

City of Blue Lake

111 Greenwood Road-P.O. Box 458 Blue Lake, CA 95525

707-668-5655(P)

707-668-5916(F) www

www.bluelake.ca.gov

PLANNING COMMISSION SPECIAL MEETING AGENDA

Monday, May 19, 2025 @ 7:00 P.M. Skinner Store - 111 Greenwood Road, Blue Lake

This meeting will be held in person at the location listed above. The City will provide alternative methods of participation for the convenience of the public. However, the City does not guarantee that there will not be technological issues or interruptions. The public is hereby notified that if there is a technological issue with live video streaming of the meeting, the meeting will continue in person as scheduled. The public may access and participate in the public meeting using one or more of the following methods:

A) **Zoom:** The meeting will be live streamed via Zoom (details below). The direct Zoom link will also be posted on the City of Blue Lake website (https://bluelake.ca.gov/). During the meeting, public comment may be made by using the raise hand feature on Zoom.

Public input will be facilitated by Zoom at the following meeting link:

https://us02web.zoom.us/j/89899669165?pwd=kmkC8paP1vQWjj1niNChFVarNShv7s.1

Meeting Id: 898 9966 9165 Passcode: 041604

- B) In-Writing: Public comments may also be made in advance by submitting written comment via citymanager@bluelake.ca.gov or by filing it with the City Clerk at 111 Greenwood Road, Blue Lake, California, 95525. All public comments (via email or mail) must be received by the City Clerk prior to 4:30 p.m. the day of the meeting. Please identify the meeting date and agenda item to which your comment pertains in the subject line. Public comments, so received, will be forwarded to the Planning Commission. Written public comments will not be read aloud during the meeting.
- 1. Approval of Minutes: January 27, 2025
- 2. **Public Input** The Public is invited to present petitions, make announcements, or provide other information to the Planning Commission that is relevant to the scope of authority of the City of Blue Lake that is not on the Agenda. The Planning Commission may provide up to 15 minutes for this public input session. To assure that each individual presentation is

heard, the Planning Commission may uniformly impose time limitations of 3 minutes to each individual presentation. The public will be given the opportunity to address items that are on the agenda at the time the Planning Commission takes up each specific agenda item.

3. Approval of Agenda

Discussion / Action:

Action-Public Hearing: Application #025-171-001/2022. Conditional Use Permit for 4. Baduwa't Watershed Council (formerly Mad River Alliance) for the Powers Creek Restoration Project. The goals of the project are to restore salmon and riparian habitats in lower Powers Creek and increase the abundance of Coho salmon and steelhead populations in the Mad River. The Project proposes restoring approximately 3,515 linear feet of lower Powers Creek from just upstream of the bridge above the confluence with the Mad River to the culvert at South Railroad Avenue near the City's Downtown. The project would occur on 12 properties, 6 of which are owned by the City of Blue Lake (APNs 025-076-003, 025-077-005, 025-141-001, 025-161-015, 025-171-001, and 025-201-001) and 5 of which are under private ownership (025-076-008, 025-077-007, 025-141-007, 312-161-020, 312-161-022). The grading limits for the restoration reach would be approximately 6.15 acres and there would also be approximately 1.46 acres of additional revegetation areas outside of the grading limits (total of \sim 7.61 acres). Project implementation is anticipated to occur in 2 to 3 phases depending on the availability of implementation funding. The recommended environmental determination for the proposed project is that the Powers Creek Restoration Project is within the scope of the California Environmental Quality Act Programmatic Environmental Impact Report for the State Water Resources Control Board Statewide Restoration General Order (SRGO PEIR: see at link below).

https://www.waterboards.ca.gov/water issues/programs/cwa401/generalorders/2022/srgo-final-peir-combined.pdf

- 5. Miscellaneous Planner Items.
- 6. Upcoming Planning Commission meetings for the next 3 months will be on June 16, 2025, July 21, 2025, and August 18, 2025.
- 7. Adjournment by 9:00 pm unless extended by the Planning Commission.

A request for disability-related modification or accommodation, including auxiliary aids or services, may be made by a person with a disability who requires a modification or accommodation in order to participate in the public meeting, by contacting City Manager Amanda Mager, (707) 668-5655, at least 24 hours prior to the commencement of the meeting.

Called to Order: 7:00PM

Commissioners Present: Elaine Hogan, Cort Pryor, Jason Cseh, Matt Issac

Commissioners Absent: Matthew Schang

Staff Present: Planner Garry Rees, City Manager Mager

1. Approval of the Minutes: November 18, 2024

Motion by: Commissioner Cseh Seconded by: Commissioner Issac

No Public Comment

Motion Summary: Motion Passed

2. Public Comment

Kent Sawatzky: Comments on the Opportunity Zone

Public Comment Closed.

3. Approval of the Agenda as Presented

Motion by: Commissioner Cseh Seconded by: Commissioner Pryor

No Public Comment

Motion Summary: Motion Passed

4. Housing Element Program HI-14 Combining Zone Presentation/Discussion

Planner Rees presents on the draft Housing Element Implementation Program HI-14 – Multi-Family Combining Zone. The combining zone would be applied to specific parcels as needed to meet State requirements; this zone would principally permit multi-family development if the development meets the City's zoning requirements; this would remove the requirement to obtain a conditional use permit.

Steps for implementation include sending the draft zoning language to HCD for review; conduct CEQA review; and apply the combining zone to a specific parcel through a zoning map amendment, that will meet the State's requirements. This zoning tool can be applied to parcels in the future to assist the City in meeting future regional housing allocations.

Public Comment:

Rebecca Collins: Comments on the zoning for her property; expresses her confusion over the combining zone and what areas of the City it will be applied.

Planner Rees: Clarifies that the zone would be applied to specific parcels and not a specific zoning district.

Kent Sawatzky: States that he would like this zone applied to his Emporium property; doesn't want more than four-plexes in the City.

Mardi Granger: Asks the Planner to speak closer to the microphone.

Lori Ponte: Questions what the next housing cycle will be.

Garry Rees: Explains that the City is working towards compliance in the current planning cycle and the City will likely receive a similar future RHNA allocation or more.

City Manager Mager: States that housing isn't punitive; Blue Lake needs housing and we need our regulations to be compliant and not preclusive to development; multi-family housing is an important part of any community.

Kent Sawatzky: States that you need people with money to build housing; he's one of the people that has the finances to develop. States his support for in-fill and tiny houses; he isn't against development but wants the City to work with him.

Terry Bayless: Questions how the combining zone would be applied; isn't against housing. **Lisa Hoover**: Questions how the combining zone will address building affordable housing. **Lori Ponte:** Comments that it's not about creating separate classes, but she's concerned about safe development for those that might not have cars.

Public Comment Closed.

Commissioner Cseh: Questions if there's a cap on development; if the City can plan for more housing.

Planner Rees: Explains that some communities have housing limitations due to infrastructure; these have to be identified to HCD; the State will most likely say to upzone or look for annexation opportunities if a community does not have adequate sites for their RHNA allocation. **Planner Rees**: Identifies potential parcels for consideration, including property on Taylor Way and the Calgon Carbon property. Next steps include working with HCD to review the language and make any necessary changes; finalize a location and recommend to the City Council for adoption and application.

5. Circulation Element

Planner Rees presents on the Circulation Element and provides an overview of the draft that was prepared in 2015; explains that the City had a grant in 2015 to update elements and code sections including the circulation element. Traffic counts were completed and figures were updated. The element was not adopted and staff is providing information to start the process of working towards an update. Next steps would include community input, dialogue with the Planning Commission, and receive feedback and direction on moving forward.

Public Comment:

Kent Sawatzky: Comments that the draft is outdated. **Julie Christie**: Comments on the public input process.

Public Comment Closed.

Planner Rees: States that the prior process took three years to complete; some public may not have participated but there was a lot of process and opportunity to participate; this is the start of the process to move forward.

Commissioner Pryor: Asks about the updated traffic studies.

Planner Rees: Explains that a traffic study was completed in the last few years and includes a cumulative analysis for the reasonably foreseeable development in the Powers Creek District.

The commissioners discuss updating the current plan to get a base document that could be discussed further.

Public Comment:

Kent Sawatzky: Comments on reviewing other small jurisdictions circulation elements; don't reinvent the wheel.

Commissioner Hogan: Would like to see an updated draft; would be willing to form an ad-hoc to spend time working on an update.

- 6. Miscellaneous Planner Items: No items for discussion.
- 7. **Upcoming Meeting Dates**: Commissioners agree to reschedule the next meeting because it falls on a holiday.

8. Motion to Adjourn-8:45pm.

Motion by: Commissioner Hogan Seconded by: Commissioner Issac Motion Summary: Motion passes



CITY OF BLUE LAKE

Post Office Box 458 • 111 Greenwood Road • Blue Lake, CA 95525 Phone 707.668.5655 Fax 707.668.5916

PLANNING COMMISSION STAFF REPORT

DATE: May 19, 2025

APPLICATION #: 025-171-001/2022

PERMIT TYPE: Conditional Use Permit

APPLICANT: Baduwa't Watershed Council (Dave Feral)

PROPERTY OWNER(S): The project would occur on 11 properties, 6 of which are owned by the City of Blue Lake and 5 of which are under private ownership. The property ownership information is detailed below.

Table 1: Property Ownership Information

Property Owner Name	Assessor Parcel Number	Address
City of Blue Lake	025-076-003, 025-077-005, 025-141-001, 025-161-015, 025-171-001, and 025-201-001	210 Chartin Road
GLJ Construction	312-161-020	No address assigned
Vaness Kuersten	312-161-022	No address assigned
Kyle Boughton	025-141-007	301 Hatchery Rd
Frank Onstine	025-076-008	100 S Railroad Ave
Al & Carlotta Clark	025-077-007	111 Chartin Rd

PROJECT LOCATION: The Project is located along 3,515 linear feet of lower Powers Creek from just upstream of the bridge above the confluence with the Mad River to the culvert at South Railroad Avenue near the City's Downtown.

ASSESSOR'S PARCEL #: See Table 1.

ZONING DISTRICT: O – Opportunity, PF – Public Facility, X – Open Space/Recreation, MU – Mixed Use, R2 – Residential Two-Family

GENERAL PLAN DESIGNATION: MU – Mixed Use, F – Public Facility, LDR – Low Density Residential, OS – Open Space, MF – Multi-Family Residential

BACKGROUND/HISTORY: The Powers Creek channel was historically realigned to accommodate the construction of the McIntosh Mill log pond in the 1940s. Review of historical photos indicate that the channel was straightened and lengthened, discharging into the Mad River much further downstream from its original confluence with what was historically the North Fork Mad River. In 2015, the Blue Lake Rancheria was awarded funding through a U.S. Fish & Wildlife Service Tribal Wildlife grant to remove and replace an undersized bridge near the confluence with the Mad River, which had previously created a fish passage barrier due to cement that reinforced the bridge. The Rancheria project also included the restoration of the portion of lower Powers Creek between the confluence with the Mad River upstream to the replaced bridge.

PROJECT DESCRIPTION: The Powers Creek Restoration Project (Project) proposes restoring approximately 3,515 linear feet of lower Powers Creek from just upstream of the bridge above the confluence with the Mad River to the culvert at South Railroad Avenue near the City's Downtown. The grading limits for the restoration reach would be approximately 6.15 acres and there would also be approximately 1.46 acres of additional revegetation areas outside of the grading limits (total of ∼7.61 acres). Project implementation is anticipated to occur in 2 to 3 phases depending on the availability of implementation funding (see Figure 1 − Site Plan). Design, permitting, and environmental review for the Project is funded by a planning grant from the California Department of Water Resources Urban Streams Restoration Program (USRP). Implementation funding will be sought from the California Department of Water Resources and/or the CDFW Fisheries Restoration Grant Program (FRGP).

The goals of the Project are to restore salmon and riparian habitats in lower Powers Creek and increase the abundance of Coho salmon and steelhead populations in the Mad River. To accomplish these goals, the Project proposes to widen, deepen, and/or realign this section of Powers Creek and remove invasive, non-native vegetation. After grading and vegetation removal activity, revegetation is proposed to re-establish a riparian forest of native vegetation, including trees, shrubs, and forbs. The Project will benefit fish populations through habitat improvements including the excavation of pools, installation of woody debris structures, and the construction of side channels, a high flow bypass channel, and coarsened riffles. It is estimated that the Project would remove approximately 40,000 cubic yards of aggraded sediment from the creek channel. To minimize the potential for bank erosion downstream of the South Railroad Avenue culvert, the Project also proposes to install rock slope protection between the culvert outlet and the confluence with South Fork Powers Creek. To accommodate the proposed restoration design, modifications are proposed to existing infrastructure in the restoration reach including the following: 1) due to the shallow depth of the water and sewer lines near the pedestrian bridge connecting Broderick Lane and Monda Way, the Project would include lowering the utility lines to allow for the proposed depth of channel excavation; and 2) the pedestrian bridge connecting Broderick Lane and Monda Way would be raised by up to 1 foot to provide additional freeboard during a 100-year flood event. Staging areas for construction are proposed to occur along the southern edge of the creek. The soils stockpile area is proposed at the wood fuel storage yard at the former power plant site and/or at the vacant City-owned property north of Taylor Way. Alternatively, the excavated soils may be transported to a local aggregate processing facility (e.g., Kernen Construction).

Post-construction activities will include monitoring and reporting for a 10-year period. Adaptive management activity may be necessary during the 10-year monitoring period to ensure the success of the restoration efforts. Adaptive management activities could include replanting native vegetation, invasive species removal, installation of additional erosion control materials, removal of debris/vegetation comprising the restoration design, modification/maintenance of woody debris structures, and repair/maintenance of irrigation infrastructure and fencing.

See the following attachments for additional information about the Project:

- Attachment 1 65% Design Plans
- Attachment 2 65% Basis of Design Report
- Attachment 3 Revegetation, Monitoring, and Reporting Plan

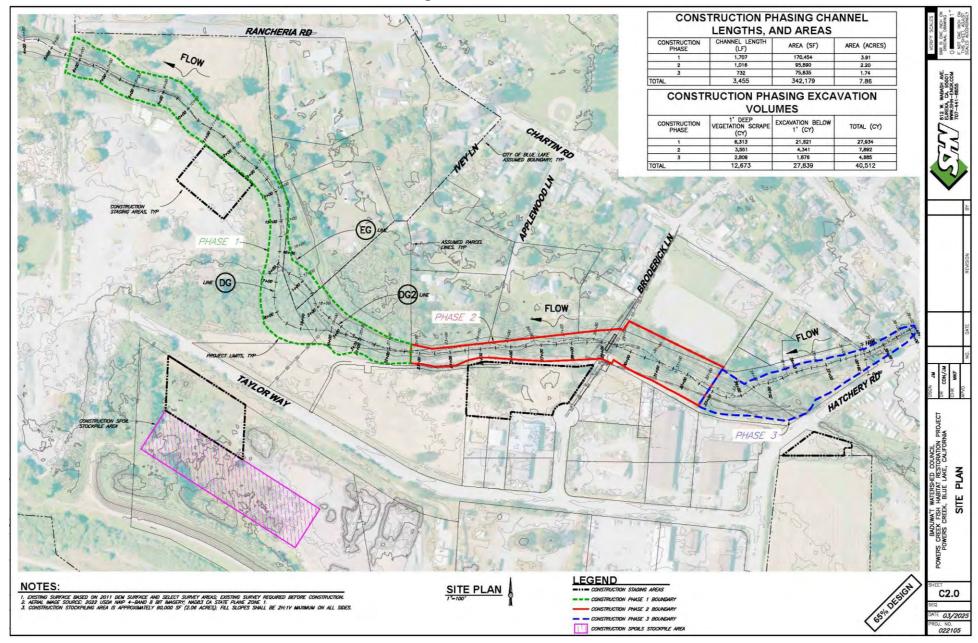
ENVIRONMENTAL REVIEW: The State Water Resources Control Board (State Water Board) has developed a General Order for Clean Water Act Section 401 Water Quality Certification and Waste Discharge Requirements for Restoration Projects Statewide to improve the efficiency of regulatory reviews for projects throughout the state that would restore aquatic and riparian resource functions and/or services. The Statewide Restoration General Order (SRGO) establishes an authorization process for environmentally beneficial restoration projects. The purpose of the SRGO is to expedite consultation, authorization, and permitting of restoration projects intended to help the State of California achieve its habitat restoration, species recovery, and water quality improvement goals.

The project team met with staff from the North Coast Regional Water Quality Control Board (NCRWQCB) on April 7, 2025 to discuss the eligibility of the Project for coverage under the SRGO. At the meeting, Senior Environmental Scientist Jake Shannon of the NCRWQCB (phone: 707- 576-2673; email: jacob.shannon@waterboards.ca.gov) determined that the Project is eligible for coverage under the SRGO and its California Environmental Quality Act (CEQA) Programmatic Environmental Impact Report (PEIR). The NCRWQCB staff further explained that since the City must issue a discretionary permit (i.e., conditional use permit) for the Project, that the City could serve as the CEQA Lead Agency and adopt a determination that the Project is within the scope of the SRGO PEIR. The CEQA determination adopted by the City could then also be used by the State permitting agencies (NCRWCB and CDFW) for the issuance of their permits for the Project.

Since the Project has been determined by the NCRWQCB to be eligible for coverage under the SRGO, the recommended environmental determination for the proposed Project is that the Powers Creek Restoration Project is within the scope of the CEQA PEIR for the State Water Board Statewide Restoration General Order (PEIR available at link below). https://www.waterboards.ca.gov/water_issues/programs/cwa401/generalorders/2022/srgo-final-peir-combined.pdf.

Attachment 4 to this staff report contains a determination on forms provided by the NCRWQCB that the Project is within the scope of the SRGO PEIR. The forms also list the mitigation measures from the PEIR that are applicable to the proposed Project.

Figure 1 – Site Plan



SITE CHARACTERISTICS: Powers Creek is an ungauged, intermittent tributary of the Mad River, which is consistently dry summer through fall. The Powers Creek tributary flows south through the watershed into the floodplains of the Mad River, and meanders west, through the City of Blue Lake to its confluence with the Mad River. The Powers Creek sub-basin is approximately 3.3 square miles. The drainage area upstream of the project site is approximately 2.7 square miles.

Powers Creek currently supports a disturbance-related vegetation community that likely originated in historical large-scale disturbance of the stream channel and surrounding vegetation, such as the realignment and channelization of Powers Creek in the 1940s. This has resulted in a species-poor, low growing willow dominated canopy, primarily arroyo willow, with a significant invasive species component, specifically Himalayan blackberry. Scattered black cottonwood, conifers, and red alder occur infrequently along the streams reach. The current riparian vegetation has choked the stream channel, making it impassible to most aquatic and terrestrial wildlife species, and resulting in serious aggradation of sediment, which has over time reduced channel capacity and has made the stream less suitable for salmonid species and more prone to flooding.

STAFF/AGENCY COMMENTS: Design, permitting, and environmental review for the Project is funded by a planning grant from the California Department of Water Resources Urban Streams Restoration Program (USRP). The City of Blue Lake is a co-sponsor for the grant funding for the Project and has coordinated with Baduwa't Watershed Council throughout the design process. This has included obtaining input from the City Manager, City Engineer, City Planner, Building Official, and Public Works Department throughout the design and permitting process. In addition to the conditional use permit that is required for the Project, City staff instructed the applicant that they must also obtain a floodplain development permit and grading permit. The requirements for obtaining these permits are outlined in Blue Lake Municipal Code Chapters 13.20 – Floodplain Management and 15.12 – Grading, Erosion, and Sediment Control.

The Project requires permits from several state and federal regulatory agencies including the California Department of Fish and Wildlife (CDFW), North Coast Regional Water Quality Control Board (NCRWQCB), and U.S. Army Corps of Engineers (USACE). Through the permitting process these agencies have reviewed the Project plans and provided comments to assist in finalizing the Project design and ensure it meets their requirements for riparian restoration projects.

GENERAL PLAN AND ZONING CODE CONSISTENCY: As noted previously, the Project would occur on 11 properties, 6 of which are owned by the City of Blue Lake and 5 of which are under private ownership. These properties have a variety of General Plan Designations including MU – Mixed Use, F – Public Facility, OS – Open Space, MF – Multi-Family Residential. The corresponding Zoning Districts include O – Opportunity, PF – Public Facility, X – Open Space/Recreation, MU – Mixed Use, R2 – Residential Two-Family.

The Creeks & Wetlands section of the Blue Lake General Plan Land Use Element contains several goals and policies related to preserving and enhancing Powers Creek. The Powers Creek Restoration Project is consistent with the following goals and policies:

GOAL: TO PROTECT AND ENHANCE POWERS CREEK AND THE VARIOUS

WETLANDS THROUGHOUT THE CITY AS ATTRACTIVE NATURAL FEATURES AND VALUABLE RESOURCES, AND TO MINIMIZE FLOOD, EROSION AND OTHER PROPERTY DAMAGE.

POLICY 1. Powers Creek shall be managed to maintain the creek as a scenic and natural resource, and to protect adjacent properties and structures to the greatest degree possible.

POLICY 6. The City shall pursue funding and collaboration with local groups, agencies, and non-profit organizations for the restoration of Powers Creek.

The proposed project is consistent with the above goals and policies because it includes a collaboration between the City of Blue Lake, Baduwa't Watershed Council, and various funding and regulatory agencies to restore a portion of lower Powers Creek.

Conditional Use Permit and Findings for Approval

Creek restoration projects are not specifically listed as a principally or conditionally permitted use in the various Zoning Districts applicable to the properties that contain the project site. However, some of the zones (i.e., MU and O) do allow uses that are not specifically listed with a use permit if the Planning Commission can find that it meets the intent or general description of the zone, would not impact nor detract from the zone, would not constitute a nuisance or be detrimental to the district or surrounding land use, and/or is found to be consistent with the General Plan. Additionally, Blue Lake Municipal Code (BLMC) Section 17.28.030.A states that use permits may be granted for any use if certain findings can be made by the Planning Commission. As stated in Section 17.28.030:

"Use permits may be granted, upon application to the Planning Commission for any use for which a use permit is permitted or required by these regulations, or for any use which, while not specifically enumerated in these regulations, is, in the opinion of the Planning Commission, similar to and compatible with the uses permitted in the zone in which the subject property is situated."

In addition to the above findings that relate to uses not specifically listed, below are the standard findings that must be made by the Planning Commission to approve a CUP (BLMC Section 17.28.030.F):

The City Planning Commission shall make the following findings before granting a use permit:

- 1. That the proposed location of the conditional use is in accord with the objectives of subsection A of this section and the purposes of the zone in which the site is located.
- 2. That the proposed location of the conditional use and the conditions under which it would be operated or maintained will not be detrimental to the public health, safety, or welfare, or materially injurious to properties or improvements in the vicinity.

The project proposes the restoration and enhancement of an existing creek in the City with the goal of restoring salmon and riparian habitats in lower Powers Creek and increasing the abundance of Coho salmon and steelhead populations in the Mad River. The restoration of this creek section is consistent with the goals and policies in the City's General Plan and would 1) not have impacts that would be inconsistent with the uses allowed in the various zones; and 2)

not be detrimental to the public, health, safety or welfare or materially injurious to properties or improvements in the vicinity.

Development Standards

The project proposes restoration of a portion of lower Powers Creek. The development standards in the City's Zoning Code (e.g., setbacks, height, ground coverage, minimum lot area, off-street parking, etc.) are primarily applicable to structures and related improvements. As such, the development standards are not applicable to a creek restoration project.

PLANNING COMMISSION ACTION OPTIONS: Listed below are the potential options for Planning Commission action on the proposed Project including recommended motions for each action.

1. <u>Approval.</u> Determine that all the necessary findings can be made for approval of the Project with or without modifications to any conditions of approval recommended by staff. **Attachment 5** to this staff report contains draft Resolution No. 1-2025, which contains the findings necessary for approval of the proposed Project. Exhibit "A" to Resolution No. 1-2025 contains the conditions of approval recommended by staff.

<u>Action</u>: Motion to adopt Resolution No. 1-2025, read by title only: "Resolution of the Planning Commission of the City of Blue Lake Approving a Conditional Use Permit Application for Baduwa't Watershed Council to allow the restoration of a portion of lower Powers Creek in the Opportunity, Public Facility, Open Space/Recreation, Mixed Use, and Residential Two-Family Zones."

	Action: A motion to deny the Conditional Use Permit application due to the findings
۷.	cannot be made.
2	Denial. Determine that one or more of the necessary findings for approval of the Project

3. Request Additional Information and continue item to next meeting agenda. Request additional information needed to assist in determining whether the necessary findings for approval of the Project can be made.

for approval not being met, specifically regarding ______.

Action: A motion to request additional information specifically regarding
be brought back to the regularly scheduled meeting of June 16,
2025 (or time certain Special) Planning Commission meeting for consideration.

STAFF RECOMMENDATION:

- 1) Receive a presentation from city staff on the Conditional Use Permit application.
- 2) Receive a presentation from the applicant (if present at the meeting).
- 3) Open the public hearing and receive public testimony.
- 4) Close the public hearing.
- 5) Discuss the application and ask questions of city staff and the applicant.
- 6) Adopt Resolution 1-2025 (Option 1).

Attachment 1

65% Design Plans

BADUWA'T WATERSHED COUNCIL

POWERS CREEK FISH HABITAT RESTORATION PROJECT POWERS CREEK, BLUE LAKE, CALIFORNIA



PREPARED BY:





MARCH 2025



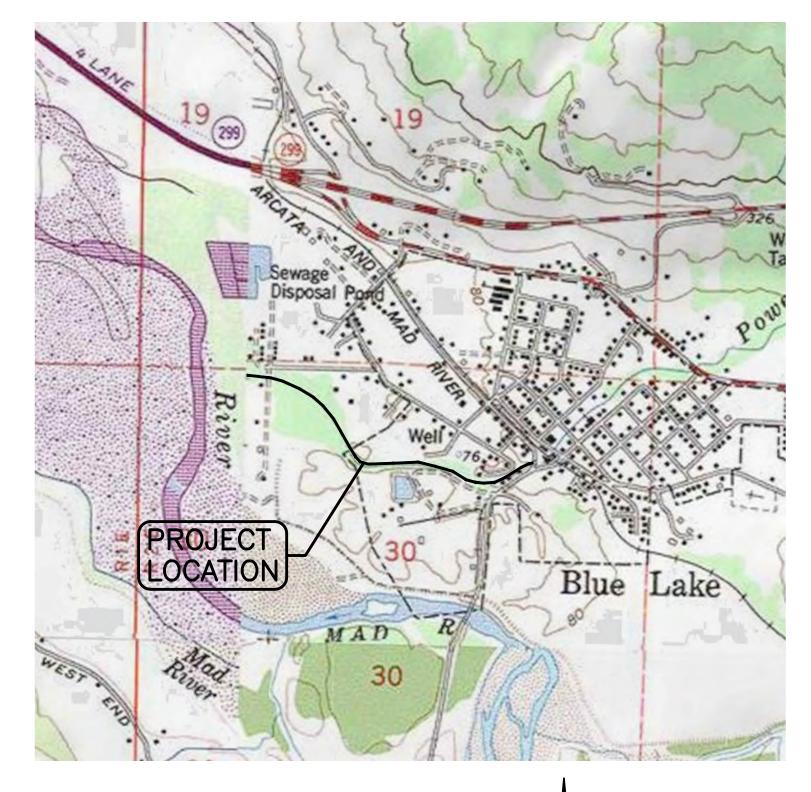


FOR THIS PROJECT HAS BEEN PROVIDED BY PROPOSITION 68

1 THE CALIFORNIA RESOURCES AGENCY AND CALIFORNIA DEPARTMENT
R RESOURCES TO IMPROVE RIVER PARKWAYS AND URBAN STREAMS

INDEX OF SHEETS

SEQ	SHEET	TITLE
1	G1.0	COVER
2	G2.0	STANDARD ABBREVIATIONS AND LEGENDS
3	G3.0	NOTES AND SPECIFICATIONS
4	G4.0	EXISTING SITE PLAN
5	C1.0	VEGETATION REMOVAL AREAS
6	C1.1	DEMOLITION SITE PLAN
7	C1.2	ENLARGED DEMOLITION PLAN
8	C1.3	ENLARGED DEMOLITION PLAN
9	C2.0	SITE PLAN
10	C3.0	UTILITY PLAN AND PROFILE
11	C3.1	UTILITY DETAILS
12	C3.2	UTILITY DETAILS
13	C4.0	GRADING INDEX
14	C4.1	ENLARGED GRADING PLAN
15	C4.2	ENLARGED GRADING PLAN
16	C4.3	ENLARGED GRADING PLAN
17	C4.4	ENLARGED GRADING PLAN
18	C4.5	ENLARGED GRADING PLAN
19	C4.6	ENLARGED GRADING PLAN
20	C5.0	CROSS SECTIONS
21	C5.1	CROSS SECTIONS
22	C6.0	THALWEG PROFILE
23	C6.1	THALWEG PROFILE
24	C6.2	HIGH BANK FLOW THALWEG PROFILE
25	C7.0	CHANNEL GRADING DETAILS
26	C7.1	WOOD STRUCTURE DETAILS
27	C7.2	WOOD STRUCTURE EXAMPLES
28	C7.3	SURFACE TREATMENT DETAILS
29	L1.0	PLANTING MAP AND LEGEND
30	L1.1	PLANTING PLAN TYPICAL SECTION
31	L1.2	ENLARGED PLANTING PLAN
32	L1.3	ENLARGED PLANTING PLAN
33	L1.4	ENLARGED PLANTING PLAN
34	L1.5	ENLARGED PLANTING PLAN
35	L1.6	ENLARGED PLANTING PLAN
36	L1.7	ENLARGED PLANTING PLAN
37	L2.0	PLANTING DETAILS
38	L3.0	PLANTING NOTES
39	L4.0	PLANTING AND IRRIGATION NOTES
40	L5.0	IRRIGATION PLAN INDEX
41	L5.1	IRRIGATION PLAN
42	L5.2	IRRIGATION PLAN
43	L5.3	IRRIGATION PLAN
44	L5.4	IRRIGATION DETAILS

