performed following installation of the stabilization measures. Objectives of the monitoring and maintenance are to:

1. Evaluate establishment and functionality of stabilization treatments and identify any required maintenance needs beginning the first year after implementation for a period of 5 years thereafter and;
2. Monitor channel treatment sites throughout the term of the license to identify maintenance needs and to ensure they function as intended to provide channel stability.

This Plan addresses monitoring and maintenance actions at the proposed treatment sites, but does not include monitoring of erosion or consider implementation of new stabilization treatments outside of the treatment areas specified in the Plan.

3.1 Maintenance and Monitoring

Monitoring will include evaluation of vegetation conditions within each treatment area to ensure successful plant establishment and inspection of rock/log non-vegetative treatments to evaluate condition and function. Monitoring will be conducted by qualified personnel having experience evaluating channel properties and vegetation conditions.

The following criteria will be used as the basis for determining success of the Project:

- > At least 75 percent vegetation cover within the planted portion of each treatment site at the end of Year 5 monitoring following implementation. Cover will also continue to be monitored every 5 years as part of long-term monitoring (discussed below)
- > Survival of 70 percent of the plantings for each of the first 5 years of monitoring following implementation.
- > Rock and log toe protection revetments retain their structural integrity sufficient to protect the bank
- > Visual inspections do not indicate new erosion at treatment sites
- > Cross-section surveys do not indicate new erosion or instability at treatment sites

3.1.1 Post-Construction 5-Year Monitoring and Maintenance Period

Monitoring

Each year for 5 years following the year of project implementation, the Upper and Lower stabilization areas will be monitored once in the summer season. Monitoring will include photopoints, vegetation survival and cover surveys, cross-section surveys, and structural assessment of rock and/or non-vegetative treatments). Vegetation replacement will occur as soon as conditions are appropriate to harvest willows.

The following monitoring methods will be performed annually and used as the basis for determining successful establishment of vegetative treatments:

1. **Fixed photo-monitoring positions** will be established (following the protocols in Powell, 2006) immediately following project implementation and photos will be taken during each monitoring site visit to show the condition of the vegetation.

2. **Survivability** will be quantified, with dead poles to be replanted as soon as is practicable following the monitoring.
3. **Percent Cover.** The absolute vegetation cover estimate will be performed annually for each of the first 5 monitoring years, and will include any natural recruitment.

Sampling information for vegetation survival and cover will be collected immediately following implementation, using the following approach:

- > Develop belt transects that extend from the upstream to the downstream limits of each treatment area. The endpoints will be permanently marked with headpins or reflectors. The width of the belt transect in each treatment area will vary depending on the width of plantings on the streambanks (2 to 3 feet above the toe of the slope). The widths of the belt transects will remain the same for a given treatment area over time. Vegetation survival and cover in future monitoring events will be calculated by surveying within each belt transect.
- > Create an accounting of the number of willow poles/stakes and number of bundled fascines planted within the belt transects for comparison against the 70% survival rate criteria.
- > Assess survival of willow poles/stakes and bundled fascines and replace as necessary relative to the 70% survival criteria. To determine the survival rate of the plantings, each individual pole/stake within the belt transect will be tallied (the percentage may be reduced if percent cover is achieved through natural recruitment). For the bundled fascines, survival will be assessed by tallying survival of the fascine bundle, not by tallying survival of each individual poles within the bundle.
- > Conduct absolute cover surveys of vegetation treatments. The percent cover of the plantings will be determined within the defined belt transect area.

The following methods will be used as the basis for determining successful installation and function of rock/log or other non-vegetative treatments:

1. Fixed photo-monitoring positions will be established immediately following project implementation and photos will be taken during each annual site inspection, once in each of the 5 years to show and compare the condition of the rock or other non-vegetative treatments.
2. Structural integrity will be assessed each year in the first 5 years following implementation. Field notes on the structural integrity of rock and log treatments will be prepared. Each treatment area should retain its as-built structural integrity sufficient to protect the bank toe section to which it was applied. Displaced rock material that could lead to failure of the stabilization treatment or to bank instability will be repaired.
3. Cross-section surveys. Two permanent monitoring cross-sections will be established immediately following construction in the Upper Erosion Site and surveyed annually for the first 5 years. Two existing long-term cross-sections in the Lower Erosion Site that were established for the Project No. 184 Geomorphology Continuing Evaluation of Representative Channel Areas Monitoring Plan (EID 2011)³ will be annually surveyed for the first 5 years of monitoring. Cross-sections will be compared to the as-built condition. Cross-sections will be re-surveyed after the spring runoff in each of the 5 post-implementation monitoring years and compared.

In Year 5 of the monitoring effort, the success of vegetative treatments and rock or other non-vegetative treatments will be evaluated to determine if establishment criteria and stability objectives have been

³ This monitoring program was established in response to the requirements of USFS 4(e) Condition 37 and SWRCB Condition 13.h, Geomorphology. The monitoring provides information on channel stability based on long-term repeat cross-section surveys conducted every 5 years.

achieved. If the vegetative and rock stabilization treatment objectives are not achieved EID will consult with the FS, SWRCB, and ERC to evaluate if additional stabilization measures are necessary.

Maintenance

The purpose of maintenance is to help ensure the overall quantity and quality of survival of the plantings and the structural integrity of rock-and-log revetments to achieve the success criteria.

Maintenance will be accomplished by periodically (see Section 3.1.3 for schedule of monitoring and maintenance) inspecting the plantings until success criteria are met, including:

- > Installed vegetation for water stress, insect and/or disease infestations, damage by high flows, herbivory, damage by recreationists, competition from invasive weeds, and other conditions that could impact survival
- > Need for irrigation or plant protections (e.g., wire cages)
- > Need for removal of invasive weeds
- > Need to re-position any displaced rocks and/or logs, or to add new rock material

The vegetation maintenance will focus on plant survival under the success criteria are met. Vegetation that is not in acceptable growing condition during the first 5 years after construction will be noted, removed, and replaced with material of the same species and size as originally specified when conditions are suitable for re-planting.

Vegetative treatments may require irrigation during the summer months to ensure satisfactory survival and plant establishment. Several potential methods may be utilized to provide irrigation to the Upper and Lower Erosion Sites. These methods include, but are not limited to: 1) make short duration, low magnitude releases from the spillway to convey water down the channel, 2) install a temporary siphon over the auxiliary dam and/or through a spillway flashboard to convey water down the channel after the lake level goes below the spillway crest, and/or 3) utilize portable pumps that can convey water from pools and/or backwatered areas in the spillway channel to a garden hose to allow for hand-watering. All irrigation equipment will be removed in the fall to prevent potential for washout during the following spring runoff.

If herbivory by deer or other animals is resulting in plant mortality such that success criteria may not be achieved, EID will install plant protections as soon as practicable.

EID will consult with the FS, SWRCB, and ERC on remedial actions to address low plant survival beyond the typical required maintenance. If willow establishment perpetually fails at certain locations in the spillway channel, EID will consult with the agencies and ERC to determine appropriate actions to stabilize the locations using other methods, including non-vegetative methods.

3.1.2 Long-Term Maintenance and Monitoring

If spillway releases exceeds 60 cfs in any year following 5 years after project implementation, EID will perform monitoring (i.e., photo monitoring, vegetation cover surveys and structural assessment of rock and/or non-vegetative treatments) and conduct cross-section surveys to document potential changes in bank and treatment stability. In the event of damage to the stabilization treatments as a result of project operations, EID will make necessary repairs to the stabilization treatments.

Additionally, for long-term monitoring EID will evaluate the success of spillway stabilization measures in conjunction with the data provided from the ongoing geomorphic monitoring of representative channel areas, which is required as part of the USFS 4(e) Condition 37 and SWRCB Condition 13.h, Geomorphology Continuing Evaluation of Representative Channel Areas (EID 2011). The cross-sections surveyed for the first 5 years following project implementation will continue to be surveyed once every 5 years thereafter over the life of the license period in order to assess channel stability at that treatment

site. Vegetative cover will also be evaluated concurrent with the monitoring performed under the Geomorphology Continuing Evaluation of Representative Channel Areas monitoring that is conducted every 5 years. If monitoring identifies significant levels of erosion (e.g., geotechnical failures or erosion rates comparable to current conditions) despite achieving vegetation success criteria, EID shall consult with the agencies and ERC on actions to reduce erosion or redefine vegetation success criteria.

3.1.3 Monitoring and Maintenance Schedule

The most intensive maintenance period will occur over a 2-year period immediately after the restoration work is completed to quickly identify potential areas within the treatments sites that may require additional actions due to plant losses. Monitoring will occur once per year through Year 5 (or until success criteria are met), and then every 5 years for the duration of the license.

Monitoring

- > Immediately after planting/construction, baseline monitoring to establish as-built conditions
- > Years 1 to 5 (or until success criteria are met), once per year (summer)
- > Remainder of license term: (a) Every 5 years concurrent with the Geomorphology Continuing Evaluation of Representative Channel Areas (b) anytime flow exceeds 60 cfs in the spill channel

Maintenance

- > Year 1 after planting: Once per month between May and October, weather permitting.
- > Year 2 after planting: Three times between May and October unless more frequent maintenance is required to identify and address potential issues.
- > Years 3, 4, and 5: Twice, between May and October, unless more frequent maintenance is required to identify and address potential issues.
- > After Year 5: Anytime the long-term monitoring indicates bank erosion, instability, or failure of stabilization treatments.

3.2 Reporting

A Caples Spillway Channel Sensitive Site Stabilization Report summarizing the implementation of the stabilization treatments (including before-and-after photographs) and results of the first six-month monthly monitoring and maintenance (Year 1) will be prepared by EID and included in the annual report to the USDA-FS, State Water Board, and the Project 184 ERC (due by June 30 each year). The final report will be filed by EID with FERC. EID will prepare a Progress Report Memo following the fall monitoring and maintenance periods in Years 2 through 4 that will be included in the annual ERC report to update the committee on the functionality of rock toe treatments and survival and growth of the vegetative stabilization treatments. The memo will include photographs, descriptive notes, and summarize any rock maintenance or re-planting. Based on the findings during the maintenance periods, EID and the ERC may call a meeting to discuss any needed modifications to the stabilization treatments. In Year 5, EID will prepare a Year 5 Caples Spillway Channel Stabilization Report that will be included in the annual ERC report. This report will summarize the results of the previous Years 1 through Year 5 maintenance periods.

El Dorado Irrigation District (EID) will implement the stabilization treatments specified in this Plan within 1 year after the approval of the Plan by the USDA-FS, State Water Board, and CDFW. The preferred timing of the planting treatments is in spring/early summer when the sites are accessible after spring thaw but before the willow buds start to break. Preferred timing for rock toe treatments is after runoff has ceased in the spillway, mid-summer to fall. EID will conduct maintenance at the stabilization treatment areas in Years 1 through Year 5 after implementation. The anticipated schedule for completing the components of the Plan are provided in Table 3-1.

Table 3-1. Schedule for Caples Lake Spillway Stabilization Implementation and Monitoring

Action	Year	Timing
Select design flow alternative and develop final Stabilization Plan	2017	Select design flow alternative – spring 2017 Develop final Stabilization Plan – fall 2017
Environmental review and permitting	2017–2018	
Implementation of Stabilization Treatments	2018	Spring or fall; establish photo-monitoring positions, collect baseline monitoring information, and survey cross-sections
Monitoring and Maintenance First 5 Years	2018 or 2019 – 2023 or 2024	Following project implementation, the treatment areas will be visited as needed during the growing season to water vegetation. Monitoring (i.e., photo monitoring, vegetation survival and cover surveys, and structural assessment of rock and/or non-vegetative treatments) will be conducted one time per year during the summer. Vegetation replacement will occur as soon as conditions are appropriate to harvest willows.
Monitoring and Maintenance After 5 Years Following Implementation	After 2023 or 2024	Any year beginning 5 years after project implementation in which flows exceed 60 cfs spill and/or at 5-year intervals concurrent with Geomorphology monitoring.
Annual Reports	2018 or 2019 – 2023 or 2024	A Monitoring & Maintenance Report will be prepared each year and distributed 2 weeks prior to Annual ERC Meeting. The report will be incorporated in Project No. 184 Adaptive Management Program Annual Report
Geomorphology Continuing Evaluation of Representative Channel Areas Report	2021, 2026, 2031, 2036, 2041, 2046, or anytime flows exceed 60 cfs	Survey two cross-sections each in Upper and Lower treatment areas and monitor vegetation cover. Results provided in Geomorphology Continuing Evaluation of Representative Channel Areas report and incorporated in Annual ERC Report

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4 References

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- EID. 2011. *Project No. 184 Geomorphology Continuing Evaluation of Representative Channel Areas Monitoring Plan*. Prepared by ENTRIX. June. <http://www.eid.org/home/showdocument?id=1138>.
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- Powell, David C., editor. 2006. Recording the changes: field guide to establishing and maintaining permanent camera point systems. Technical Publication FS-14-SO-09-06. Pendleton, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Region, Umatilla National Forest. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev7_015665.pdf
- State Water Resources Control Board (SWRCB). 2014. Response to Request for Comments on the Caples Spillway Channel Stabilization Plan for the El Dorado Hydroelectric Project, FERC No. 184. Letter from Mr. Michael Maher to Mr. Brian Deason. August 13.
- USDA Forest Service. 2014. Comments on Caples Spillway Channel Stabilization Plan El Dorado Project, FERC No. 184. Letter from Mr. Laurence Crabtree to Mr. Brian Deason dated August 15, 2014.

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Caples Spillway Channel
Stabilization Plan
El Dorado Hydroelectric Project
(FERC No. 184)

APPENDIX

A

APPROVAL LETTERS FROM CDFW,
SWRCB, AND USFS

From: [Hatton, Laurie@Wildlife](mailto:Hatton.Laurie@Wildlife)
To: Deason, Brian
Cc: McLean, Laura@Wildlife
Subject: CDFW comments on the Caples Spillway Channel Stabilization Plan
Date: Wednesday, February 01, 2017 5:31:52 PM

Hi Brian,

The following are the California Department of Fish and Wildlife's comments on the Caples Spillway Channel Stabilization Plan:

- 1) The proposed Caples Spillway Channel Stabilization Plan for a 60 cfs design (minimal channel rehabilitation) is acceptable as long as the design is not predicated on amending the FERC license to lower the minimum lake elevation requirements. If in fact the design is dependent upon a change to the FERC license, design approval would be premature.
- 2) The design report should include the basic background information needed to evaluate the appropriateness of the design in context with the license requirements and previous work. Relevant information is scattered throughout various documents put together over the last 16 years.

Let me know if you have any questions.

Laurie A. Hatton
Interim Water Program Supervisor
California Department of Fish and Wildlife
North Central Region
1701 Nimbus Rd, Suite A
Rancho Cordova, Ca 95670
Work: 916-358-2847
Cell: 916-817-0434

State Water Resources Control Board

JUN 13 2017

Mr. Brian Mueller
El Dorado Irrigation District
2890 Mosquito Road
Placerville, CA 95667

Dear Mr. Mueller:

CONDITIONAL APPROVAL OF THE 60 CUBIC FEET PER SECOND STABILIZATION ALTERNATIVE FOR THE CAPLES SPILLWAY STABILIZATION PLAN FOR THE EL DORADO HYDROELECTRIC PROJECT, FEDERAL ENERGY REGULATORY COMMISSION PROJECT NO. 184; EL DORADO, ALPINE, AND AMADOR COUNTIES

Thank you for your letter, dated April 20, 2017, which requests approval of the 60 cubic feet per second (cfs) stabilization alternative for the Caples Spillway Channel Stabilization Plan (Plan). The request letter also responds to previous State Water Resources Control Board (State Water Board) staff comments on the Plan. El Dorado Irrigation District (District) prepared the Plan in compliance with Condition 5 of the water quality certification for the El Dorado Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC) Project No. 184.

Background

On August 14, 2013, the District emailed the draft Plan to State Water Board staff. The draft Plan contained a 60 cfs stabilization design developed to a 10 percent design-level. On August 28, 2013, State Water Board staff received a letter from the District requesting comments on the Plan. On August 8, 2014, State Water Board staff provided comments on the Plan, specifically requesting that the District evaluate shear stress and velocity information for stabilization measures at 60, 120, and 250 cfs. Per the August 8, 2014 letter, following review of the requested analysis, the United States Forest Service (USFS), California Department of Fish and Wildlife (CDFW), and State Water Board are to determine the appropriate flow rate and associated measures required to stabilize the spillway channel.

At the October 13, 2016, Ecological Resources Committee meeting, District staff presented the *Design Alternatives Documentation Report* for the Plan (Alternatives Report) developed to a 30 percent design-level. The Alternatives Report was emailed to State Water Board staff on October 24, 2016. The Alternatives Report presents design alternatives to stabilize the Caples spillway channel (spillway channel) at 60, 120, and 250 cfs. The 60 cfs stabilization alternative uses willow stakes and willow fascines to stabilize the spillway channel. Minimal construction (e.g., hand tools) would be needed to implement the 60 cfs stabilization alternative. The 120 cfs and 250 cfs stabilization alternatives use willow stakes, willow fascine, and rock toe treatments

to stabilize the spillway channel. Significant construction (e.g., excavator) would be needed to install the rock toe treatments for the 120 cfs and 250 cfs stabilization alternatives.

In a letter dated November 30, 2016, the District requested comments on the Alternatives Report. State Water Board staff provided comments on the Alternatives Report on February 14, 2017. In a letter, dated April 20, 2017, the District responded to State Water Board staff comments and requested approval of the 60 cfs stabilization alternative.

The District requests approval of the 60 cfs stabilization alternative for the following reasons:

1. The 60 cfs stabilization alternative reduces erosion not only at 60 cfs, but also at higher flows in the event an unanticipated release of 120 cfs or 250 cfs occurs. The 60 cfs stabilization alternative is estimated to reduce erosion (compared to current conditions without stabilization) as follows:
 - 60 cfs flows result in 50 to 80 percent reduction in erosion;
 - 120 cfs flows result in 24 to 79 percent reduction in erosion; and
 - 250 cfs flows result in 34 to 92 percent reduction in erosion;
2. Stabilization work can be completed by hand crews with less ground disturbance and no tree removal as compared the 120 cfs and 250 cfs stabilization alternatives;
3. The vegetation-only treatment blends well with the existing environment;
4. Vegetative techniques provide self-sustaining stabilization once vegetation is established;
5. Straightforward environmental review and permitting processes; and
6. Lowest construction cost of the three stabilization alternatives evaluated (60, 120, and 250 cfs).

Determination

State Water Board staff reviewed the Alternatives Report and the District's responses to State Water Board staff comments regarding the Alternatives Report. State Water Board staff evaluated the 60 cfs, 120 cfs, and 250 cfs stabilization alternatives. Although the 120 cfs and 250 cfs stabilization alternatives are more effective than the 60 cfs stabilization alternative at reducing erosion, State Water Board staff supports the District's recommendation to pursue the 60 cfs stabilization alternative when considering the frequency and magnitude of historic spillway channel flows¹, erosion reduction, level of construction disturbance, and blending with the natural environment.

State Water Board staff concludes that the District's recommended 60 cfs stabilization alternative is appropriate, provided that the District implements the following conditions:

¹ During normal operations, the District infrequently releases short duration and small magnitude flows down the Caples spillway channel to remove debris at the Caples Lake Auxiliary Dam. Since implementation of the El Dorado Relicensing Settlement Agreement on April 30, 2003, the Caples spillway channel has experienced 10 years with no spills, three years with spills less than 60 cfs (including one year in which a spill was induced for geomorphology investigation), and one year with a spill greater than 60 cfs.

Condition 1:

In a letter dated April 20, 2017, the District defines vegetation success criteria as 70 percent survival rate and 50 percent cover. The District proposes to monitor vegetation success criteria each year for the first five years after stabilization implementation and, thereafter, in the event of spills greater than or equal to 60 cfs that result from Project operations.

If vegetation success criteria are met in the fifth year after implementation of the stabilization alternative, the District shall continue to monitor vegetation success criteria simultaneously with geomorphology monitoring, which occurs every five years, and replant vegetation as necessary to meet the vegetation success criteria or other criteria approved by the Deputy Director as part of review of the 100 percent design-level plan (final plan). Supplemental plantings shall be monitored and maintained annually for the first five years after initial planting. The District shall follow the vegetation watering, monitoring, maintenance, and reporting outlined for initial plantings in the Alternatives Report, unless alternative monitoring, maintenance, and reporting are approved by the Deputy Director.

Condition 2:

If willow establishment perpetually fails at certain locations in the spillway channel, the District shall consult with the State Water Board, USFS, and CDFW to determine appropriate actions to stabilize the locations using other methods, including non-vegetative methods.

Condition 3:

If, during the term of the FERC license, monitoring identifies significant levels of erosion (e.g., geotechnical failures or erosion rates comparable to current conditions) despite achieving vegetation success criteria, the District shall consult with the State Water Board, USFS, and CDFW on actions to reduce erosion or redefine vegetation success criteria.

Condition 4:

The Deputy Director reserves the right to require additional bank stabilization if Project operations result in flows greater than or equal to 60 cfs in the spillway channel.

Condition 5:

State Water Board staff identified two locations (Stations 97 and 260) where vegetation permissible shear stress criteria are exceeded. In response, the District proposed non-vegetative treatments to stabilize Stations 97 and 260. Construction of the proposed treatments should be consistent with disturbance associated with the 60 cfs stabilization alternative. The District shall consult with State Water Board staff, USFS, and CDFW to determine appropriate stabilization method(s) at Stations 97 and 260. The District shall include the appropriate methods identified as part of consultation in the final plan that is submitted to the Deputy Director for review and approval.

With implementation of the above conditions, the 60 cfs stabilization alternative is hereby approved. Approving the District's recommendation to stabilize the spillway channel with the 60 cfs stabilization alternative does not imply that in the future: (1) flows greater than 60 cfs will not be required to occur in the spillway channel per Condition 5 of the certification; or (2) additional stabilization measures will not be required.

JUN 13 2017

Future Steps

With this approval, the District shall develop the final plan for the 60 cfs stabilization alternative to a 100 percent design-level, and submit the final plan to the Deputy Director for review and approval. The final plan is subject to modification by the Deputy Director as part of any approval.

If you have questions regarding this letter, please contact Mr. Philip Choy, Project Manager, by phone at: (916) 341-5408 or by email at: Philip.Choy@waterboards.ca.gov. Written correspondence should be directed to:

State Water Resources Control Board
Division of Water Rights - Water Quality Certification Program
Attention: Philip Choy
P.O. Box 2000
Sacramento, CA 95812-2000

Sincerely,



Leslie F. Grober, Deputy Director
Division of Water Rights

cc: Ms. Kimberly D. Bose
Federal Energy Regulatory Commission
888 First Street, NE
Washington, D.C. 20426

Mr. Adam Laputz
Central Valley Regional Water Quality Control Board
11020 Sun Center Drive, Suite 200
Rancho Cordova, CA 95670

Ms. Teresa Fraser
United States Forest Service
4260 Eight Mile Road
Camino, CA 95709

Ms. Laurie Hatton
California Department of Fish and Wildlife
1701 Nimbus Road, Suite A
Rancho Cordova, CA 95670



File Code: 2770
Date: June 14, 2017

Mr. Brian Mueller
Director of Engineering
El Dorado Irrigation District
2890 Mosquito Road
Placerville, CA 95667

Dear Mr. Mueller,

The Eldorado National Forest has received your letter dated April 20, 2017, Caples Spillway Channel Stabilization Plan Response to Comments and Request for Approval of Recommended Alternative. We have reviewed the letter and the Response to Agency Comments Memorandum prepared by Cardno.

The Forest Service has some additional comments listed below.

In the Cardno memo (pg. 6), it states:

Maintenance activities will be implemented in response to bank erosion and stabilization treatment failures associated with project operations (i.e., spillway releases). Maintenance activities would not be implemented in response to bank instability that may be caused by landslides, debris jams, wind-throw of trees, or similar causes which are not related to project operations.

The Forest Service requests that the above statement be removed from the Plan. It is unclear whether the monitoring of events exceeding 60 cfs included in the plan would result in any action being taken. Not maintaining the stabilization treatments would increase the risk of the future project-related effects. Therefore, the above statement should not be included in the plan.

In the Cardno memo (pg. 7), it states:

Cover will be assessed in each of the five monitoring years, with the requirement that at the end of Year 5, absolute vegetation cover within the planted portion of each treatment site is 50 percent or greater. The absolute vegetation cover estimate will include any natural recruitment.

The Forest Service recommends a minimum of 75% cover, which is used by Forest Service Stream Condition Inventory protocols for determining streambank stability, unless a lesser amount can be justified and agreed upon with the Forest Service. We also recommend that following the first five years of monitoring, cover should continue to be assessed concurrent with the Geomorphology Continuing Evaluation of Representative Channel Areas monitoring. If cover requirements are repeatedly not met, the Forest Service may require the development and



implementation of additional stabilization measures and/or additional monitoring.

Post-project monitoring should include field observations noting any substantial changes in streambank stability within the stabilization sites. The Forest Service supports establishment of fixed photo-monitoring sites, but requests inclusion of a rod in the photo points, to provide scale. The Forest Service also requests that the photo-monitoring points be used in conjunction with cross-section surveys to evaluate the effectiveness of the implemented treatments. The Forest Service may require additional stabilization measures be implemented if we determine that erosion appears to be occurring in a manner likely to detrimentally impact aquatic resources below the spillway channel.

After addressing our additional comments presented here, this letter represents USFS approval of EID's recommended design flow alternative utilizing stabilization treatments for the 60 cfs design flow as presented in the Alternatives Analysis and supplemented by the Cardno memorandum. With this approval, we are authorizing EID to proceed to the next step of design and project implementation. However, specific design decisions should be discussed with the Forest Service prior to the development of the final design, to ensure the most appropriate designs are included in the final submission for agency review.

If you have any questions or concerns about the comments, please contact Katy Parr, Forest Public Services Staff Officer at 530-621-5203.

Sincerely,

A handwritten signature in blue ink, appearing to read "Laurence Crabtree". The signature is fluid and cursive, with the first name "Laurence" written in a smaller, more legible script than the last name "Crabtree", which is more stylized and larger.

LAURENCE CRABTREE
Forest Supervisor

Caples Spillway Channel
Stabilization Plan
El Dorado Hydroelectric Project
(FERC No. 184)

APPENDIX

B

DESIGN DRAWINGS

CAPLES LAKE SPILLWAY CHANNEL STABILIZATION

PROJECT NO: 060764
 EL DORADO COUNTY, CA
 DECEMBER 2017

NO.	REVISIONS	DATE

SEAL


 5496 RENO CORPORATE DR
 RENO, NV 89511
 (775) 828-4362

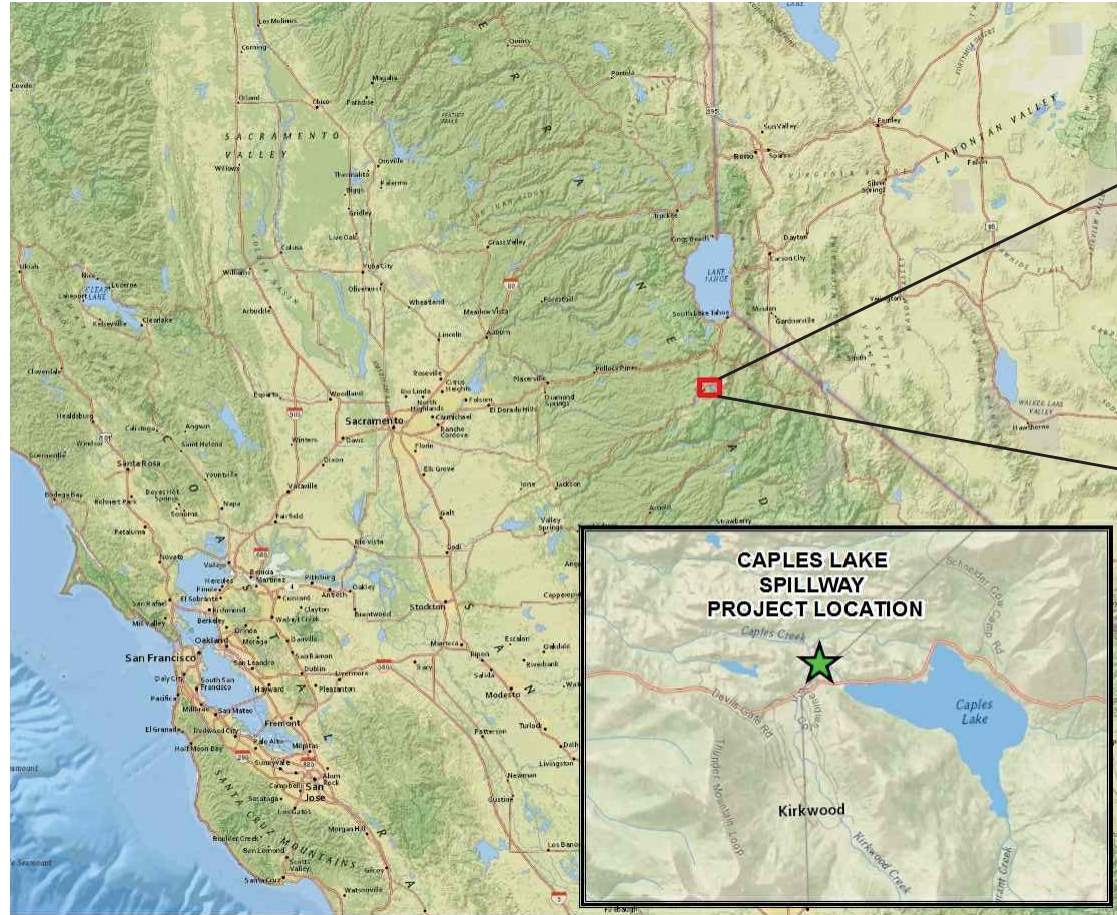


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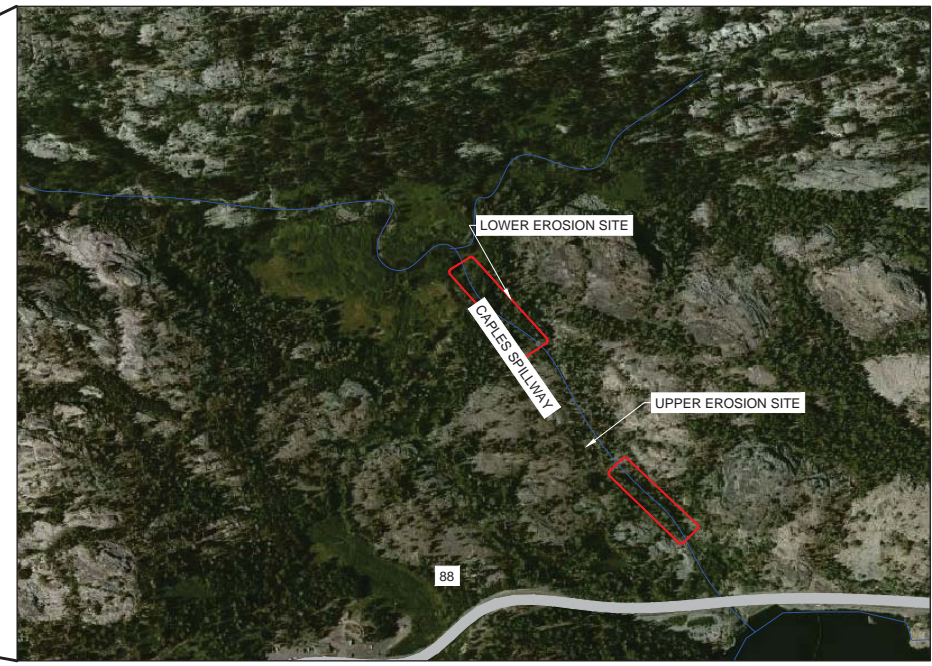
CAPLES LAKE SPILLWAY STABILIZATION

EL DORADO COUNTY, CA

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CHECKED BY:	SP, MG, JC, MK
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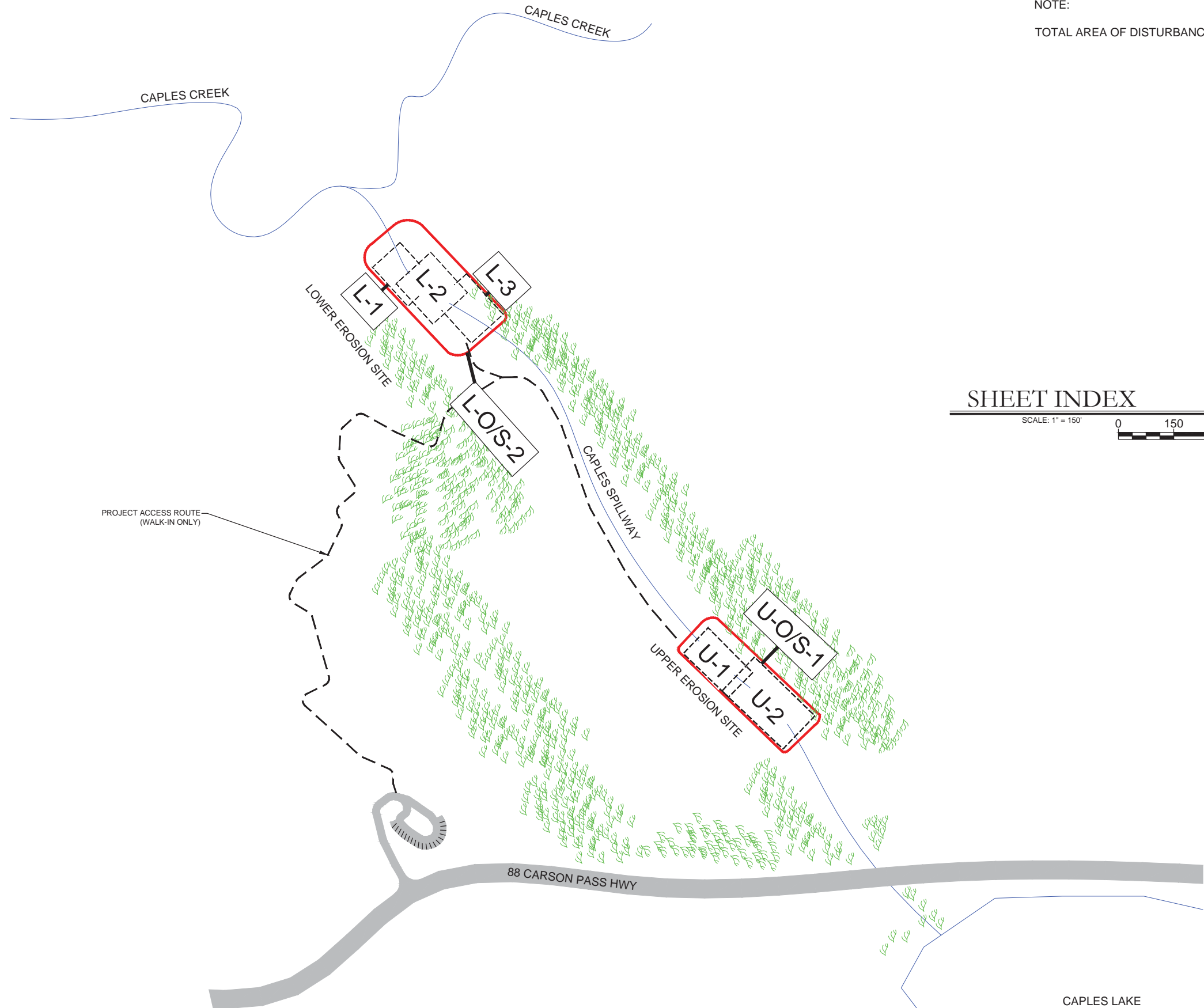
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2	INDEX SHEET
3	OVERALL PROJECT ACCESS PLAN
4	UPPER EROSION SITE- CHANNEL STORAGE PLAN
5	LOWER EROSION SITE- CHANNEL STORAGE PLAN
6	UPPER EROSION SITE- OVERVIEW
7	UPPER EROSION SITE- PLAN SHEET 1
8	UPPER EROSION SITE- PLAN SHEET 2
9	LOWER EROSION SITE- OVERVIEW
10	LOWER EROSION SITE- PLAN SHEET 1
11	LOWER EROSION SITE- PLAN SHEET 2
12	LOWER EROSION SITE- PLAN SHEET 3
13	DETAIL SHEET 1
14	DETAIL SHEET 2
15	DETAIL SHEET 3

LIMITATIONS AND ASSUMPTIONS:

- ALL CONSTRUCTION WORK WILL BE COMPLETED BY CALIFORNIA CONSERVATION CORP OR EL DORADO IRRIGATION DISTRICT STAFF/CREWS.
- ALL WORK WILL BE OBSERVED BY THE EID PROJECT ENGINEER, OR HIS/HER DESIGNEE. NO CHANGES TO THE PLANS ARE ALLOWED WITHOUT THE DIRECT APPROVAL, IN WRITING OF THE EID PROJECT ENGINEER
- THE MAXIMUM DESIGN FLOW, UPON VEGETATION ESTABLISHMENT, IS 60 CUBIC FEET PER SECOND AS DIRECTED BY THE EL DORADO IRRIGATION DISTRICT. DESIGN FLOW IS NOT BASED ON A KNOWN HYDROGRAPH, FLOW FREQUENCY OR ANY OTHER ENGINEERING STANDARD.
- ALL ROCK AND WOOD/LOG SIZES ARE BASED ON THE WEIGHT OF THE ITEM, NOT ON SIZE. ANY CHANGE OF WEIGHT OR SIZE WILL REQUIRE REVIEW AND APPROVAL BY THE EID ENGINEER.

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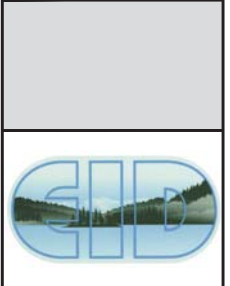
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NO.	REVISIONS	DATE

SEAL

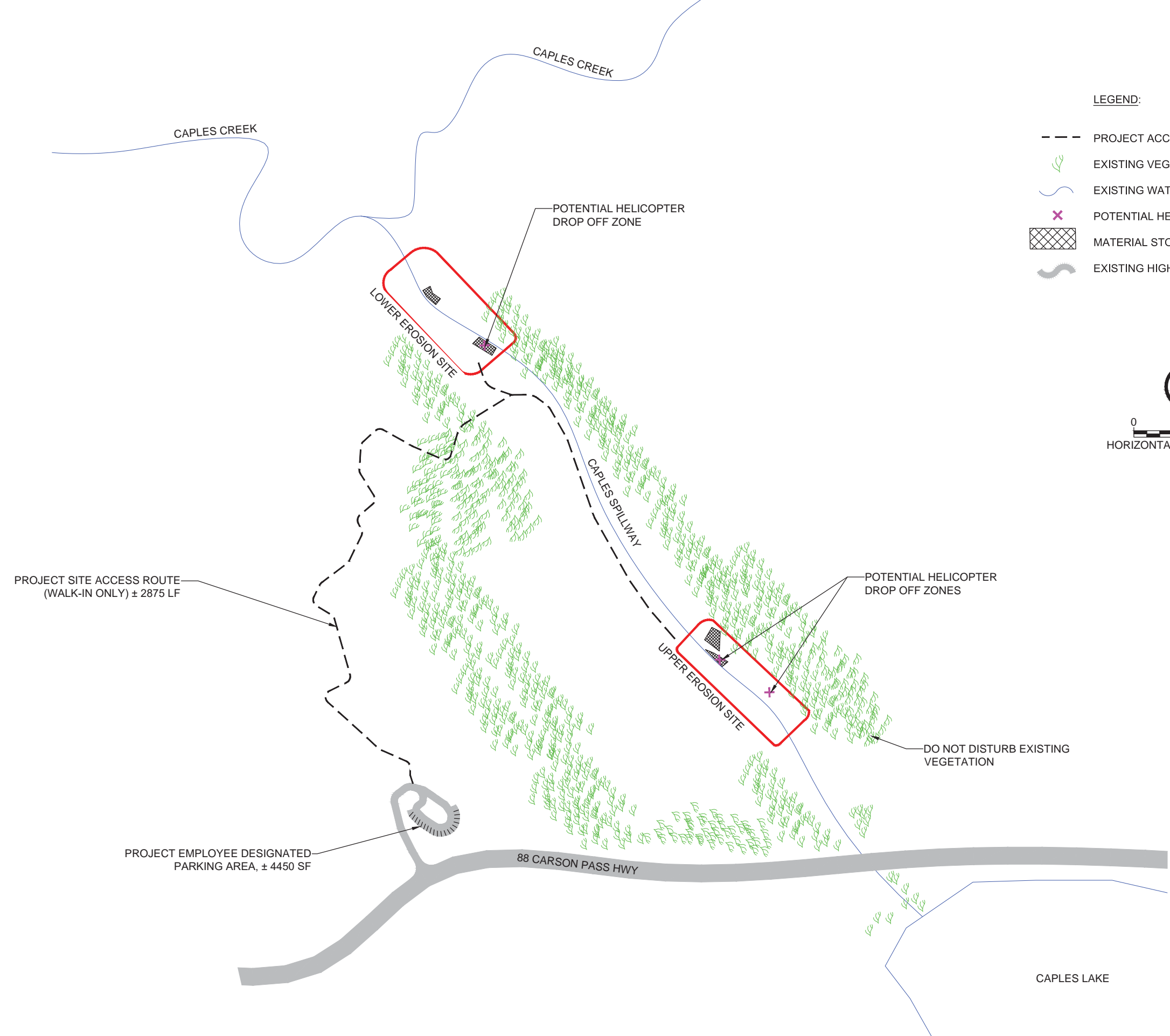
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 RENO, NV 89511
 (775) 828-4362



INDEX SHEET
CAPLES LAKE SPILLWAY STABILIZATION
EL DORADO COUNTY, CA

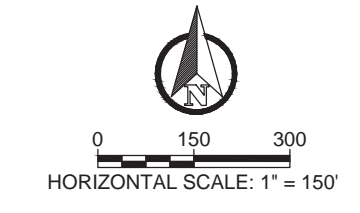
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LEGEND:

- PROJECT ACCESS ROUTE
- EXISTING VEGETATION
- EXISTING WATER LINE
- ✗ POTENTIAL HELICOPTER DROP OFF ZONE
- Material Storage and Loading Area
- EXISTING HIGHWAY



NO.	REVISIONS	DATE

Cardno

5496 RENO CORPORATE DR
RENO, NV 89511
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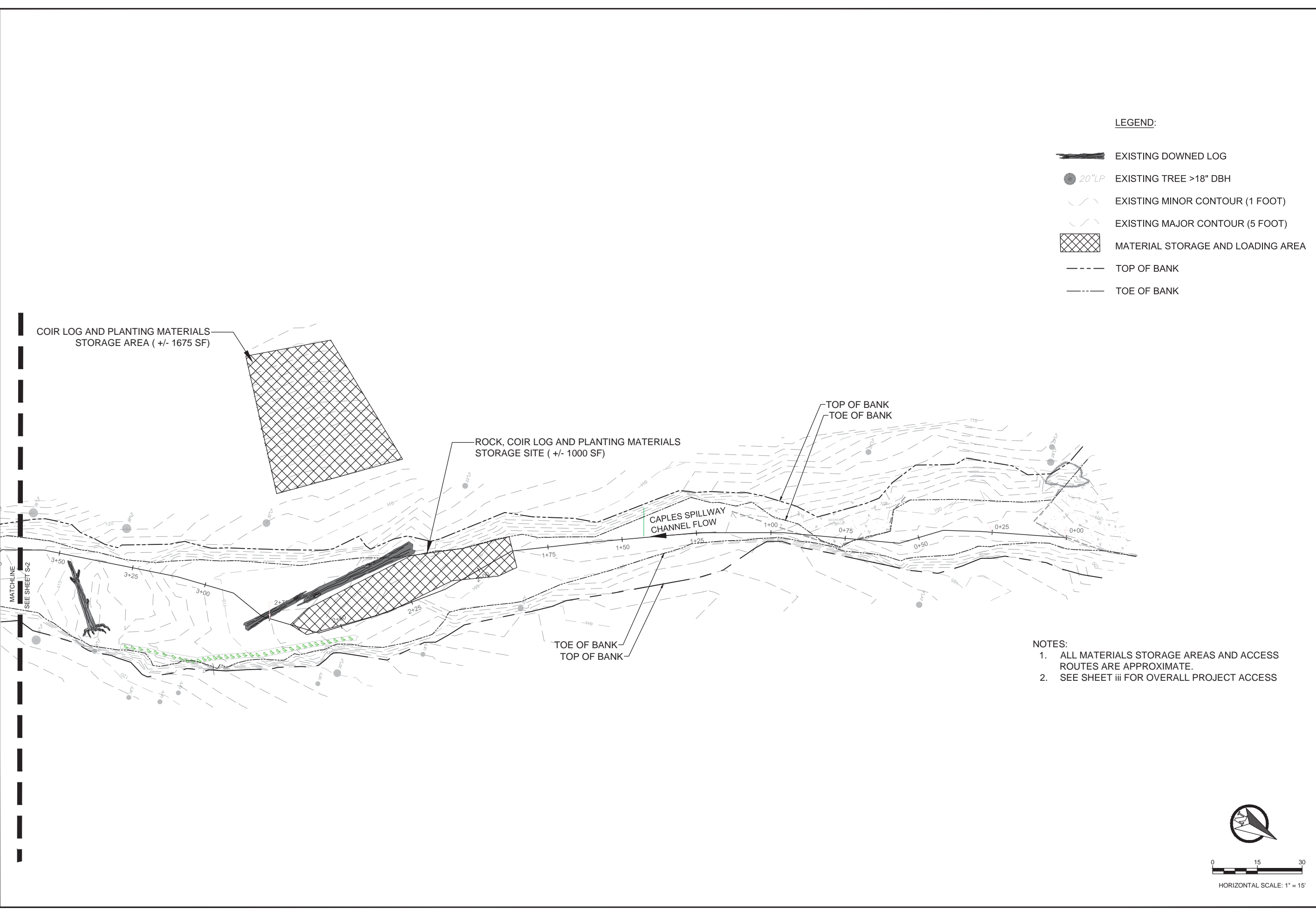
OVERALL PROJECT ACCESS PLAN