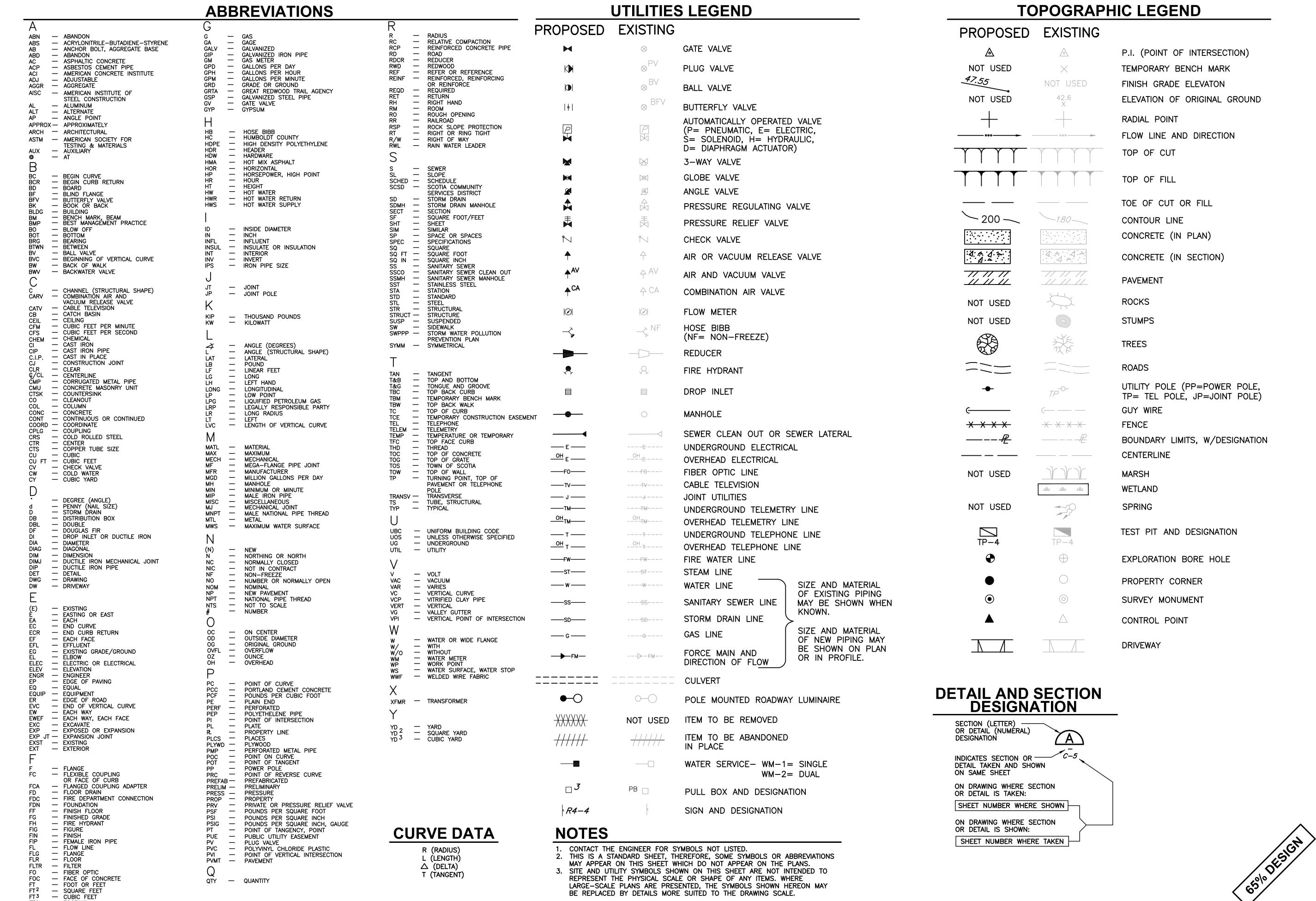


VICINITY MAP

G1.0

DATE 03/2025

022105



LARGE-SCALE PLANS ARE PRESENTED, THE SYMBOLS SHOWN HEREON MAY

BE REPLACED BY DETAILS MORE SUITED TO THE DRAWING SCALE.

SQUARE FEET

— CUBIC FEET

— FOOTING

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G2.0

022105

DATE 03/2025

PROJ. NO.

GENERAL NOTES:

- 1. ALL WORK SHALL CONFORM TO CURRENT CALIFORNIA BUILDING CODE.
 2. THE WORKING DRAWINGS ARE GENERALLY DIAGRAMMATIC. THEY DO NOT SHOW EVERY OFFSET, BEND OR ELBOW REQUIRED FOR INSTALLATION IN THE SPACE PROVIDED. THEY DO NOT SHOW EVERY DIMENSION, COMPONENT PIECE, SECTION, JOINT OR FITTING REQUIRED TO COMPLETE THE PROJECT. ALL LOCATIONS FOR WORK SHALL BE CHECKED AND COORDINATED WITH EXISTING CONDITIONS IN THE FIELD BEFORE BEGINNING CONSTRUCTION. EXISTING UNDERGROUND UTILITIES WITHIN THE LIMITS OF EXCAVATION SHALL BE VERIFIED AS TO CONDITION, SIZE AND LOCATION BY UNCOVERING, PROVIDED SUCH IS PERMITTED BY LOCAL PUBLIC AUTHORITIES WITH JURISDICTION, BEFORE BEGINNING CONSTRUCTION. CONTRACTOR SHALL NOTIFY ENGINEER OF ANY DISCREPANCIES.
- 3. THE CONTRACTOR SHALL SECURE ALL NECESSARY PERMITS PRIOR TO THE COMMENCEMENT
- 4. THE CONTRACTOR SHALL PROVIDE A COPY OF THE TRENCH PERMIT FROM THE CALIFORNIA DIVISION OF INDUSTRIAL SAFETY PRIOR TO THE EXCAVATION OF ANY TRENCH OVER FIVE
- 5. CONTRACTOR SHALL PERFORM TRENCH WORK IN CONFORMANCE WITH THE CALIFORNIA DIVISION OF INDUSTRIAL SAFETY REQUIREMENTS AND SHALL CONFORM TO ALL APPLICABLE OCCUPATIONAL SAFETY AND HEALTH STANDARDS, RULES, REGULATIONS AND ORDERS ESTABLISHED BY THE STATE OF CALIFORNIA AND OTHER APPLICABLE AGENCIES.
- 6. CONTRACTOR AGREES THAT IN ACCORDANCE WITH GENERALLY ACCEPTED CONSTRUCTION PRACTICES, GENERAL CONTRACTOR WILL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THE PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY. ALL WORK AND EQUIPMENT SHALL COMPLY WITH THE CALIFORNIA DIVISION OF INDUSTRIAL SAFETY REQUIREMENTS. THIS REQUIREMENT SHALL BE MADE TO APPLY CONTINUOUSLY, AND NOT BE LIMITED TO NORMAL WORKING HOURS. CONTRACTOR FURTHER AGREES TO HOLD HARMLESS, INDEMNIFY AND DEFEND THE OWNER. THE ENGINEER AND HIS/HER CONSULTANTS.
- 7. THE CONTRACTOR SHALL INDEPENDENTLY REVIEW GROUND, TOPOGRAPHY AND TREE CONDITIONS THROUGHOUT THE SITE, AND ASSUME THE RISK OF COMPLETING THE WORK SET OUT ON THESE PLANS, REGARDLESS OF ROCK, WATER TABLE OR OTHER CONDITIONS WHICH MAY BE ENCOUNTERED IN THE COURSE OF THE WORK.
- 8. ANY DISCREPANCY DISCOVERED BY THE CONTRACTOR IN THESE PLANS, OR ANY FIELD CONDITIONS DISCOVERED BY THE CONTRACTOR THAT MAY DELAY OR OBSTRUCT THE PROPER COMPLETION OF THE WORK SHOWN HEREIN SHALL BE BROUGHT TO THE ATTENTION OF THE OWNER AND THE ENGINEER IMMEDIATELY UPON DISCOVERY. SAID NOTIFICATION SHALL BE IN WRITING.
- 9. ALL UNDERGROUND IMPROVEMENTS SHALL BE INSTALLED TESTED AND APPROVED PRIOR TO
- 10. THE CONTRACTOR SHALL NOT BEGIN EXCAVATING UNTIL ALL EXISTING UTILITIES HAVE BEEN MARKED IN THE FIELD. THE CONTRACTOR SHALL NOTIFY EACH APPLICABLE ENTITY AT LEAST 48 HOURS PRIOR TO COMMENCING WORK. CALL UNDERGROUND SERVICE ALERT (USA) TWO WORKING DAYS BEFORE DIGGING AT (800) 642—2444 (OR 811) FOR LOCATES.
- 11. GRADING AND CONSTRUCTION CONTRACTORS SHALL STOP WORK AND NOTIFY THE OWNER AND THE ENGINEER IF CULTURAL RESOURCES ARE DISCOVERED DURING CONSTRUCTION.
- 13. THE CONTRACTOR SHALL GIVE THE INSPECTOR 48 HOURS ADVANCE NOTICE OF ANY CONSTRUCTION OR REQUIRED TESTING.
- 14. SHOULD THE CONTRACTOR OR ANY OF HIS AGENTS OR EMPLOYEES ENCOUNTER OR DISCOVER MATERIALS WHICH APPEAR TO BE HAZARDOUS DURING THE PERFORMANCE OF THE WORK, THE CONTRACTOR SHALL INFORM THE ENGINEER IMMEDIATELY AND SUSPEND WORK IN THE AFFECTED AREA UNTIL THE ENGINEER HAS INSPECTED THE LOCATION AND
- WORK IN THE AFFECTED AREA UNTIL THE ENGINEER HAS INSPECTED THE LOCATION AND MATERIALS IN QUESTION. SHOULD IT BE NECESSARY TO UNDERTAKE REMEDIATION, THE ENGINEER WILL GIVE WRITTEN NOTICE TO SUSPEND WORK IN THE AFFECTED AREA UNTIL THE PROPER COURSE OF ACTION HAS BEEN DETERMINED. OPERATIONS IN THE AFFECTED AREA SHALL BE RESUMED ONLY UPON WRITTEN NOTICE BY THE ENGINEER.

 15. ALL SITE GRADING WILL BE INSPECTED BY THE ENGINEER. COMPACTION TESTING WILL BE
- CONDUCTED AFTER SUFFICIENT DENSITIES HAVE BEEN ACHIEVED IN THE CONTRACTOR'S OPINION. THE CONTRACTOR SHALL MAKE ALL REQUESTS FOR MATERIALS TESTING AT LEAST 48 HOURS IN ADVANCE. ANY SOILS THAT FAIL TO MEET THE REQUIRED COMPACTION LEVELS SHALL BE REMOVED, AND RECOMPACTED. ALL COSTS ASSOCIATED WITH ACHIEVING COMPACTION STANDARDS SHALL BE INCLUDED IN THE CONTRACTOR'S ORIGINAL BID.
- 16. THE TOPSOIL SHALL BE REMOVED FROM CUT AND FILL AREAS AND SHALL NOT BE USED FOR ENGINEERED FILL. TOPSOIL SHALL BE STOCKPILED SEPARATELY AND REPLACED OVER AREAS OF EXPOSED SUBGRADE TO A MINIMUM DEPTH OF 6 INCHES.
- 17. NO CHANGES OR MODIFICATIONS SHALL BE MADE TO THESE PLANS WITHOUT WRITTEN APPROVAL BY THE ENGINEER.

IMAGERY & EXISTING SURFACE NOTES:

1. EXISTING SURFACE BASED ON 2011 DEM SURFACE AND SELECT SURVEY AREAS; EXISTING SURVEY REQUIRED BEFORE CONSTRUCTION.
2. AERIAL IMAGE SOURCE: AERIAL IMAGE SOURCE: 2022 USDA NAIP 4—BAND 8 BIT IMAGERY; NAD83 CA STATE PLANE ZONE 1.

65% DESIGN

BAR IS ONE INCH ON ORIGINAL DRAWING

OFFICE OF INCH ON IF NOT ONE INCH ON THIS SHEET, ADJUST

812 W. WABASH AV EUREKA, CA. 95501 WWW.SHN—ENGR.COI 707—441—8855

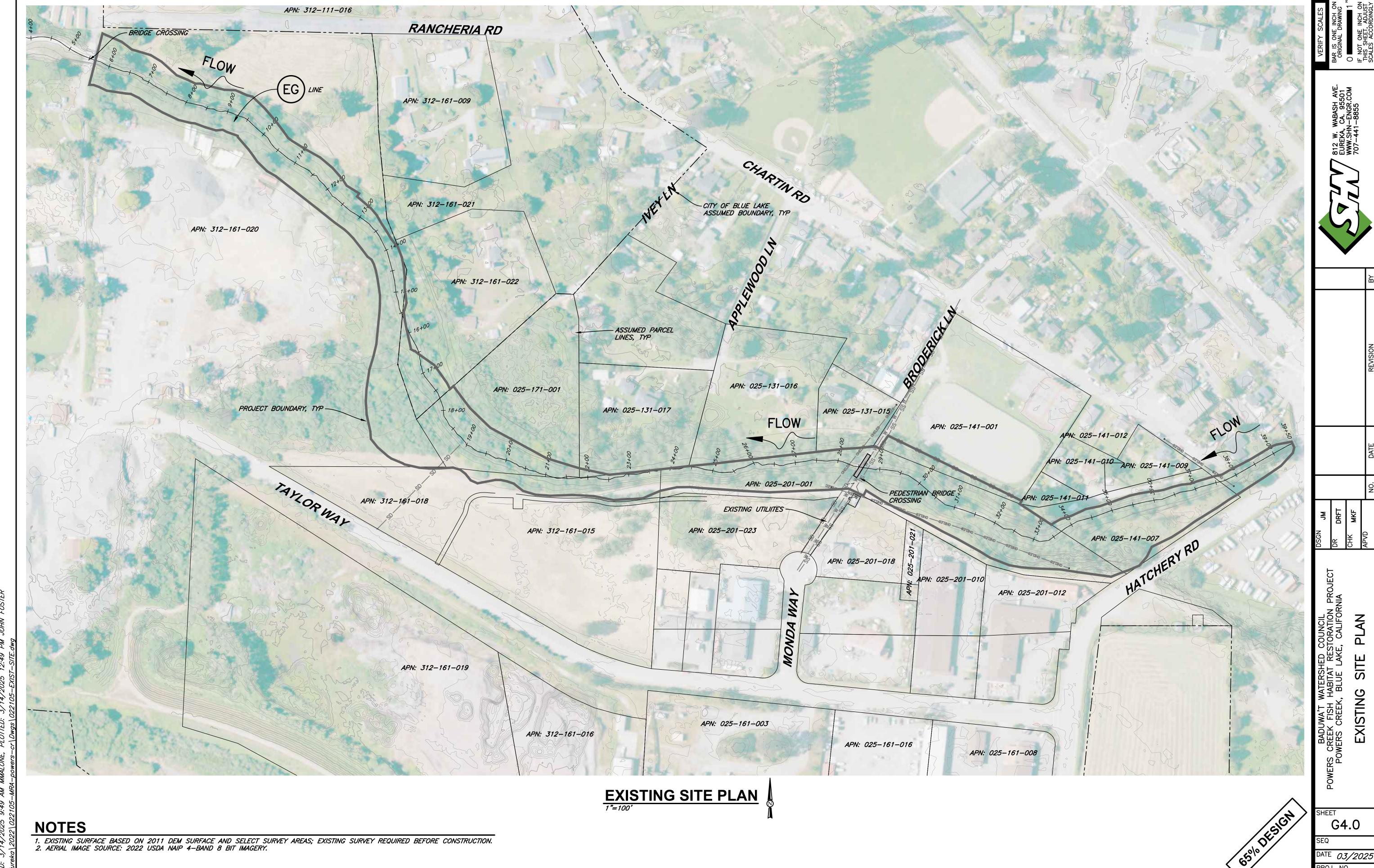
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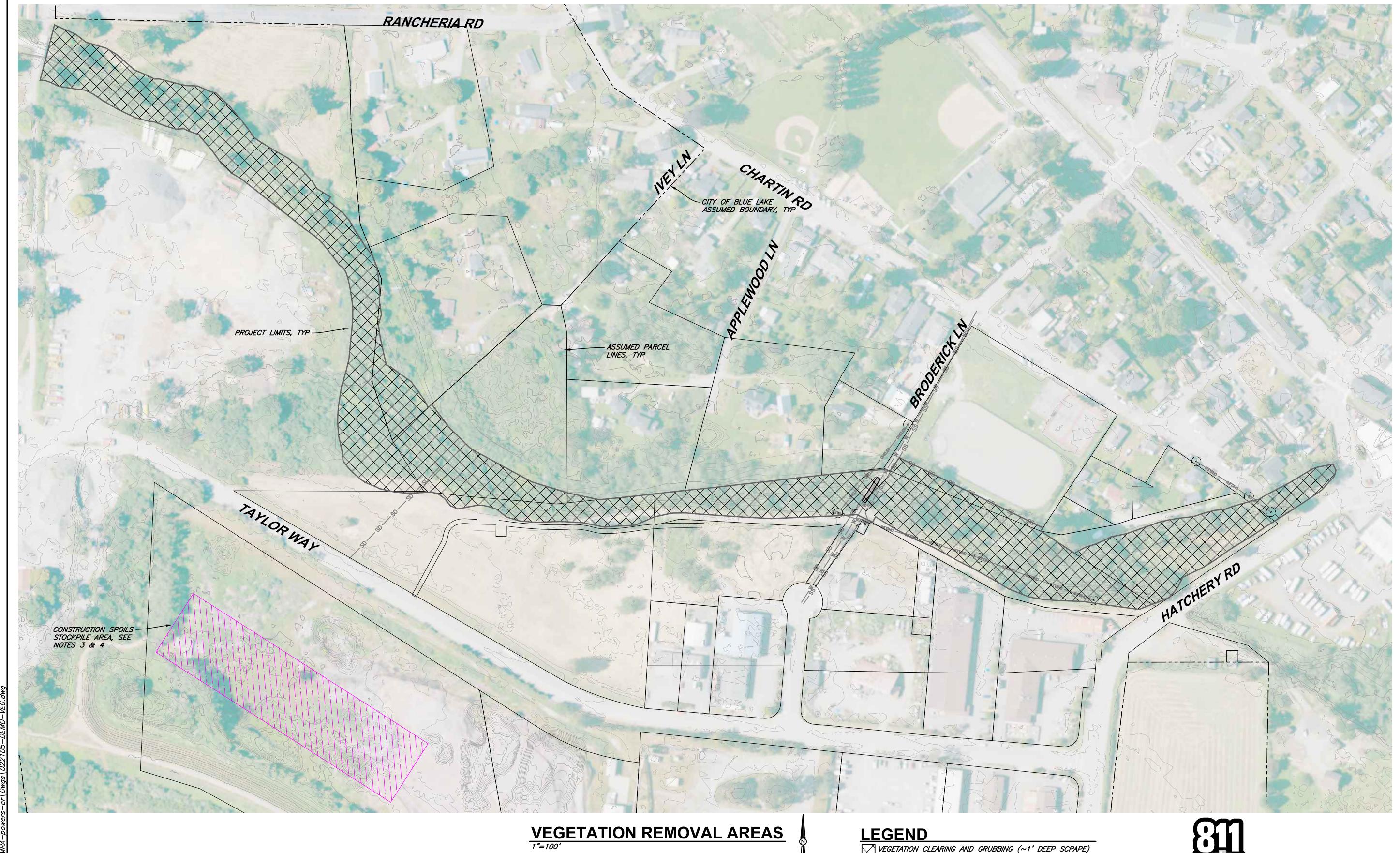
EEK, BLUE LAK NOTES

BADUWA'T W.
OWERS CREEK FISH H
POWERS CREEK,

SHEET
G3.0

SEQ
DATE 03/2025
PROJ. NO.
022105





1. EXISTING SURFACE BASED ON 2011 DEM SURFACE AND SELECT SURVEY AREAS; EXISTING SURVEY REQUIRED BEFORE CONSTRUCTION.
2. AERIAL IMAGE SOURCE: 2022 USDA NAIP 4—BAND 8 BIT IMAGERY.
3. APPROXIMATE VEGETATION REMOVAL EXCAVATION VOLUME OF ~12,673 CY.
4. CONSTRUCTION STOCKPILING AREA IS APPROXIMATELY 90,000 SF (2.06 ACRES); FILL SLOPES SHALL BE 2H:1V MAXIMUM ON ALL SIDES.

VEGETATION CLEARING AND GRUBBING (~1' DEEP SCRAPE)

CONSTRUCTION SPOILS STOCKPILE AREA



Know what's below. Call before you dig.

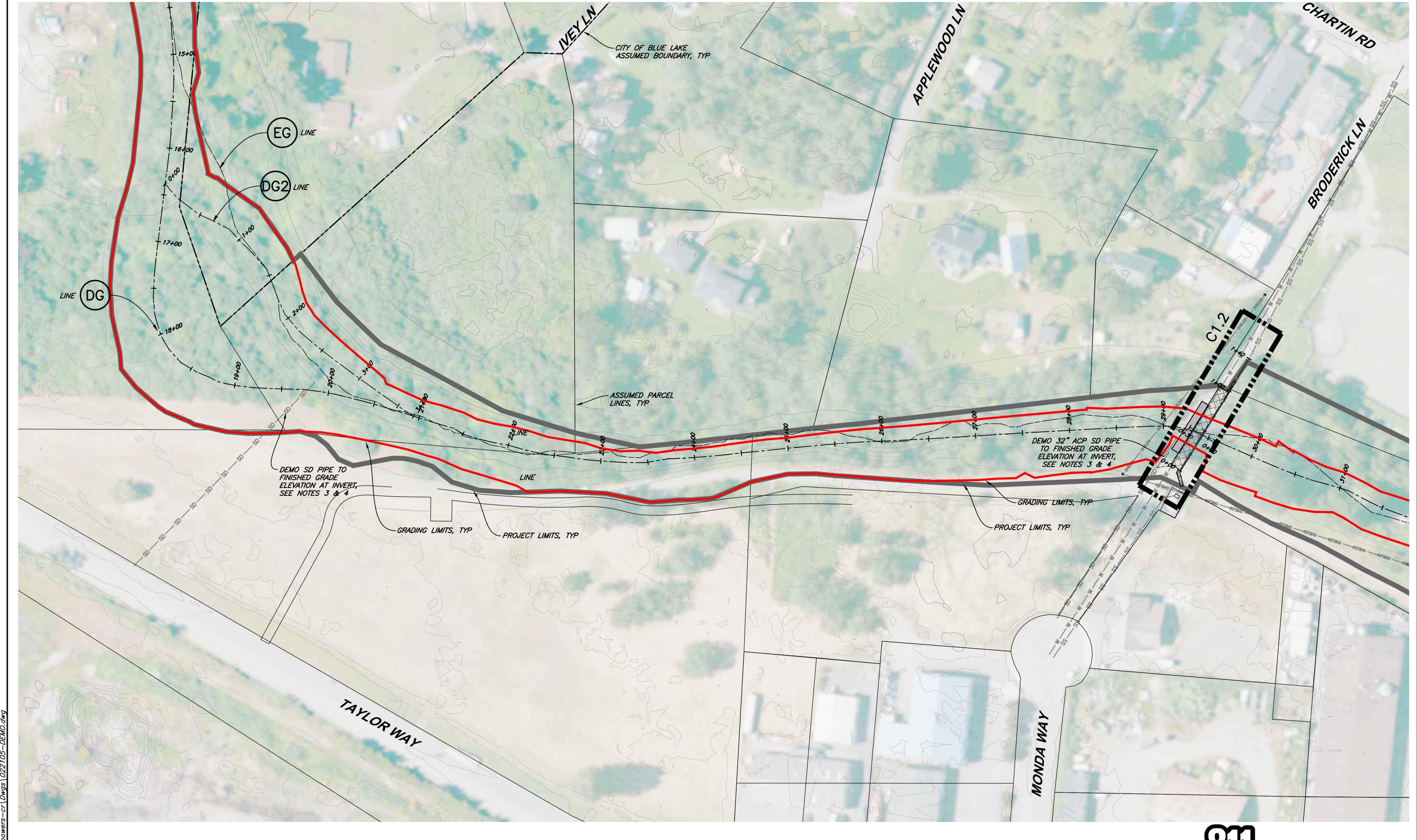
Contractor shall call Underground Service Alert at 811 two working days prior to excavation. Landline:1 1-800-227-2600

C1.0

DATE 03/2025 PROJ. NO. 022105

REMOVAL

VEGETATION



1. EXISTING SURFACE BASED ON 2011 DEM SURFACE AND SELECT SURVEY AREAS; EXISTING SURVEY REQUIRED BEFORE CONSTRUCTION.
2. AERIAL IMAGE SOURCE: 2022 USDA NAIP 4—BAND 8 BIT IMAGERY; NAD83 CA STATE PLANE ZONE 1.
3. LOCATIONS OF SHOWN UTILITIES ARE APPROXIMATE BASED OFF PREVIOUS DESIGN DATA AND POTHOLING EFFORTS. CONTRACTOR TO VERIFY CONCRETE IMBEDMENT EXTENTS AND ELEVATIONS VIA POTHOLING BEFORE DEMOLITON & CONSTRUCTION.
4. DEMO SD PIPES TO MATCH FG AT INVERT, SEE SHEET C3.2 DETAIL 3 FOR RSP AT CULVERT OUTLETS.
5. ESTABLISH TEMPORARY BYPASS FOR EXISTING SS/WATER UTILITIES (SEE C3.1 DETAIL 1) PRIOR TO DEMOLITION OF (E) FORCE MAINS.

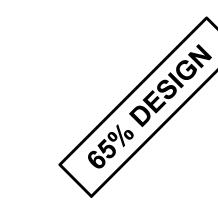
DEMOLITION PLAN

1"=100"



Know what's below. Call before you dig.

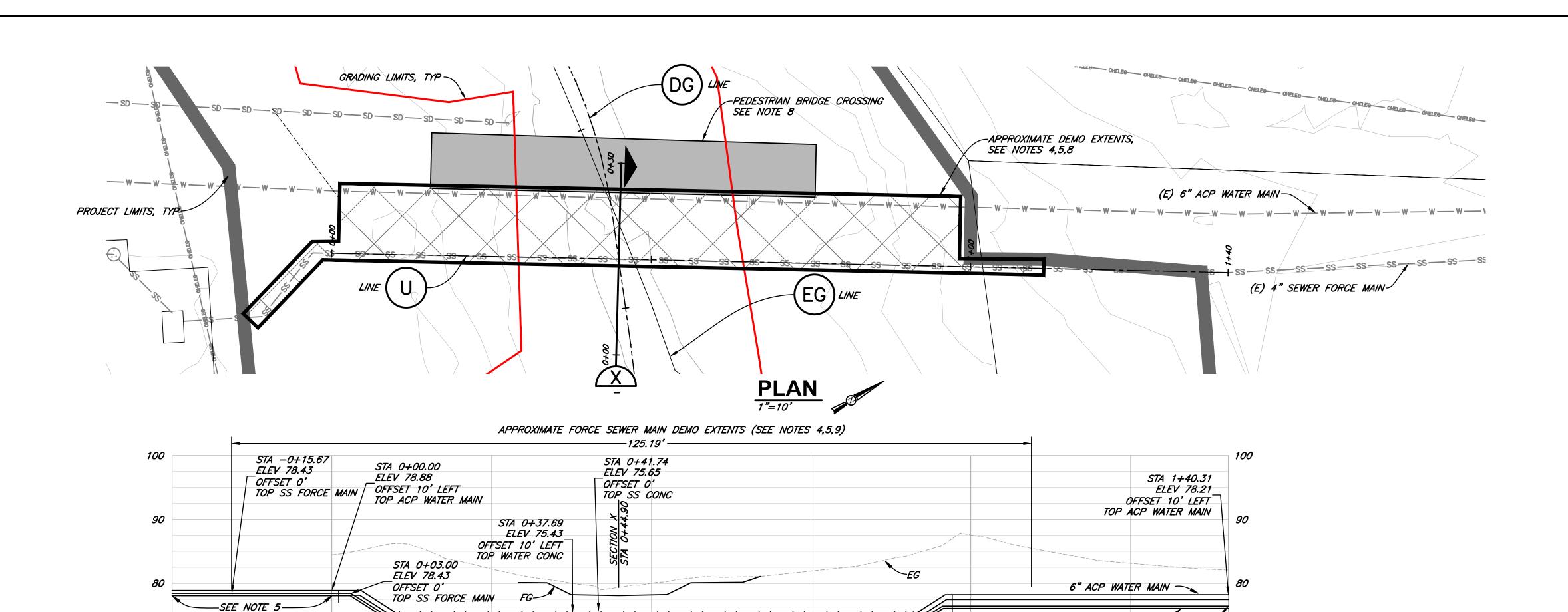
Contractor shall call
Underground Service Alert at
811 two working days prior
to excavation.
Landline: I 1-800-227-2600



DATE 03/2025 PROJ. NO.