CAPLES LAKE SPILLWAY STABILIZATION





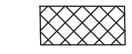
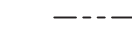

EL DORADO COUNTY, CA

DATE:	12/17
DRAWN BY:	PB, GP
CHECKED BY:	SP, MG, JC, MK
SCALE:	AS SHOWN
CARDNO JOB NO.	E315010900
FIGURE NO.	iii
SHEET	3 OF 15

Plot Date: 12/07/17 2:58PM, Plover 5/18/2018
Plot Title: Upper Erosion Site - Material Staging Plan
Plot Path: \\server\projects\2018\20180727_2_58PM_Plover_5/18/2018



LEGEND:

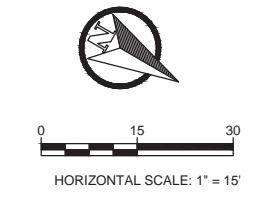
-  EXISTING DOWNED LOG
-  20" LP EXISTING TREE >18" DBH
-  EXISTING MINOR CONTOUR (1 FOOT)
-  EXISTING MAJOR CONTOUR (5 FOOT)
-  MATERIAL STORAGE AND LOADING AREA
-  TOP OF BANK
-  TOE OF BANK

COIR LOG AND PLANTING MATERIALS STORAGE AREA (+/- 1675 SF)

ROCK, COIR LOG AND PLANTING MATERIALS STORAGE SITE (+/- 1000 SF)

CAPLES SPILLWAY CHANNEL FLOW

- NOTES:**
1. ALL MATERIALS STORAGE AREAS AND ACCESS ROUTES ARE APPROXIMATE.
 2. SEE SHEET iii FOR OVERALL PROJECT ACCESS

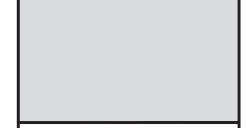


HORIZONTAL SCALE: 1" = 15'

NO.	REVISIONS	DATE

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UPPER EROSION SITE- MATERIAL STAGING PLAN
 CAPLES LAKE SPILLWAY STABILIZATION
 EL DORADO COUNTY, CA

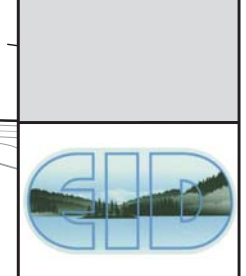
DATE:	12/17
DRAWN BY:	PB, GP
CHECKED BY:	SP, MG, JC, MK
SCALE:	AS SHOWN
CARDNO JOB NO.	E315010900
FIGURE NO.	S-1
SHEET	4 OF 15

DATE	NO.	REVISIONS

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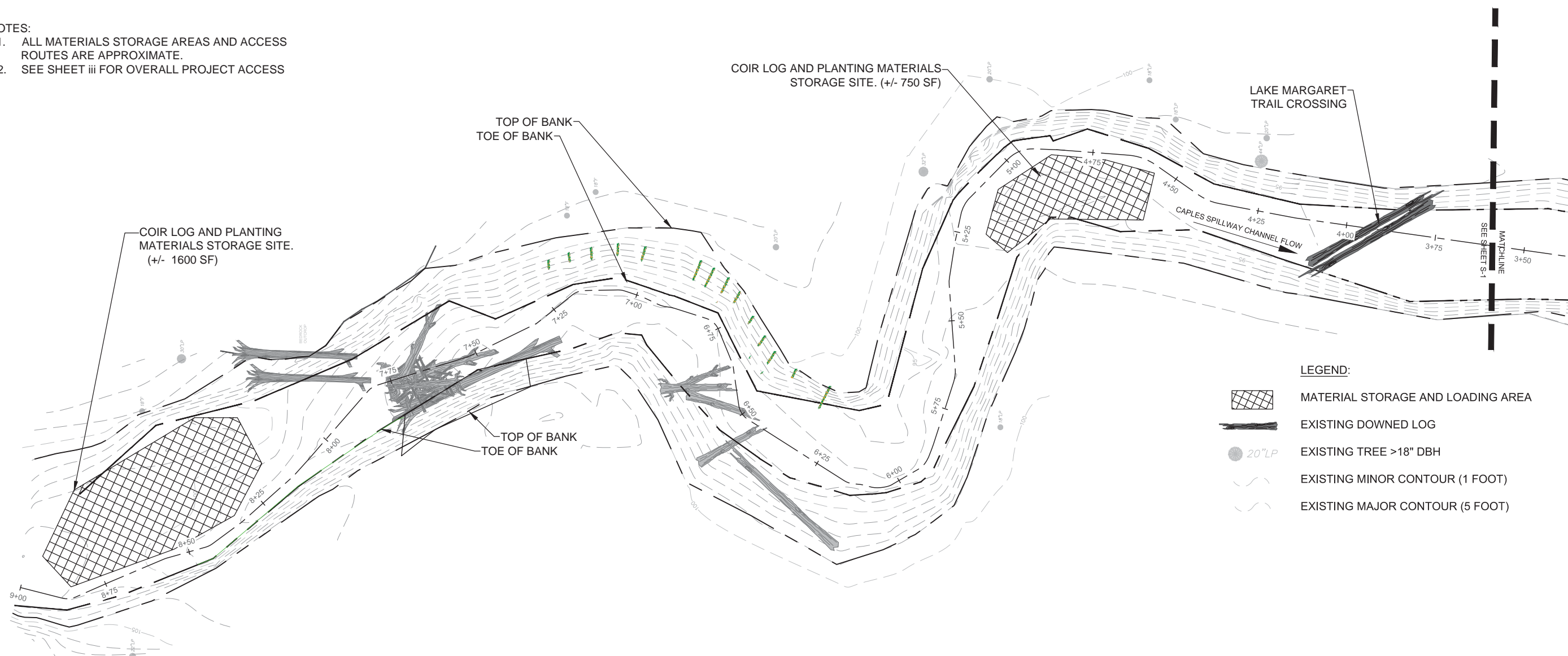
LOWER EROSION SITE- MATERIAL STAGING PLAN

CAPLES LAKE SPILLWAY STABILIZATION

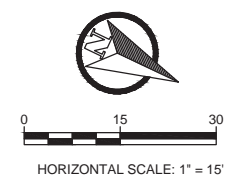
EL DORADO COUNTY, CA

DATE:	12/17
DRAWN BY:	PB, GP
CHECKED BY:	SP, MG, JC, MK
SCALE:	AS SHOWN
CARDNO JOB NO.	E315010900
FIGURE NO.	S-2
SHEET	5 OF 15

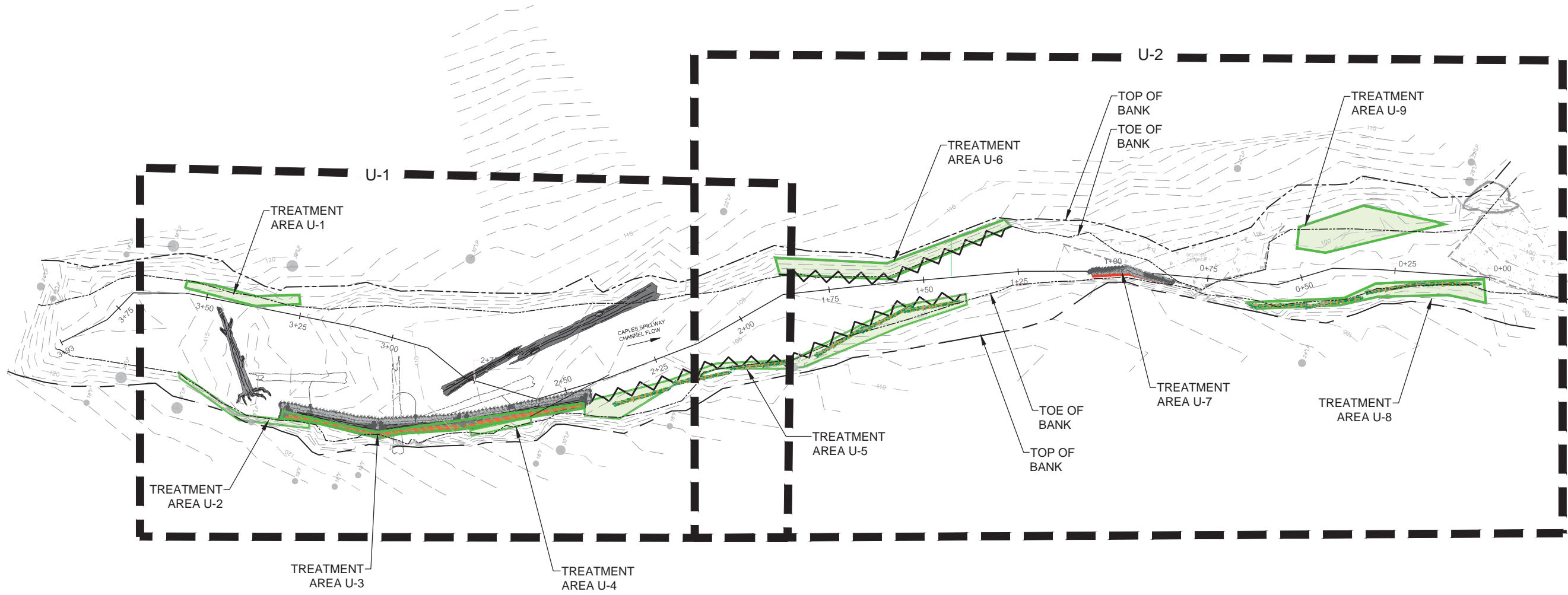
- NOTES:**
1. ALL MATERIALS STORAGE AREAS AND ACCESS ROUTES ARE APPROXIMATE.
 2. SEE SHEET iii FOR OVERALL PROJECT ACCESS



- LEGEND:**
- MATERIAL STORAGE AND LOADING AREA
 - EXISTING DOWNED LOG
 - 20" LP EXISTING TREE >18" DBH
 - EXISTING MINOR CONTOUR (1 FOOT)
 - EXISTING MAJOR CONTOUR (5 FOOT)



RED Stamp: 12/05/17 2:41 PM, Peter Johnson
Title: Upper Erosion Site-Overview



HORIZONTAL SCALE: 1" = 15'

NO.	REVISIONS	DATE

SEAL

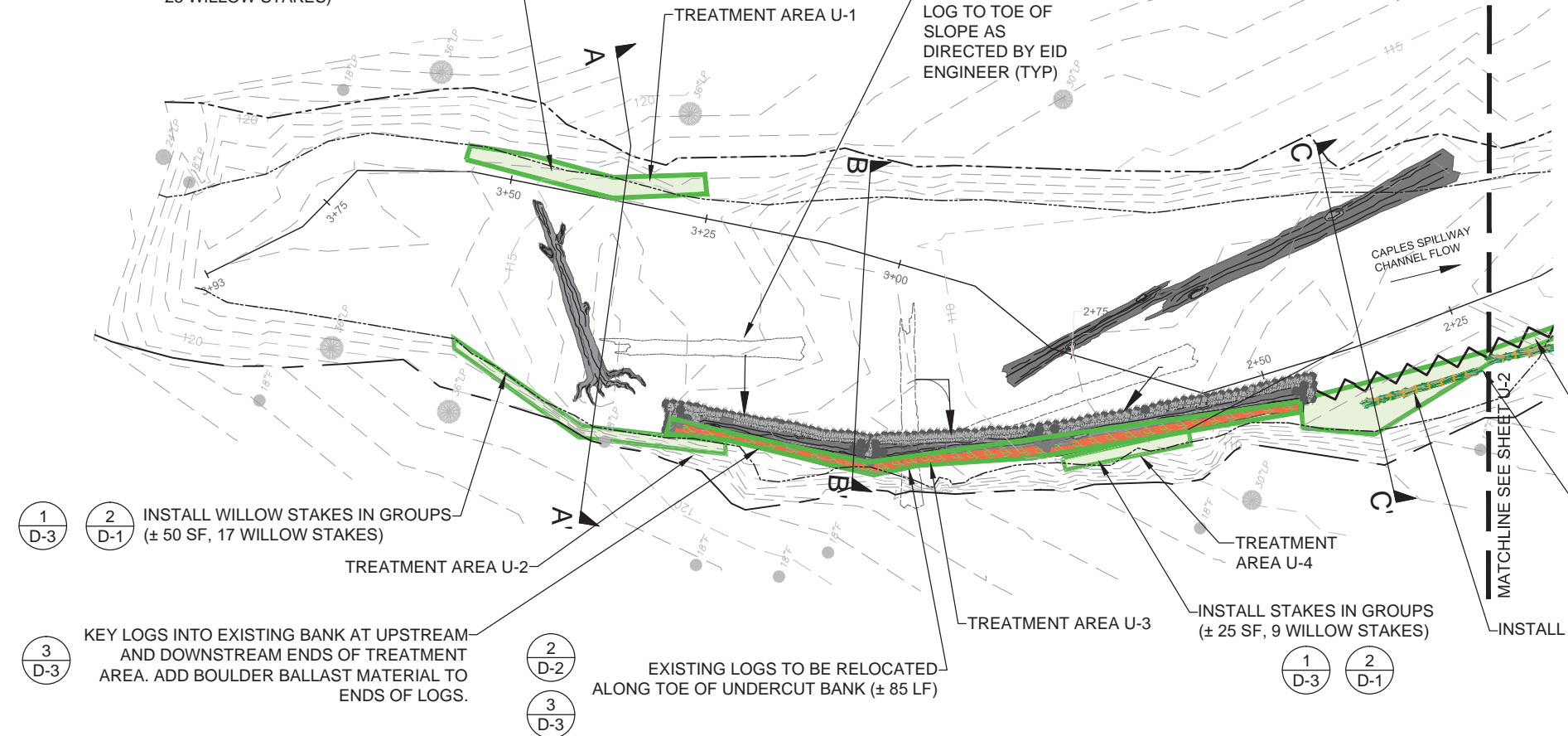

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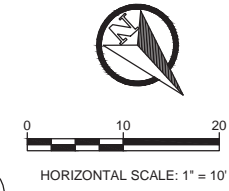
UPPER EROSION SITE- OVERVIEW
CAPLES LAKE SPILLWAY STABILIZATION
EL DORADO COUNTY, CA

DATE: 12/17
DRAWN BY: PB, GP
CHECKED BY: SP, MG, JC, MK
SCALE: AS SHOWN
CARDNO JOB NO. E315010900
FIGURE NO.
U-0
SHEET 6 OF 15

2
D-3 2
D-1
INSTALL WILLOW STAKES SPACED ALONG TOE OF SLOPE INTERMITTENTLY AMONGST EXISTING BOULDERS (± 75 SF, 25 WILLOW STAKES)

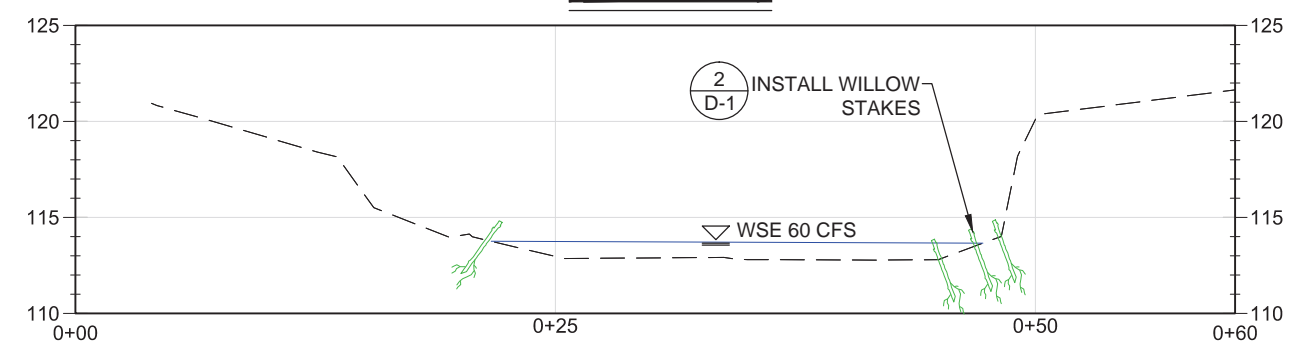


- LEGEND:**
- COIR LOG
 - LIVE STAKE/POLE PLANTING
 - EXISTING DOWNED LOG
 - EXISTING TREE
 - EXISTING MINOR CONTOUR (1 FOOT)
 - EXISTING MAJOR CONTOUR (5 FOOT)
 - WILLOW FASCINE
 - LOG/ROCK TOE REVETMENT
 - BOULDERS AND ROCK

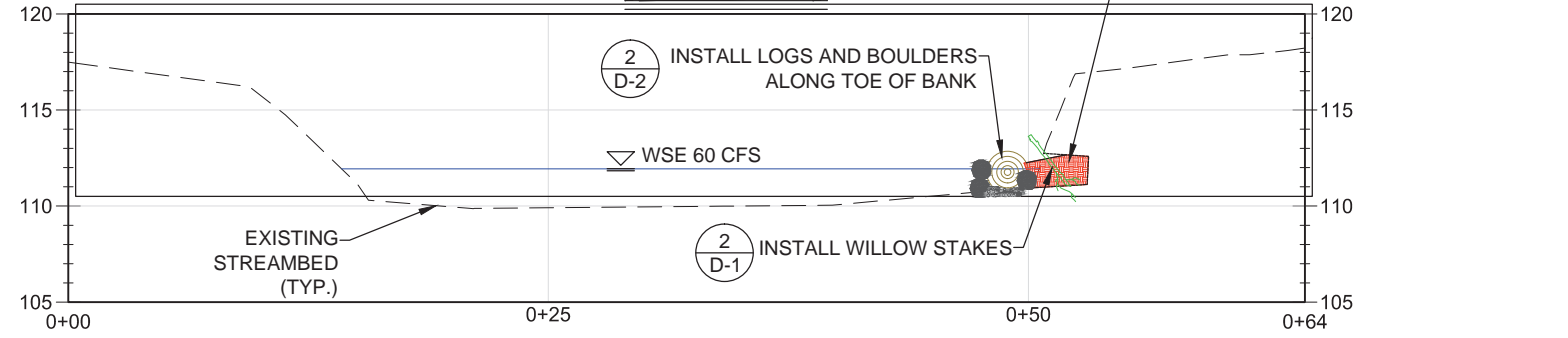


NOTE:
1. NATIVE MATERIAL FOR ALL BACKFILL SHALL BE NATIVE TO THE PROJECT SITE, CONTAIN ORGANIC MATERIAL, NOT BE ROCK, SAND, COBBLE AS TO PROMOTE VEGETATION GROWTH.

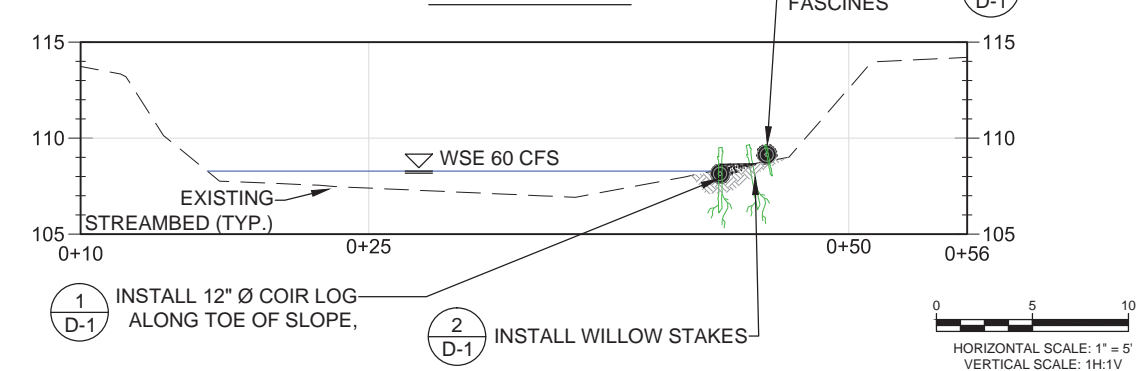
SECTION A-A'



SECTION B-B'



SECTION C-C'



DATE	
REVISIONS	
NO.	

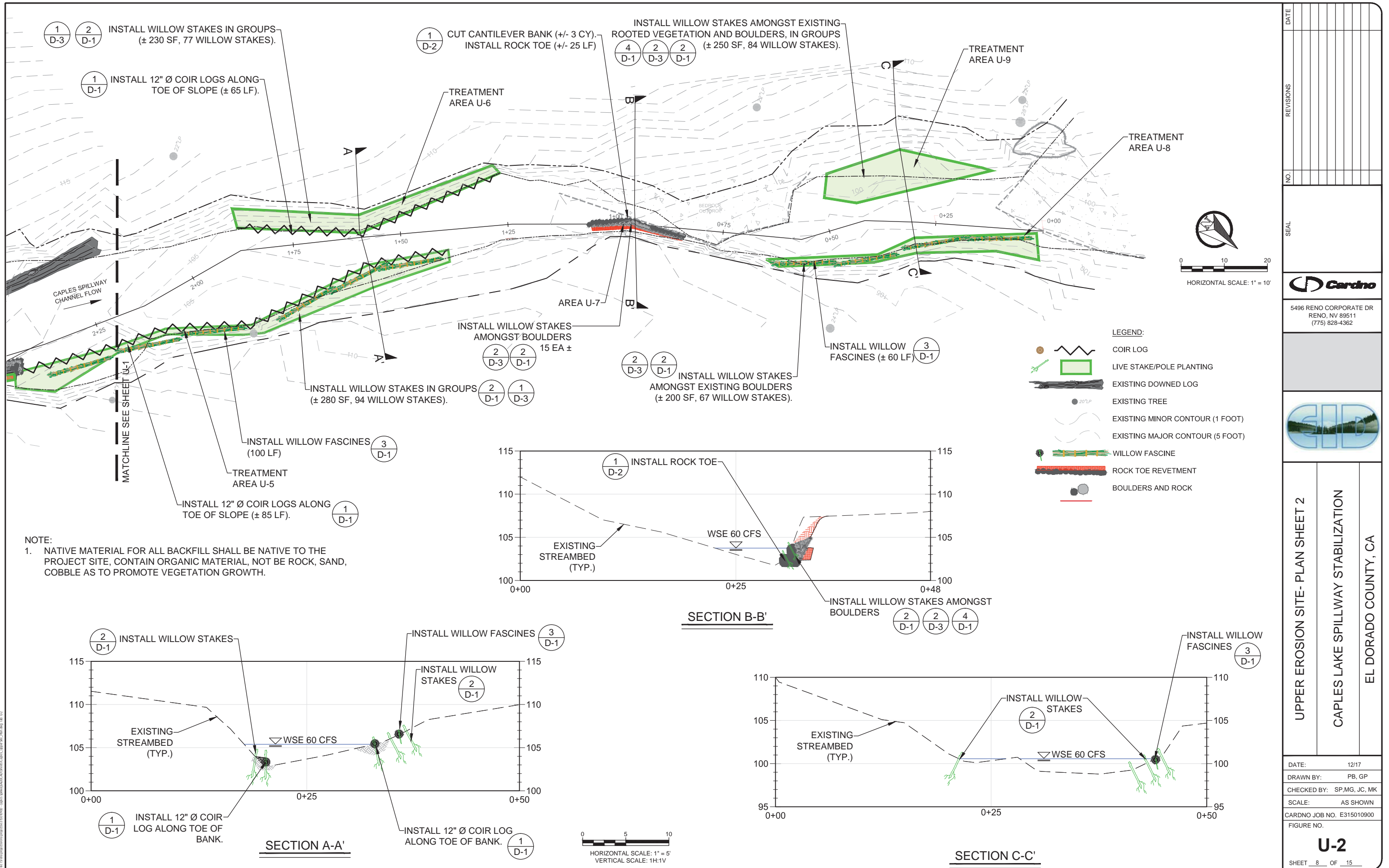
Cardno
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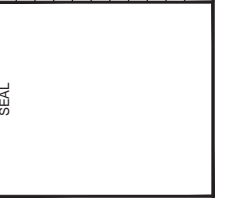
UPPER EROSION SITE- PLAN SHEET 1
CAPLES LAKE SPILLWAY STABILIZATION
EL DORADO COUNTY, CA

DATE:	12/17
DRAWN BY:	PB, GP
CHECKED BY:	SP, MG, JC, MK
SCALE:	AS SHOWN
CARDNO JOB NO.	E315010900
FIGURE NO.	U-1
SHEET	7 OF 15

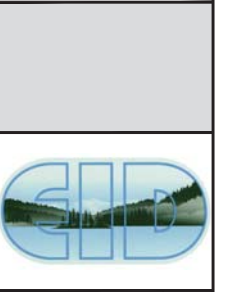
Red Stamp: 12/08/2017 2:41 PM, Project: EROSION CONTROL AT CAPLES LAKE SPILLWAY STABILIZATION, Location: Upper Site, Plan: U-1, Scale: 1/4" = 10'



NO.	REVISIONS	DATE



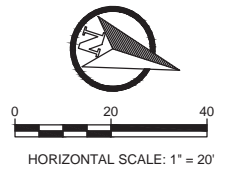
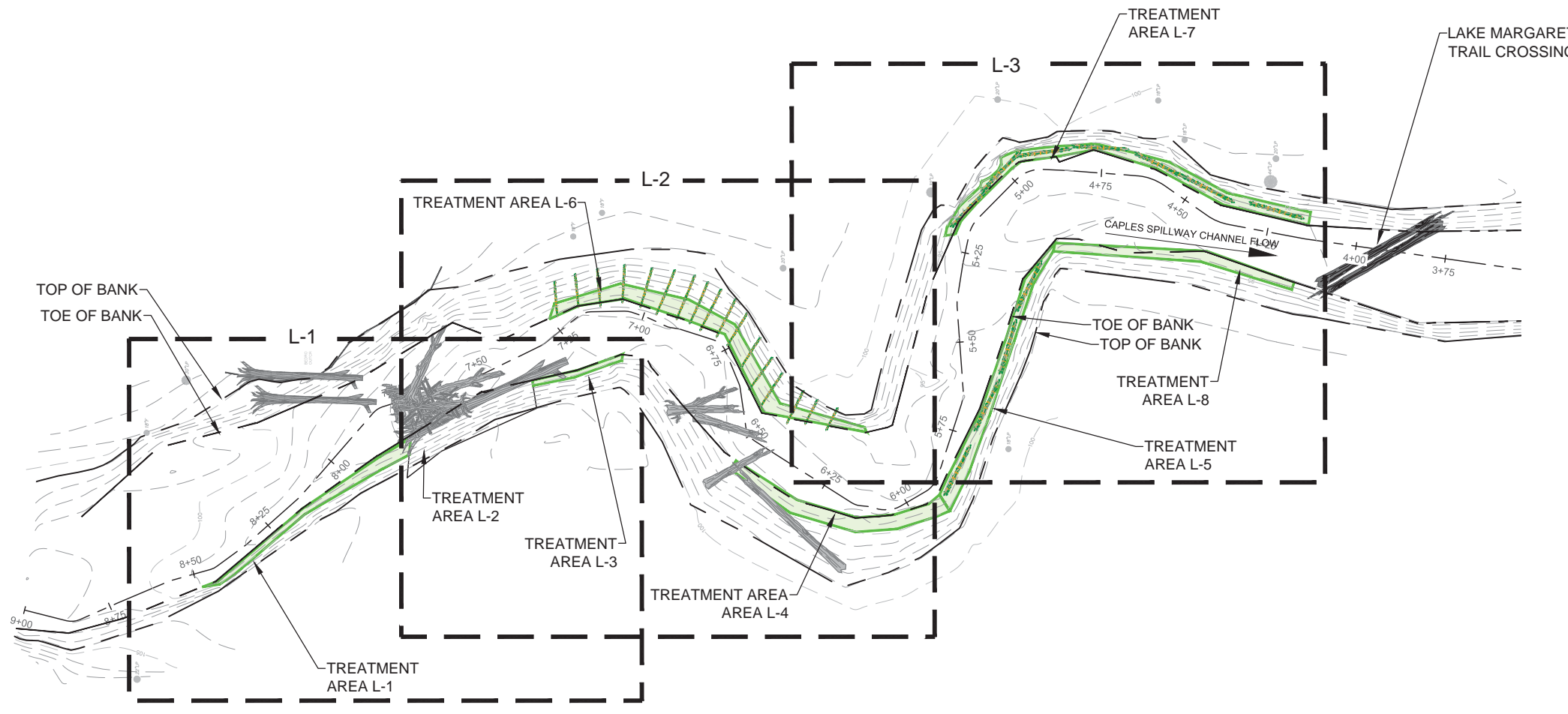
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UPPER EROSION SITE- PLAN SHEET 2
CAPLES LAKE SPILLWAY STABILIZATION
 EL DORADO COUNTY, CA

DATE: 12/17
 DRAWN BY: PB, GP
 CHECKED BY: SP, MG, JC, MK
 SCALE: AS SHOWN
 CARDNO JOB NO. E315010900
 FIGURE NO.

U-2
 SHEET 8 OF 15

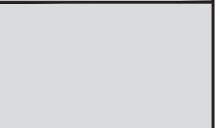


NO.	REVISIONS	DATE

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LOWER EROSION SITE - OVERVIEW
CAPLES LAKE SPILLWAY STABILIZATION
EL DORADO COUNTY, CA

DATE:	12/17
DRAWN BY:	PB, GP
CHECKED BY:	SP, MG, JC, MK
SCALE:	AS SHOWN
CARDNO JOB NO.	E315010900
FIGURE NO.	

L-0
SHEET 9 OF 15

Ref Stamp: 1580797 2-611214 Permit Address: 5496 Reno Corporate Dr, Reno, NV 89511
 Ref Stamp: 1580797 2-611214 Permit Address: 5496 Reno Corporate Dr, Reno, NV 89511

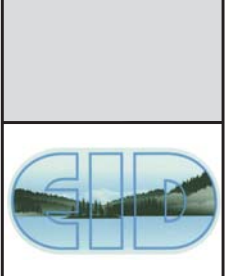
NOTE:

- NATIVE MATERIAL FOR ALL BACKFILL SHALL BE NATIVE TO THE PROJECT SITE, CONTAIN ORGANIC MATERIAL, NOT BE ROCK, SAND, COBBLE AS TO PROMOTE VEGETATION GROWTH.
- LOGS AND DEBRIS TO BE REMOVED SHALL BE "SCATTERED" IN VICINITY. NO DEBRIS SHALL BE PLACED WITHIN THE CHANNEL.

NO.	REVISIONS	DATE

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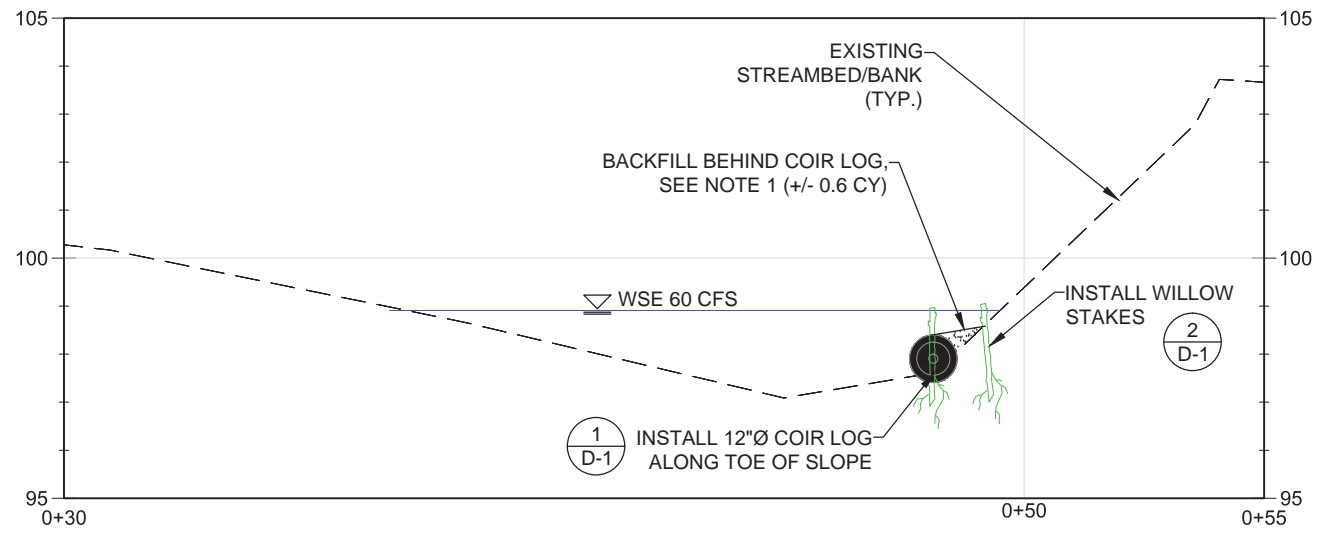
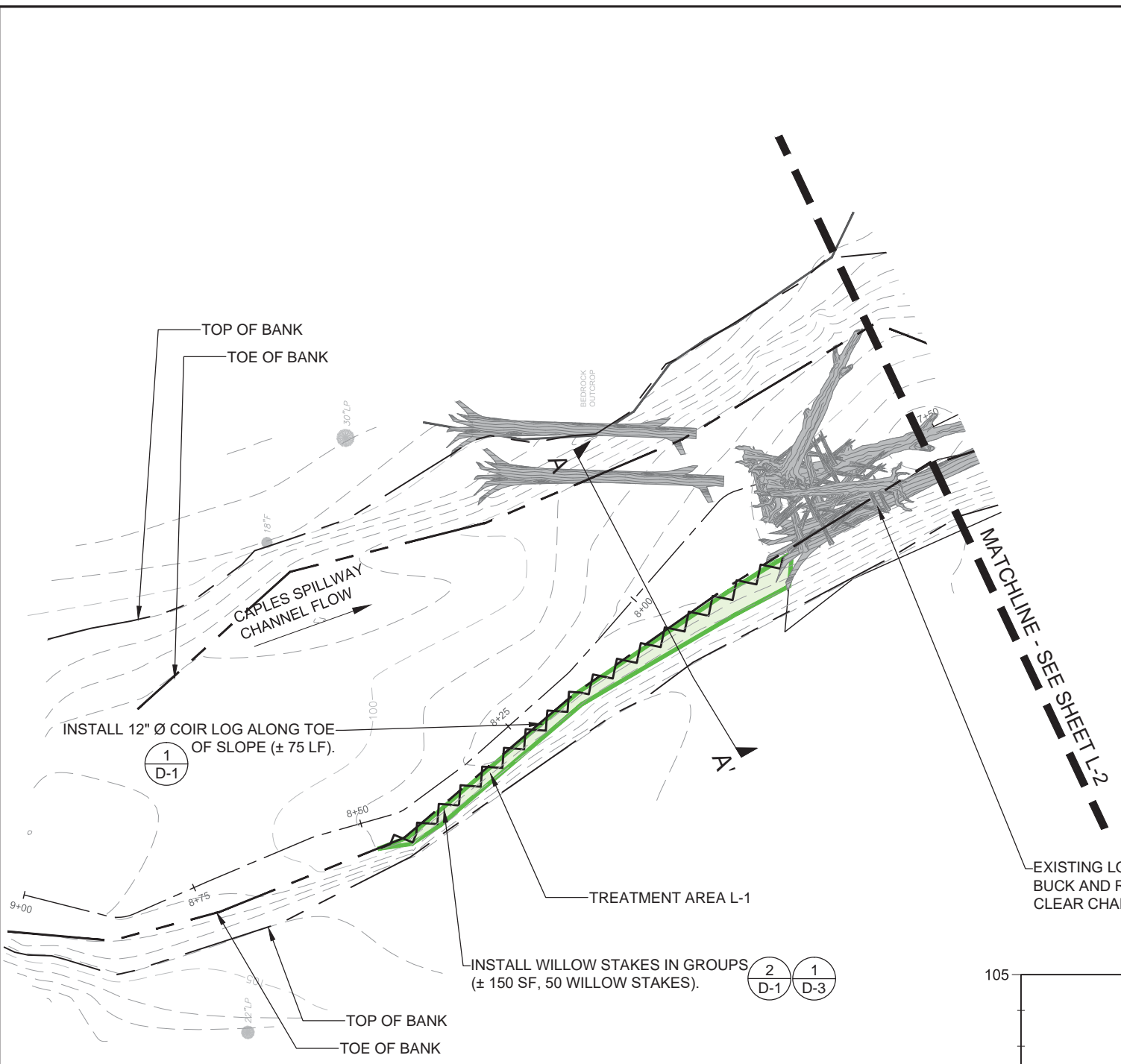
LOWER EROSION SITE- PLAN SHEET 1
 CAPLES LAKE SPILLWAY STABILIZATION
 EL DORADO COUNTY, CA

DATE: 12/17
 DRAWN BY: PB, GP
 CHECKED BY: SP, MG, JC, MK
 SCALE: AS SHOWN
 CARDNO JOB NO. E315010900
 FIGURE NO.

L-1
 SHEET 10 OF 15

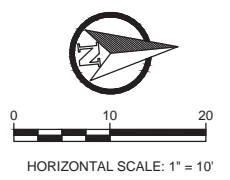
LEGEND:

- COIR LOG
- LIVE STAKE/POLE PLANTING
- EXISTING DOWNED LOG
- EXISTING TREE
- EXISTING MINOR CONTOUR (1 FOOT)
- EXISTING MAJOR CONTOUR (5 FOOT)
- WILLOW FASCINE

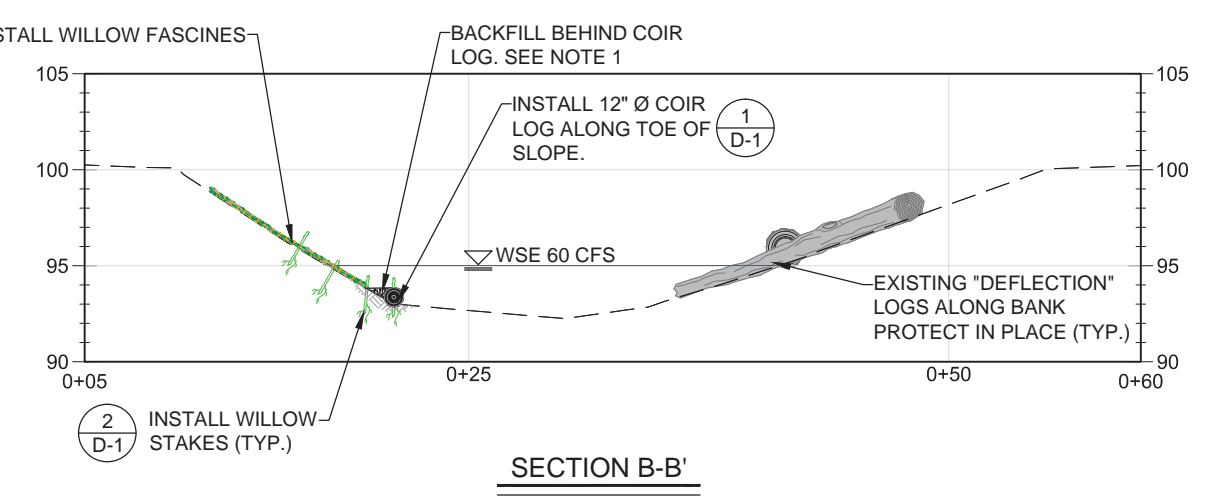
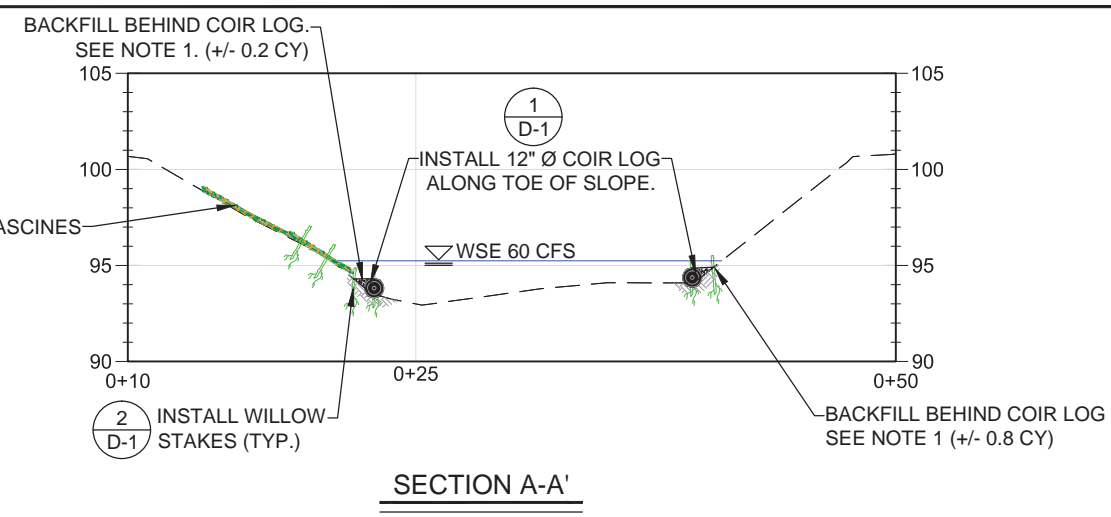
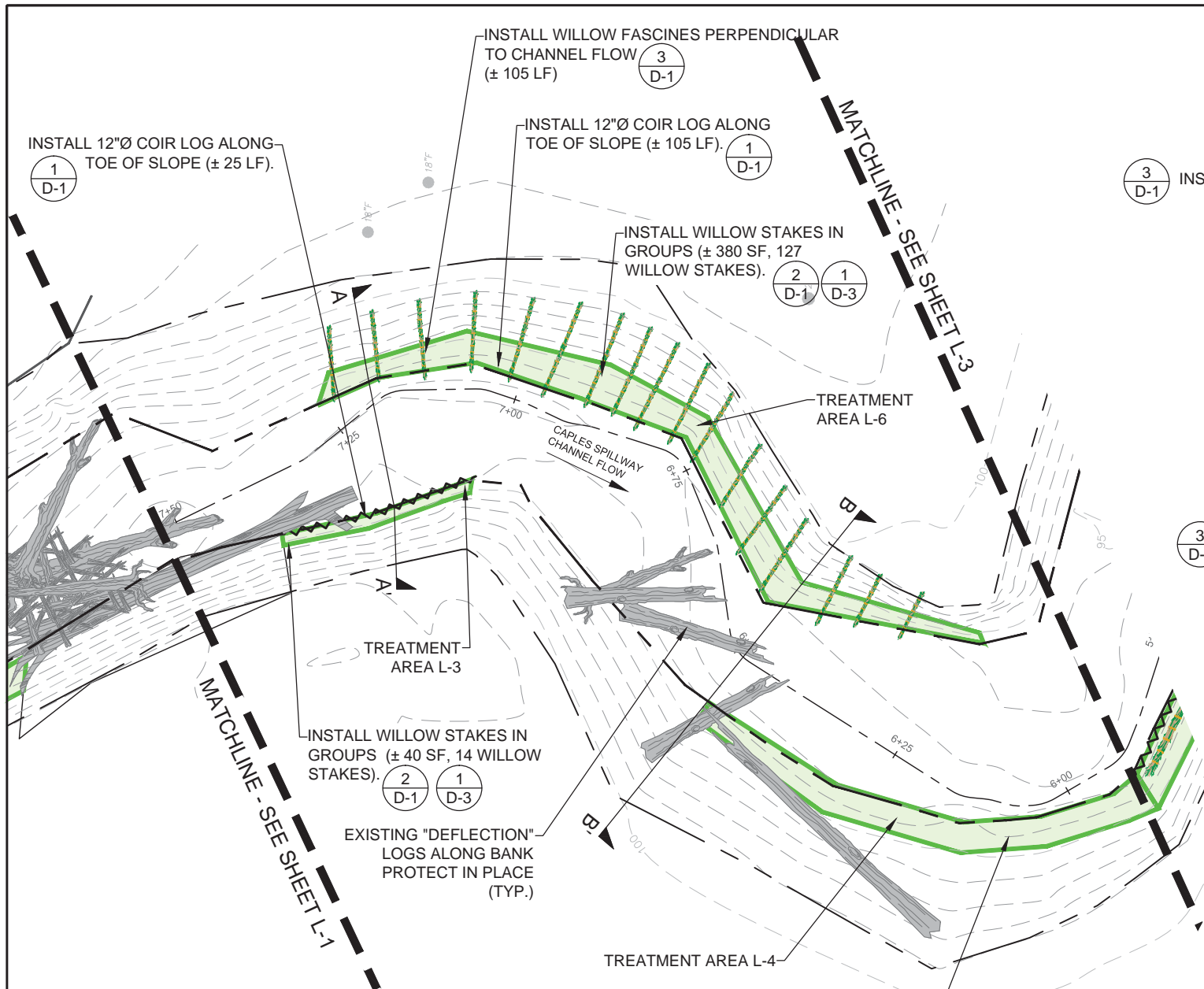


SECTION A-A'

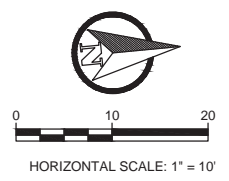
HORIZONTAL SCALE: 1" = 2'
 VERTICAL SCALE: 1H:1V



Red Stamp: 12/08/2017 2:43 PM, P:\proj\2017\12\17\121710900\121710900.dwg, User: pb, Plot Date: 12/17/17, Plot Time: 2:43 PM, Plot Scale: 1:1



- LEGEND:**
- COIR LOG
 - LIVE STAKE/POLE PLANTING
 - EXISTING DOWNED LOG
 - EXISTING TREE
 - EXISTING MINOR CONTOUR (1 FOOT)
 - EXISTING MAJOR CONTOUR (5 FOOT)
 - WILLOW FASCINE

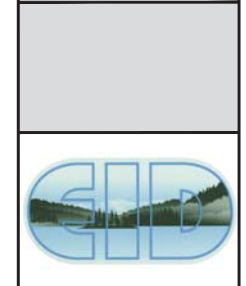


NOTE:
 1. NATIVE MATERIAL FOR ALL BACKFILL SHALL BE NATIVE TO THE PROJECT SITE, CONTAIN ORGANIC MATERIAL, NOT BE ROCK, SAND, COBBLE AS TO PROMOTE VEGETATION GROWTH.