022105

DEMOLITION



"U" LINE PROFILE

-APPROXIMATE EXISTING CONCRETE EMBEDMENT EXTENTS

-*96.05'* -

APPROXIMATE FORCE WATER MAIN DEMO EXTENTS (SEE NOTES 4,7,8,10)

4" PVC FORCE SS MAIN-

1+00

STA 1+40.31 ELEV 76.43

---- 60 1+40

OFFSET O'TOP SS FORCE MAIN

NOTES:

1. EXISTING SURFACE BASED ON 2011 DEM SURFACE; EXISTING SURVEY REQUIRED BEFORE CONSTRUCTION.

-0+25

2. DESIGN SURFACE CONTOUR INTERVALS: 2 FT MINOR & 10 FT MAJOR

3. CHANNEL GRADING EXTENTS IS IN DEVELOPMENT AND WILL CONFORM TO BE WITHIN PROJECT LIMITS BY FINAL DESIGN. 4. ELEVATION LABEL LOCATIONS OF SHOWN UTILITIES ARE BASED OFF POTHOLING EFFORTS; CONTRACTOR TO VERIFY CONCRETE UTILITY

0+00

5. THE FIRST ~25' OF SS PIPE IS APPROXIMATE. POTHOLE AND EXCAVATE EXISTING PIPE WITH APPROVAL OF SHN BEFORE DEMOLITION. 6. SURVEY DATA AT CROSS SECTIONS WILL BE INCORPORATED INTO EXISTING SURFACE BY FINAL DESIGN.

7. EXISTING WATER LINE IS OFFSET 10' LEFT OF EXISTING SANITARY SEWER LINE.

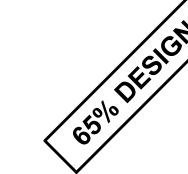
9. ESTABLISH TEMPORARY BYPASS FOR 4" SS FORCE MAIN PRIOR TO DEMOLITION OF (E) SS FORCE MAIN.

10. ESTABLISH TEMPORARY BYPASS FOR 4" WATER FORCE MAIN (SEE C3.1 DETAIL 1) PRIOR TO DEMOLITION OF (E) WATER FORCE MAIN.

Know what's below. Call before you dig. Contractor shall call Underground Service Alert at 811 two working days prior

to excavation.

Landline: I 1-800-227-2600



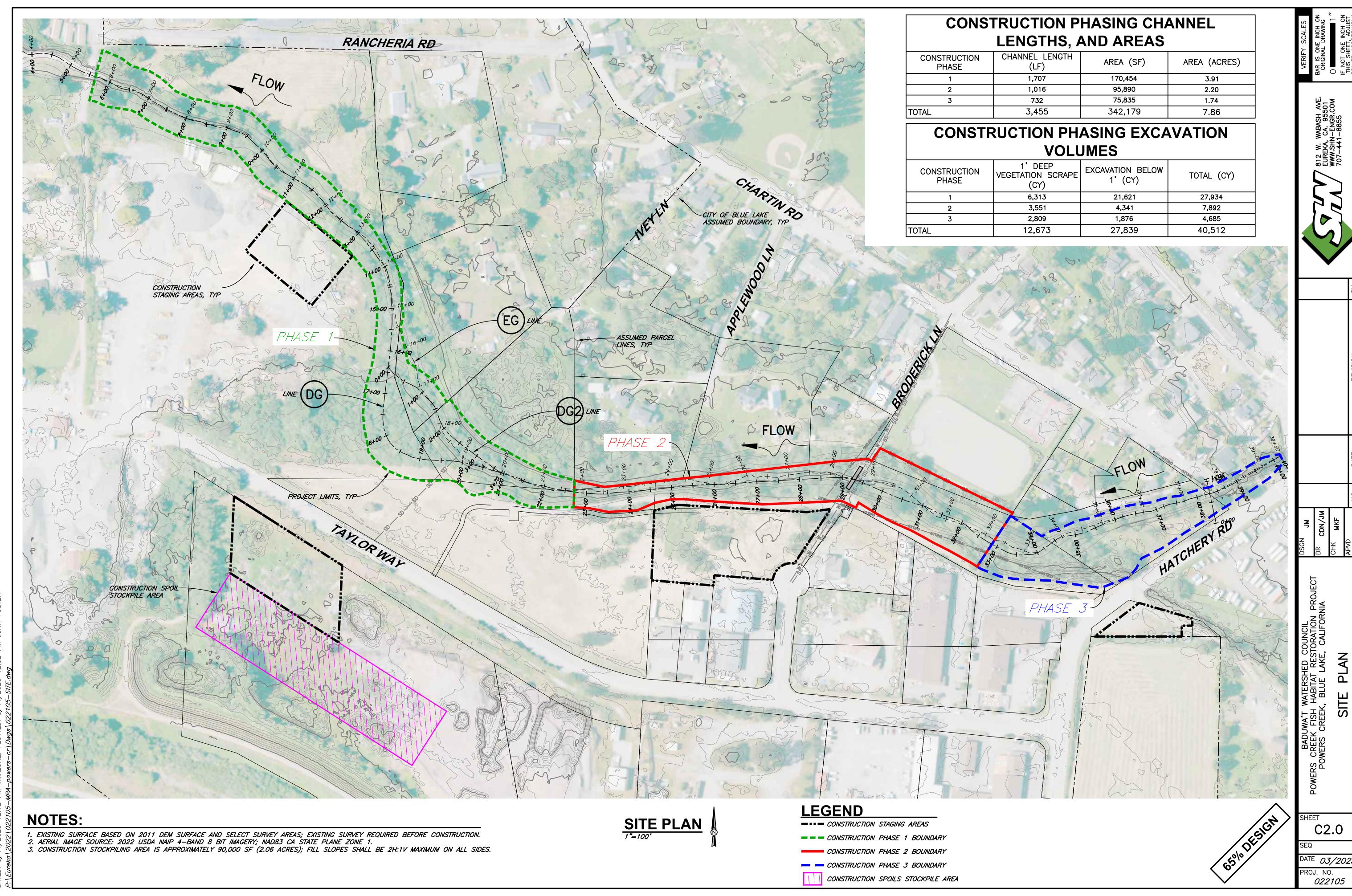
DEMOLITION

DATE 03/2025

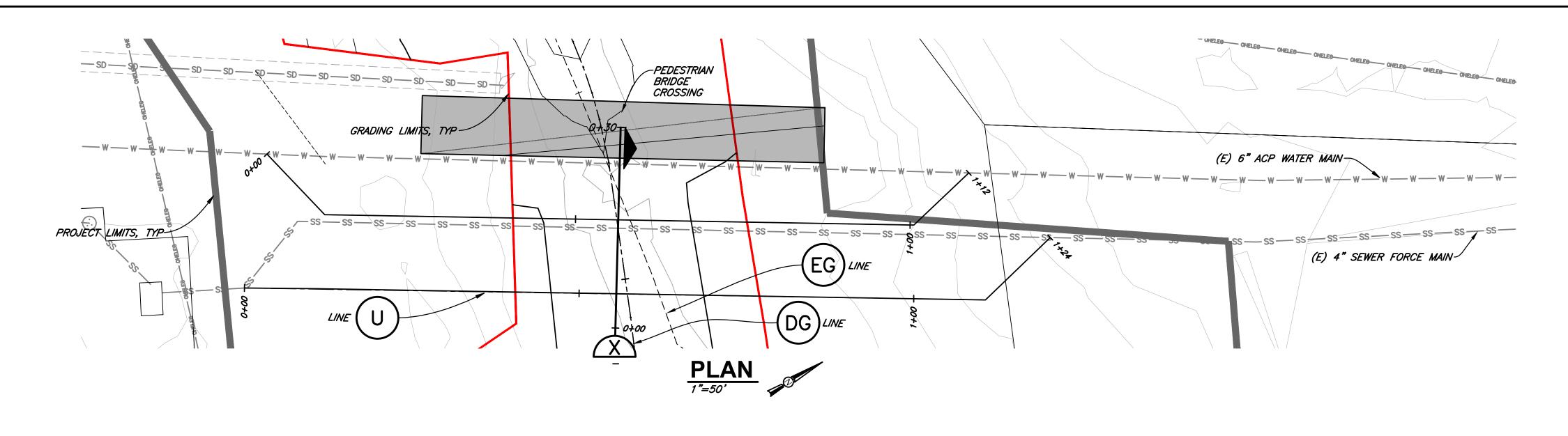
022105

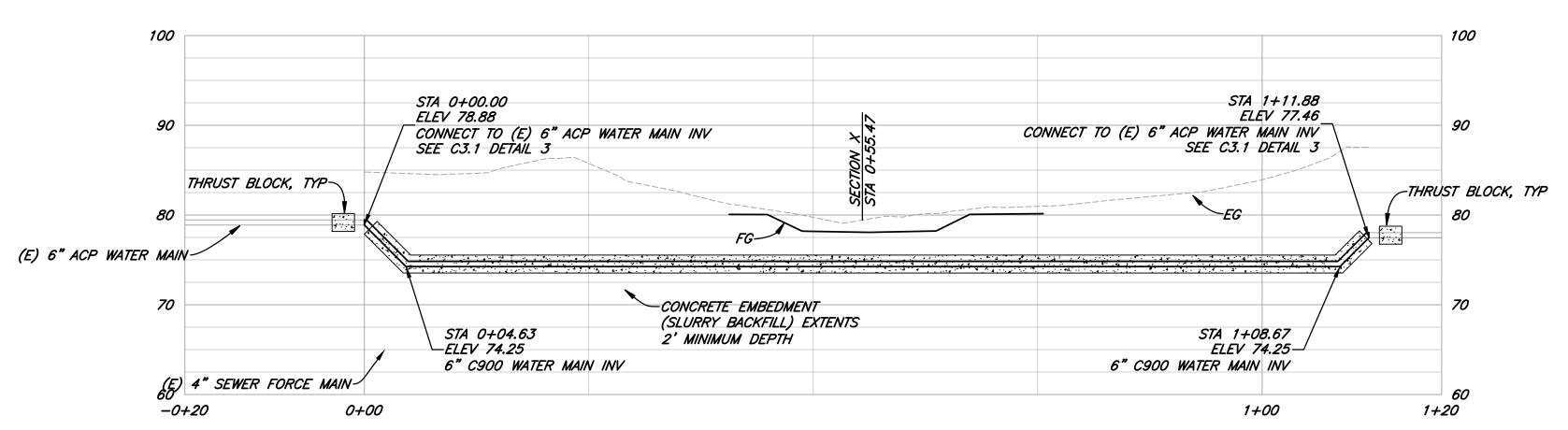
PROJ. NO.

1"=10' H 1"=10' V STA 0+25.00 ELEV 75.43— STA 0+15.00 ELEV 75.63 TOP SS CONC TOP WATER CONC EG CONCRETE -(E) 6" ACP WATER MAIN (E) 4" SEWER FORCE MAIN-EMBEDMENT, 70 SEE NOTE 4 APPROXIMATE DEMO EXTENTS, SEE NOTE 4 LOCATIONS, IMBEDMENT EXTENTS, AND PIPE DIAMETERS VIA POTHOLING WITH APPROVAL FROM SHN BEFORE DEMOLITION & CONSTRUCTION. —12.00**'**——— 0+00 0+30 "X" SECTION 8. PEDESTRIAN BRIDGE FOOTING SHALL REMAIN, CUT (E) WATER LINE AT EACH SIDE OF FOOTING.



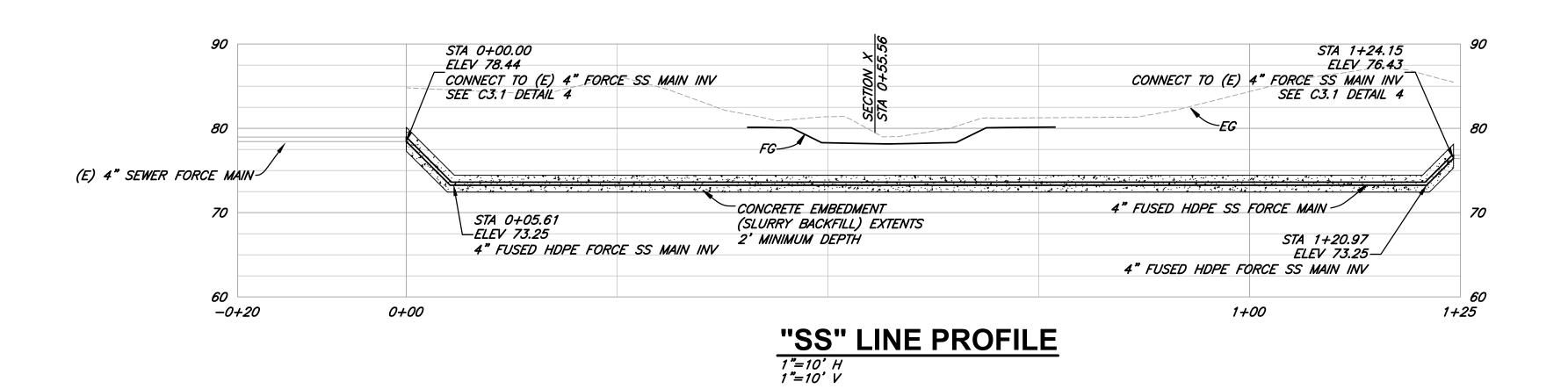
DATE 03/2025

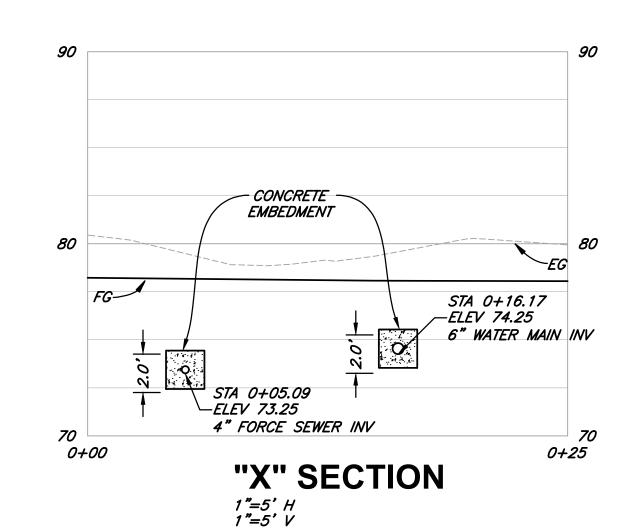




"W" LINE PROFILE 1"=10' H

1"=10' V





NOTES:

1. EXISTING SURFACE BASED ON 2011 DEM SURFACE; EXISTING SURVEY REQUIRED BEFORE CONSTRUCTION.
2. DESIGN SURFACE CONTOUR INTERVALS: 2 FT MINOR & 10 FT MAJOR
3. CHANNEL GRADING EXTENTS IS IN DEVELOPMENT AND WILL CONFORM TO BE WITHIN PROJECT LIMITS BY FINAL DESIGN.
4. LOCATIONS OF SHOWN UTILITIES ARE APPROXIMATE BASED OFF PREVIOUS DESIGN DATA AND POTHOLING EFFORTS.
CONTRACTOR TO VERIFY CONCRETE IMBEDMENT EXTENTS AND ELEVATIONS VIA POTHOLING BEFORE CONSTRUCTION.
5. SURVEY DATA AT CROSS SECTIONS WILL BE INCORPORATED INTO EXISTING SURFACE BY FINAL DESIGN.
6. SEE SHEETS FOR ADDITIONAL UTILITY DETAILS NOT REFERENCED ABOVE:

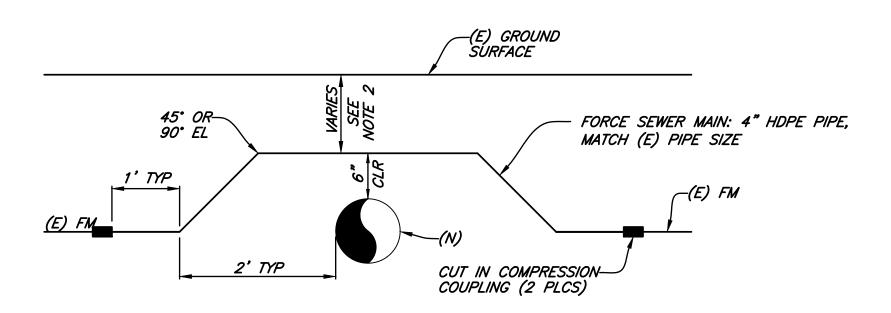
6A. SHEET C3.1 MINIMUM UTILITY CLEARANCES 6B. SHEET C3.2 FOR RESTRAINED JOINT SIZING FOR PVC PIPES (DETAIL 1) AND TYPICAL TRENCH DETAILS (DETAIL 2).

812 W. WABASH AVE. EUREKA, CA. 95501 WWW.SHN-ENGR.COM 707-441-8855

PROFILE AND

C3.0

DATE 03/2025 PROJ. NO. 022105



- 1. IF EXISTING PIPE GREATER THAN 4 INCHES, USE SIMILAR OR AS DIRECTED BY ENGINEER
- 2. IF TEMPORARY BYPASS IS <12 INCHES CLEAR TO GROUND SURFACE, USE SAND CEMENT SLURRY BACKFILL FOR TEMPORARY BYPASS UNLESS ENGINEER DIRECTS OTHERWISE



(EXISTING FORCE MAIN TEMPORARY BYPASS)

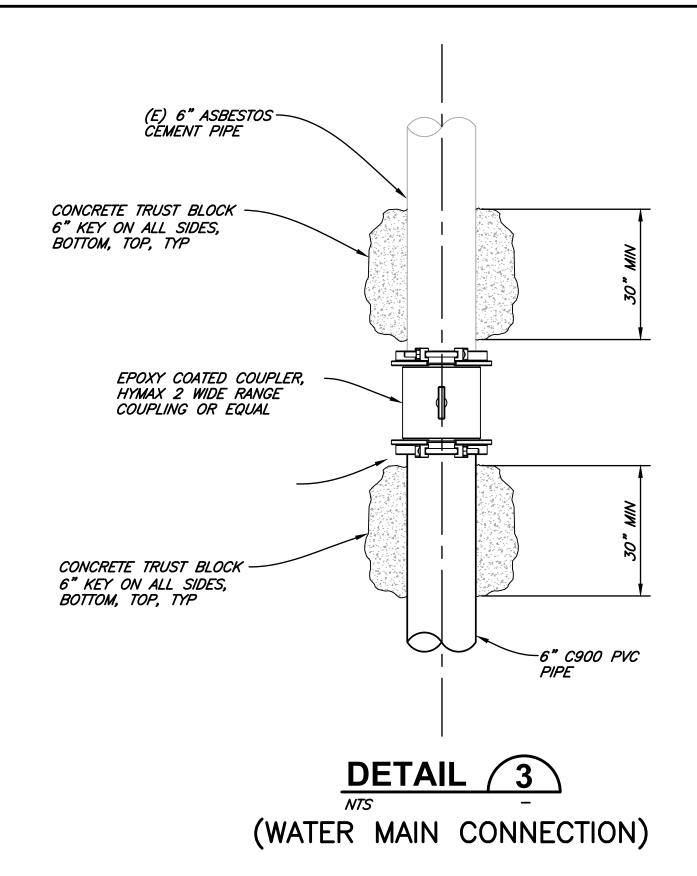
MINIMUM UNDERGROUND UTILITY CLEARANCES (in inches out-to-out)

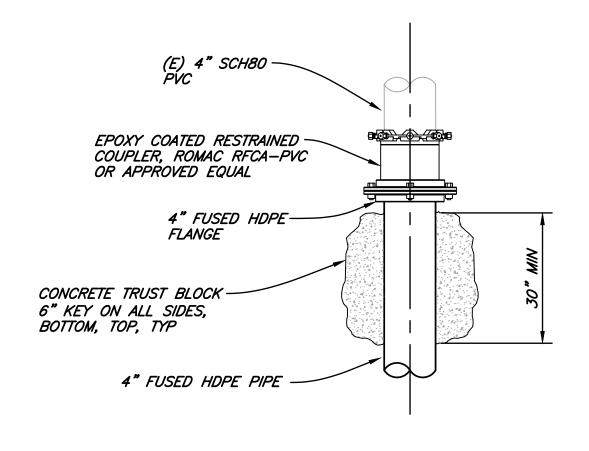
		New Utility					
		(N) W Main	(N) W Serv	(N) SS Main	(N) SS Lat	OS (N)	
New	(N) W Main	12 100		(1)	(1)	(2)	
	(N) W Service			(1)		(2)	
Ì	(N) SS Main					12	
	(N) SS Lat	201 1920	Kojin sisu ji			12	
Existing	Water Main	6 V; 12 H	6 V; 12 H	(1)	(1)	(2)	
to Remain	Fire Water	6 V; 12 H	6 V; 12 H	6 V; 12 H	6 V; 12 H	6 V; 12 H	
	SS Main	(1)	(1)	12 V; 12 H	6 V; 12 H	6 V; 12 H	
	SD	(2)	(2)	6 V; 12 H	6 V; 12 H	6 V; 12 H	
	Gas main			12 V; 36 H			
	Gas Service			12 V; 36 H			
	Fiber Optic			12 V; 12 H			
	Electrical			12 V; 36 H			
	Telephone			12 V; 12 H			
	Cable	12 V; 12 H	12 V; 12 H	12 V; 12 H	12 V; 12 H	12 V; 12 F	
Exist. To be Abandoned		6 V; 6H	6 V; 6 H	6 V; 6 H	6 V; 6 H	6 V; 6 H	

(1) Water parallel: 120"H with no V requirement. Less than 120"H requires 12"V and exemption measures.
Water crossing above: 12"V with no W joints within 96"H. Water crossing below: requires exemption measures.
(2) Water parallel: 48"H with no V requirement. Less than 48"H requires 12"V and exemption measures.
Water crossing above: 12"V with no W joints within 96"H. Water crossing below: requires exemption measures.



(MINIMUM UNDERGROUND UTILITY CLEARANCES)





DETAIL 4

WIS
(SEWER MAIN CONNECTION)

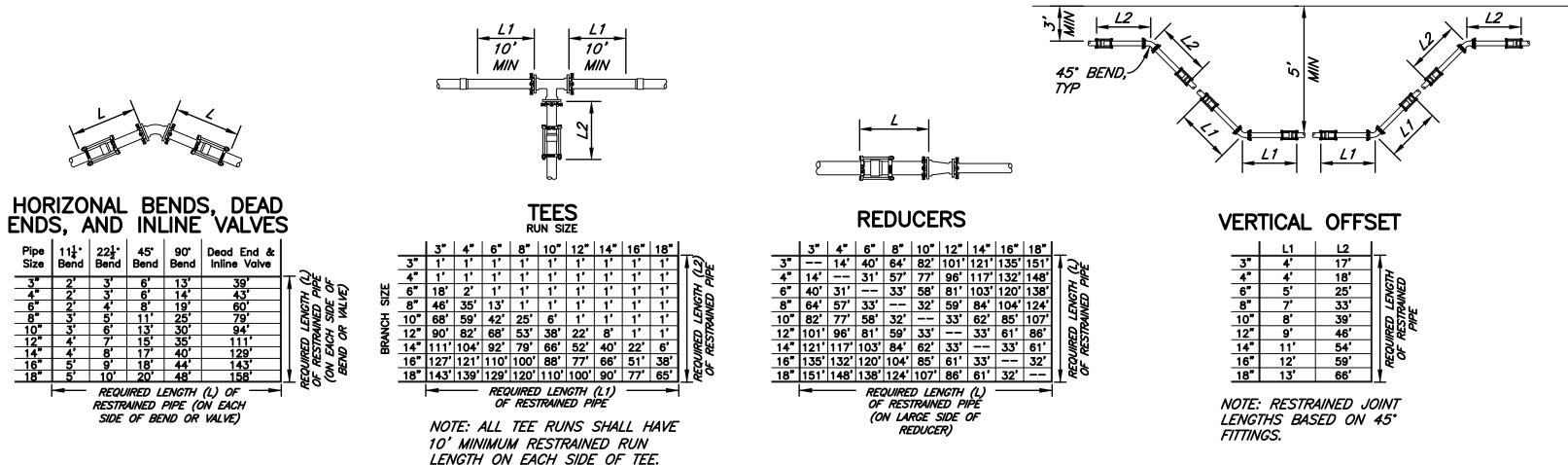
65% DESIGN

SAVED: 2/19/2025 4:52 PM MMALONE, PLOTTED: 3/14/2025 12: P:\Eureka\2022\022105-MRA-powers-cr\Dwgs\022105-UTIL-DT
 DSGN JM
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 DRFT
 NO. DATE
 REVISION
 BY

ADUWA'T WATERSHED COUNCIL
EEK FISH HABITAT RESTORATION
RS CREEK, BLUE LAKE, CALIFOR
UTILITY DETAILS

SHEET C3.1

DATE 03/2025
PROJ. NO.
022105



- 1. JOINT RESTRAINT DEVICES SHALL BE USED IN LIEU OF THRUST BLOCKING FOR ALL PRESSURE MAIN AND APPURTENANCE INSTALLATIONS UNLESS PROJECT PLANS OR DESIGN CONDITIONS SPECIFICALLY REQUIRE THRUST BLOCKING.
- 2. THE RESTRAINED LENGTHS LISTED IN THE ABOVE TABLES ARE VALID FOR THE FOLLOWING INSTALLATION CONDITIONS:

SOIL CLASSIFICATION: GW (ASTM STD. D2487); INCLUDES CLASS 2 AGGREGATE BASE BACKFILL

TRENCH TYPE: TYPE 5 (AWWA C605)

TEST PRESSURE: 150 PSI` SAFETY FACTOR: 2 TO 1

DEPTH OF BURY: 36" FROM SURFACE TO TOP OF PIPE

PVC C900 WHERE INSTALLATION CONDITIONS DO MOT MATCH THOSE LISTED ABOVE, THE RESTRAINED LENGTHS SHALL BE RECALCULATED TO SUIT THE ACTUAL SITE CONDITIONS. ALL REVISED CALCULATIONS SHALL BE MADE WITH A TEST PRESSURE OF 150 PSI MINIMUM AND A SAFETY FACTOR OF 2. REVISED RESTRAINED LENGTHS SHALL BE APPROVED BY THE ENGINEER PRIOR TO PIPE INSTALLATION.

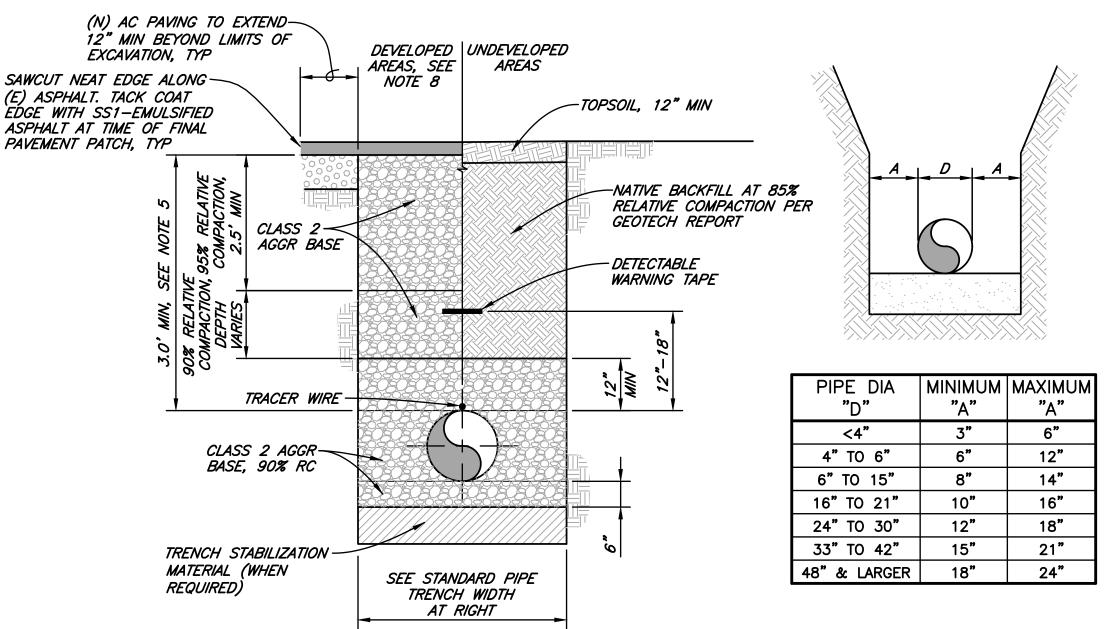
3. ALL RESTRAINT FITTINGS SHALL BE FACTORY MANUFACTURED AND APPROVED FOR USE BY THE ENGINEER PRIOR TO PIPE INSTALLATION. THE FOLLOWING RESTRAINT FITTINGS HAVE BEEN PREQUALIFIED FOR USE:

MECHANICAL JOINT GLANDS: ROMAC 'GRIPRING' PIPE RESTRAINER EBBA IRON SERIES 2000 PV

BELL AND SPIGOT JOINTS: ROMAC MODEL 611 (4" THROUGH 8") EBBA IRON SERIES 1600 (4" THROUGH 12")

EBBA IRON SERIES 2800 (14" THROUGH 36") 4. <u>All</u> Mechanical joint connections at fittings shall be restrained.

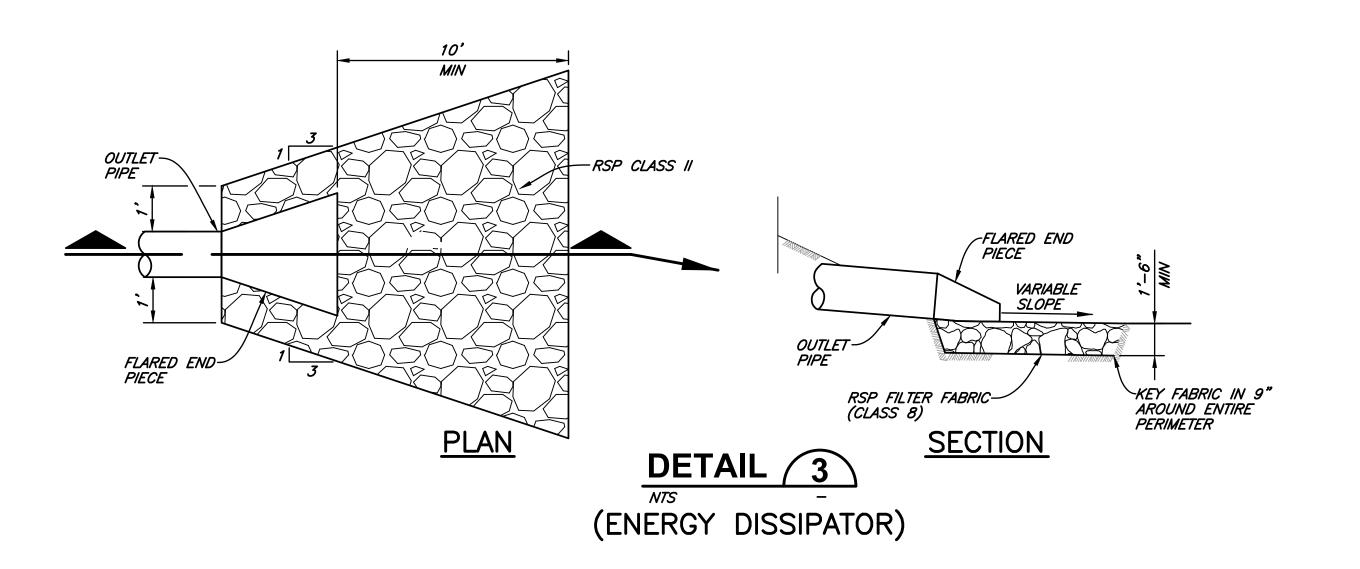
(RESTRAINED JOINTS FOR PVC PIPES)



NOTES:

- WIDER TRENCHES MAY REQUIRE HIGHER STRENGTH PIPE AND/OR SPECIAL BEDDING.
- DIFFERING TRENCH WIDTHS REQUIRE PRIOR APPROVAL OF ENGINEER.
- IN MAKING EXCAVATIONS FOR THIS PROJECT, THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR PROVIDING AND INSTALLING ADEQUATE SHEETING, SHORING AND BRACING AS MAY BE NECESSARY AS A PRECAUTION AGAINST SLIDES OR CAVE-INS. AND TO PROTECT ALL EXISTING IMPROVEMENTS OF ANY KIND, EITHER ON PUBLIC OR PRIVATE PROPERTY, FULLY FROM DAMAGE.
- 4. SATISFACTORY NATIVE BACKFILL MATERIAL USED AS UTILITY TRENCH BACKFILL BELOW UNPAVED AREAS SHALL BE APPROVED BY THE ENGINEER PRIOR TO USE.
- 5. 2-SACK SLURRY BACKFILL MAY BE USED IN TRENCH WHEN MINIMUM PIPE COVER NOT POSSIBLE, WHEN APPROVED BY OWNER'S REPRESENTATIVE.
- 6. DETECTABLE WARNING TAPE SHALL BE BRIGHT COLORED, CONTINUOUSLY PRINTED, MINIMUM 6" WIDE BY 4 MIL THICK, MANUFACTURED FOR DIRECT BURIAL.
- DETECTABLE WARNING TAPE NOT REQUIRED FOR IRRIGATION LINES.
- 8. GRAVEL ROADS AND SURFACES EXPOSED TO VEHICLE LOADS SHALL USE DEVELOPED AREA TRENCH SECTION BUT WITH AGGREGATE BASE AS SURFACE INSTEAD OF PAVING.





812 W. W EUREKA, (WWW.SHN-707-441-

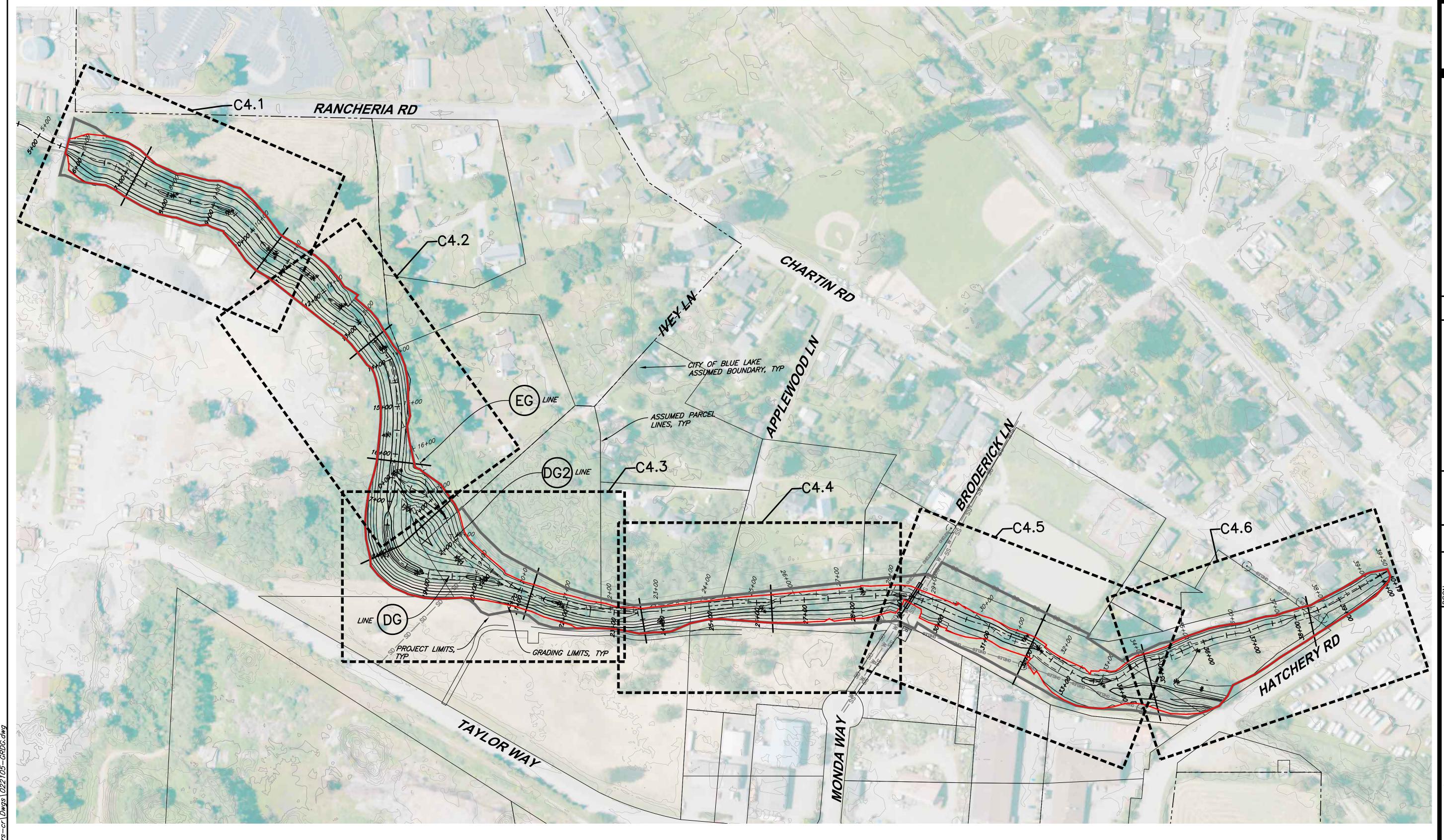
DETAIL!

C3.2

DATE 03/2025

022105

PROJ. NO.







Know what's below. Call before you dig.

Contractor shall call Underground Service Alert at 811 two working days prior to excavation.
Landline: I 1-800-227-2600

C4.0

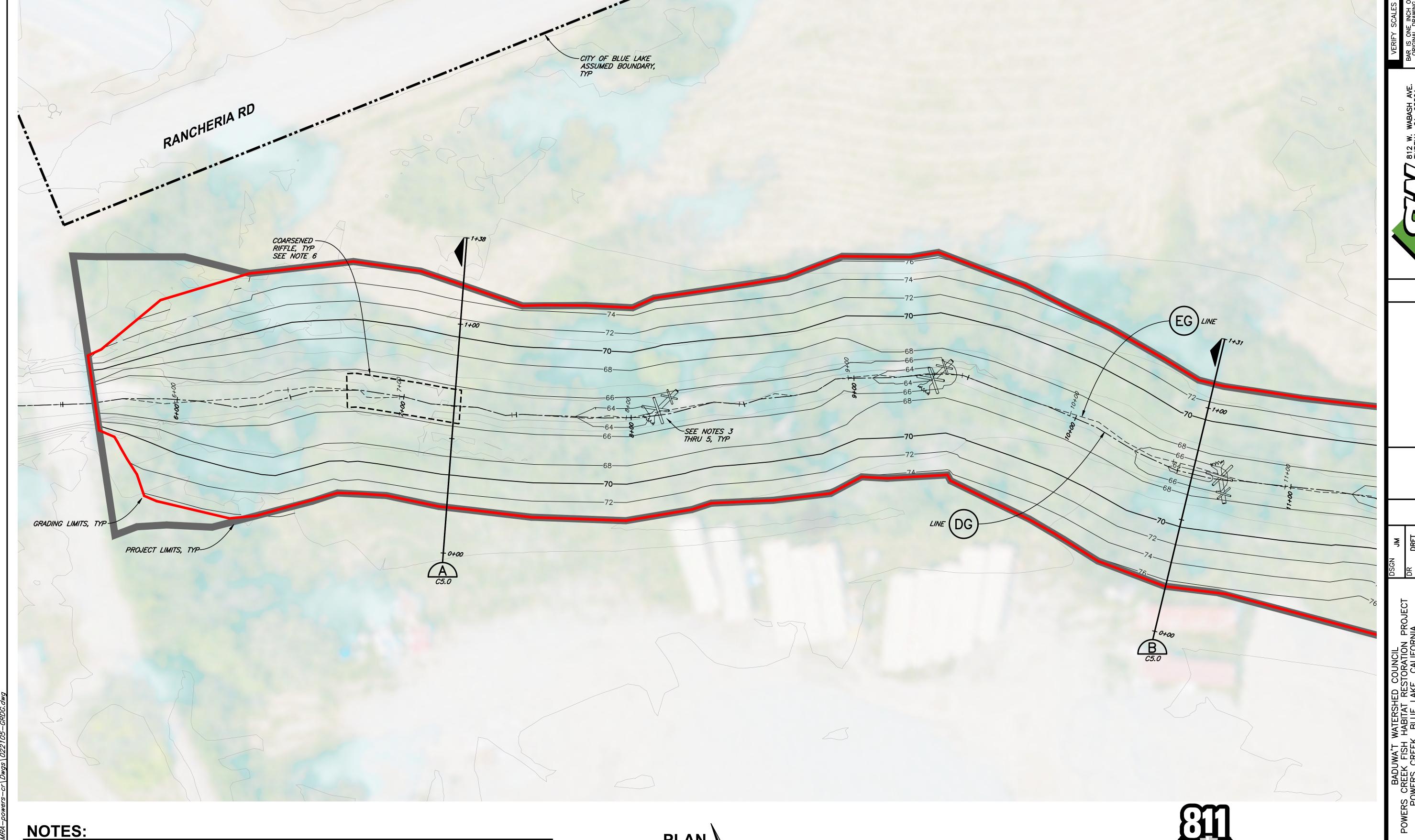
DATE 03/2025 PROJ. NO. 022105

INDEX

GRADING

NOTES:

1. EXISTING SURFACE BASED ON 2011 DEM SURFACE AND SELECT SURVEY AREAS; EXISTING SURVEY REQUIRED BEFORE CONSTRUCTION. 2. AERIAL IMAGE SOURCE: 2022 USDA NAIP 4—BAND 8 BIT IMAGERY. 3. SEE ENLARGED GRADING FOR DETAILED NOTES.



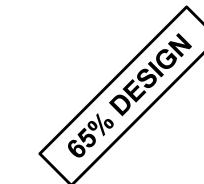
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3. THIS SHEET SHOWS APPROXIMATE LARGE WOOD STRUCTURE LOCATIONS, CONFIGURATIONS, GRADES, DIMENSIONS, AND PLACEMENT.
4. DUE TO VARIABLE FIELD CONDITIONS, LOG VARIABILITY, AND OTHER UNFORESEEN CONDITIONS, THE FINAL LARGE WOOD LOCATIONS, CONFIGURATIONS, GRADES, DIMENSIONS, AND PLACEMENT WILL BE DETERMINED IN THE FIELD WITH THE CONTRACTOR, AND SHN.
5. SEE DETAILS SHEET C7.1 & C7.2 FOR LARGE WOOD STRUCTURE DETAILS.
6. COARSENED RIFFLES LOCATIONS ARE APPROXIMATE AND IN DEVELOPMENT, SEE SHEET C7.0 DETAIL 3.
7. BANK EROSION FABRIC (TYPE 1) IS IN DEVELOPMENT AND WILL BE ADDED AS A NEW SHEET BY FINAL DESIGN, SEE SHEET C7.3 FOR DETAILS.





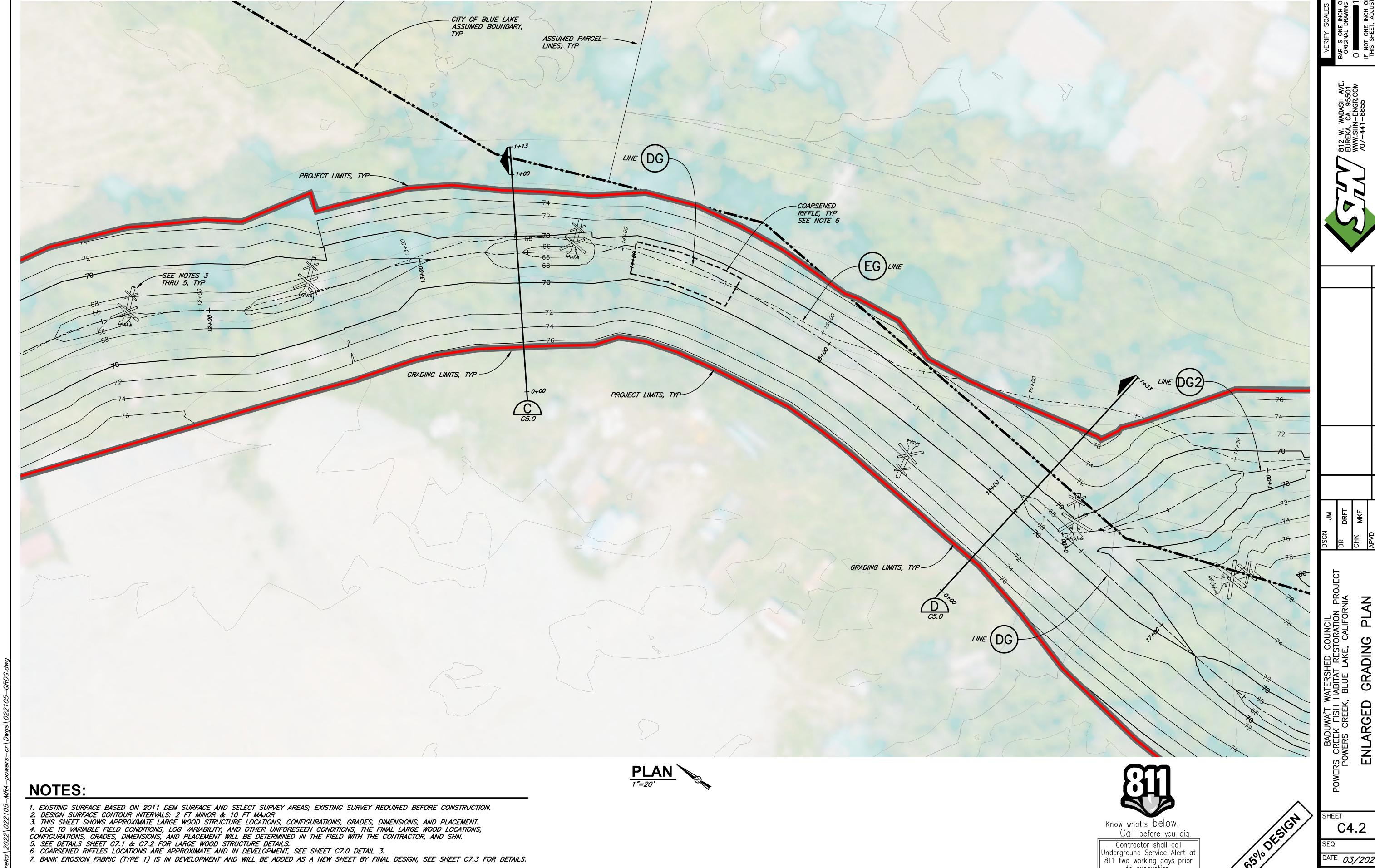
Know what's below. Call before you dig.

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DATE 03/2025 PROJ. NO. 022105

GRADING



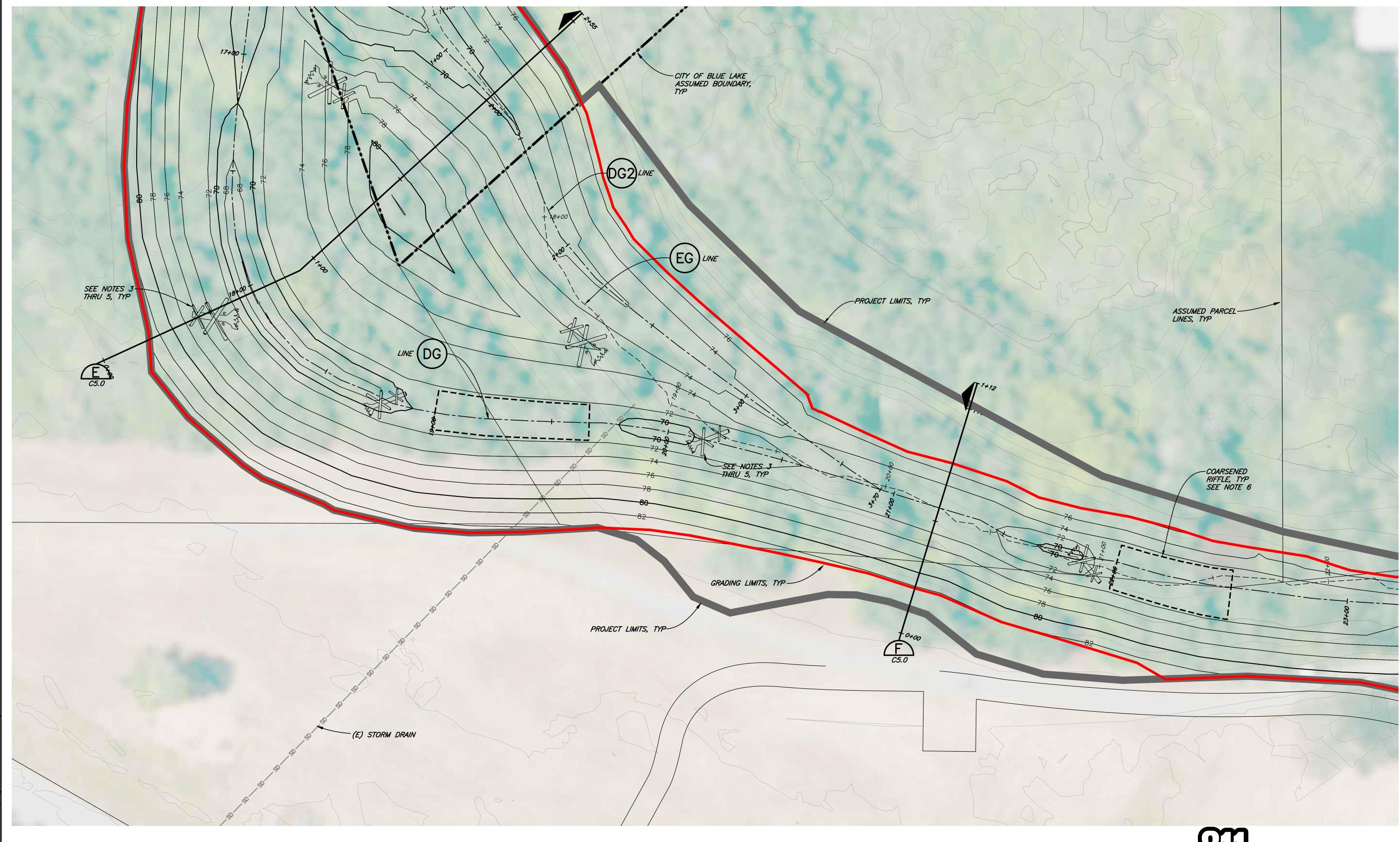
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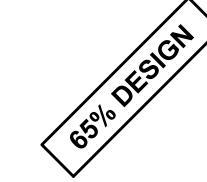




Know what's below. Call before you dig.

Contractor shall call Underground Service Alert at 811 two working days prior to excavation.

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DATE 03/2025 PROJ. NO. 022105

C4.3

GRADING

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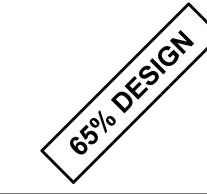
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8. SEE SHEET C3.0 FOR UTILITY CROSSING PROFILE.
9. GRADING EXTENTS WILL BE MODIFIED TO AVOID UTILITY POLE SETBACK.





Know what's below. Call before you dig.

Contractor shall call Underground Service Alert at 811 two working days prior to excavation. Landline:1 1-800-227-2600



C4.4

DATE 03/2025 PROJ. NO. 022105

GRADING

ENLARGED



1. EXISTING SURFACE BASED ON 2011 DEM SURFACE AND SELECT SURVEY AREAS; EXISTING SURVEY REQUIRED BEFORE CONSTRUCTION.
2. DESIGN SURFACE CONTOUR INTERVALS: 2 FT MINOR & 10 FT MAJOR
3. THIS SHEET SHOWS APPROXIMATE LARGE WOOD STRUCTURE LOCATIONS, CONFIGURATIONS, GRADES, DIMENSIONS, AND PLACEMENT.
4. DUE TO VARIABLE FIELD CONDITIONS, LOG VARIABILITY, AND OTHER UNFORESEEN CONDITIONS, THE FINAL LARGE WOOD LOCATIONS, CONFIGURATIONS, GRADES, DIMENSIONS, AND PLACEMENT WILL BE DETERMINED IN THE FIELD WITH THE CONTRACTOR, AND SHN.
5. SEE DETAILS SHEET C7.1 & C7.2 FOR LARGE WOOD STRUCTURE DETAILS.
6. COARSENED RIFFLES LOCATIONS ARE APPROXIMATE AND IN DEVELOPMENT, SEE SHEET C7.0 DETAIL 3.
7. BANK EROSION FABRIC (TYPE 1) IS IN DEVELOPMENT AND WILL BE ADDED AS A NEW SHEET BY FINAL DESIGN, SEE SHEET C7.3 FOR DETAILS.
8. SEE SHEET C3.0 FOR UTILITY CROSSING PROFILE.
9. GRADING EXTENTS WILL BE MODIFIED TO AVOID UTILITY POLE SETBACK.

9. GRADING EXTENTS WILL BE MODIFIED TO AVOID UTILITY POLE SETBACK.





Know what's below. Call before you dig.

Contractor shall call Underground Service Alert at 811 two working days prior to excavation. || Landline:1 1-800-227-2600



C4.5

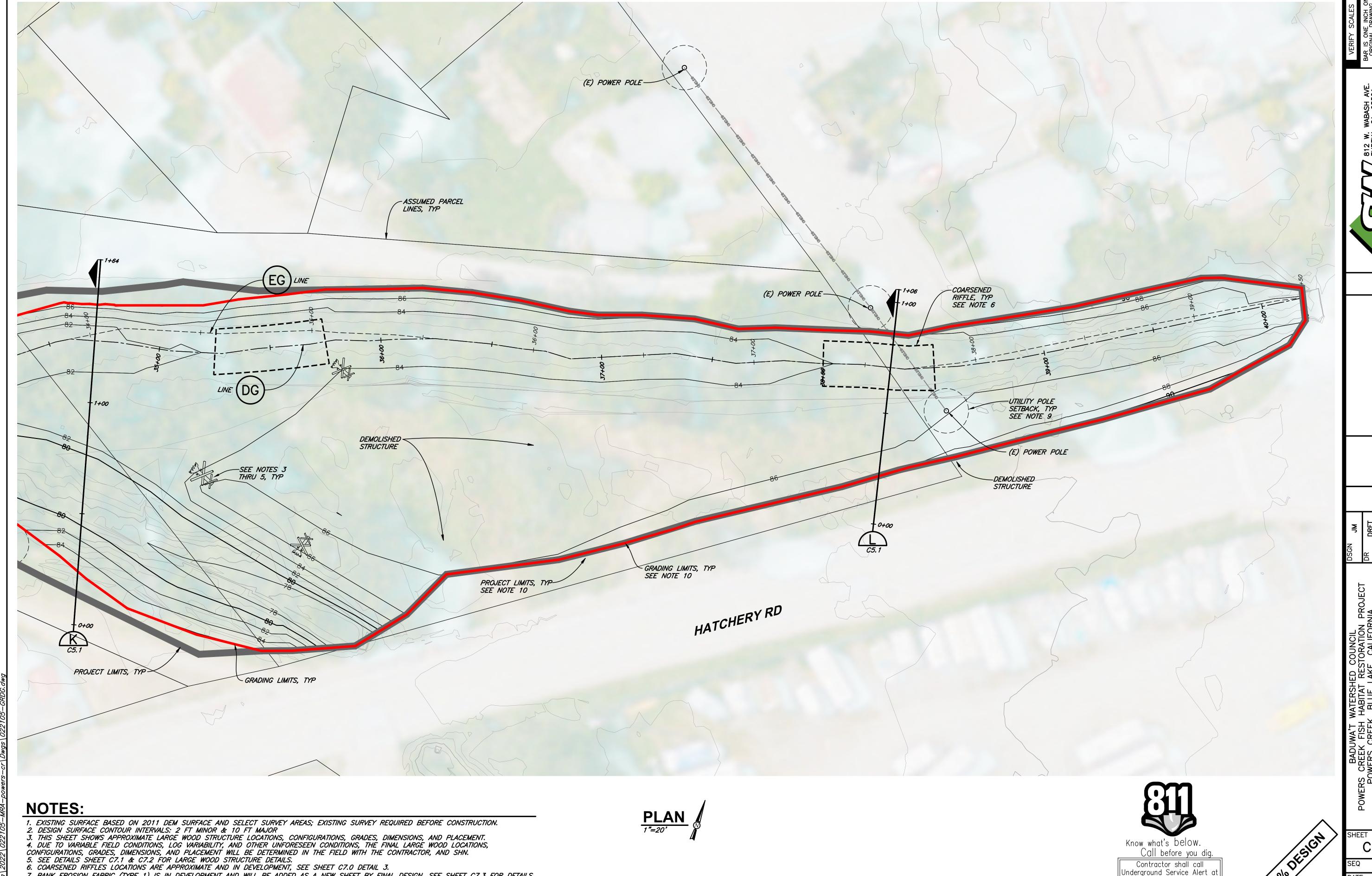
DATE 03/2025

PLAN

GRADING

ENLARGED

PROJ. NO. 022105



7. BANK EROSION FABRIC (TYPE 1) IS IN DEVELOPMENT AND WILL BE ADDED AS A NEW SHEET BY FINAL DESIGN, SEE SHEET C7.3 FOR DETAILS. 8. SEE SHEET C3.0 FOR UTIILITY CROSSING PROFILE.

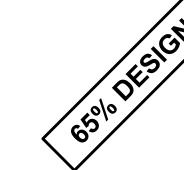
9. GRADING EXTENTS WILL BE MODIFIED TO AVOID UTILITY POLE SETBACK.

10. PROJECT BOUNDARY AND GRADING EXTENTS ARE IN DEVELOPMENT IN THIS AREA AND COMPLETE BY FINAL DESIGN.



Know what's below. Call before you dig.