NO.	REVISIONS	DATE

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LOWER EROSION SITE- PLAN SHEET 2

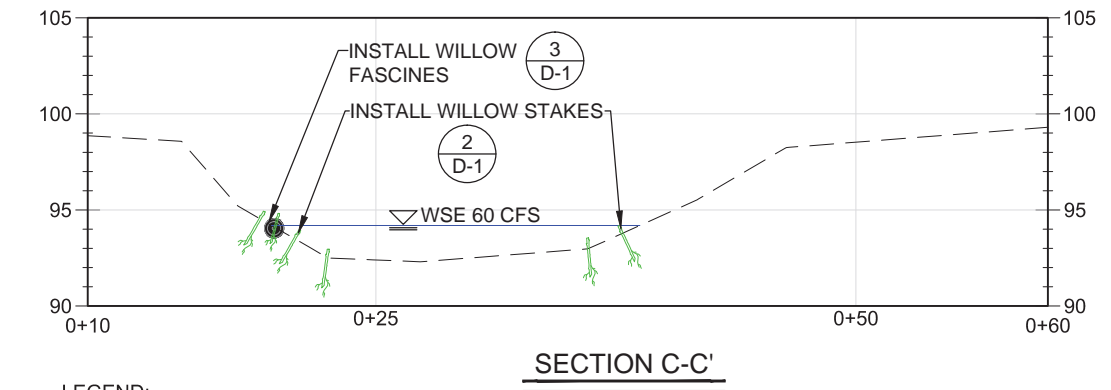
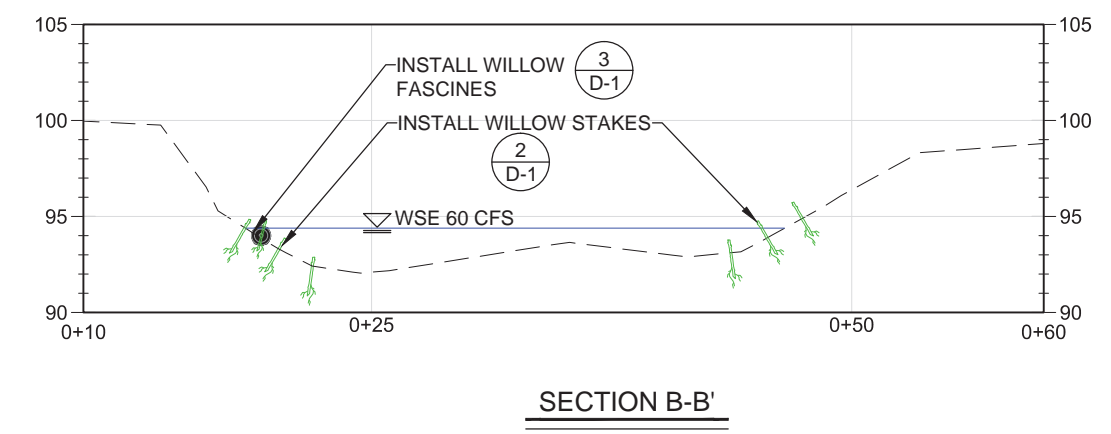
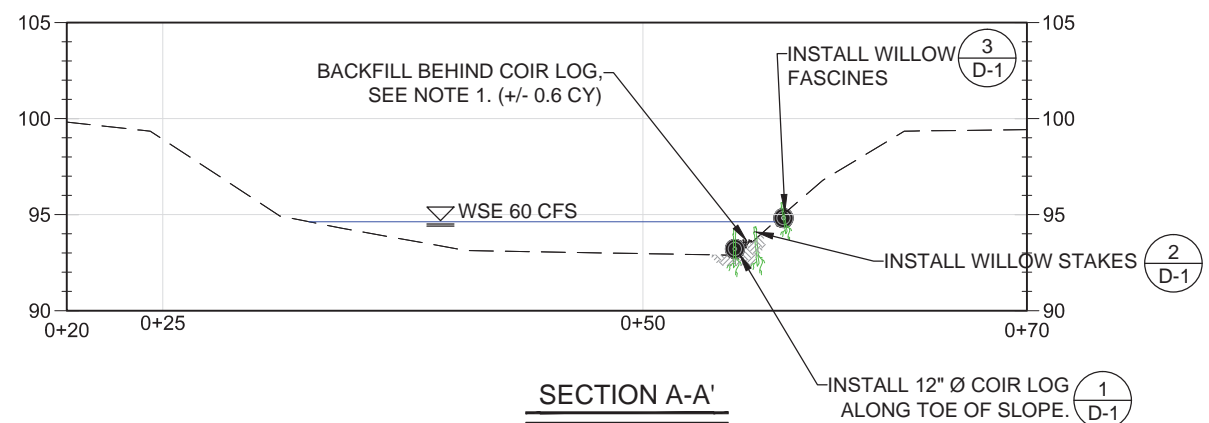
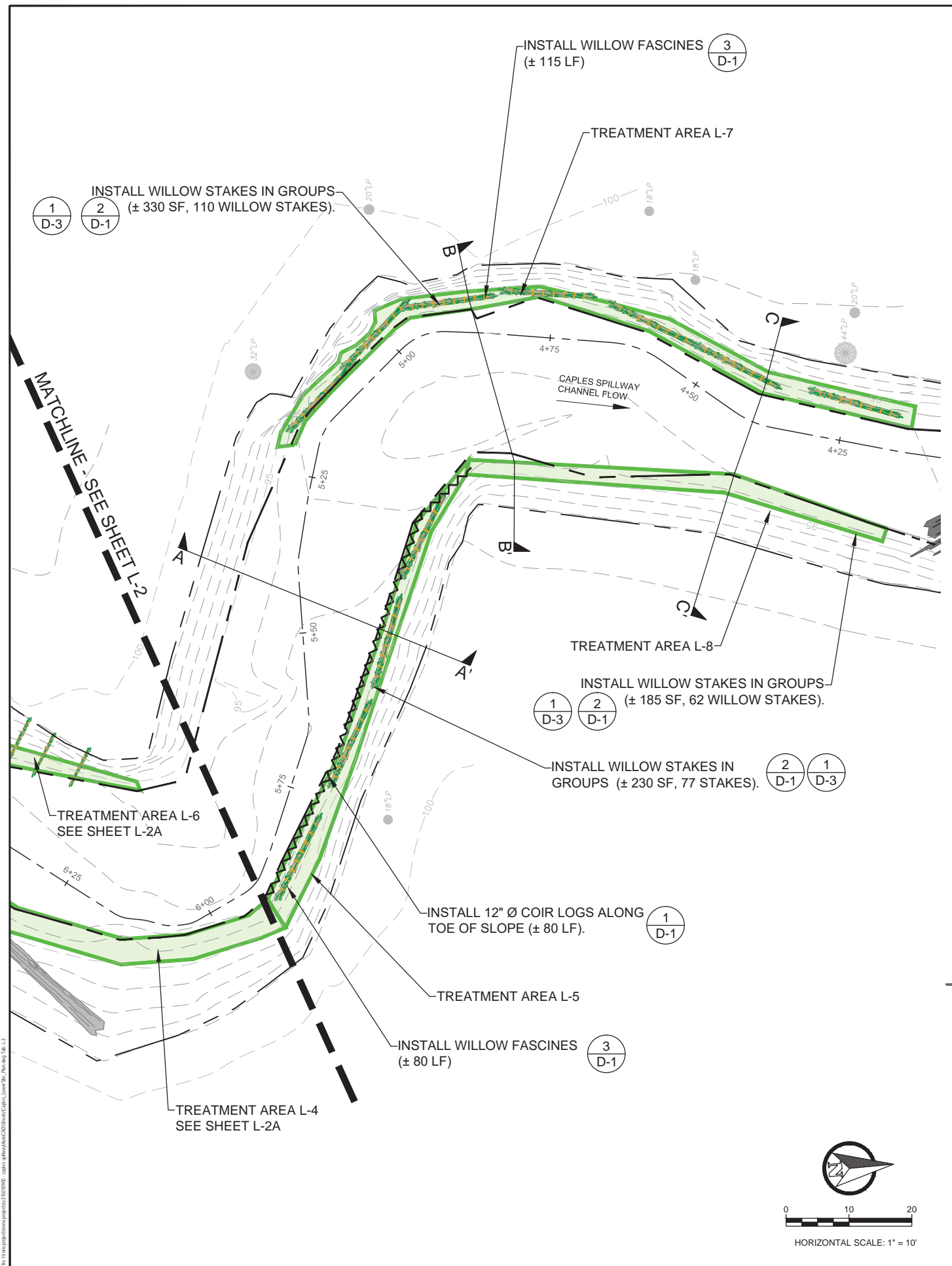
CAPLES LAKE SPILLWAY STABILIZATION

EL DORADO COUNTY, CA

DATE: 12/17
 DRAWN BY: PB, GP
 CHECKED BY: SP, MG, JC, MK
 SCALE: AS SHOWN
 CARDNO JOB NO. E315010900
 FIGURE NO.

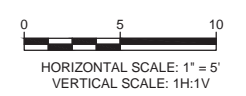
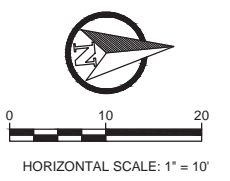
L-2
 SHEET 11 OF 15

PLOT DATE: 12/07/17 2:43:14 PM PLOT ADDRESS: C:\Users\jgibson\Documents\Projects\Caples Lake Spillway\Drawings\Plan_Sheet_2.dwg PLOT SCALE: 1:10



- LEGEND:**
- COIR LOG
 - LIVE STAKE/POLE PLANTING
 - EXISTING DOWNED LOG
 - EXISTING TREE
 - EXISTING MINOR CONTOUR (1 FOOT)
 - EXISTING MAJOR CONTOUR (5 FOOT)
 - WILLOW FASCINE

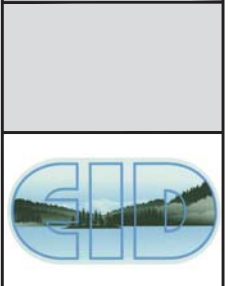
NOTE:
 1. NATIVE MATERIAL FOR ALL BACKFILL SHALL BE NATIVE TO THE PROJECT SITE, CONTAIN ORGANIC MATERIAL, NOT BE ROCK, SAND, COBBLE AS TO PROMOTE VEGETATION GROWTH.



NO.	REVISIONS	DATE

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LOWER EROSION SITE- PLAN SHEET 3

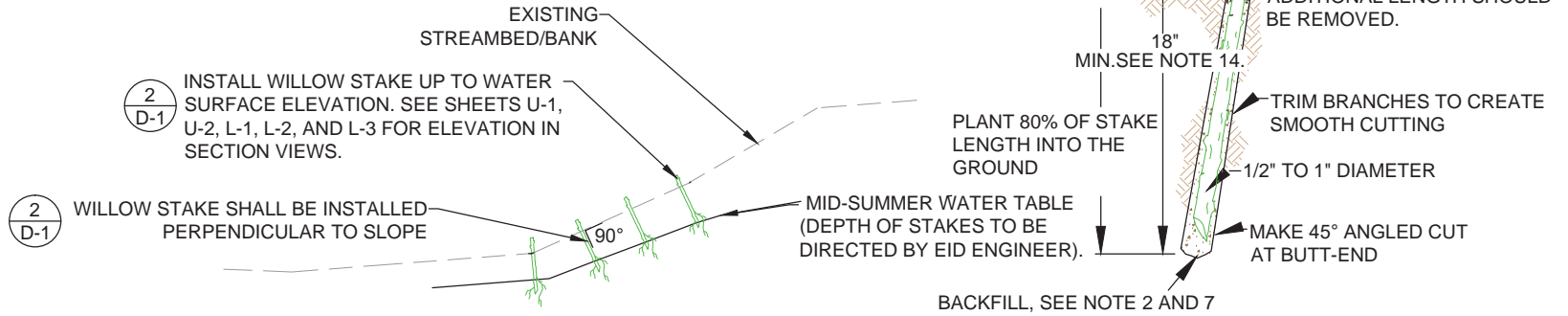
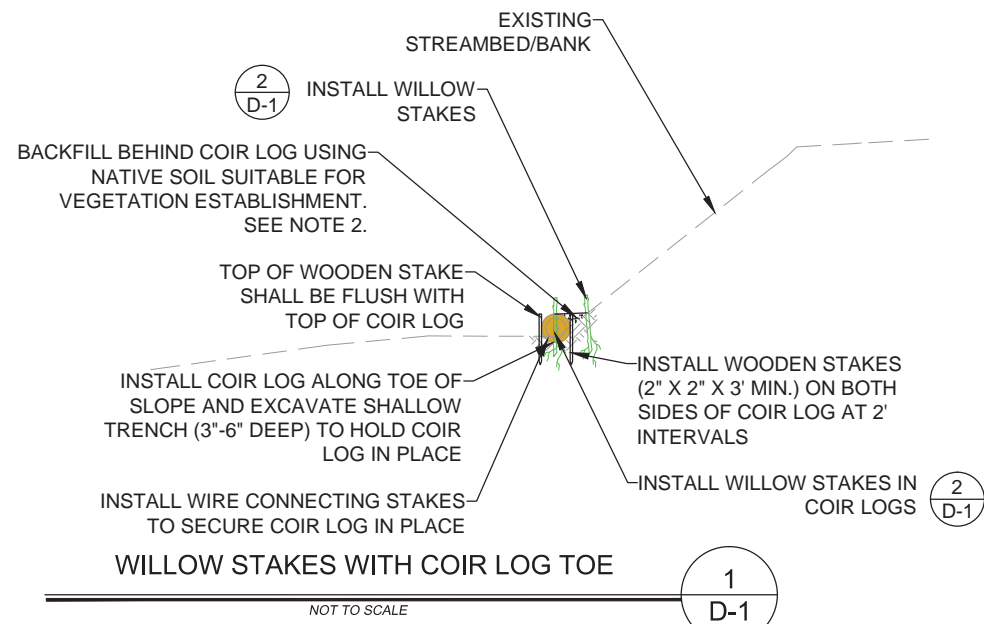
CAPLES LAKE SPILLWAY STABILIZATION

EL DORADO COUNTY, CA

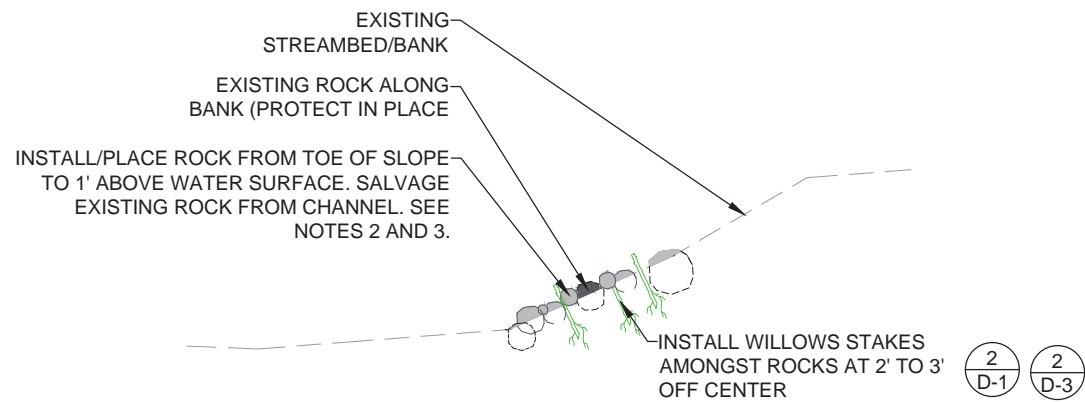
DATE: 12/17
 DRAWN BY: PB, GP
 CHECKED BY: SP, MG, JC, MK
 SCALE: AS SHOWN
 CARDNO JOB NO. E315010900
 FIGURE NO.

L-3

SHEET 12 OF 15



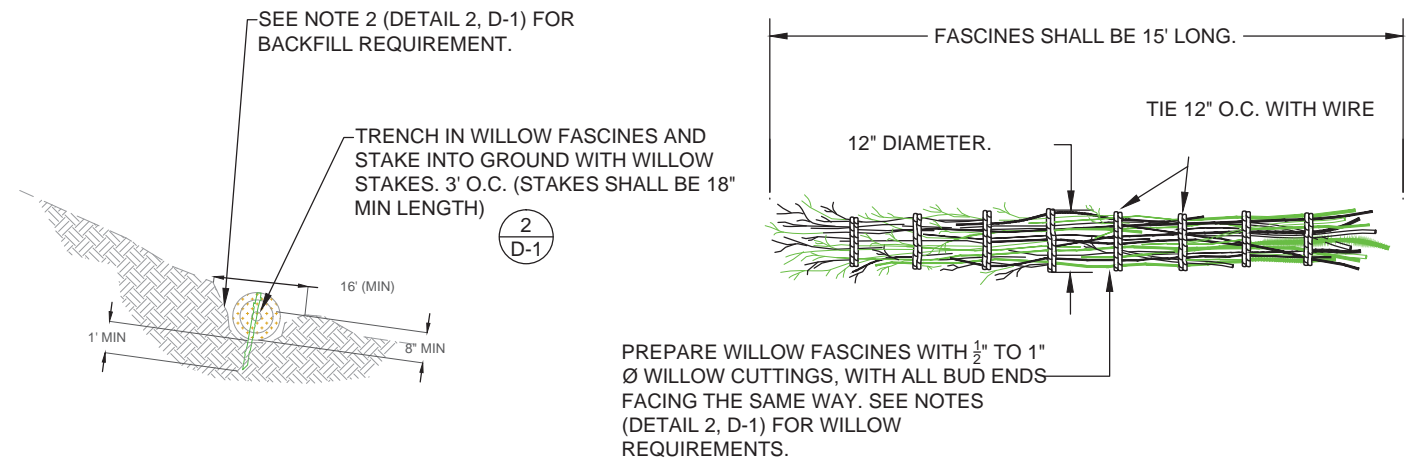
- NOTES:
- ALL MATERIALS (WILLOW STAKES) SHALL BE CUT FROM LIVE, YOUNG, VIGOROUS GROWTH STOCK BRANCHES WHICH ARE IN A DORMANT STATE FROM WILLOW SPECIES (*SALIX LEMMONII*, *S. GEYERIANA*, *S. LUCIDA* OR *POPULUS TRICHOCARPA*)
 - NATIVE MATERIAL FOR ALL BACKFILL SHALL BE NATIVE TO THE PROJECT SITE, CONTAIN ORGANIC MATERIAL, NOT BE ROCK, SAND, COBBLE AS TO PROMOTE VEGETATION GROWTH.
 - OLD GROWTH BRANCH CUTTINGS SHALL NOT BE USED.
 - EACH SALVAGED WILLOW STAKE SHALL HAVE AN ADEQUATE NUMBER OF BUDS FOR THE INTENDED PURPOSE.
 - ANY SALVAGED MATERIAL THAT DOES NOT MEET THE REQUIREMENTS AS STATED HEREIN IS SUBJECT TO REJECTION BY ENGINEER AT THE TIME OF INSTALLATION AND/OR INSPECTION.
 - STAKES MAY VARY IN LENGTH, DEPENDING ON SOURCE MATERIAL AND APPLICATION, BUT SHALL BE A MINIMUM OF TWENTY-FOUR (24) INCHES IN LENGTH AND A MINIMUM OF ONE-HALF (1/2) INCH DIAMETER AND A MAXIMUM OF ONE (1) INCH DIAMETER.
 - BACKFILL VOIDS IN STAKE LOCATIONS (SEE NOTE 2) AND TAMP THE BACKFILLED MATERIAL AROUND THE STAKE.
 - MATERIAL SHALL NOT BE CUT MORE THAN SEVEN (7) DAYS PRIOR TO INSTALLATION
 - WILLOW STAKES SHALL BE STRAIGHT, WITH ALL EXTRANEIOUS LEAVES AND TWIGS/BRANCHES REMOVED FROM THE MAIN STEMS.
 - ALL CUTS SHALL BE CLEAN WITHOUT FRAYED ENDS.
 - CUT BOTTOMS ON A FORTY-FIVE DEGREE ANGLE.
 - TEMPORARILY STORE AND KEEP ALL PLANT CUTTING STOCK AND MATERIALS THOROUGHLY MOISTENED, IMMERSED IN WATER AND IN A SHADED ENVIRONMENT
 - ALL CUTTING STOCK SHALL BE SUBMERGED IN WATER (FOR A PERIOD OF 24 HOURS MIN) PRIOR TO INSTALLATION AND PLANTING)
 - DEPTH OF WILLOW STAKES SHALL BE DIRECTED BY EID ENGINEER TO ASSURE DEPTH IS AT MID-SUMMER WATER TABLE ELEVATION.



- NOTES:
- PROPOSED ROCK SHALL BE PLACED BETWEEN, IN, AROUND, ETC. TO CREATE CONTINUOUS ROCK SURFACE
 - ROCK SIZE SHALL BE A MINIMUM OF 8" DIAMETER AND 25 POUNDS.
 - ROCK SHALL BE ANGULAR IN NATURE
 - ROCK SHALL BE GENERALLY UNIFORM IN DIAMETER
 - ROCK SHALL BE 1/3 BURIED IN NATIVE STREAMBED/BANK

COMBINATION OF ROCK AND WILLOW STAKES

NOT TO SCALE



WILLOW FASCINES

NOT TO SCALE

WILLOW STAKE PLANTING

Red Stamp: 1508707 2 ALPHA: Permit Address: 5496 Reno Corporate Dr, Reno, NV 89511. Date: 12/17/2017 10:00:00 AM. User: sp,mg,jc,mk. Scale: AS SHOWN. Figure No: D-1. Project: CAPLES LAKE SPILLWAY STABILIZATION. Location: EL DORADO COUNTY, CA. Job No: E315010900.

NO.	REVISIONS	DATE



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DETAIL SHEET 1

CAPLES LAKE SPILLWAY STABILIZATION

EL DORADO COUNTY, CA

DATE: 12/17

DRAWN BY: PB, GP

CHECKED BY: SP, MG, JC, MK

SCALE: AS SHOWN

CARDNO JOB NO. E315010900

FIGURE NO.

D-1

SHEET 13 OF 15

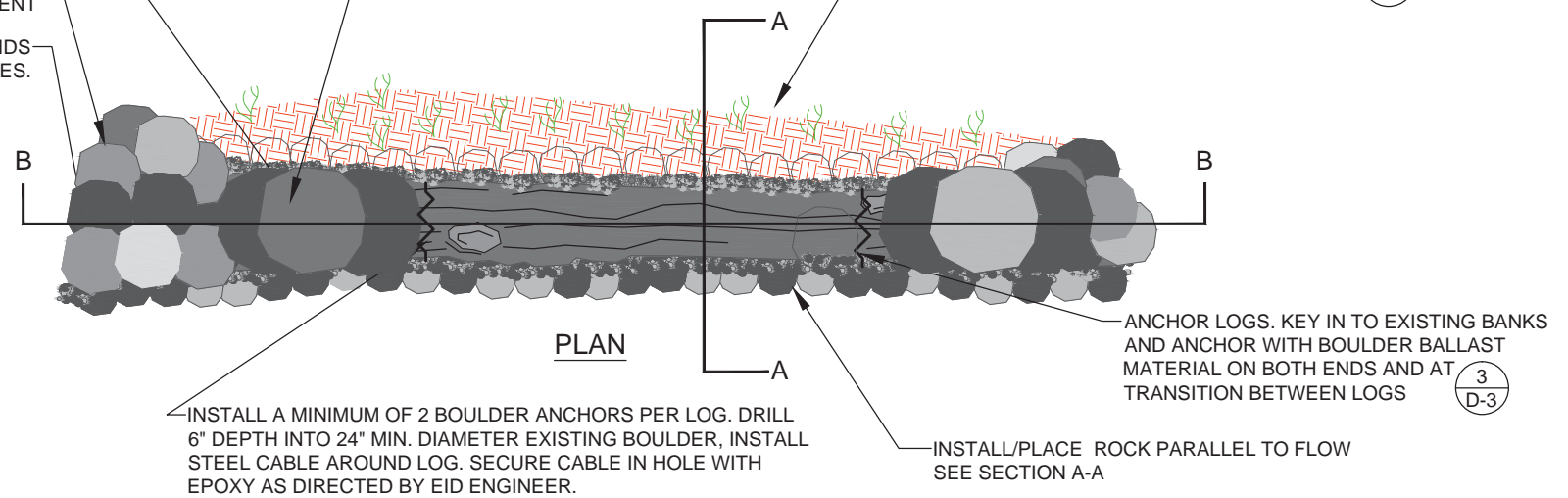
RELOCATE/MOVE EXISTING LOGS PARALLEL TO FLOW. AS SHOWN ON PLAN AND DIRECTED BY EID ENGINEER.

INSTALL MINIMUM 1.35 TONS TOTAL BALLAST BOULDERS (18" DIAMETER, 150 LBS MINIMUM PER BOULDER) OVER LOG.

BACKFILL AND PACK SOIL IN UNDERCUT BANK SEE NOTE 1. INSTALL WILLOW STAKES AT 2' O.C. 2
D-1

3
D-3 INSTALL BALLAST BOULDERS FOR END TREATMENT

INSTALL CHINKING MATERIAL TO FILL ALL VOIDS AS DIRECTED BY ENGINEER. SEE NOTES.



- NOTE:**
- NATIVE MATERIAL FOR ALL BACKFILL SHALL BE NATIVE TO THE PROJECT SITE, CONTAIN ORGANIC MATERIAL, NOT BE ROCK, SAND, COBBLE AS TO PROMOTE VEGETATION GROWTH.
 - CHINKING ROCK SHALL BE INSTALLED IN ALL AREAS WHERE BOULDERS AND ROCK ARE TO BE PLACED TO REDUCE/ELIMINATE VOID SPACE IN AND AROUND THE BOULDERS AND ROCKS (EXISTING AND PROPOSED). THE INTENT IS TO PROVIDE A SOLID MATRIX OF ROCK TO REDUCE POTENTIAL FOR FAILURE OF THE ROCK, BOULDER AND/OR LOG STRUCTURES ASSOCIATED WITH THE PROJECT.
 - ALL CHINKING ROCK MATERIAL SHALL BE ANGULAR IN NATURE
 - "DUMPING" OF CHINKING ROCK MATERIAL SHALL NOT BE PERMITTED. ALL CHINKING ROCK MATERIAL SHALL BE PLACED BY HAND TO ASSURE THAT ALL VOIDS ARE COMPLETELY FILLED.
 - VARIATION IN THE SIZE AND SHAPE OF CHINKING ROCK MATERIAL WILL BE REQUIRED TO FILL ALL VOIDS
 - TAMPING AND LIGHT "HAMMERING" OF CHINKING ROCK WITH RUBBER MALLETS WILL BE REQUIRED TO FILL ALL VOIDS
 - ALL CHINKING MATERIAL SHALL CREATE A FIRM, TIGHT AND WELL COMPACTED COHESIVE STRUCTURE.
 - THE FINISHED HEIGHT/POSITION OF ANY CHINKING MATERIALS SHALL BE LEFT A MINIMUM OF 6" AND A MAXIMUM OF 12" BELOW ANY EXPOSED ROCK, BOULDER, LOG, ETC.
 - ALL CHINKING SHALL BE OBSERVED AND ACCEPTED BY THE ENGINEER PRIOR TO ANY BACKFILL, COVERING, ETC. OF THE CHINKING MATERIALS

INSTALL A MINIMUM OF 2 BOULDER ANCHORS PER LOG. DRILL 6" DEPTH INTO 24" MIN. DIAMETER EXISTING BOULDER, INSTALL STEEL CABLE AROUND LOG. SECURE CABLE IN HOLE WITH EPOXY AS DIRECTED BY EID ENGINEER.

INSTALL/PLACE ROCK PARALLEL TO FLOW SEE SECTION A-A

ANCHOR LOGS. KEY IN TO EXISTING BANKS AND ANCHOR WITH BOULDER BALLAST MATERIAL ON BOTH ENDS AND AT TRANSITION BETWEEN LOGS 3
D-3

REMOVE CANTILEVER BANK AND USE MATERIAL TO FILL CUT SLOPE VOID. MATERIAL SHALL BE SCREENED, SEE NOTE 1. EXCESS MATERIAL SHALL BE DISPOSED OF, SEE NOTE 2.

INSTALL WILLOW STAKES IN BACKFILLED SLOPE BEHIND ROCKS AT 2' O.C. WHERE FEASIBLE. 2
D-1

INSTALL CHINKING MATERIAL TO FILL ALL VOIDS AS DIRECTED BY ENGINEER. SEE NOTES 3,4 AND NOTES OF DETAIL 2, SHEET D-2.

FILL AND SMOOTH BANK WITH EXISTING BANK SOIL SEE NOTE 1.

2.0' MINIMUM

INSTALL ROCK TOE USING MINIMUM 18" DIAMETER ANGULAR ROCK (150 LB MINIMUM). BOTTOM LAYER SHALL CONSIST OF LARGER ROCK, (18", 300 LB MINIMUM) SALVAGE ROCK FROM EXISTING CHANNEL AND/OR IMPORT.

INSTALL CHINKING MATERIAL TO FILL ALL VOIDS AS DIRECTED BY ENGINEER. SEE NOTES 3,4 AND NOTES OF DETAIL 2, SHEET D-2.

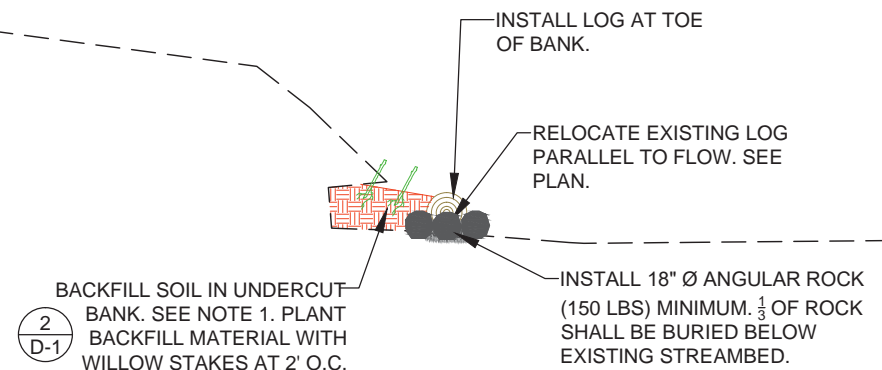
PROFILE

- NOTE:**
- NATIVE MATERIAL FOR ALL BACKFILL SHALL BE NATIVE TO THE PROJECT SITE, CONTAIN ORGANIC MATERIAL, NOT BE ROCK, SAND, COBBLE AS TO PROMOTE VEGETATION GROWTH.
 - LOGS AND DEBRIS TO BE REMOVED SHALL BE "SCATTERED" IN VICINITY. NO DEBRIS SHALL BE PLACED WITHIN 50' OF TOP OF CHANNEL SLOPE/BANK.
 - ALL CHINKING ROCK MATERIAL SHALL BE ANGULAR IN NATURE
 - TAMPING AND LIGHT "HAMMERING" OF CHINKING ROCK WITH RUBBER MALLETS WILL BE REQUIRED TO FILL ALL VOIDS

BANK WITH ROCK TOE

NOT TO SCALE

1
D-2



BACKFILL SOIL IN UNDERCUT BANK. SEE NOTE 1. PLANT BACKFILL MATERIAL WITH WILLOW STAKES AT 2' O.C. 2
D-1

INSTALL LOG AT TOE OF BANK.

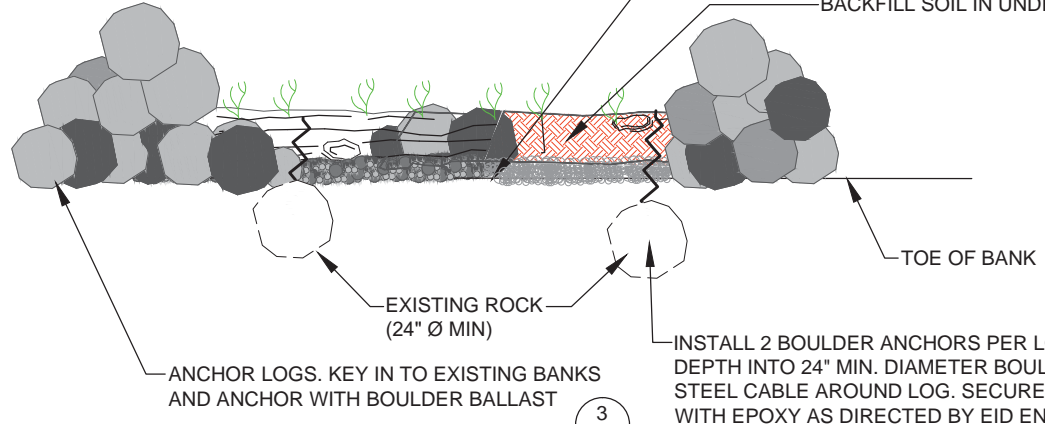
RELOCATE EXISTING LOG PARALLEL TO FLOW. SEE PLAN.

INSTALL 18" Ø ANGULAR ROCK (150 LBS) MINIMUM. 1/3 OF ROCK SHALL BE BURIED BELOW EXISTING STREAMBED.

SECTION A-A

CREATE FLAT SURFACE WITH 1-3" COBBLE MATERIAL. ALL MATERIAL SHALL BE CHINKED, SEE NOTES.

BACKFILL SOIL IN UNDERCUT BANK, SEE NOTE 1



ANCHOR LOGS. KEY IN TO EXISTING BANKS AND ANCHOR WITH BOULDER BALLAST 3
D-3

INSTALL 2 BOULDER ANCHORS PER LOG. DRILL 6" DEPTH INTO 24" MIN. DIAMETER BOULDER, INSTALL STEEL CABLE AROUND LOG. SECURE CABLE IN HOLE WITH EPOXY AS DIRECTED BY EID ENGINEER.

SECTION B-B

LOG BANK PROTECTION

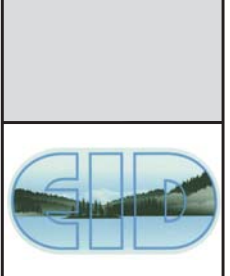
NOT TO SCALE

2
D-2

NO.	REVISIONS	DATE

SEAL

Cardno
5496 RENO CORPORATE DR
RENO, NV 89511
(775) 828-4362



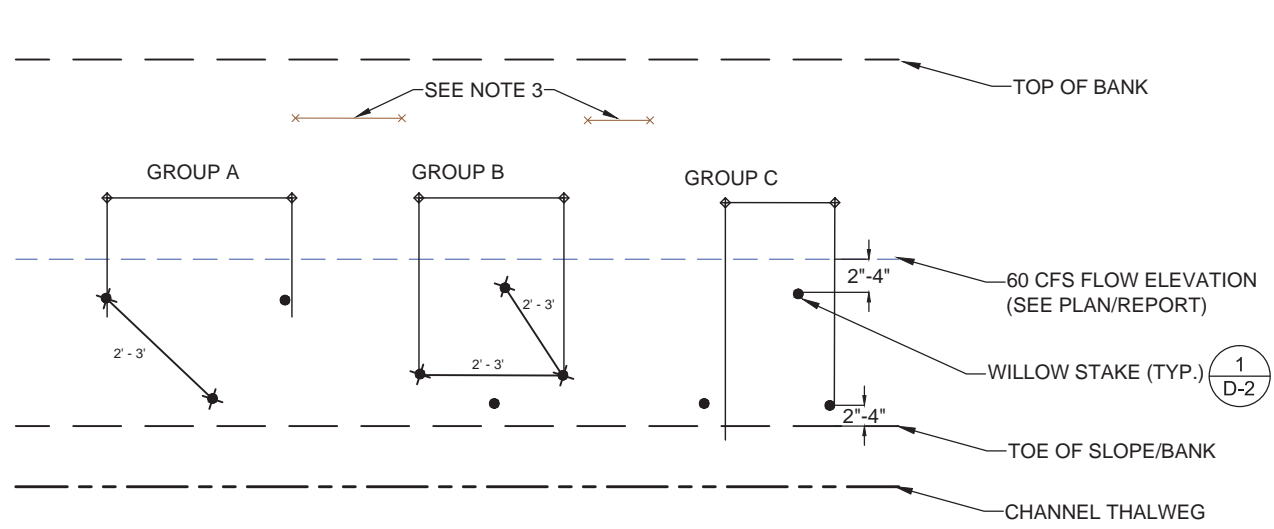
DETAIL SHEET 2
CAPLES LAKE SPILLWAY STABILIZATION
EL DORADO COUNTY, CA

DATE: 12/17
DRAWN BY: PB, GP
CHECKED BY: SP, MG, JC, MK
SCALE: AS SHOWN
CARDNO JOB NO. E315010900
FIGURE NO.

D-2

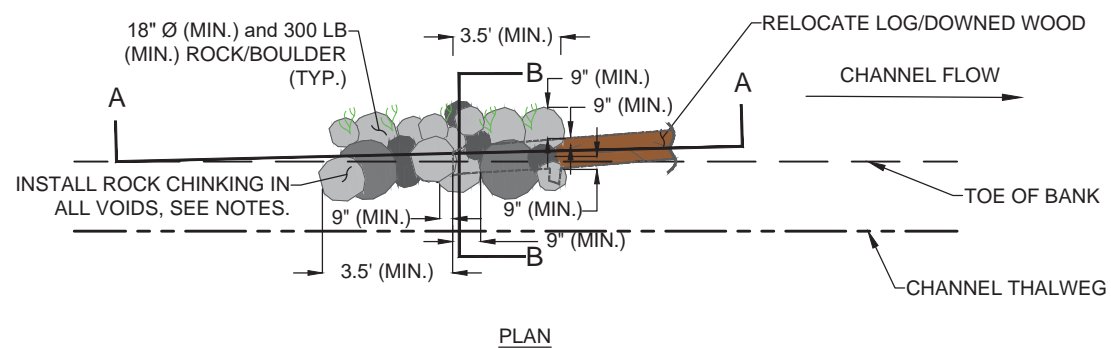
SHEET 14 OF 15

PLOT DATE: 12/07/17 2:43:14 PM; PLOT BY: SP; PLOT SCALE: 1:1; PLOT SHEET: 14 OF 15; PLOT FIGURE: D-2; PLOT PROJECT: CAPLES LAKE SPILLWAY STABILIZATION; PLOT COUNTY: EL DORADO COUNTY, CA; PLOT SHEET: D-2



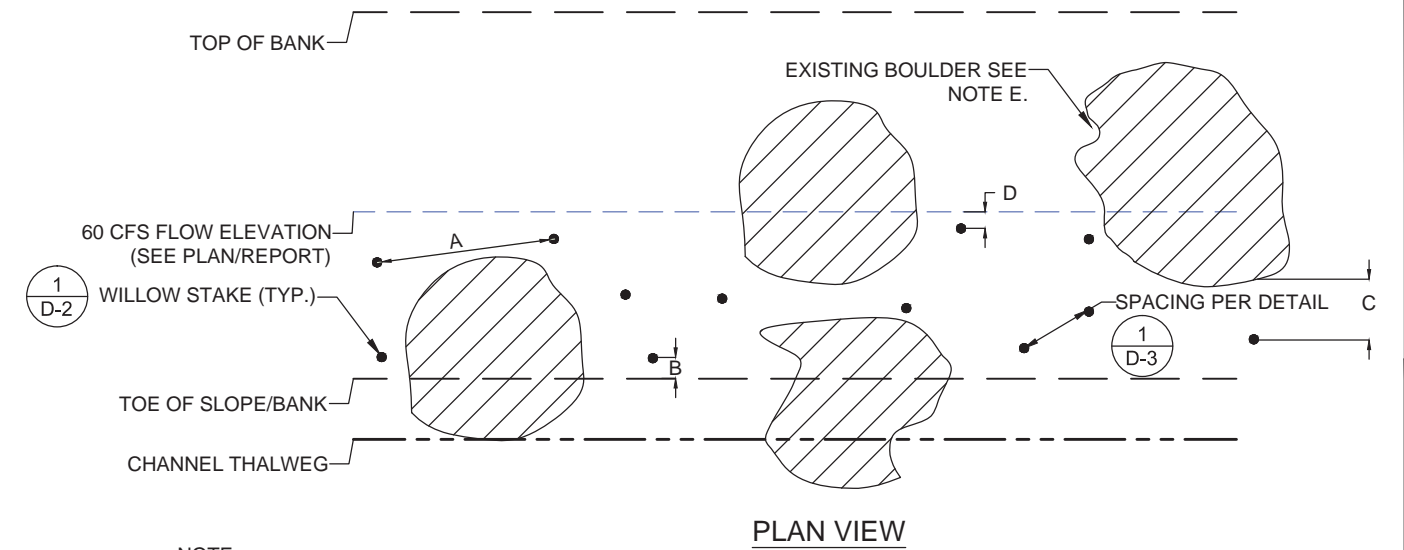
- NOTE:
1. X = 2' O.C. ±
 2. WILLOW STAKING GROUPS (A,B,C) SHALL BE ALTERNATED LONGITUDINALLY DOWN CHANNEL.
 3. SPACING BETWEEN GROUPS SHALL BE 3' - 5' AS DIRECTED BY EID ENGINEER.