Contractor shall call Underground Service Alert at 811 two working days prior to excavation. || Landline:1 1-800-227-2600



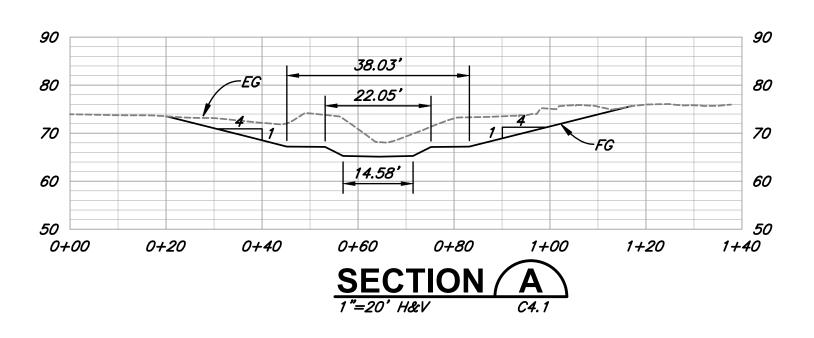
C4.6

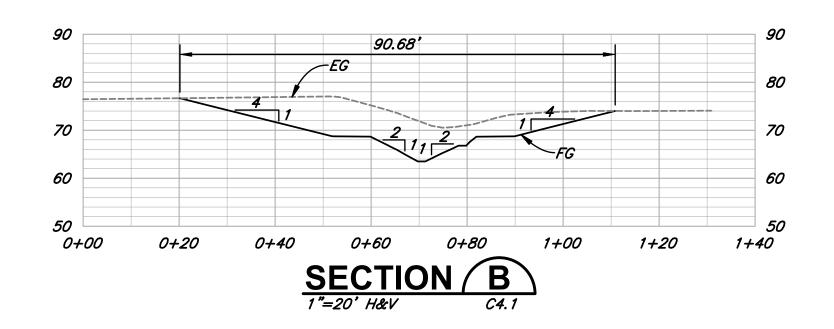
DATE 03/2025 PROJ. NO. 022105

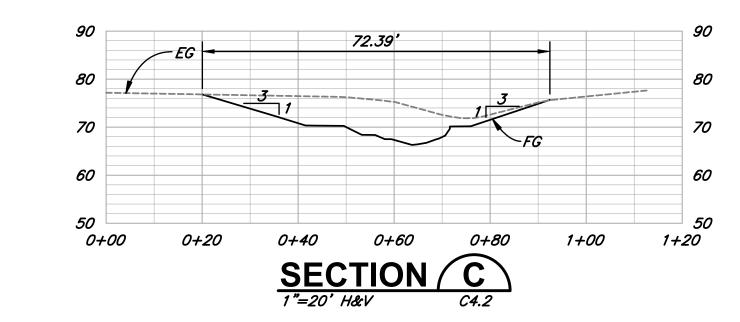
PLAN

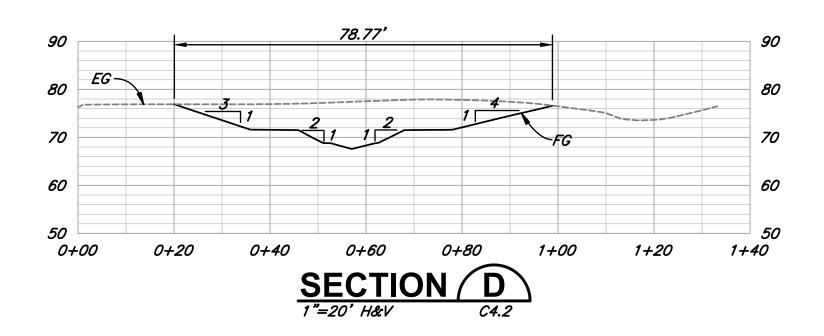
GRADING

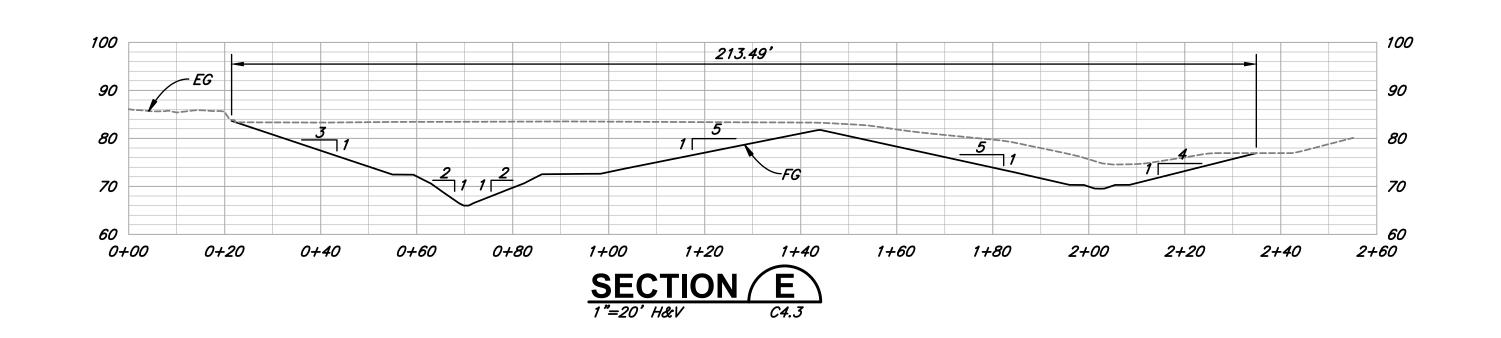
ENLARGED

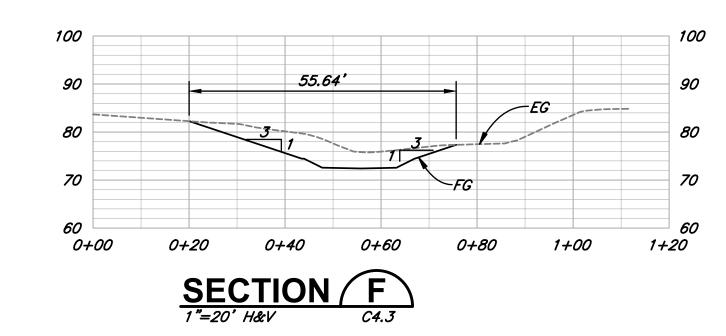


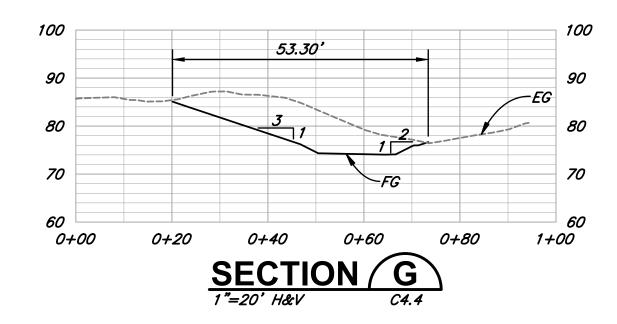


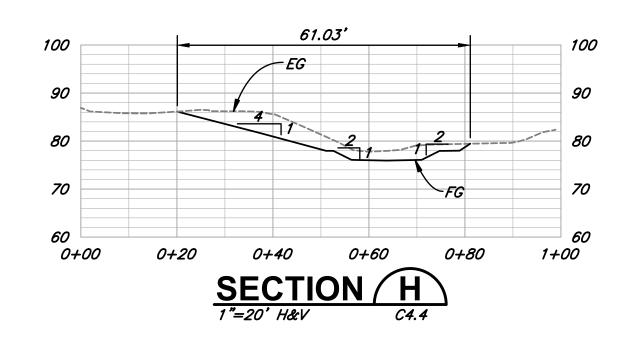










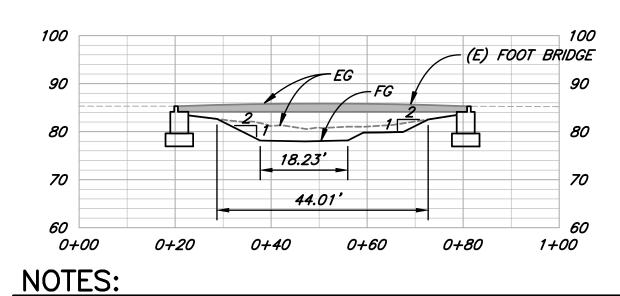


1. EXISTING SURFACE BASED ON 2011 DEM SURFACE; EXISTING SURVEY REQUIRED BEFORE CONSTRUCTION.
2. EXISTING GRADE SURVEY DATA WILL BE INCORPORATED INTO EG SURFACE BEFORE FINAL DESIGN.
3. ALL CROSS—SECTIONS ARE LOOKING DOWNSTREAM.

SECTIONS

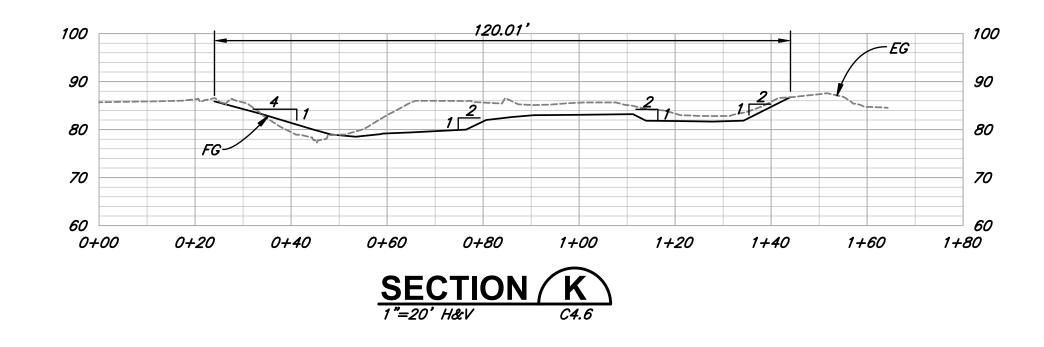
C5.0

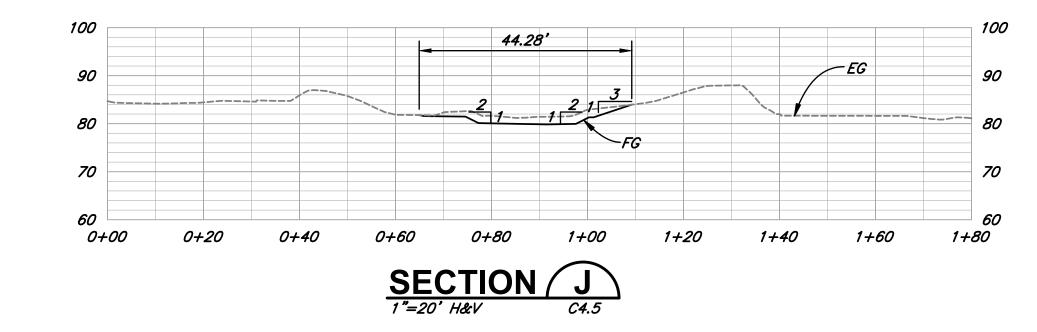
DATE 03/2025 PROJ. NO. 022105

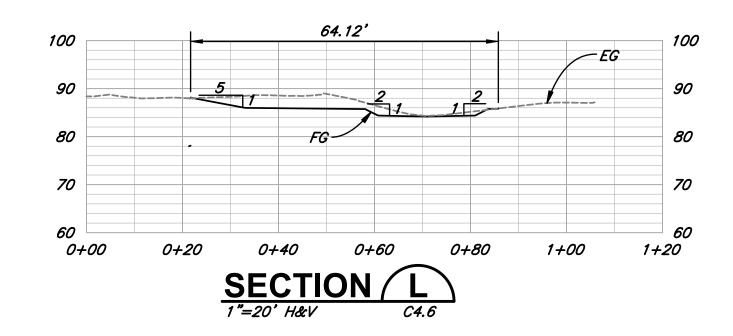


- EG SURFACE SHOWN IS BASED ON SURVEY INFORMATION AT PEDESTRIAN BRIDGE CROSSING.
 FG SURFACE IS APPROXIMATE AND UNDER DEVELOPMENT.







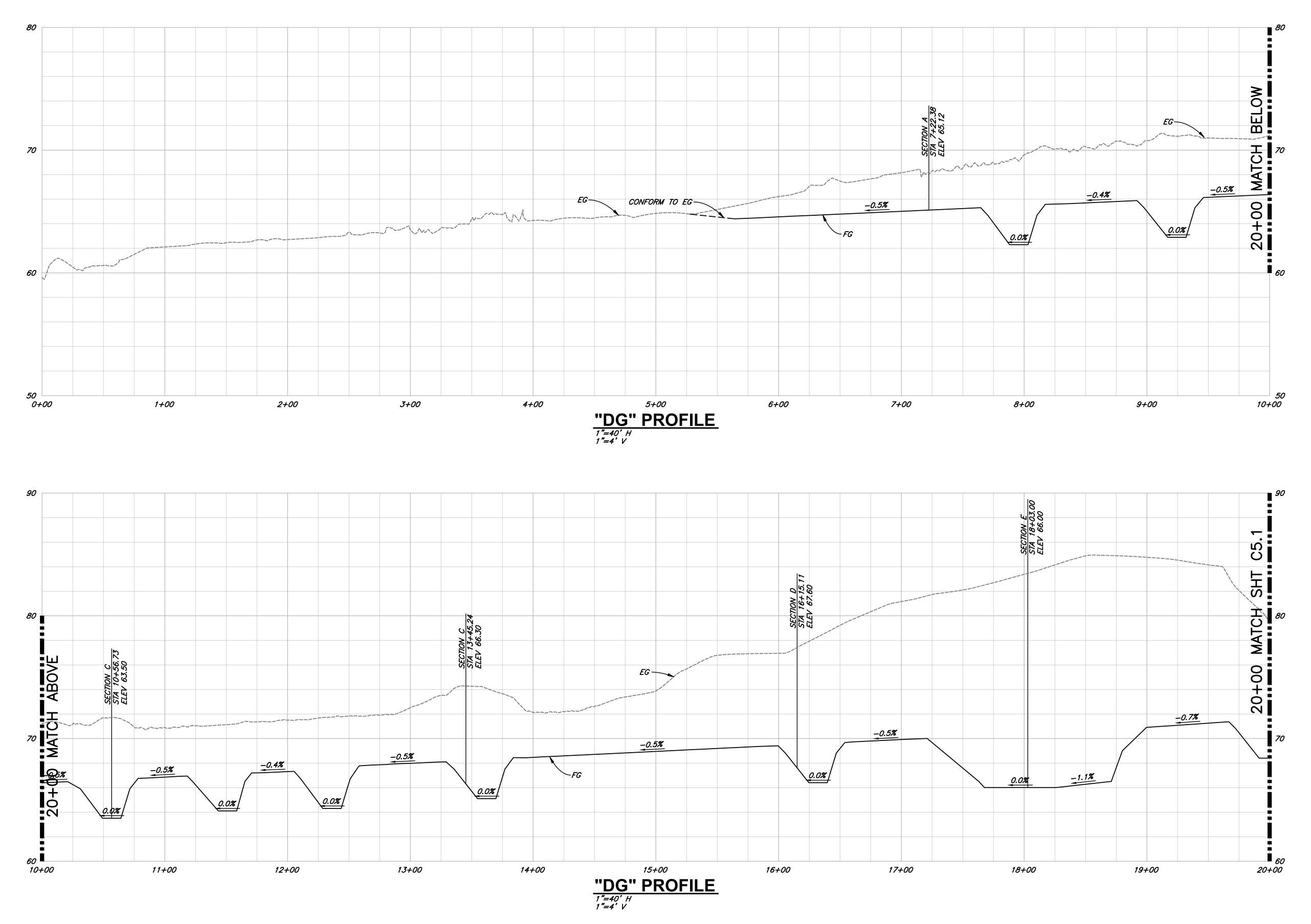


1. EXISTING SURFACE BASED ON 2011 DEM SURFACE; EXISTING SURVEY REQUIRED BEFORE CONSTRUCTION. 2. EXISTING GRADE SURVEY DATA WILL BE INCORPORATED INTO EG SURFACE BEFORE FINAL DESIGN. 3. ALL CROSS—SECTIONS ARE LOOKING DOWNSTREAM.

SECTIONS

C5.1

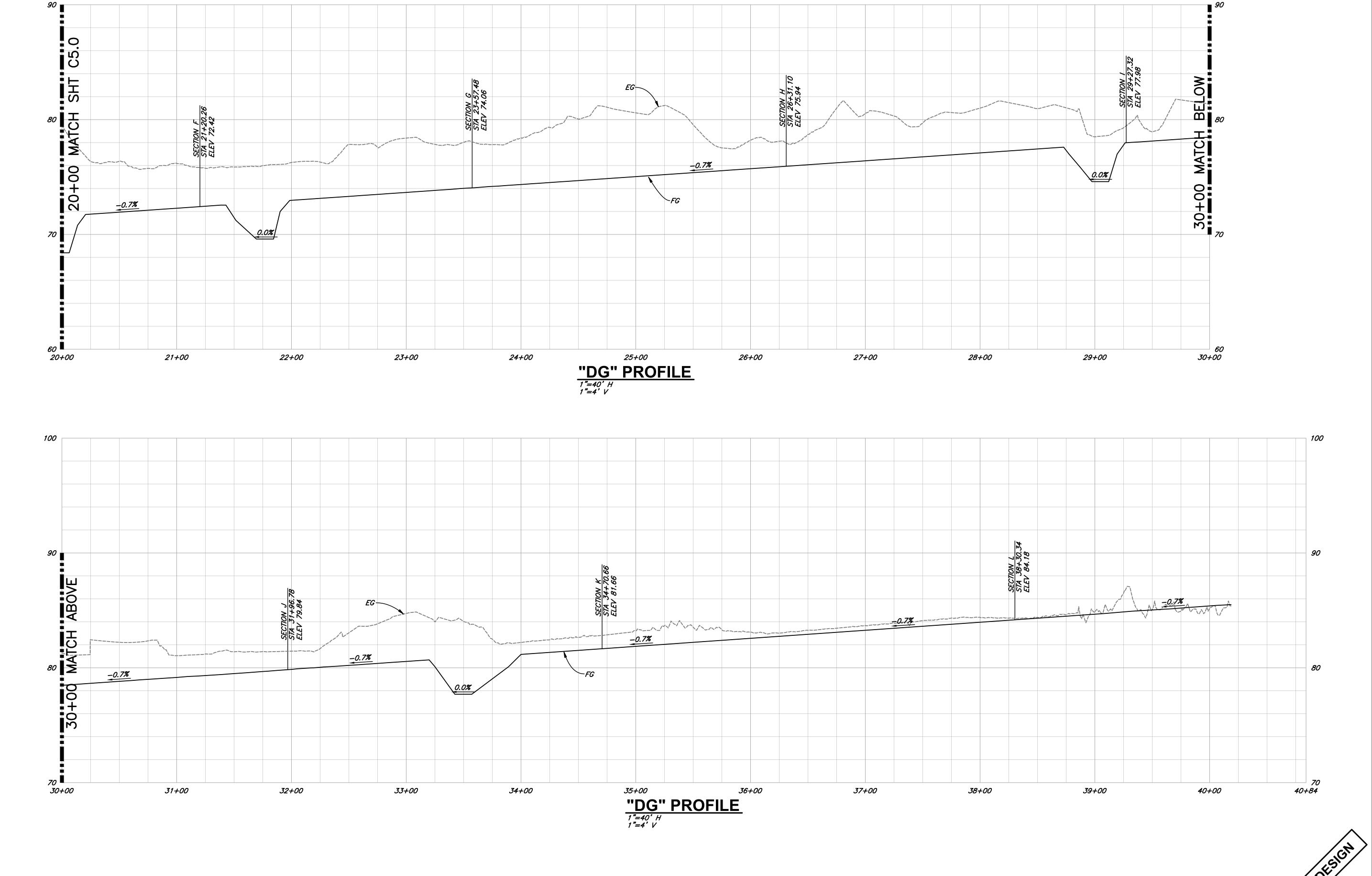
DATE 03/2025 PROJ. NO. 022105



C6.0 DATE 03/2025 PROJ. NO. 022105

PROFILE

THALWEG

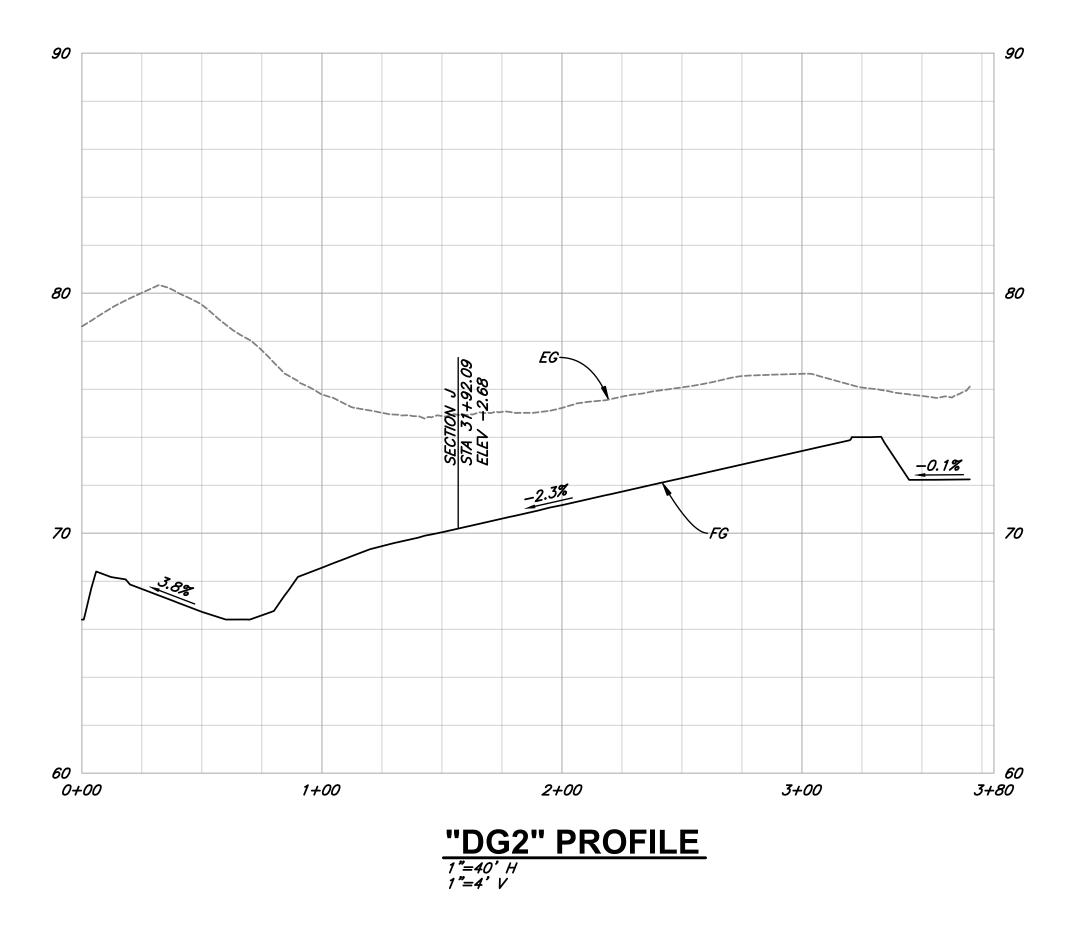


* 812 W. WABASH AVE. EUREKA, CA. 95501 WWW.SHN-ENGR.COM 707-441-8855

PROFILE THALWEG

C6.1

DATE 03/2025 PROJ. NO. 022105

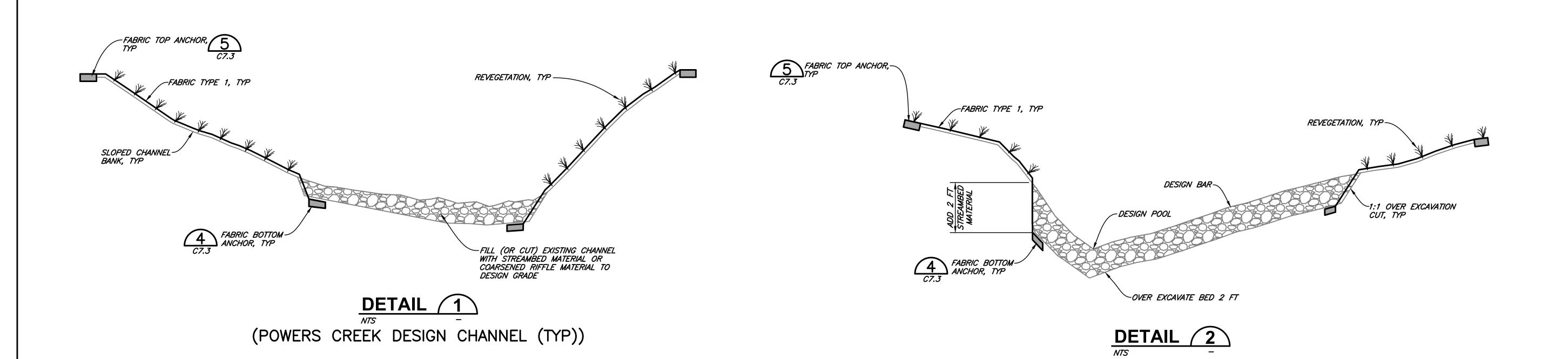


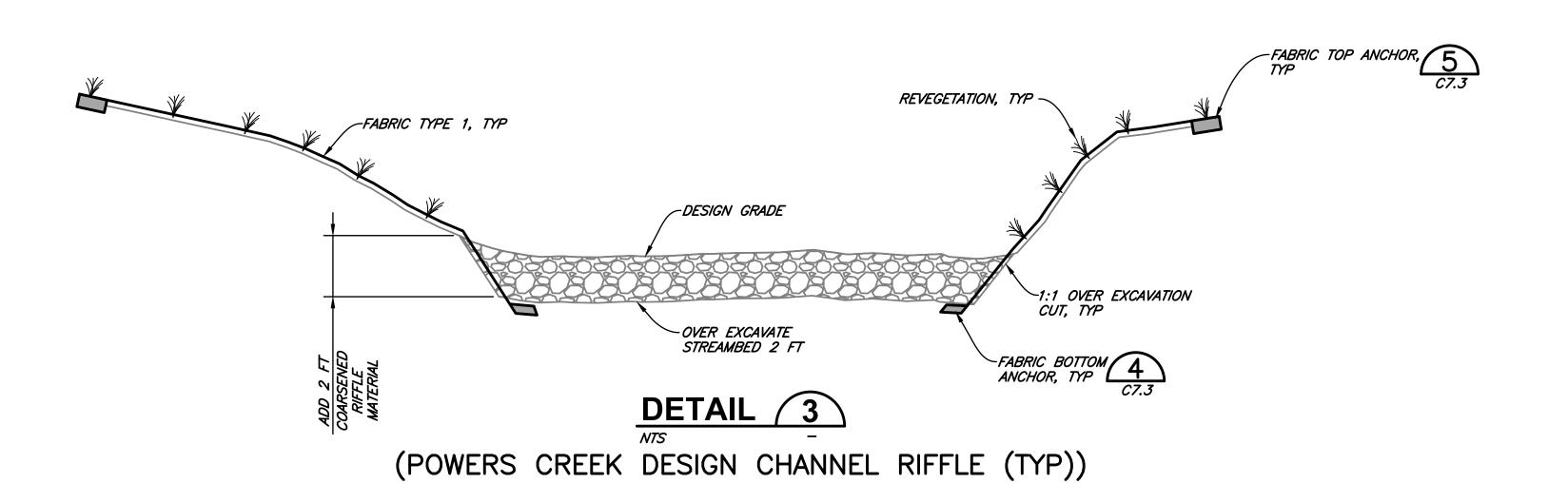
PROFILE THALWEG

BANK

C6.2

DATE 03/2025
PROJ. NO. 022105





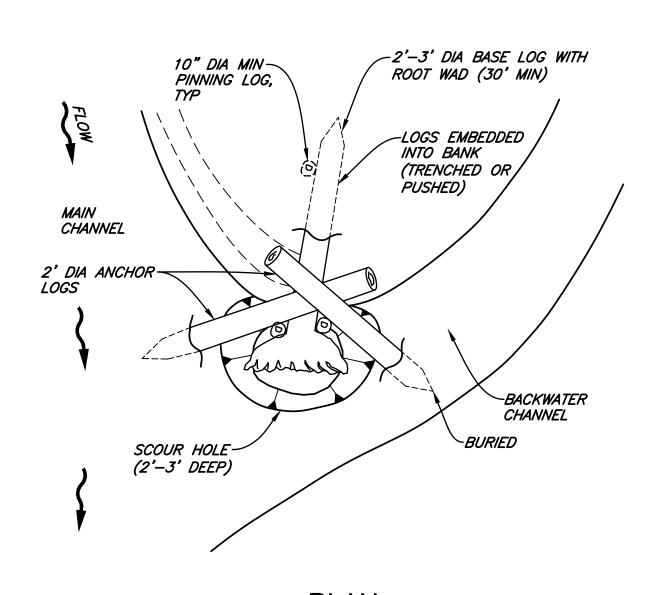
NOTES:

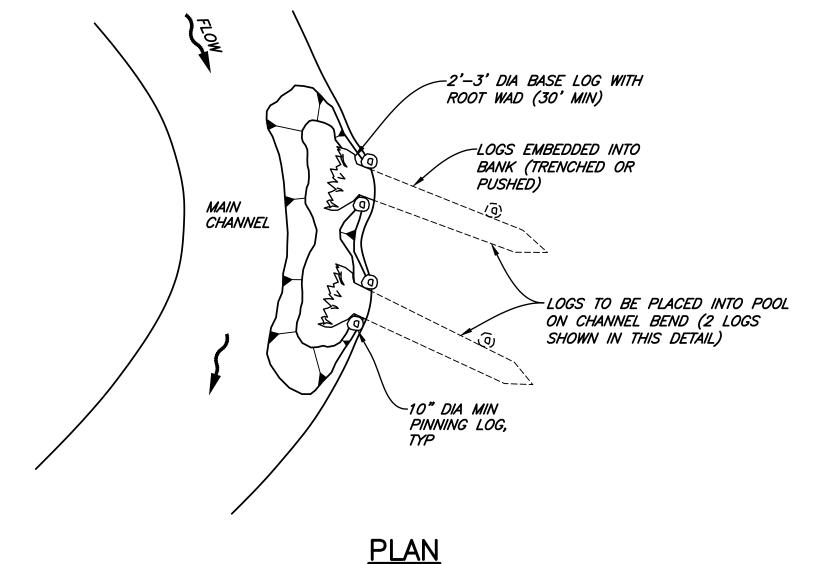
- THIS SHEET SHOWS GENERAL GRADING AND INSTALLATION (CONSTRUCTION) DETAILS FOR MAJOR PROJECT ELEMENTS.
 STREAMBED MATERIAL, ENGINEERED RIFFLE MATERIAL DESIGN/GRADATION TO BE DEVELOPED DURING THE IMPLEMENTATION PHASES OF THE PROJECT.
 LARGE WOOD STRUCTURES ARE NOT SHOWN ON THIS DRAWING. IT WILL BE NECESSARY TO INTEGRATE LARGE WOOD WITH EROSION CONTROL FABRIC.

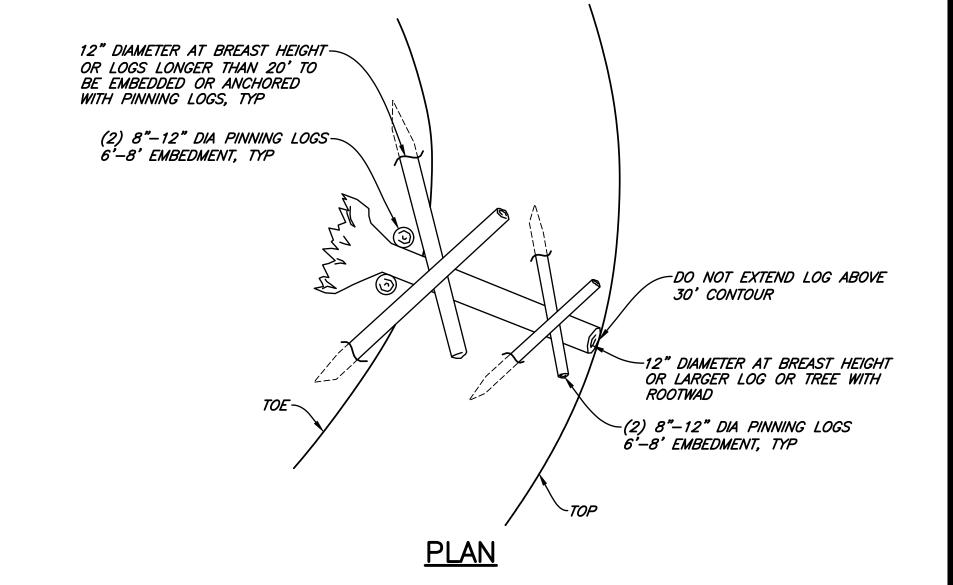
(POWERS CREEK DESIGN CHANNEL POOL & BAR (TYP))

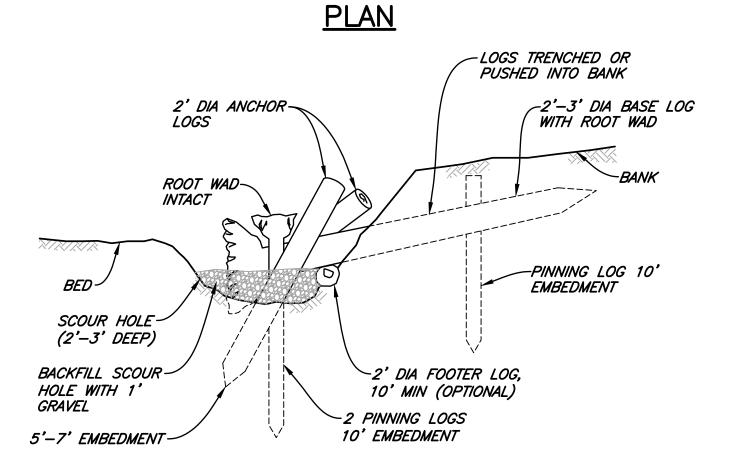
DETAILS GRADING

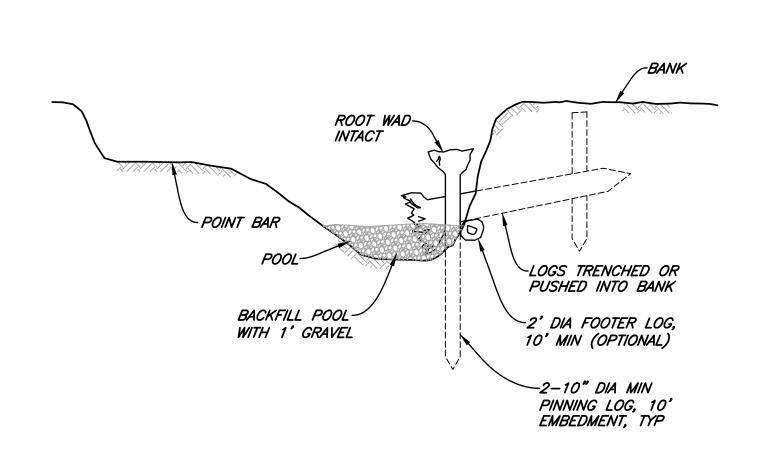
DATE 03/2025 PROJ. NO. 022105

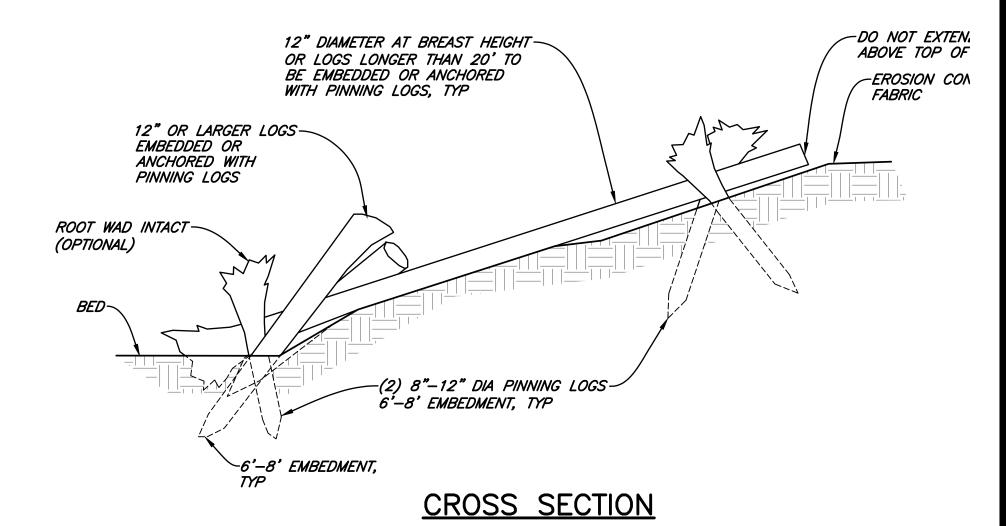












CROSS SECTION DETAIL 1 CONFLUENCE LARGE WOOD STRUCTURE

DETAIL 2 CHANNEL BEND LARGE WOOD STRUCTURE

CROSS SECTION

CHANNEL BANK/FLOODPLAIN LARGE WOOD STRUCTURE

DETAIL 3

SHEET NOTES:

- THIS SHEET SHOWS APPROXIMATE LARGE WOOD STRUCTURE LOCATIONS, CONFIGURATIONS, GRADES, DIMENSIONS, AND PLACEMENT.
 DUE TO VARIABLE FIELD CONDITIONS, LOG VARIABILITY, AND OTHER UNFORESEEN CONDITIONS, THE FINAL LARGE WOOD LOCATIONS, CONFIGURATIONS, GRADES, DIMENSIONS, AND PLACEMENT WILL BE DETERMINED IN THE FIELD WITH THE CONTRACTOR, AND SHN.
 ALL LARGE WOOD GREATER THAN 12 INCHES DBH OR LONGER THAN 20 FEET WILL BE ANCHORED WITH PINNING LOGS.
 FOR CLARITY ONLY LARGE WOOD AND PINNING LOGS ARE SHOWN ON THE DETAILS. SMALL WOOD LESS THAN 6 TO 8 INCHES DBH MAY BE INTEGRATED INTO THE LOG STRUCTURES. SMALL WOOD COURSE AND LOOPING. WOOD SHOULD BE PLACED SO THAT THE LARGE WOOD AND PINNING LOGS PROVIDE ANCHORING.
- 5. LOGS TO BE PUSHED INTO BANK OR BED WILL NEED A TIP CUT ONTO THE EMBEDDED END (SHOWN ON DETAILS). LOGS TRENCHED INTO BANK CAN BE FLUSH CUT AT EMBEDDED END (NOT SHOWN ON DETAILS).

DETAILS

WOOD

DATE 03/2025 022105



EXAMPLE 1 LWS INSTALLATION AND INTEGRATION AT TOP OF STREAM BANK (PHOTO CREDIT: SHN)



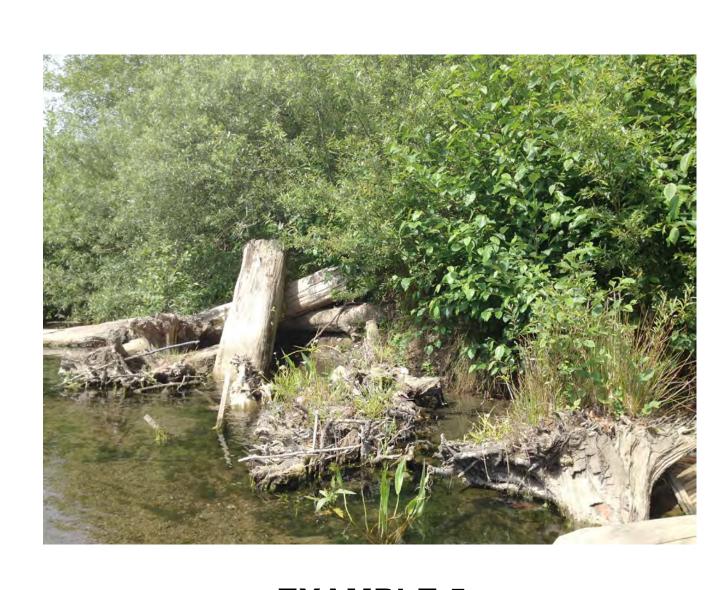
EXAMPLE 2 LWS INSTALLATION AND INTEGRATION AT STREAM BAR (PHOTO CREDIT: SHN)



EXAMPLE 3 LWS INSTALLATION AND INTEGRATION IN STREAMBED/POOL (PHOTO CREDIT: SHN)



EXAMPLE 4 LWS INSTALLATION AND INTEGRATION ON FLOODPLAIN (PHOTO CREDIT: SHN)



EXAMPLE 5 MEDIUM LWS INSTALLATION ALONG STREAM BANK A FEW YEARS AFTER CONSTRUCTION (PHOTO CREDIT: NHE)



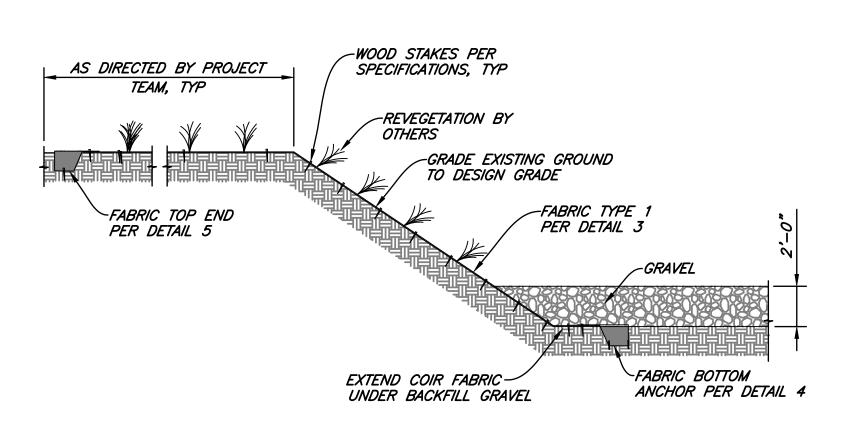
EXAMPLE 6 SMALL LWS INSTALLATION ALONG STREAM BANK A FEW YEARS AFTER CONSTRUCTION (PHOTO CREDIT: NHE)

SHEET NOTES:

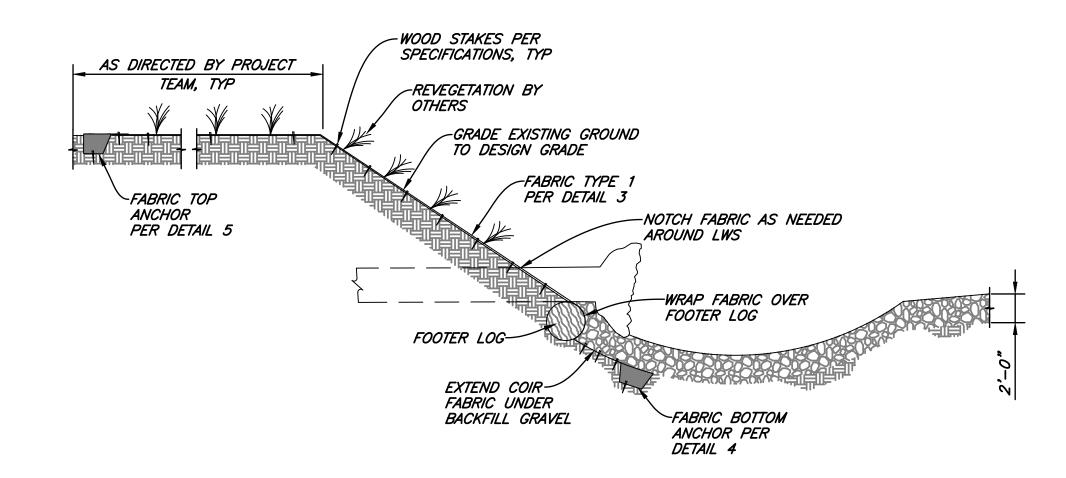
- THE INTENT OF THIS SHEET IS TO SHOW GENERAL EXAMPLES OF THE TYPES OF LARGE WOOD STRUCTURES TO BE INSTALLED.
 THE DESIGN, CONFIGURATION AND SPECIFICATIONS FOR THESE LARGE WOOD STRUCTURES TO BE DEVELOPED DURING THE IMPLEMENTATION PHASES OF THE PROJECT.
 ALL LARGE WOOD GREATER THAN 12 INCHES DBH AND LONGER THAN 20 FEET WILL BE ANCHORED WITH PINNING LOGS OR EMBEDDED INTO STREAM BANK AND/OR BED.

DATE 03/2025

022105

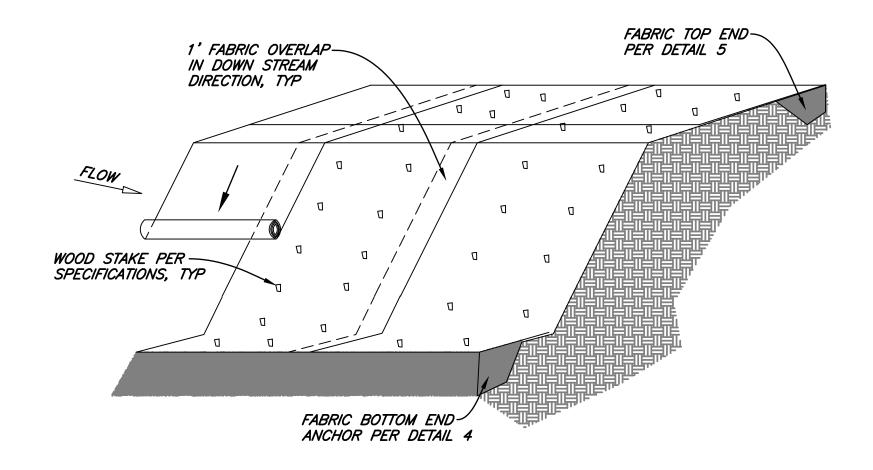




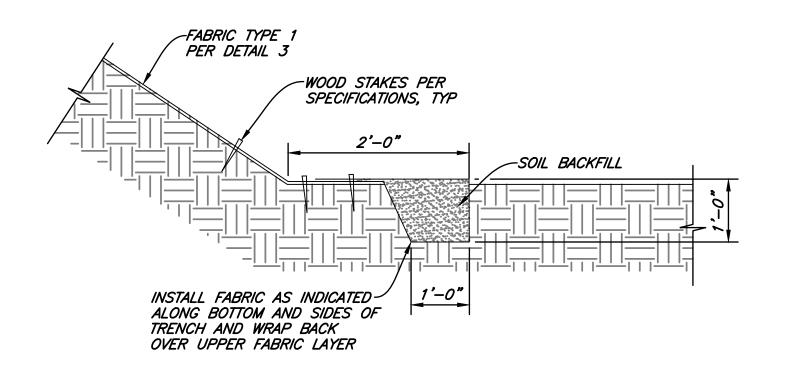


DETAIL 2

(POOL AND LWS FABRIC TYPE 1 DETAIL (TYP))

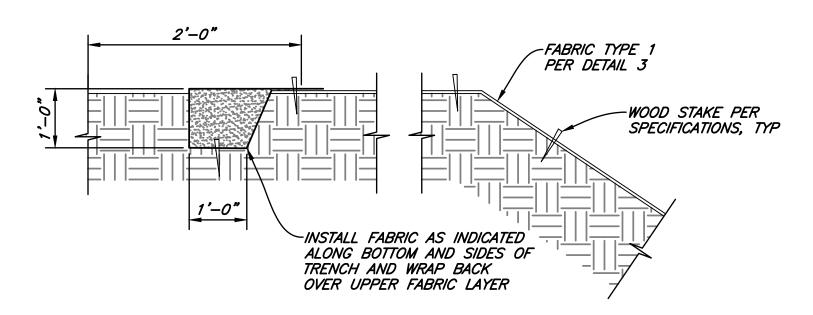






DETAIL 4

NTS C7.0 (FABRIC ANCHOR BOTTOM (TYP))



DETAIL 5 (FABRIC ANCHOR TOP (TYP))