WILLOW STAKING IN GROUPS
NOT TO SCALE



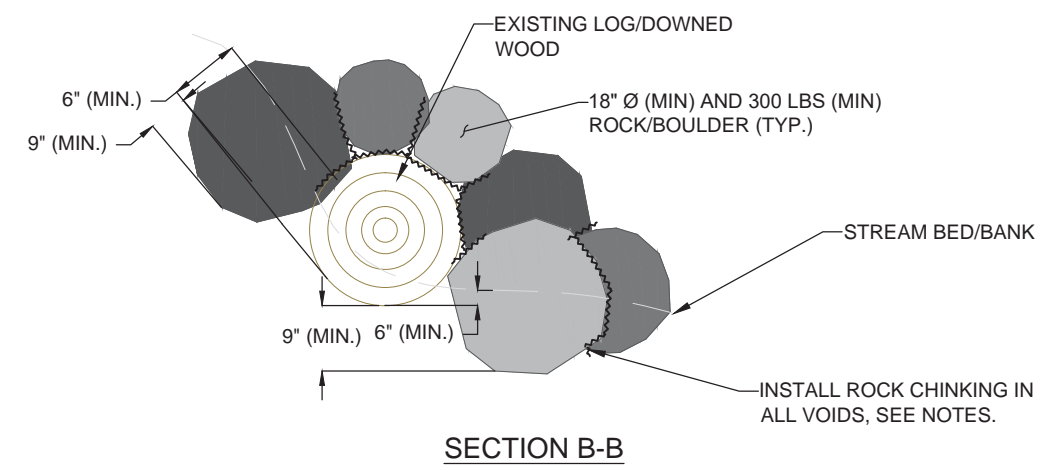
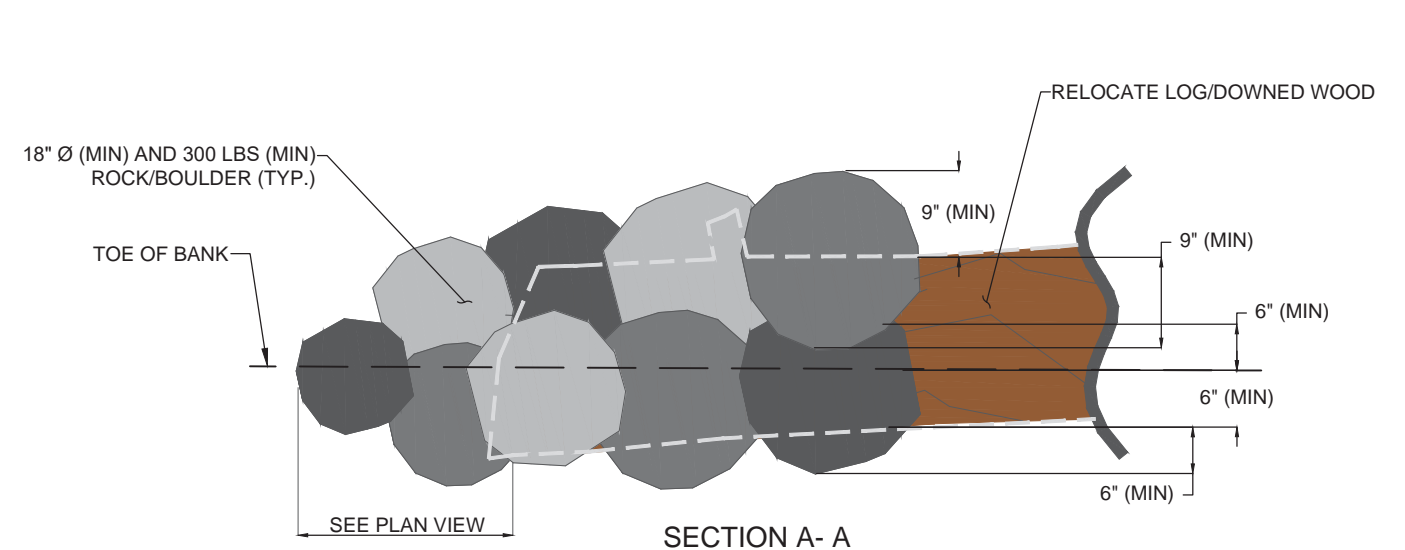
- NOTE:
1. NATIVE MATERIAL FOR ALL BACKFILL SHALL BE NATIVE TO THE PROJECT SITE, CONTAIN ORGANIC MATERIAL, NOT BE ROCK, SAND, COBBLE AS TO PROMOTE VEGETATION GROWTH.
 2. CHINKING ROCK SHALL BE INSTALLED IN ALL AREAS WHERE BOULDERS AND ROCK ARE TO BE PLACED TO REDUCE/ELIMINATE VOID SPACE IN AND AROUND THE BOULDERS AND ROCKS (EXISTING AND PROPOSED). THE INTENT IS TO PROVIDE A SOLID MATRIX OF ROCK TO REDUCE POTENTIAL FOR FAILURE OF THE ROCK, BOULDER AND/OR LOG STRUCTURES ASSOCIATED WITH THE PROJECT.
 3. ALL CHINKING ROCK MATERIAL SHALL BE ANGULAR IN NATURE
 4. "DUMPING" OF CHINKING ROCK MATERIAL SHALL NOT BE PERMITTED. ALL CHINKING ROCK MATERIAL SHALL BE PLACED BY HAND TO ASSURE THAT ALL VOIDS ARE COMPLETELY FILLED.
 5. VARIATION IN THE SIZE AND SHAPE OF CHINKING ROCK MATERIAL WILL BE REQUIRED TO FILL ALL VOIDS
 6. TAMPING AND LIGHT "HAMMERING" OF CHINKING ROCK WITH RUBBER MALLETS WILL BE REQUIRED TO FILL ALL VOIDS
 7. ALL CHINKING MATERIAL SHALL CREATE A FIRM, TIGHT AND WELL COMPACTED COHESIVE STRUCTURE.
 8. THE FINISHED HEIGHT/POSTION OF ANY CHINKING MATERIALS SHALL BE LEFT A MINIMUM OF 6" AND A MAXIMUM OF 12" BELOW ANY EXPOSED ROCK, BOULDER, LOG, ETC.
 9. ALL CHINKING SHALL BE OBSERVED AND ACCEPTED BY THE ENGINEER PRIOR TO ANY BACKFILL, COVERING, ETC. OF THE CHINKING MATERIALS

LOG BANK PROTECTION - END TREATMENT
NOT TO SCALE



- NOTE:
- A. SPACING OF WILLOW STAKES SHALL BE 2-3' O.C.
 - B. WILLOWS SHALL BE SET NO CLOSER THAN 2" TO TOE OF SLOPE/BANK
 - C. WILLOW STAKES SHALL BE SET NO CLOSER THAN 6" TO EXISTING ROCK/BOULDERS
 - D. WILLOW STAKES SHALL BE SET NO CLOSER THAN 2" FROM 60 CFS FLOW ELEVATION AS DIRECTED BY EID ENGINEER
 - E. BOULDER MAY REPRESENT VEGETATION, ROCK, ETC. - OBJECT PREVENTING WILLOW STAKE INSTALLATION.

WILLOW STAKING IN AMONGST BOULDERS
NOT TO SCALE



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RENO, NV 89511
(775) 828-4362



DETAIL SHEET 3
CAPLES LAKE SPILLWAY STABILIZATION
EL DORADO COUNTY, CA

DATE:	12/17
DRAWN BY:	PB, GP
CHECKED BY:	SP, MG, JC, MK
SCALE:	AS SHOWN
CARDNO JOB NO.	E315010900
FIGURE NO.	D-3
SHEET	15 OF 15

PLOT DATE: 12/07/2017 2:43:14 PM; PLOT BY: SP; PLOT SCALE: 1:1; PLOT SHEET: 15 OF 15; PLOT JOB NO: E315010900; PLOT FIGURE NO: D-3

Caples Spillway Channel
Stabilization Plan
El Dorado Hydroelectric Project
(FERC No. 184)

APPENDIX

C

VEGETATION TREATMENT
PHOTO LOG



Figure 1 Upper Site – Treatment Area U-1: LB 3+55 to 3+25

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Figure 2 Upper Site – Treatment Area U-2: RB 3+57 to 3+17

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Figure 3 Upper Site - Treatment Area U-3: 2+45 to 3+30

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Figure 4 Upper Site - Treatment Area U-4: 2+72 to 2+58

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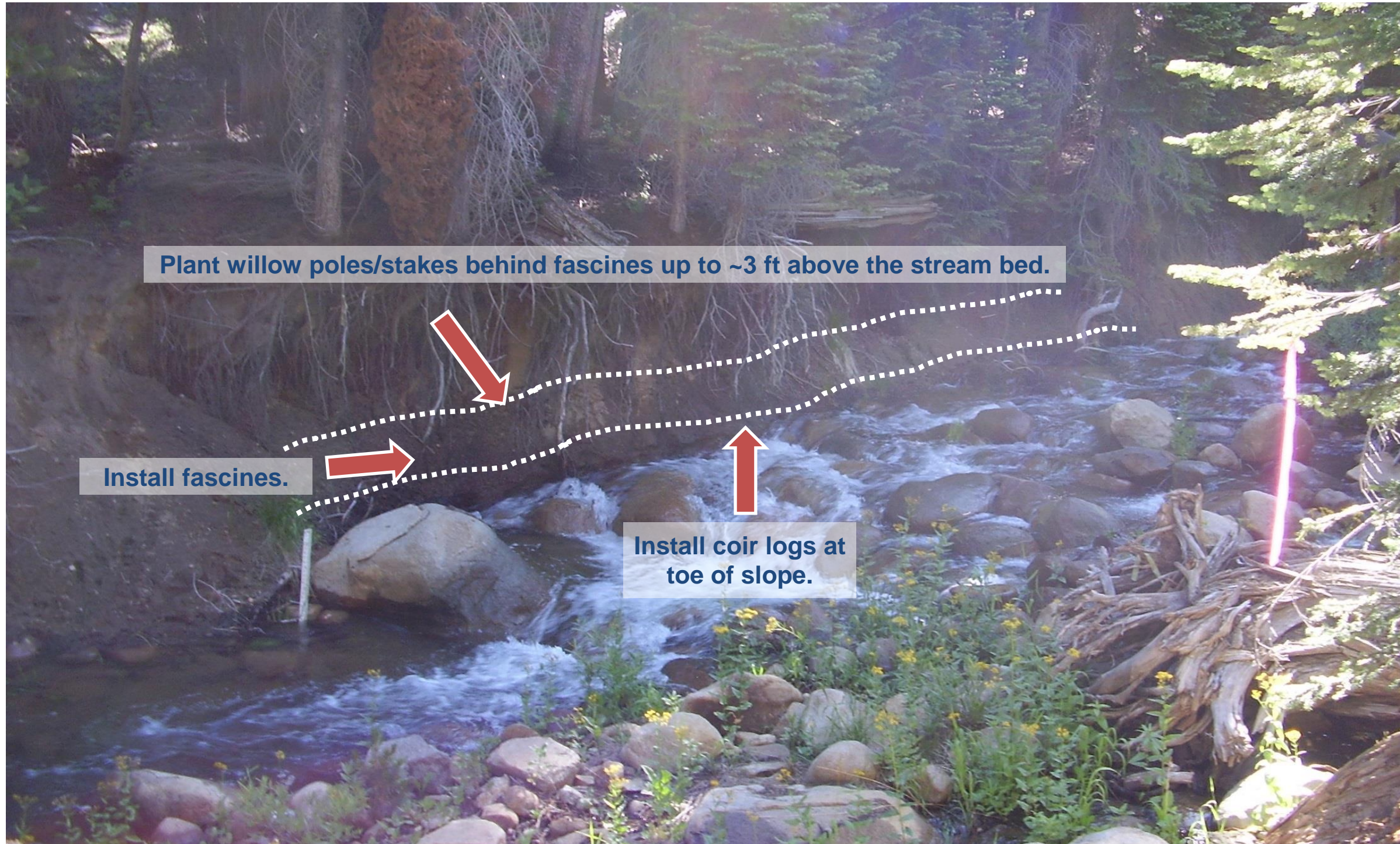


Figure 5 Upper Site – Treatment Area U-5: RB 2+46 to 1+39

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Figure 6a Upper Site – Treatment Area U-6: LB 1+87 to 1+25 (Photo 1 of 2)

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Figure 6b Upper Site – Treatment Area U-6: LB 2+46-1+39 (Photo 2 of 2)

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Figure 7. Upper Site – Treatment Area U-7: RB 0+60 to 1+08

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Figure 8 Upper Site – Treatment Area U-8: RB 0+64 to 0+01

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Figure 9 Upper Site – Treatment Area U-9: LB 0+48 to 0+12

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Figure 9a Lower Site – Treatment Area L-1: RB 8+48 to 7+74 (Photo 1 of 2)

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Figure 9b Lower Site – Treatment Area L-1: RB 8+48 to 7+74 (Photo 2 of 2)

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Figure 10 Lower Site – Treatment Area L-3: RB 7+38 to 7+02

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Figure 11 Lower Site – Treatment Area L-4: RB 6+48 to 5+91 (upstream end)
Note: Left bank (left side of photo) is Treatment Area L-6, with details depicted in Figures 13a and 13b.

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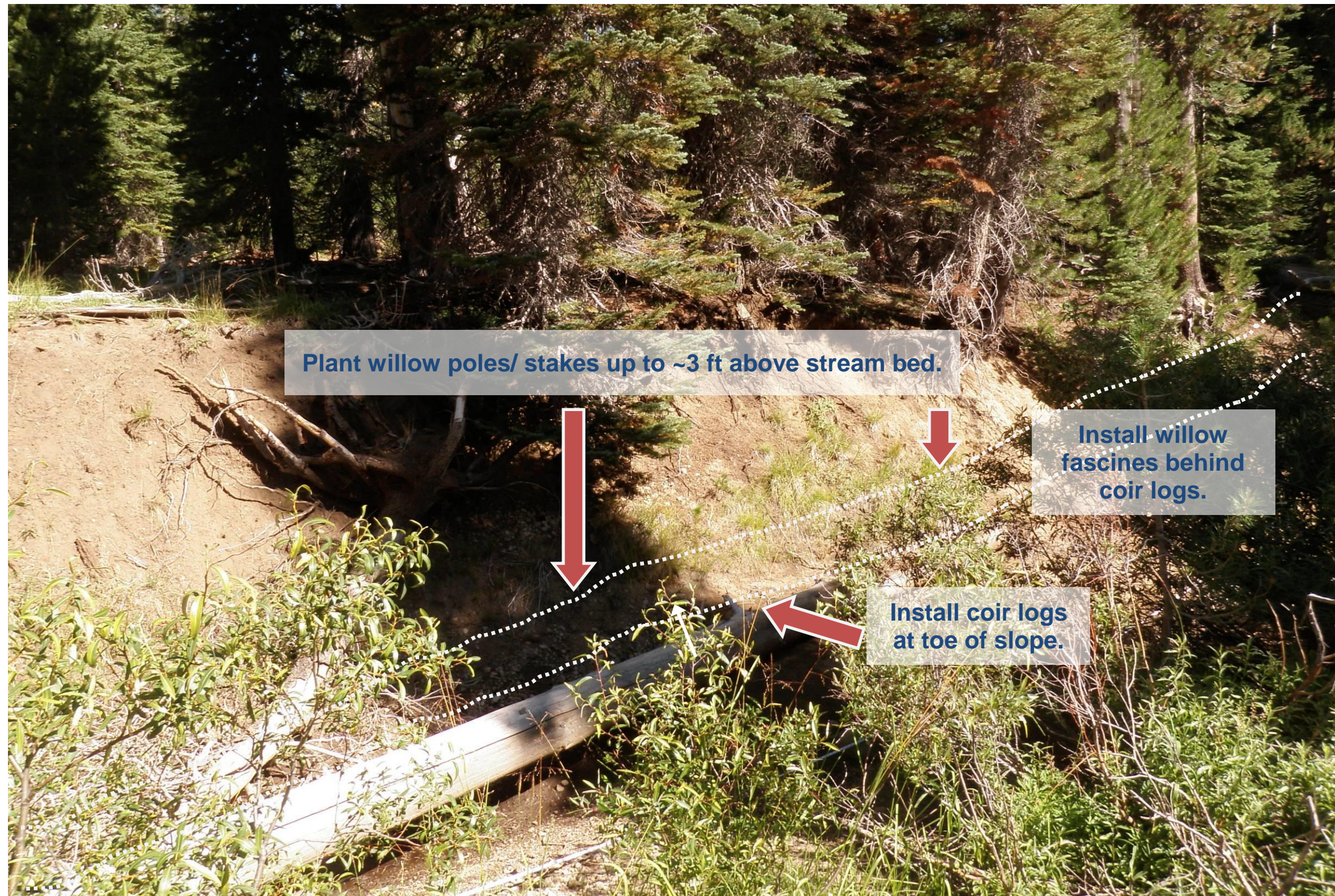


Figure 12 Lower Site – Treatment Area L-5: RB 5+91 to 5+04

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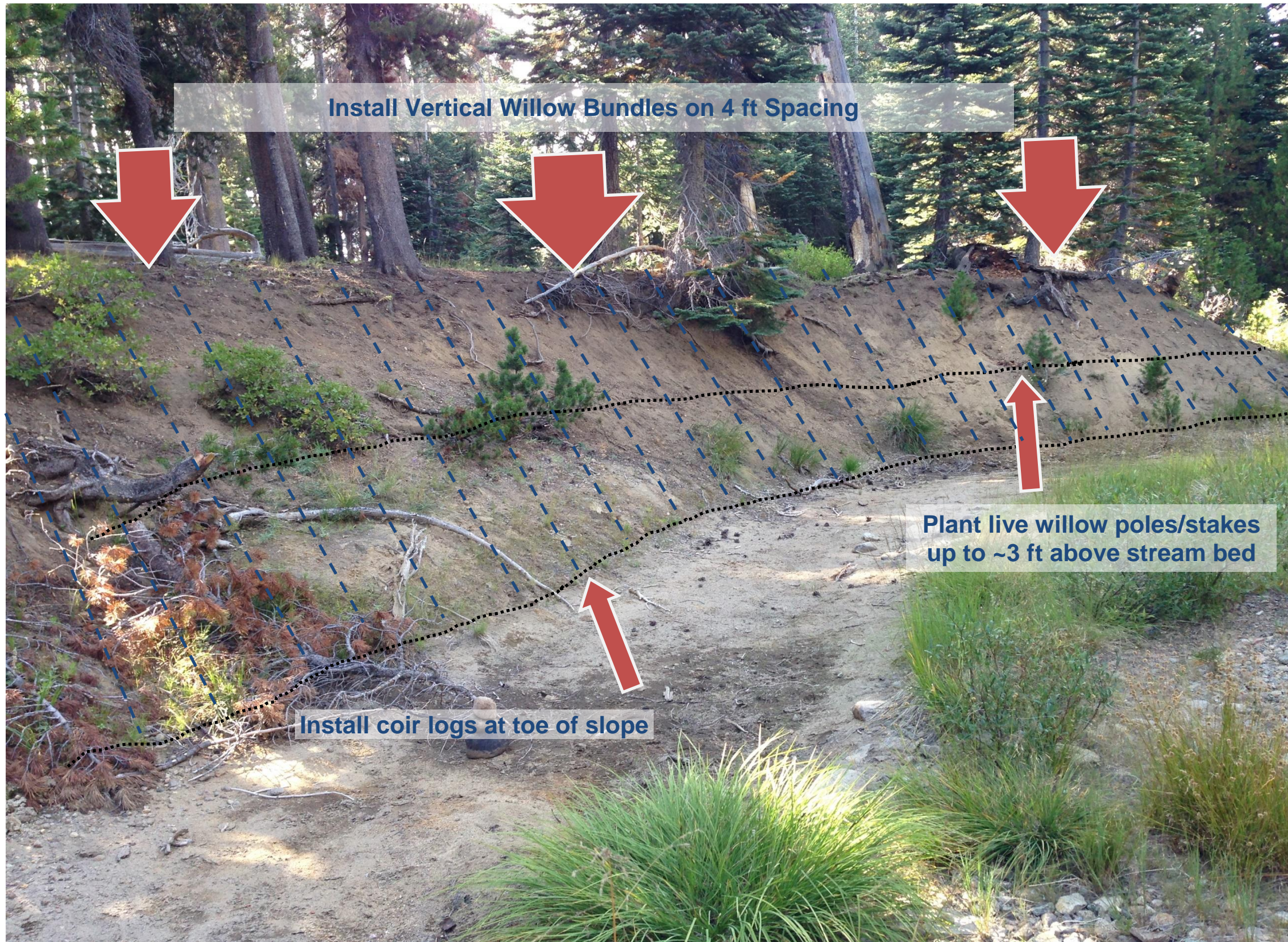


Figure 13. Lower Site - Treatment Area L-6: LB 7+25 to 6+23

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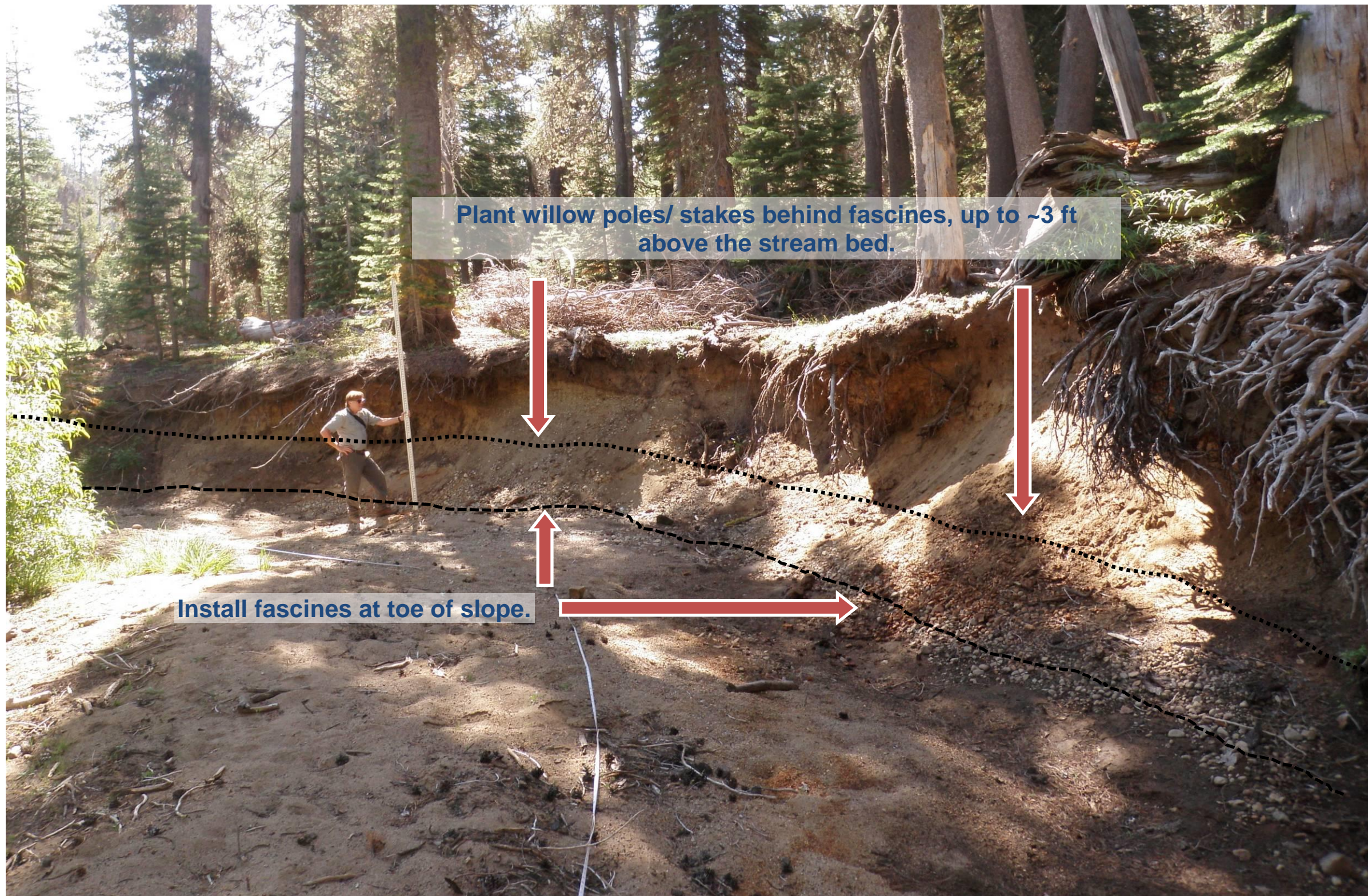


Figure 14 Lower Site - Treatment Area L-7: LB 5+20 to 4+13 (Photo 1 of 4)

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Figure 14b Lower Site - Treatment Area L-7: LB 5+20 to 4+13 (Photo 2 of 4)

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Figure 14c Lower Site - Treatment Area L-7: LB 5+20 to 4+13 (Photo 3 of 4)

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Figure 14d Lower Site - Treatment Area L-7: LB 5+20 to 4+13 (Photo 4 of 4)

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Figure 15 Lower Site – Treatment Area L-8: RB 5+04-4+15

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Caples Spillway Channel
Stabilization Plan
El Dorado Hydroelectric Project
(FERC No. 184)

APPENDIX

D

VEGETATION INSTALLATION
DETAILS

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D.1.3	Pole and Stake Preparation	D-3
D.1.4	Installation of Willow Poles	D-3
D.2	Collection, Preparation, and Installation of Willow Fascines.....	D-3
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Appendix D

Vegetation Installation Methods

The proposed stabilization treatments use native materials available on-site or locally (e.g., willow cuttings, large cobbles) and hand tools, and do not require use of mechanical equipment or additional site grading. The following sections provide detailed methods for:

- > Collecting, preparing, and installing willow poles as direct plantings or as live stakes; and
- > Collecting, preparing, and installing willow fascines.