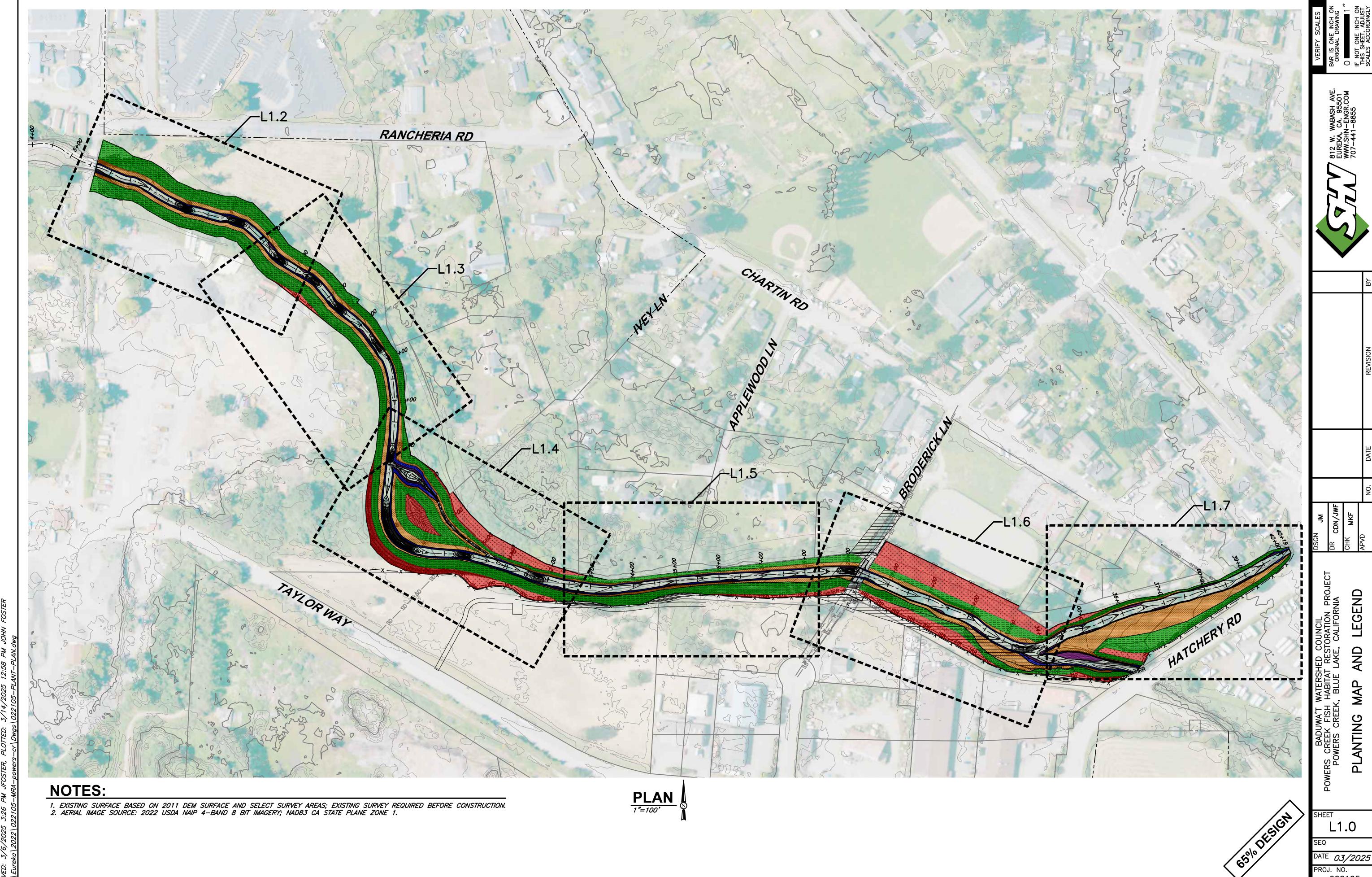
C7.3

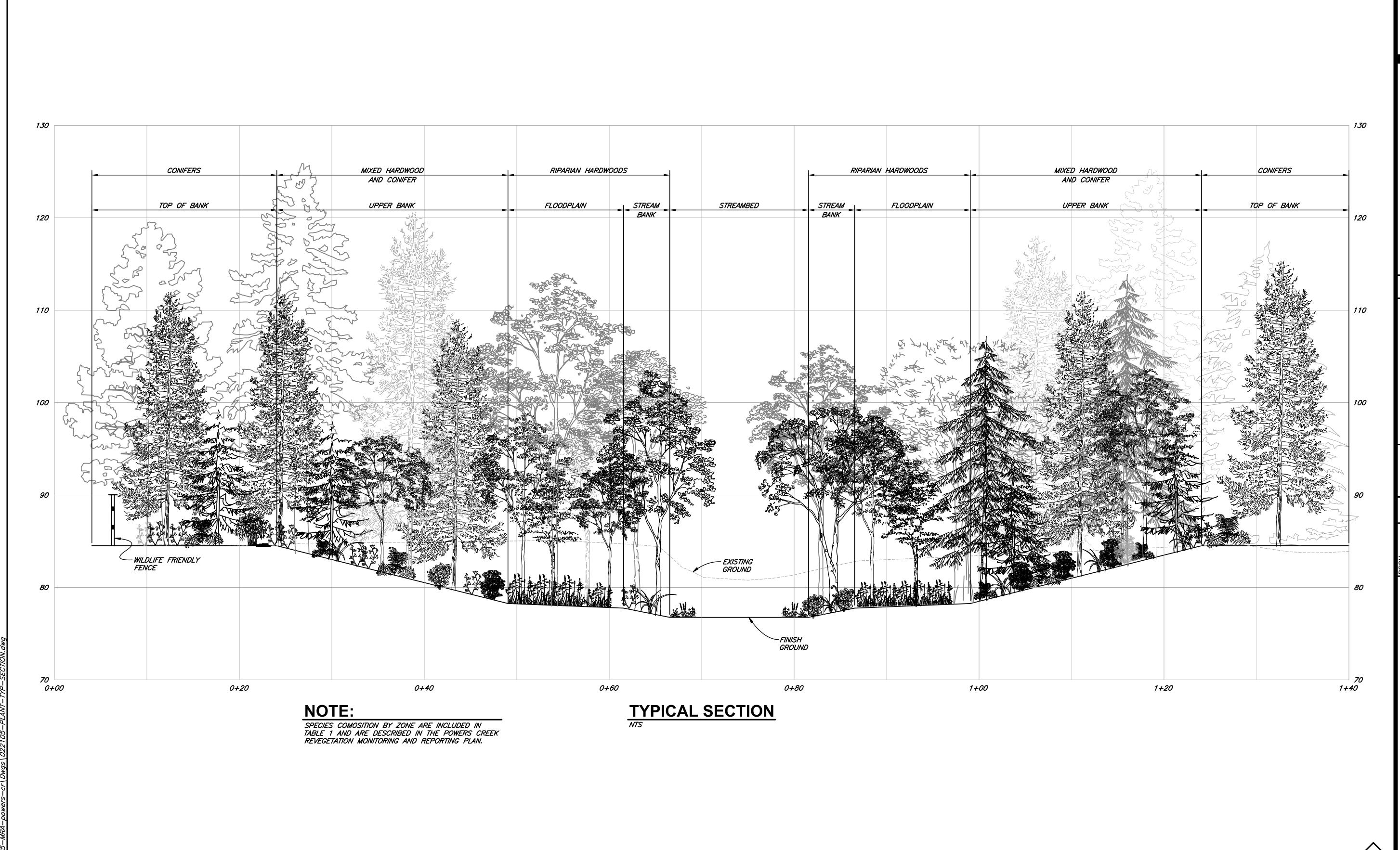
DETAILS

TREATMENT

SURFACE

DATE 03/2025 PROJ. NO. 022105





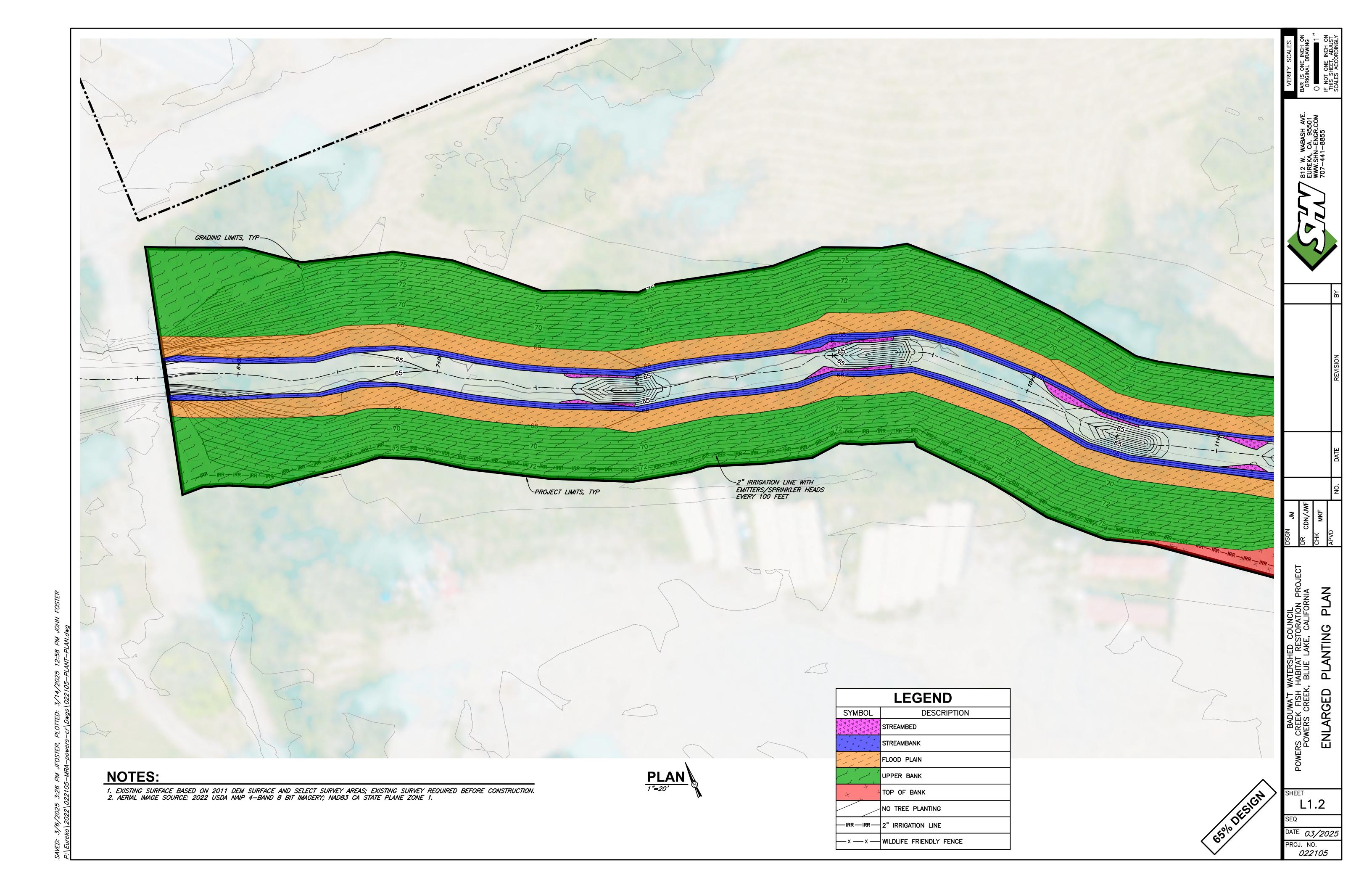
65% DESIGN

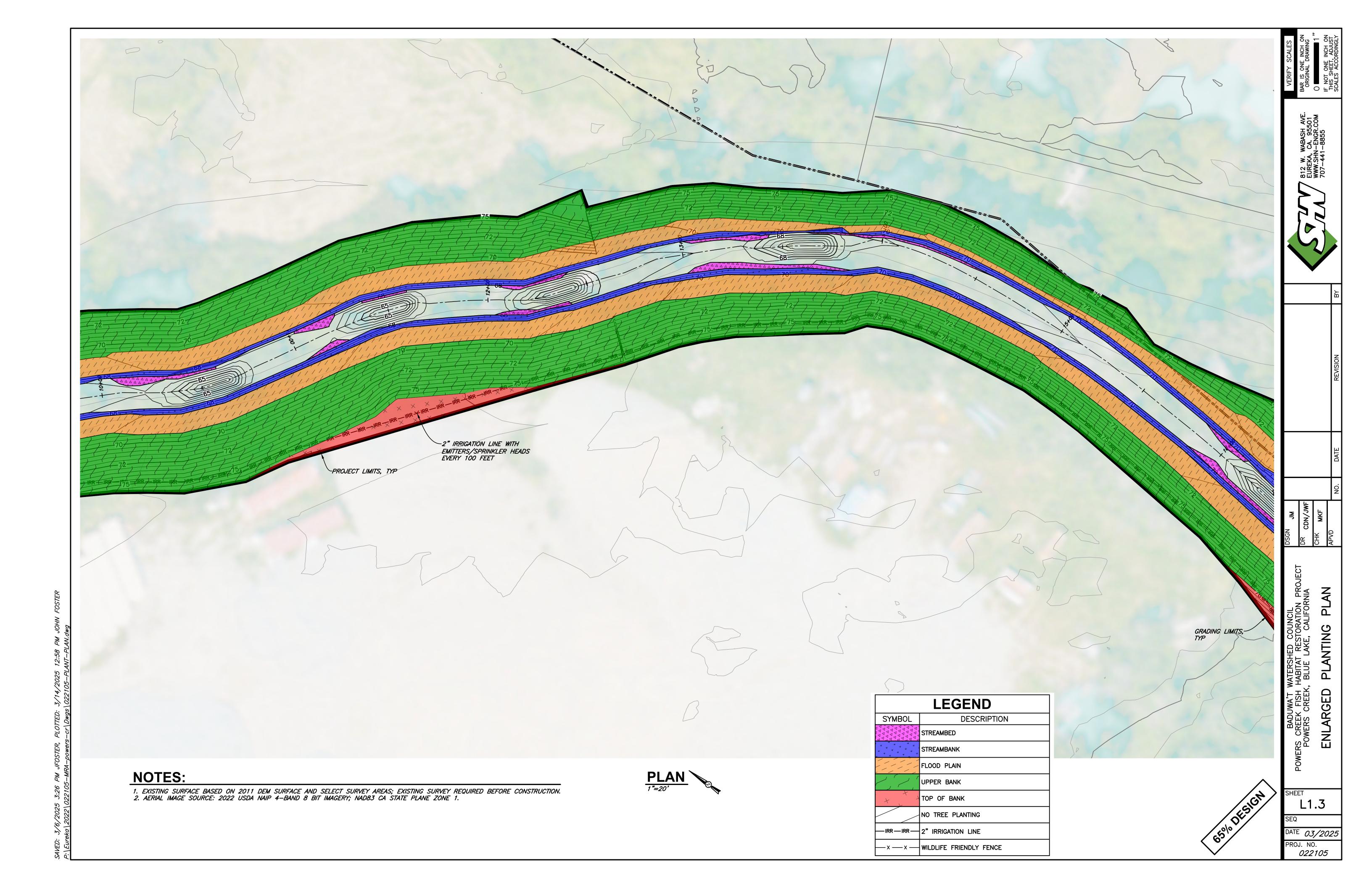
SHEET
L1.1
SEQ

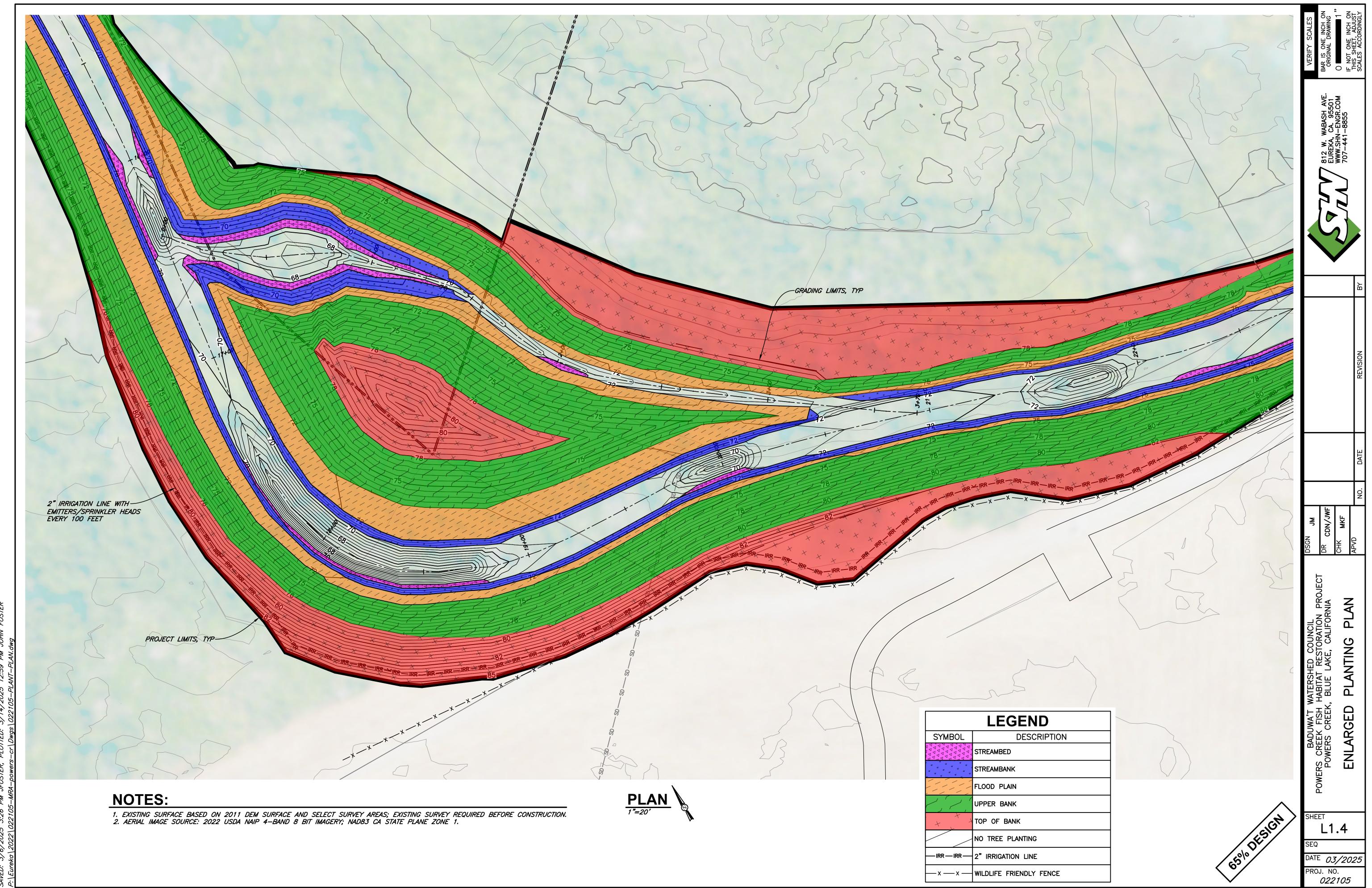
SECTION

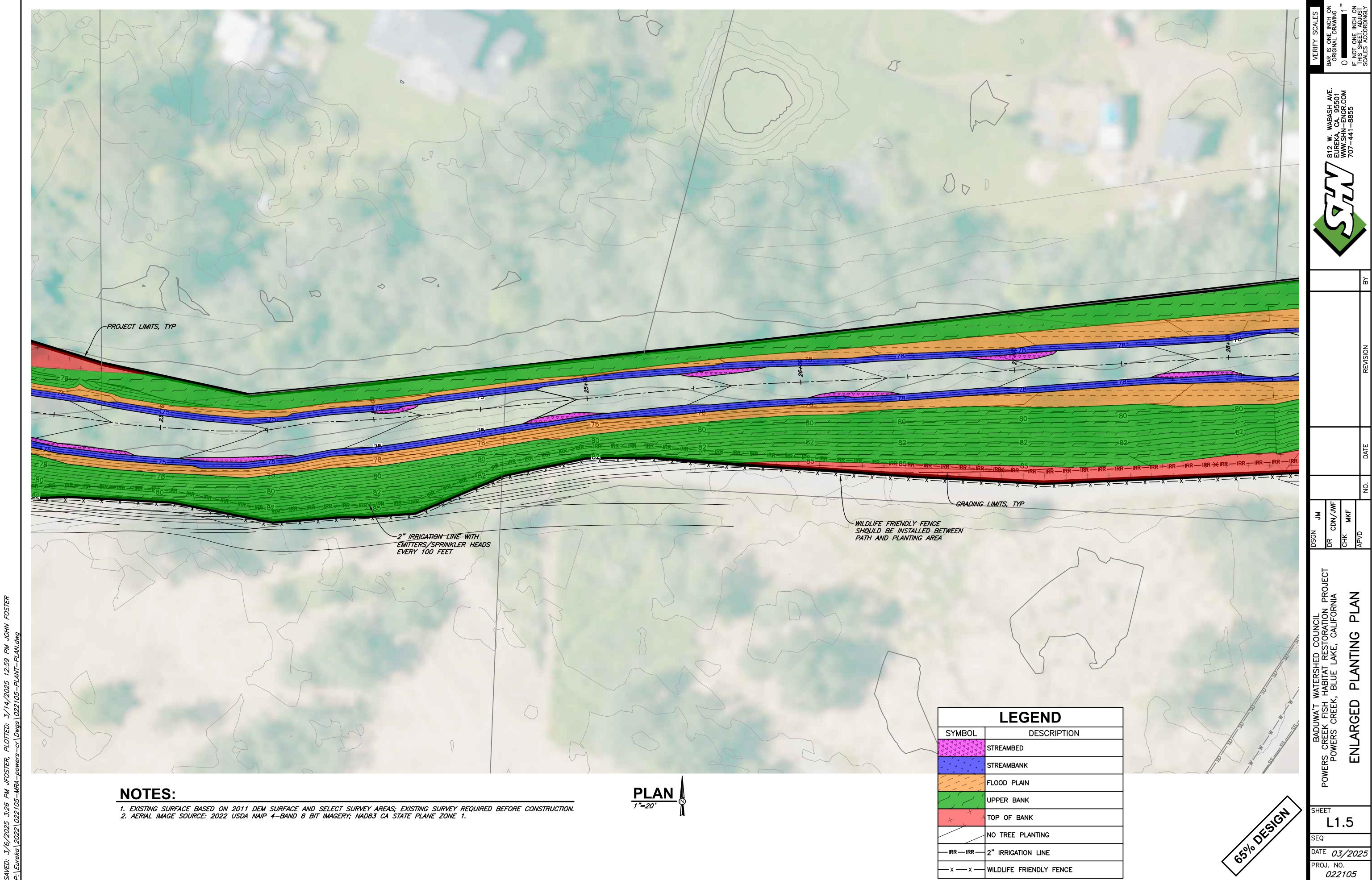
PLANTING

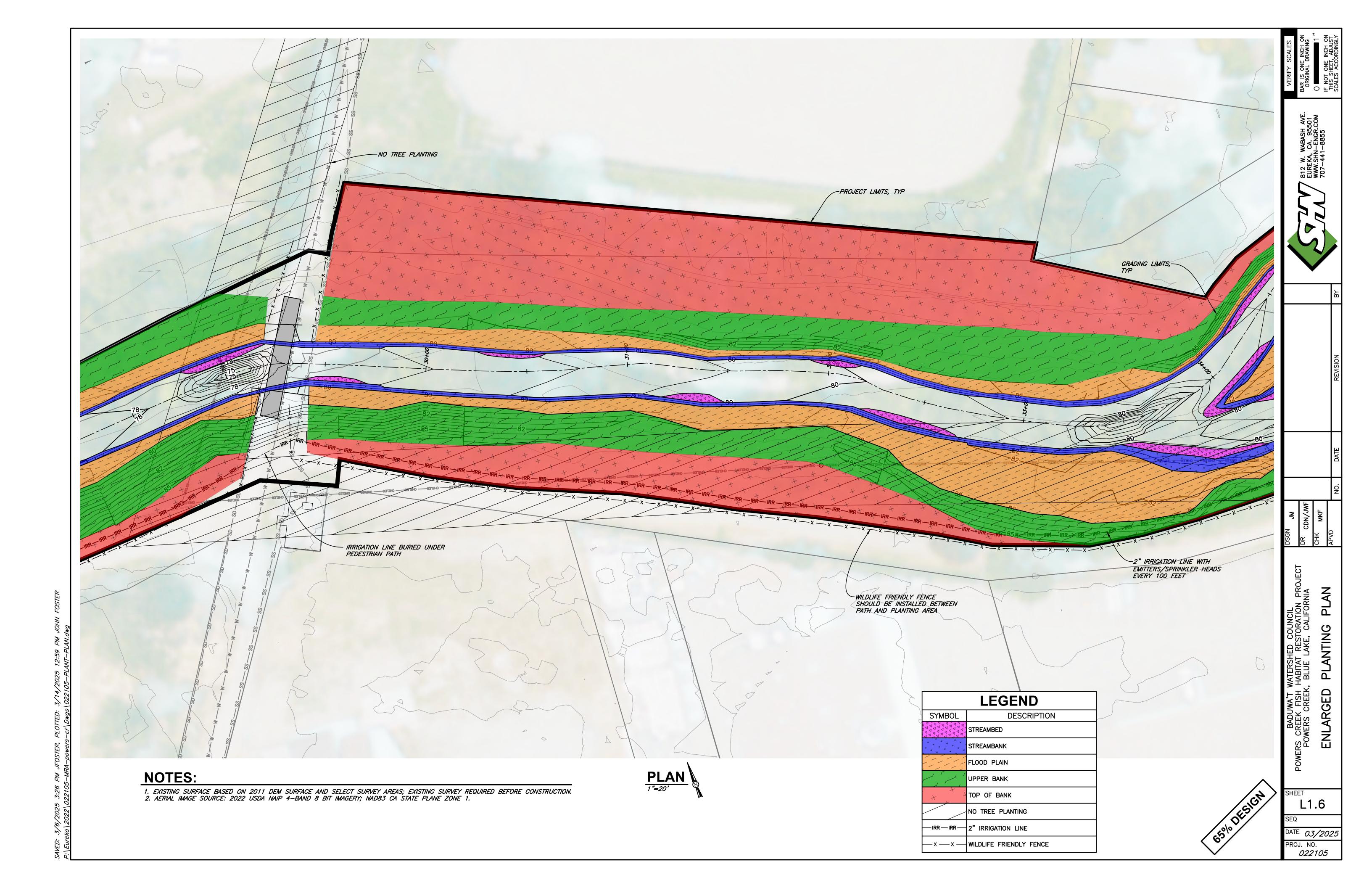
DATE 03/2025 PROJ. NO. 022105

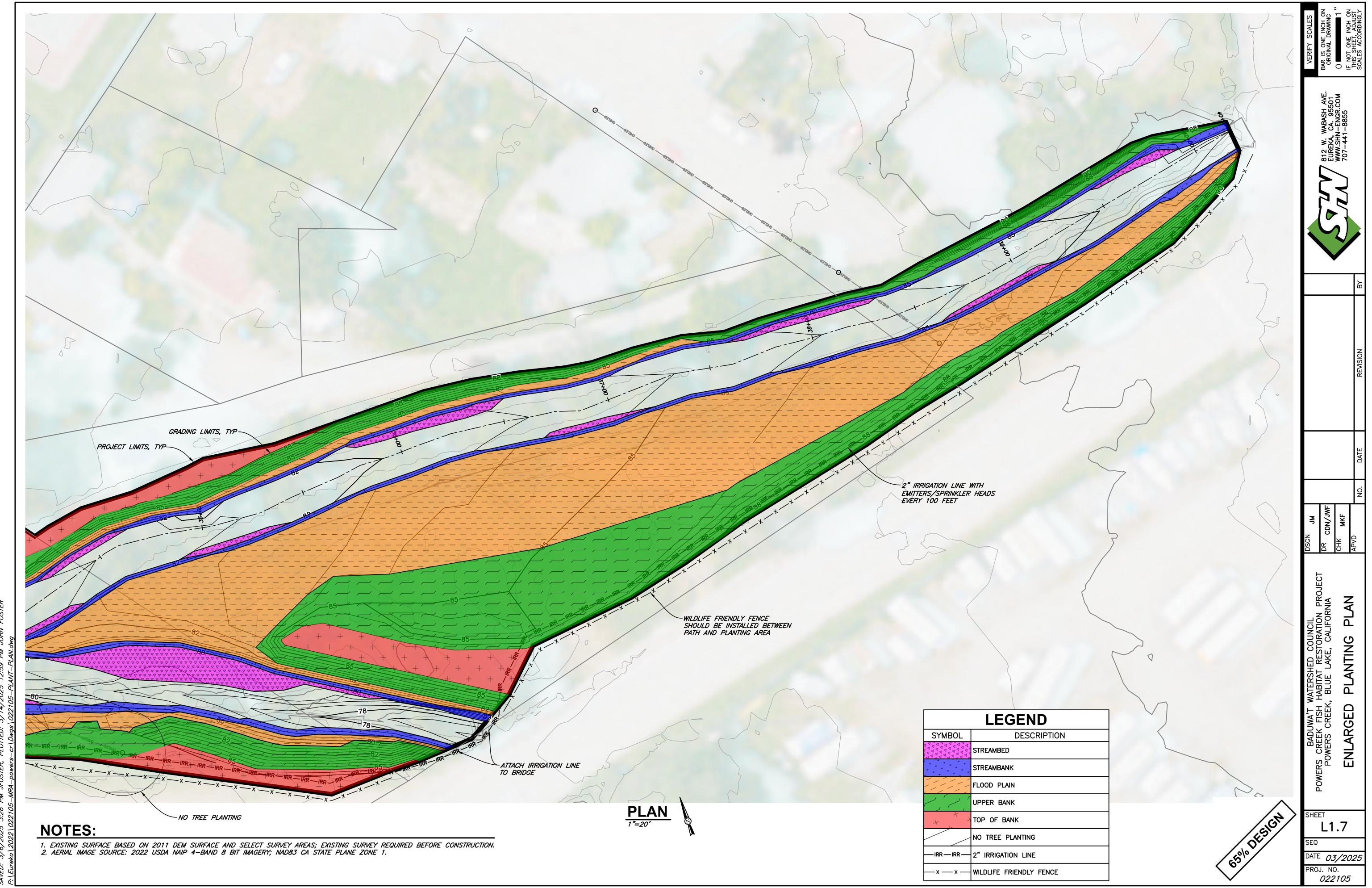


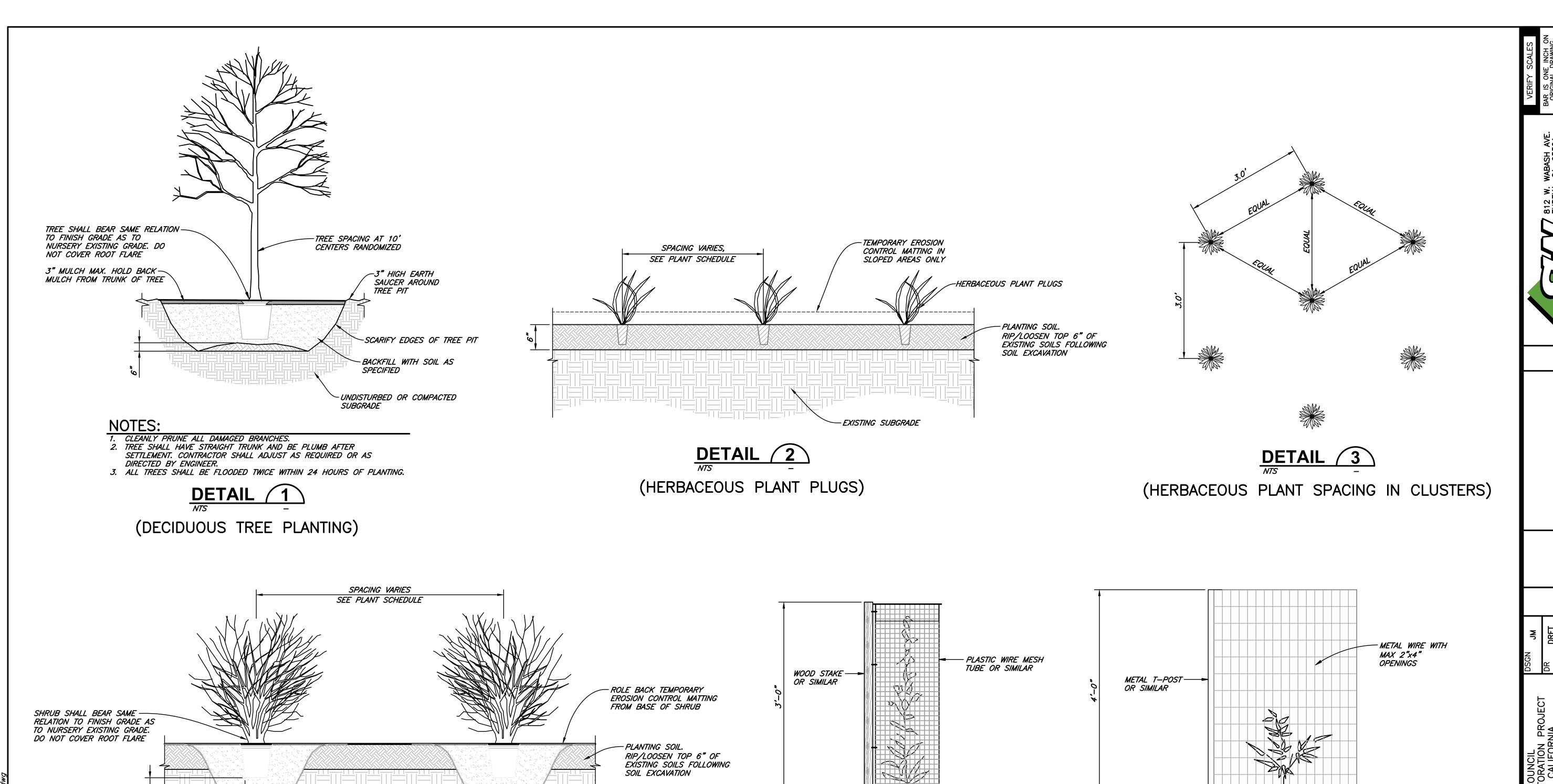












DETAIL 5

EXCAVATE EACH SHRUB
INDIVIDUALLY TO REQUIRED
DEPTH AND BACKFILL WITH
UPLAND PLANTING SOIL
AS SPECIFIED

-*UNDISTURBED* SUBGRADE

DETAIL 4

(SHRUB PLANTING)

DETAIL 6

PROJ. NO.

DATE 03/2025

022105

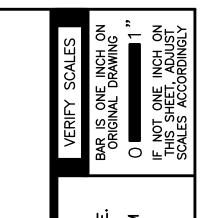
		- TOTTE INC	CREEK PLANTING			
PLANTING ZONE	VEGETATION TYPE	COMMON NAME	SCIENTIFIC NAME	ON-CENTER PLANT SPACING (FT)	ESTIMATED PLANT COMPOSITION (%)	
STREAMBED		SLOUGH EDGE	CAREX OBNUPTA	*PLANTS IN CLUSTERS OF 3	20	
	HERBS	RUSTY BROOMSEDGE	CAREX SUBFUSCA	*PLANT IN CLUSTERS OF 3	20	
		SCOURING HORSETAIL	EQUISETUM HYEMALE	10	20	
		PACIFIC RUSH	JUNCUS EFFUSUS	*PLANT IN CLUSTERS OF 3	20	
		COMMON RUSH	JUNCUS PATENS	*PLANT IN CLUSTERS OF 3	20	
		BIG LEAF MAPLE	ACER MACROPHYLLUM	10	15	
		RED ALDER	ALNUS RUBRA	10	30	
	TREES	OREGON ASH	FRAXINUS LATIFOLIA	10	10	
		BLACK COTTONWOOD	POPULUS TRICHOCARPA	10	40	
		PACIFIC WILLOW	SALIX LASIANDRA VAR. LASIANDRA	10	5	
	CURURG	CASCARA	FRANGULA PURSHIANA SSP. PURSHIANA	5	55	
	SHRUBS	SPIREA	SPIREA DOUGLASII	5	45	
		WESTERN YARROW	ACHILLEA MILLEFOLIUM SSP. OCCIDENTALE	*PLANT IN CLUSTERS OF 5	12	
		CALIFORNIA MUGWORT	ARTEMISIA DOUGLASIANA	*PLANT IN CLUSTERS OF 3	8	
STREAMBANK		CALIFORNIA HARIGRASS	DESCHAMPSIA CESPITOSA SSP. HOLCIFORMIS	5	3	
		SCOURING HORSETAIL	EQUISETUM HYEMALE	10	20	
		SWORD FERN	POLYSTICHUM MUNITUM	*PLANT IN CLUSTERS OF 3	1	
		CALIFORNIA BEE PLANT	SCROPHULARIA CALIFORNICA	*PLANT IN CLUSTERS OF 3	2	
	HERBS	CALIFORNIA GOLDENROD	SOLIDAGO VELUTINA SSP. CALIFORNIACA (SOLIDAGO CALIFORNICA) *PLANT IN CLUSTERS OF 3		10	
		SLOUGH SEDGE	CAREX OBNUPTA	*PLANT IN CLUSTERS OF 3	20	
		RUSTY BROOMSEDGE	CAREX SUBFUSCA	*PLANT IN CLUSTERS OF 3	3	
		PACIFIC RUSH	JUNCUS EFFUSUS	*PLANT IN CLUSTERS OF 3	8	
		SMALL FRUITED BULRUSH	SCIRPUS MICROCARPUS	*PLANT IN CLUSTERS OF 5	8	
		MEXICAN HEDGENETTLE	STACHYS MEXICANA	*PLANT IN CLUSTERS OF 3	5	
		BIG LEAF MAPLE	ACER MACROPHYLLUM	10	12	
		RED ALDER	ALNUS RUBRA	10	20	
		OREGON ASH	FRAXINUS LATIFOLIA	10	16	
	TREES	SITKA SPRUCE	PICEA SITCHENSIS	10	12	
		BLACK COTTONWOOD	POPULUS TRICHOCARPA	10	26	
		WESTERN HEMLOCK	TSUGA HETEROPHYLLA	10	4	
		WESTERN REDCEDAR	THUJA PLICATA	10	10	
	SHRUBS	CASCARA	FRANGULA PURSHIANA SSP. PURSHIANA	5	15	
		TWINBERRY	LONICERA INVOLUCRATA SSP. LEDEBOURII	5	20	
		RED ELDERBERRY	SAMBUCUS RACEMOSA VAR. RACEMOSA	5	40	
		WAX MYRTLE	MORELLA CALIFORNICA	5	25	
	HERBS	WESTERN YARROW	ACHILLEA MILLEFOLIUM SSP. OCCIDENTALE	*PLANT IN CLUSTERS OF 5	10	
FLOODPLAIN		CALIFORNIA MUGWORT	ARTEMISIA DOUGLASII	*PLANT IN CLUSTERS OF 3	10	
		SCOURING HORSETAIL	EQUISETUM HYEMALE	10	18	
		CALIFORNIA FESCUE	FESTUCA CALIFORNICA	5	10	
		COW PARSNIP	HERACLEUM MAXIMUM	*PLANT IN CLUSTERS OF 3	2	
		SWORD FERN	POLYSTICHUM MUNITUM	*PLANT IN CLUSTERS OF 3	1	
		CALIFORNIA BEE PLANT	SCROPHULARIA CALIFORNICA	*PLANT IN CLUSTERS OF 3	5	
		CALIFORNIA GOLDENROD	SOLIDAGO VELUTINA SSP CALIFORNICA (SOLIDAGO CALIFORNICA)	*PLANT IN CLUSTERS OF 5	10	
		ROUGH HEDGENETTLE	STACHYS RIGIDA	*PLANT IN CLUSTERS OF 3	3	
		PACIFIC ASTER	SYMPHYOTRICHUM CHILENSE	*PLANT IN CLUSTERS OF 5	5	
		RUSTY BROOMSEDGE	CAREX SUBFUSCA	*PLANT IN CLUSTERS OF 5	5	
		SLOUGH SEDGE	CAREX OBNUPTA	*PLANT IN CLUSTERS OF 5	12	
		PACIFIC RUSH	JUNCUS EFFUSUS	*PLANT IN CLUSTERS OF 3	6	
		MEXICAN HEDGENETTLE	STACHYS MEXICANA	*PLANT IN CLUSTERS OF 3	3	