D.1 Collection, Preparation, and Installation of Willow Poles and Live Stakes

The following section describes specific methods for collecting and planting willow poles and live willow stakes. Live willow stakes are only used to secure willow fascines.

D.1.1 Collection

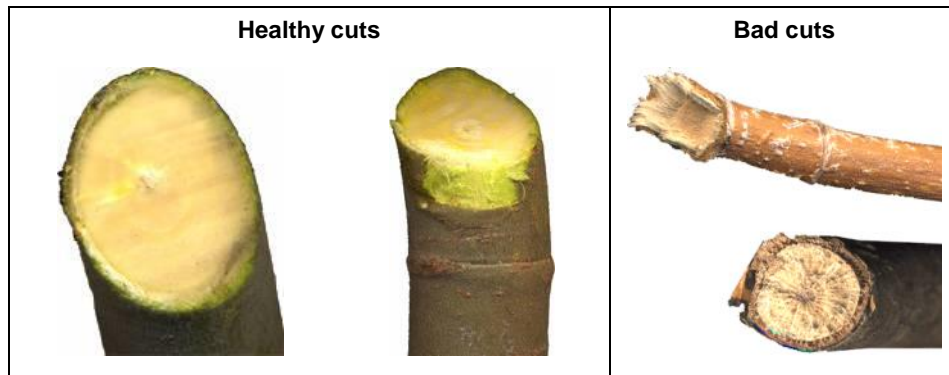
Select healthy individuals for harvesting the cuttings by checking for the following:

- > **Insect damage** such as:
 - Bright red bumps growing on the leaves;
 - Colonies of aphids, caterpillars, or scale (white powdery bugs);
 - More than 30% of the leaves have obvious holes from insect consumption; or
 - Little brownish balls that break off the stem when you rub them.
- > **Sick leaves** that are:
 - Curling;
 - Strongly dimpled or uneven;
 - Withered at the tip;
 - Spotty or black; or
 - Brown or yellow and still firmly attached to the stem.
- > **Trees with sap exuding** from the bark, or have places where the trunk and branches are decomposing.
- > **White or brown rings** around the trunk that do not seem natural.
- > Select **cuttings** that are more or less **straight**.

D.1.2 Cutting and Pruning a Pole and Stakes

- > Cuttings should be a minimum of **1/3 to 2** inches in diameter **and 2 to 3** ft long. Poles that are approximately 4-5 ft long will be needed at several erosion treatment areas. Cuttings should have several viable buds along the stems.
- > Cuttings that will be used as live stakes should be a minimum of $\frac{3}{4}$ to 1.5 inches in diameter and a minimum of 18 inches long.
- > When cutting a branch, leave at least $\frac{1}{4}$ -inch of the lowermost part of the branch on the main stem. Do not cut the branch flush with the main stem.
- > For poles, **cut the branch at a 45 degree** angle, so that the bottom end is sharp for easy insertion into the soil. The top should be cut square. For live stakes, the cut should be square on both ends.

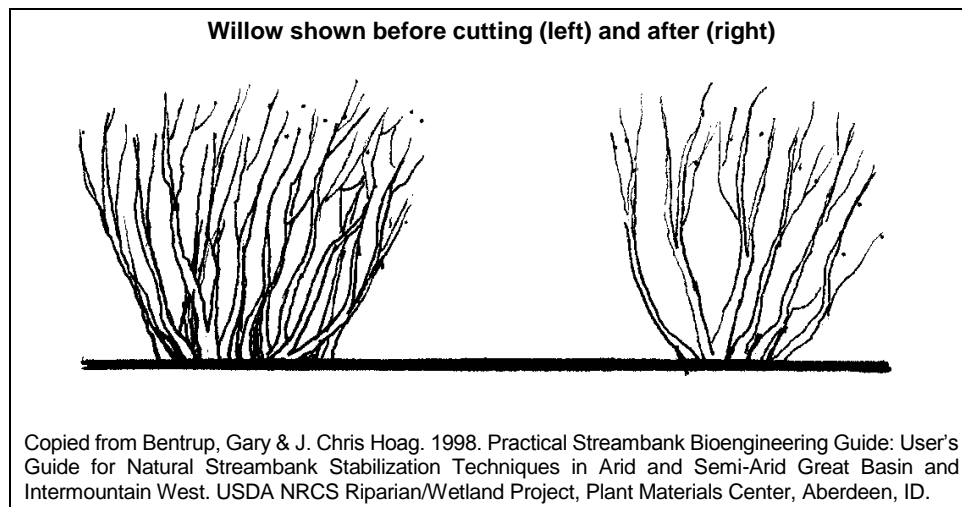
- > **The cut should be smooth, moist and light tan with a green layer** around it. If the inside of the stem is dry and rough or dark gray, dark brown, or black, don't use it or cut higher on the pole.



- > If the end of the branch is **thin and flimsy or laden with buds**, cut it off.



- > **Do not cut more than 35%** of the tree/shrub to prevent overharvesting.



- > **Prune the pole by:**

- **Cutting off the side branches** so that the pole is a straight stem. The bark should remain intact.
- **Cutting the tips** off each pole.
- **Remove any leaves and flowers** but leave the unopened buds.

D.1.3 Pole and Stake Preparation

As soon as the pole/stake is removed from the tree, put it in the stream, bucket, or tub full of water. Make sure that the basal end is submerged and the buds are pointing up. The elapsed time between collecting and installing the pole cuttings should be as short as possible.

- > **Tie the poles/stakes into bundles** to transport them easily, if necessary.
- > **Remove any remaining leaves.**



D.1.4 Installation of Willow Poles

The procedure for installation of willow poles is described below. Figure D-1 illustrates the planting methods. The methods for plantings live stakes is described in the section for installing willow fascines.

- > Prior to planting the pole cuttings, use a pick, a piece of rebar, or similar tool to make installation holes for the cutting. Make them as deep as possible (best if reaches the water table).
- > **Cut an inch off the bottom** (also with a 45 degree angle) right before putting the pole in its hole. The buds should be pointing up.
- > Set the pole as deep as possible in the hole. No less than $\frac{1}{2}$ of the total length of the pole should be in the ground. Ideally, the pole should reach the summer water table.
- > **Tamp (pack) the soil** once the pole is in the ground to ensure good contact between the cutting and soil for root development. Pour water into the hole, add more soil, and tamp the soil around it until it feels solid.
- > Place **1 to 3 poles** per hole.
- > Poles should be planted at a density of approximately **one pole per 3 ft** of unvegetated channel bank (**3-ft centers**). The final planting density will be determined in the field by a qualified ecologist.
- > Install browse tube around each willow pole.

D.2 Collection, Preparation, and Installation of Willow Fascines

The following section describes specific methods for collecting and installing willow fascines (Figures D-2 and D-3).

Dormant willow branches that are generally longer and smaller in diameter than the pole cuttings will be collected for preparing willow fascines. Collect healthy branches as described in the previous section on willow pole cuttings.

D.2.5 Cutting and Pruning Branches

- > **Don't cut more than 35%** of the tree/ shrub to prevent overharvesting and remove branches from different areas of any one tree/shrub.
- > When cutting the branch, leave at least $\frac{1}{4}$ -inch of the lowermost part of the branch on the main stem. Do not cut the branch flush with the main stem.

- > Cuttings should be a minimum of **0.5 to 1.5** inches in diameter, and may vary in length, depending on source material, but should average **8** ft long. Cuttings should have several viable buds along the stems.
- > Both ends of the branch should be cut square.
- > **The cut should be smooth, moist and light tan with a green layer** around it. If the inside of the stem is dry and rough or dark gray, dark brown, or black, do not use it or cut higher on the pole.
- > **Cut the tips** off each branch, but leave side branches on the main stems.
- > As soon as the branch is clean off the tree, put it in the stream, bucket, or tub full of water. Make sure that the basal end is submerged and the buds are pointing up. The elapsed time between collecting branches and installing the willow fascines should be as short as possible.

D.2.1 **Preparation of Fascines**

- > Fascines will be approximately **10-20** ft long and **at least 6-8** inches in diameter (Figure D-2)¹
- > Place the branches in the bundle so that approximately one-half the butt ends are at each end of the fascine.
- > Stagger the branches in the bundle so that the fascine is relatively uniform in diameter.
- > Firmly tie the fascine at 12- inch centers with two wraps of biodegradable, untreated twine with a non-slipping knot.

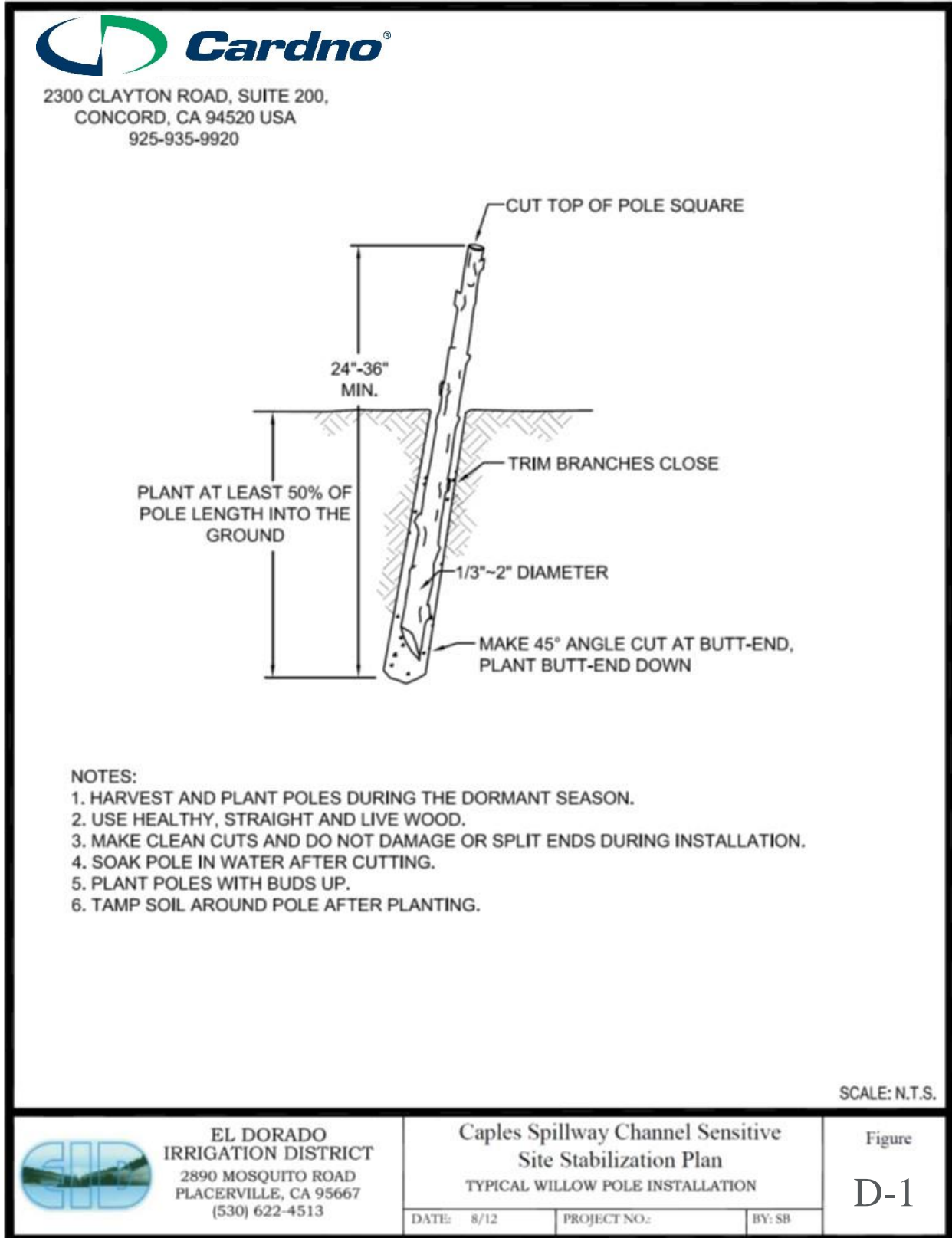
D.2.2 **Installation of Fascines**

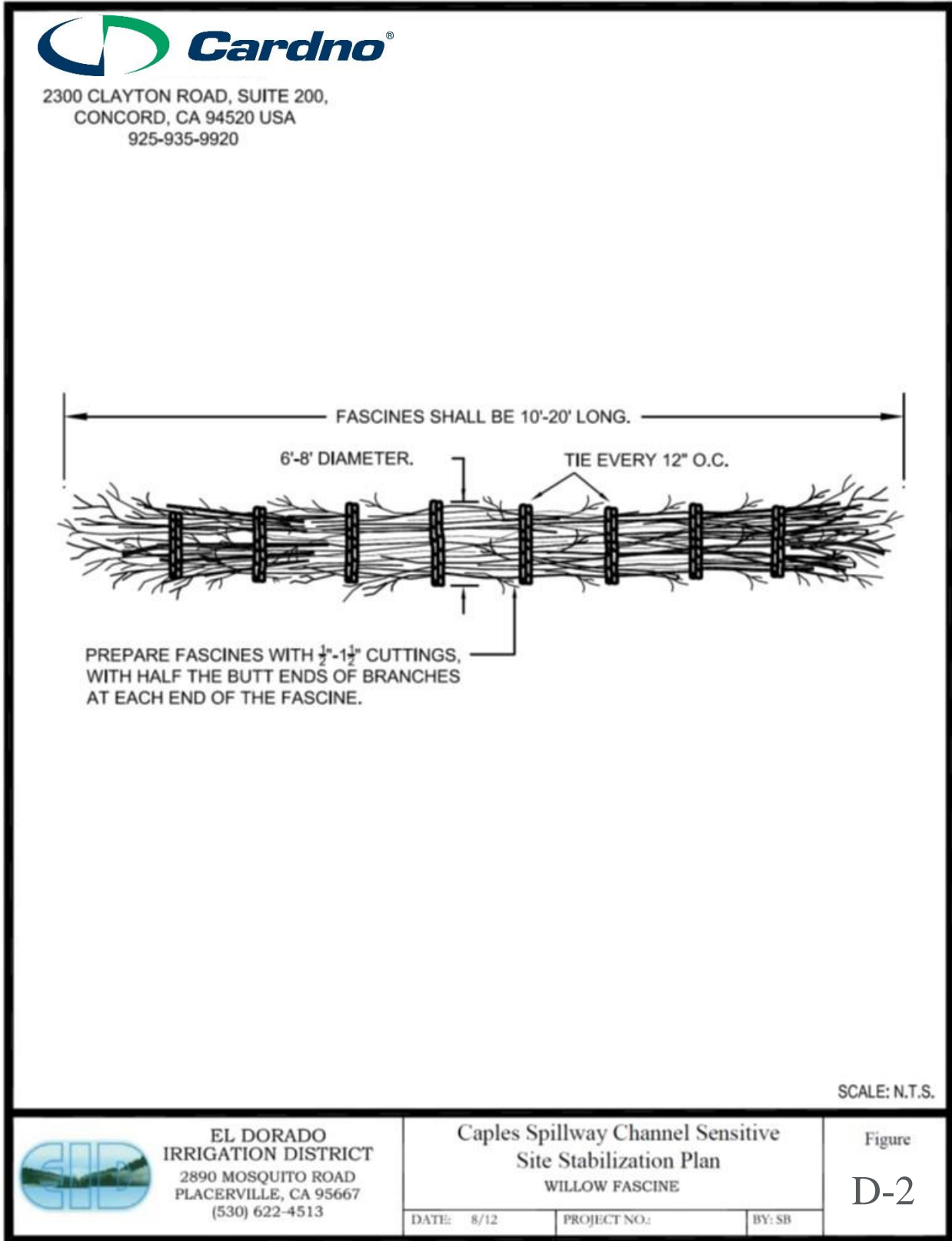
- > **Minimize disturbance of the surrounding areas during fascine installation.**
- > Excavate a trench using hand tools at the designated location that is approximately 2/3 the diameter of the fascine.
- > Place the fascine in the trench and backfill with existing soil using hand tools, leaving the top portion of the fascine visible. Place soil in between branches.
- > Drive live willow stakes on the downslope side of the fascine at approximately every 2-3 ft. Angle the stake so it is pointing upslope (Figure D-3). **Plant stakes so that 75-80% of the stake is buried.**
- > Drive live willow stakes into the fascines at approximately 2-3 ft centers that are slightly offset from the downslope stakes (Figure D-3). Plant stakes so that 75-80% of the stake is buried. Angle the stake so it is perpendicular with the slope or slightly pointing downslope. These stakes and the downslope stakes will anchor the fascine firmly in the ground.
- > Secure the fascine so it makes firm contact with the soil. Tamp soil around the stakes firmly into place to eliminate air pockets.
- > Additional staking may be required for treatment locations that only include fascines (e.g., no cobble).

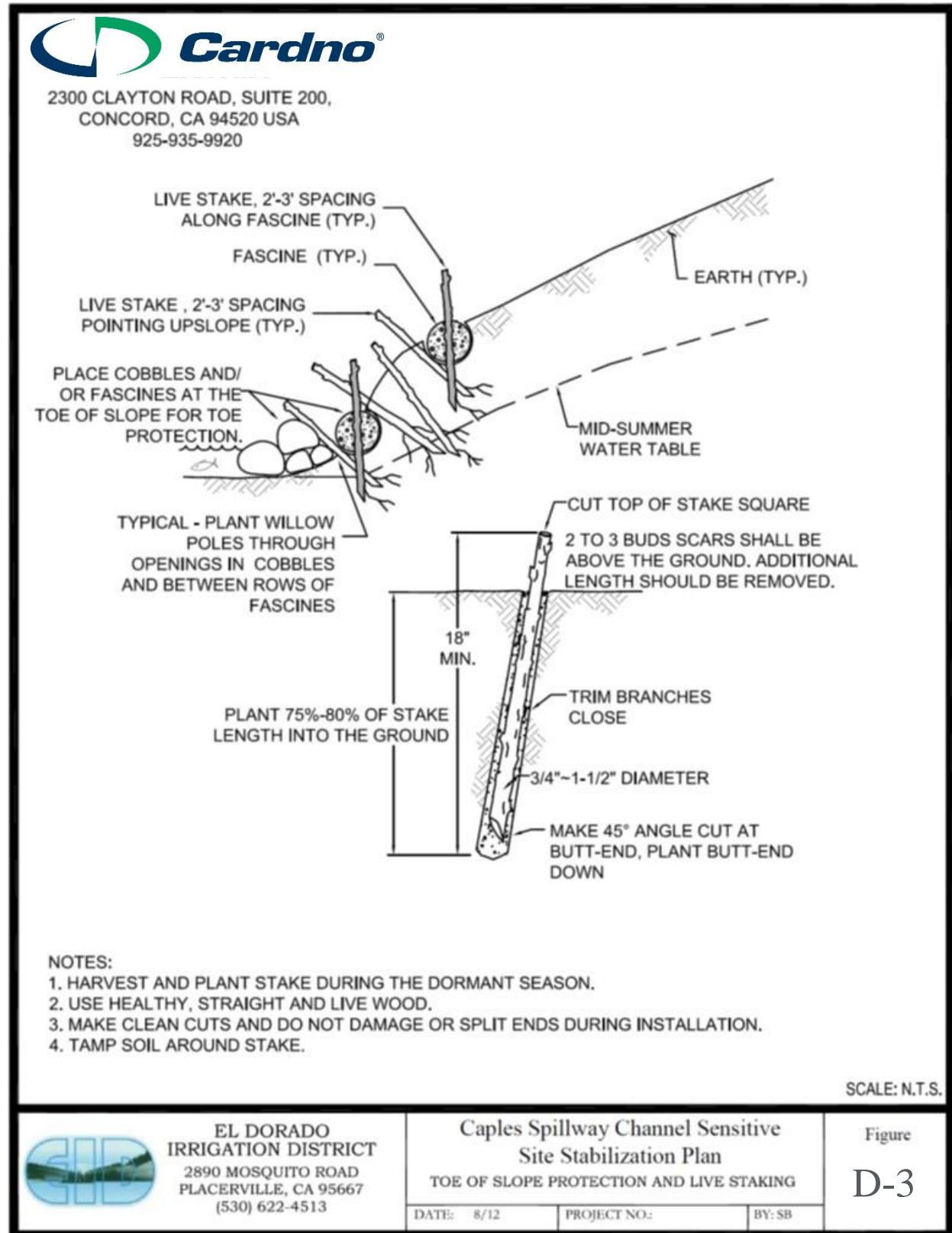
D.3 **References**

Bentrup, G. and J. C. Hoag. 1998. Practical Streambank Bioengineering Guide: User's Guide for Natural Streambank Stabilization Techniques in Arid and Semi-Arid Great Basin and Intermountain West. USDA NRCS Riparian/Wetland Project, Plant Materials Center, Aberdeen, ID.

¹ The length and diameter of the fascines may vary from these measurements depending on the amount and size of material available. Dead stems may also be incorporated in the center of the fascines. Stems from other species may also be used if insufficient willow stems are available (e.g., dogwood, alder).







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