POWERS CREEK PLANTING PLAN					
PLANTING ZONE	VEGETATION TYPE	COMMON NAME	SCIENTIFIC NAME	ON-CENTER PLANT SPACING (FT)	ESTIMATED PLANT COMPOSITION (%)
	,	BIGLEAF MAPLE	ACER MACROPHYLLUM	10	4
l	,	RED ALDER	ALNUS RUBRA	10	3
	,	OREGON ASH	FRAXINUS LATIFOLIA	10	3
	, t	SITKA SPRUCE	PICEA SITCHENSIS	10	15
	TREES -	BLACK COTTONWOOD	POPULUS TRICHOCARPA	10	5
	,	DOUGLAS FIR	PSEUDOTSUGA MENZIESSII VAR MENZIESSI	10	20
	, ,	COAST REDWOOD	SEQUOIA SEMPERVIRENS	10	45
<i>l</i>	L	CALIFORNIA LAUREL	UMBELLULARIA CALIFORNICA	10	5
		HAIRY MANZANITA	ARCTOSTAPHYLOS COLUMBIANA	5	40
		OREGON GRAPE	BERBERIS AQUIFOLIUM	5	5
	ı J	BLUE BLOSSOM	CEANOTHUS THYRSIFLORUS	5	55
	, Γ	COFFEEBERRY	FRANGULA CALIFORNICA	5	45
	ſ	COAST SILKTASSEL	GARRYA ELLIPTICA	10	12
UPPER BANK	SHRUBS	TOYON	HETEROMELES ARBUTIFOLIA	5	8
	Γ	WAX MYRTLE	MORELLA CALIFORNICA	5	3
	ŗ	RED FLOWERING CURRANT	RIBES SANGUINEUM	5	20
	Ţ	RED EDLERBERRY	SAMBUCUS RACEMOSA	5	1
	ŗ	SNOWBERRY	SYMPHORICARPOS ALBUS	5	2
		EVERGREEN HUCKLEBERRY	VACCINIUM OVATUM	5	10
		WESTERN YARROW	ACHILLEA MILLEFOLIUM SSP. OCCIDENTALE	*PLANT IN CLUSTERS OF 5	25
Í [CALIFORNIA MUGWORT	ARTEMISIA DOUGLASIANA	*PLANT IN CLUSTERS OF 3	15
		CALIFORNIA FESCUE	FESTUCA CALIFORNICA	5	15
	HERBS	SWORD FERN	POLYSTICHUM MUNITUM	*PLANT IN CLUSTERS OF 3	5
	,	CALIFORNIA BEE PLANT	SCROPHULARIA COALIFORNICA	*PLANT IN CLUSTERS OF 3	15
	1	CALIFORNIA GOLDENROD	SOLIDAGO CALIFORNICA AKA SOLIDAGO VELUTINA SSP. CALIFORNICA	*PLANT IN CLUSTER OF 5	15
		ROUGH HEDGENETTLE	STACHYS RIGIDA	*PLANT IN CLUSTERS OF 5	10
		SITKA SPRUCE	PICEA SITCHENSIS	10	10
1	TREES -	DOUGLAS FIR	PSEUDOTSUGA MENZIESII VAR MENZIESII		20
	,	COAST REDWOOD	SEQUOIA SEMPERVIRENS	10	60
<i>l</i>	<u>, </u>	CALIFORNIA LAUREL	UMBELLULARIA CALIFORNICA	10	10
Í I	, ,	HAIRY MANZANITA	ARCTOSTAPHYLOS COLUMBIANA	5	5
Í [, ,	OREGON GRAPE	BERBERIS AQUIFOLIUM	5	5
	1	BLUE BLOSSOM	CEANOTHUS THYRSIFLORUS	5	25
TOP OF BANK	SHRUBS	COFFEEBERRY	FRANGULA CALIFORNICA	5	10
ĺ	, 1	TOYON	HETEROMELES ARBUTIFOLIA	5	15
Í [, ,	WAX MYRTLE	MORELLA CALFIORNICA	5	25
1		RED FLOWERING CURRANT	RIBES SANGUINEUM	5	10
1		EVERGREEN HUCKLEBERRY	VACCINIUM OVATUM	5	5
	1	WESTERN YARROW	ACHILLEA MILLEFOLIUM SSP. OCCIDENTALE	*PLANT IN CLUSTERS OF 5	34
1	HERBS	CALIFORNIA BEE PLANT	SCROPHULARIA CALIFORNICA	*PLANT IN CLUSTERS OF 5	33
		CALIFORNIA GOLDENROD	SOLIDAGO VELUTINA SSP. CALIFORNICA (SOLIDAGO CALIFORNICA)	*PLANT IN CLUSTERS OF 3	33

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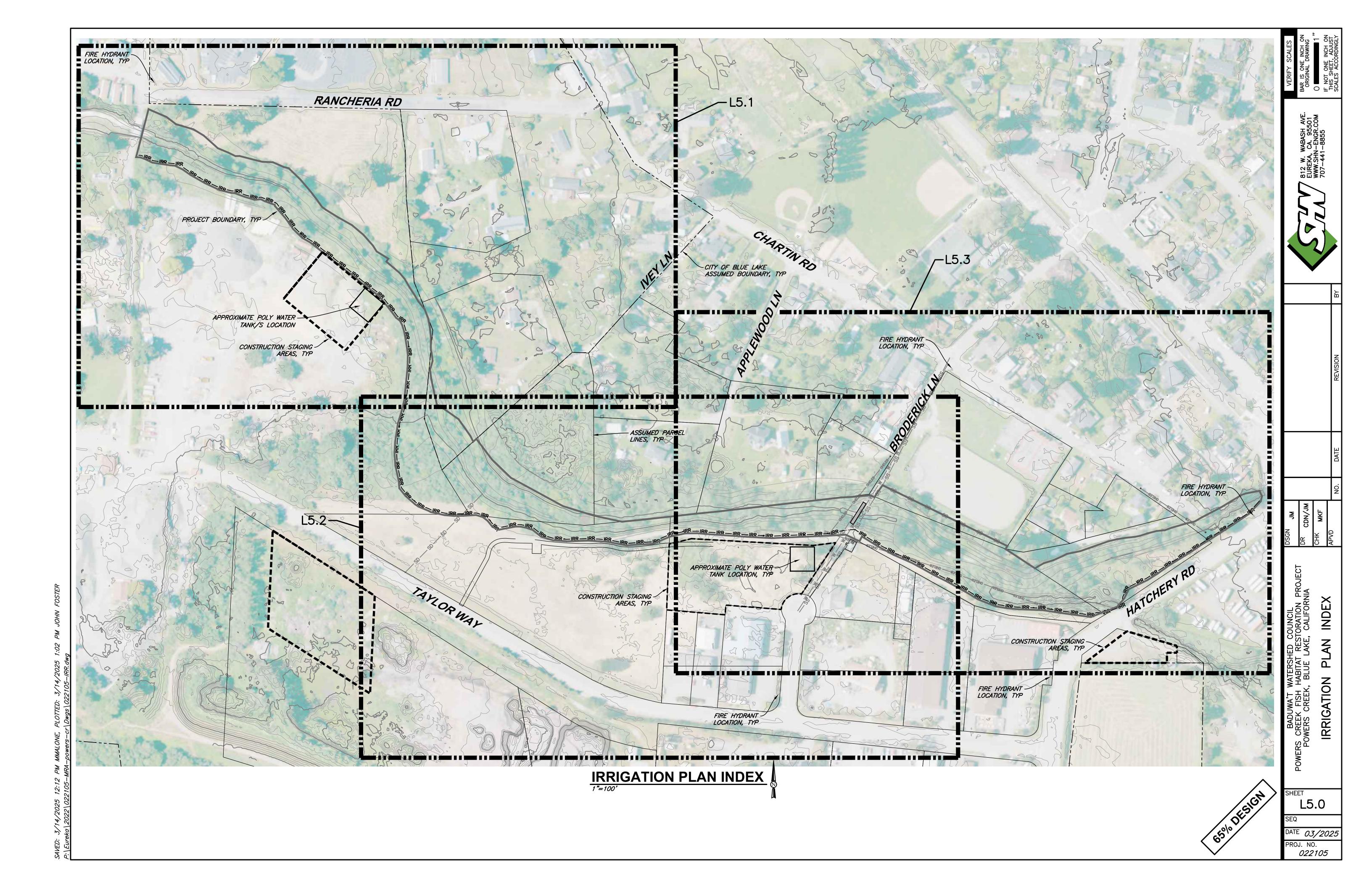


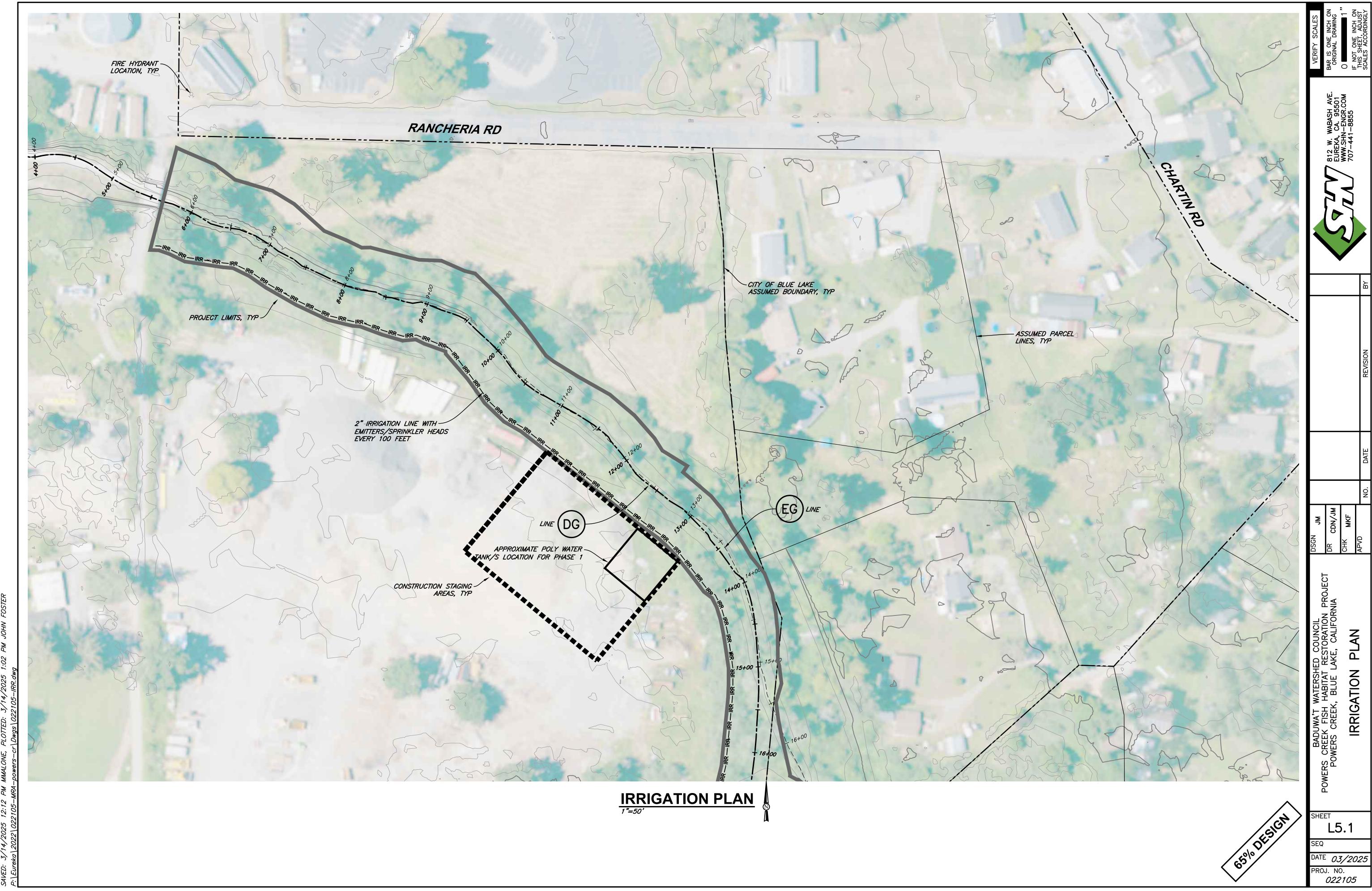
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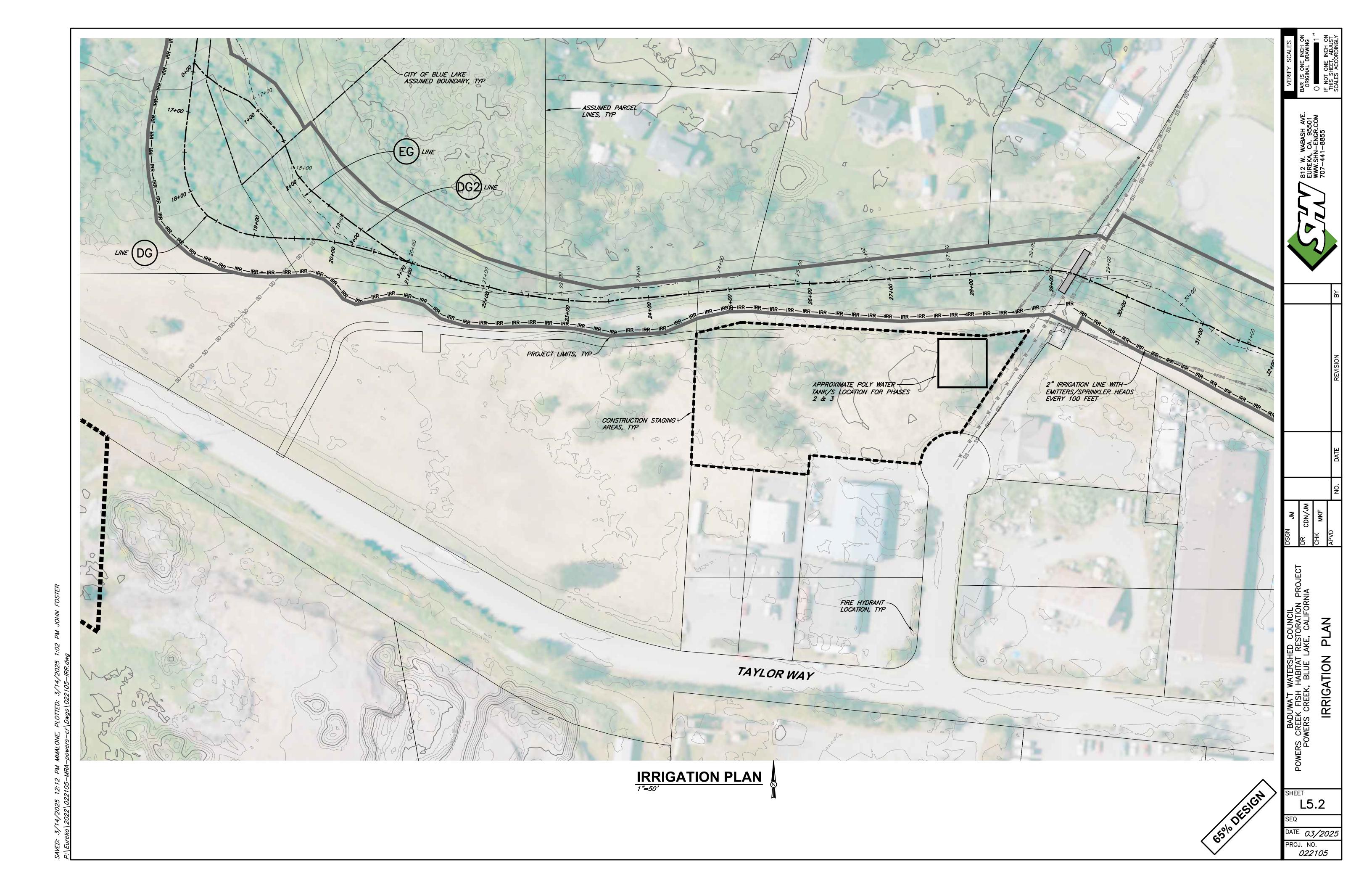
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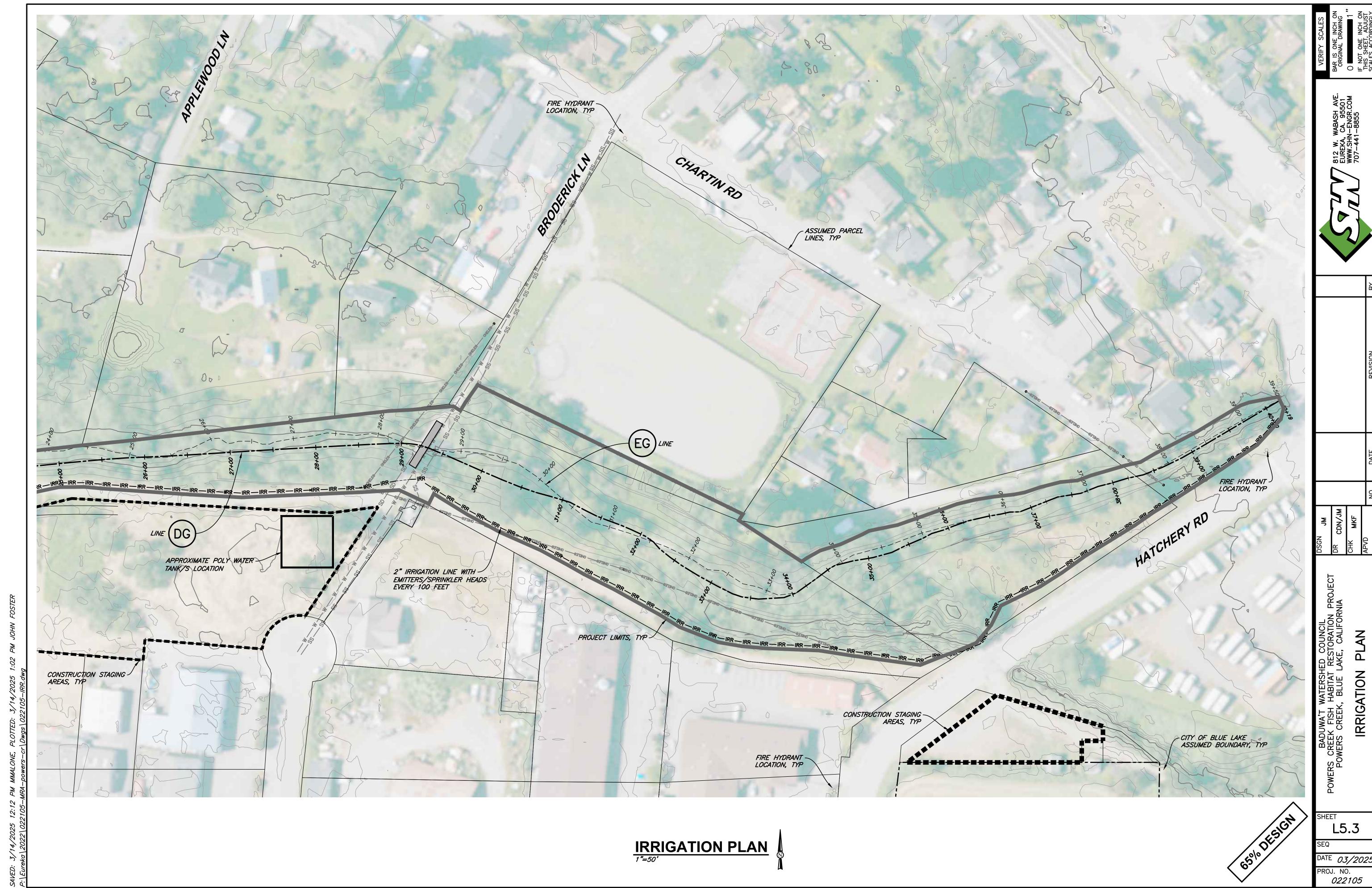
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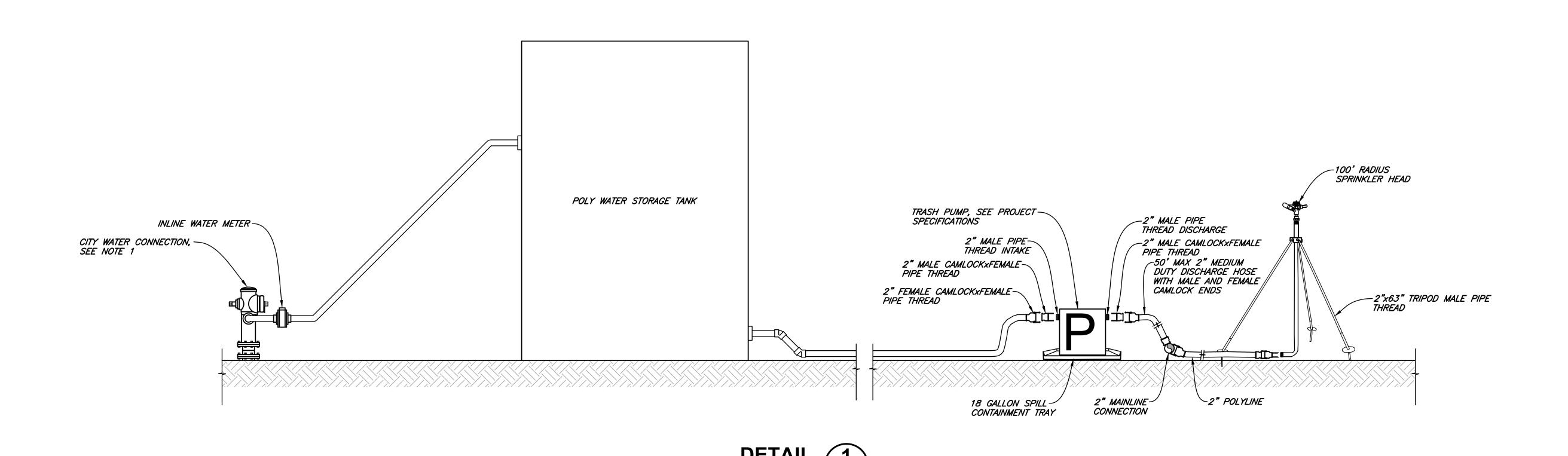








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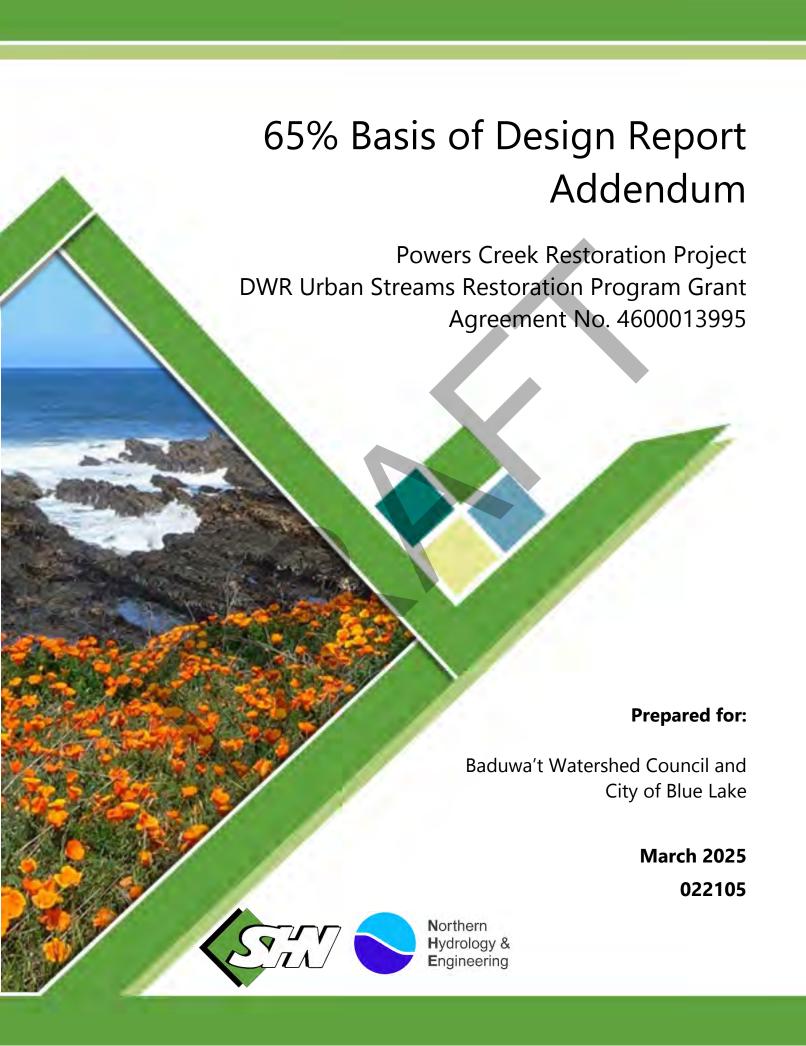
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Attachment 2

65% Basis of Design Report



65% Basis of Design Report Addendum

Powers Creek Restoration Project

DWR Urban Streams Restoration Program Grant

Agreement No. 4600013995

Prepared for:

Baduwa't Watershed Council and City of Blue Lake





812 W. Wabash Ave. Eureka, CA 95501-2138 (707) 441-8855

March 2025

QA/QC: MKF

Reference: 022105

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Abbreviations and Acronyms

Term Definition BOD basis of design

BWC Baduwa't Watershed Council

CCS83 California Coordinate System of 1983
CDFW California Department of Fish and Wildlife

cfs cubic feet per second

COE U.S. Army Corps of Engineers
DFIRM Digital Flood Insurance Rate Map

DWR California Department of Water Resources FEMA Federal Emergency Management Agency

FIS Flood Insurance Study

ft feet

GM silty gravels, gravel-sand-silt mixtures
GW well graded gravels or gravel-sand mixtures
NAVD88 North American Vertical Datum of 1988
NHE Northern Hydrology Engineering
NMFS National Marine Fisheries Service

Project Powers Creek Restoration Project SM silty sands, sand-silt mixtures

SONCC Southern Oregon/Northern California Coast

SW well graded sands or gravelly sands
USRP Urban Streams Restoration Program





Project Overview

This basis of design (BOD) addendum is intended to provide the additional requested information from both the California Department of Water Resources (DWR) Urban Streams Restoration Program (USRP) and the California Department of Fish and Wildlife (CDFW) in the July 2018 Basis of Design report prepared by Greenway Partners (2018; Attachment 1). The Powers Creek Fish Habitat Restoration Project Environmental Setting and Project Description Report presents background data.

Project Purpose/Need

The overall goal of this project is to help increase the abundance of coho salmon and steelhead in the Mad River. To that end, the objectives of the Powers Creek Restoration Project (Project) are to widen, deepen, and realign the downstream reach of Powers Creek; to create a self-maintaining creek channel with abundant, healthy spawning and rearing habitat for coho salmon, steelhead, and other fish species; to develop viable over-wintering habitat for salmonids; and to replace non-native vegetation with a healthy assemblage of native riparian species for cover, food, shade, and eventual wood recruitment. Wood and rock structures will be installed to protect the banks and to create refuge and rearing habitat. Within the National Marine Fisheries Service (NMFS) Southern Oregon/Northern California Coast (SONCC) coho salmon recovery plan (NMFS, 2014), Powers Creek is identified as one of the highest value restoration targets for the Mad River population of coho salmon.

Project Location

The Project is located on Powers Creek near its confluence with the Mad River, approximately 12 river miles upstream from the Pacific Ocean near Latitude 40°52'48"N, Longitude 123°59'38"W (Figure 1). The Project is mostly within the City of Blue Lake in Humboldt County. The Powers Creek Restoration project area is shown on Figure 2. The stream channel within the project site traverses through public and private lands before it crosses tribal lands and drains into the Baduwa't (Mad River). This report provides a summary of the data collected and analyses performed to support the 65% designs.

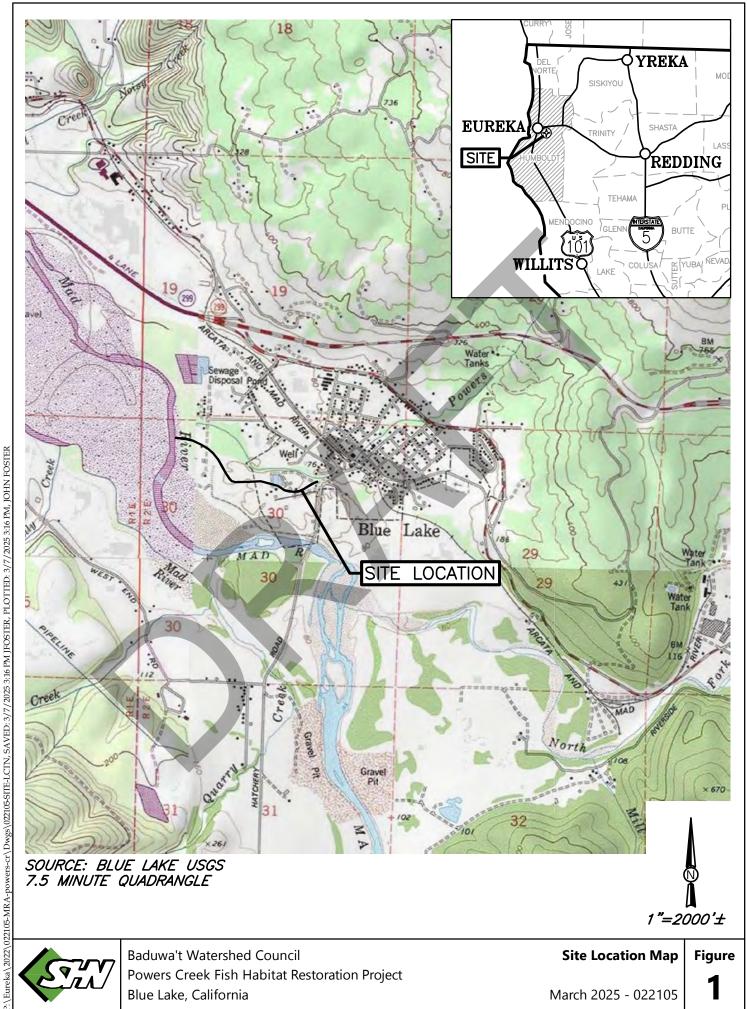
The greater Project reach extends from the new Blue Lake Rancheria Bridge (approximately 500 feet upstream from Powers Creek confluence with the Mad River) and then upstream approximately 3,700 feet on the main stem and 250 feet on the South Fork.

Project Team

The design team for this project, along with the roles of each consultant, is described below:

- SHN
 - Topographic Survey
 - o Grading Plan & Bid Documents
 - Basis of Design Report Addendum
 - o Revegetation and Monitoring Plan (includes maintenance and irrigation)
- Northern Hydrology Engineering (NHE)
 - o Hydrology and Hydraulics Analysis
 - Stream Restoration Design



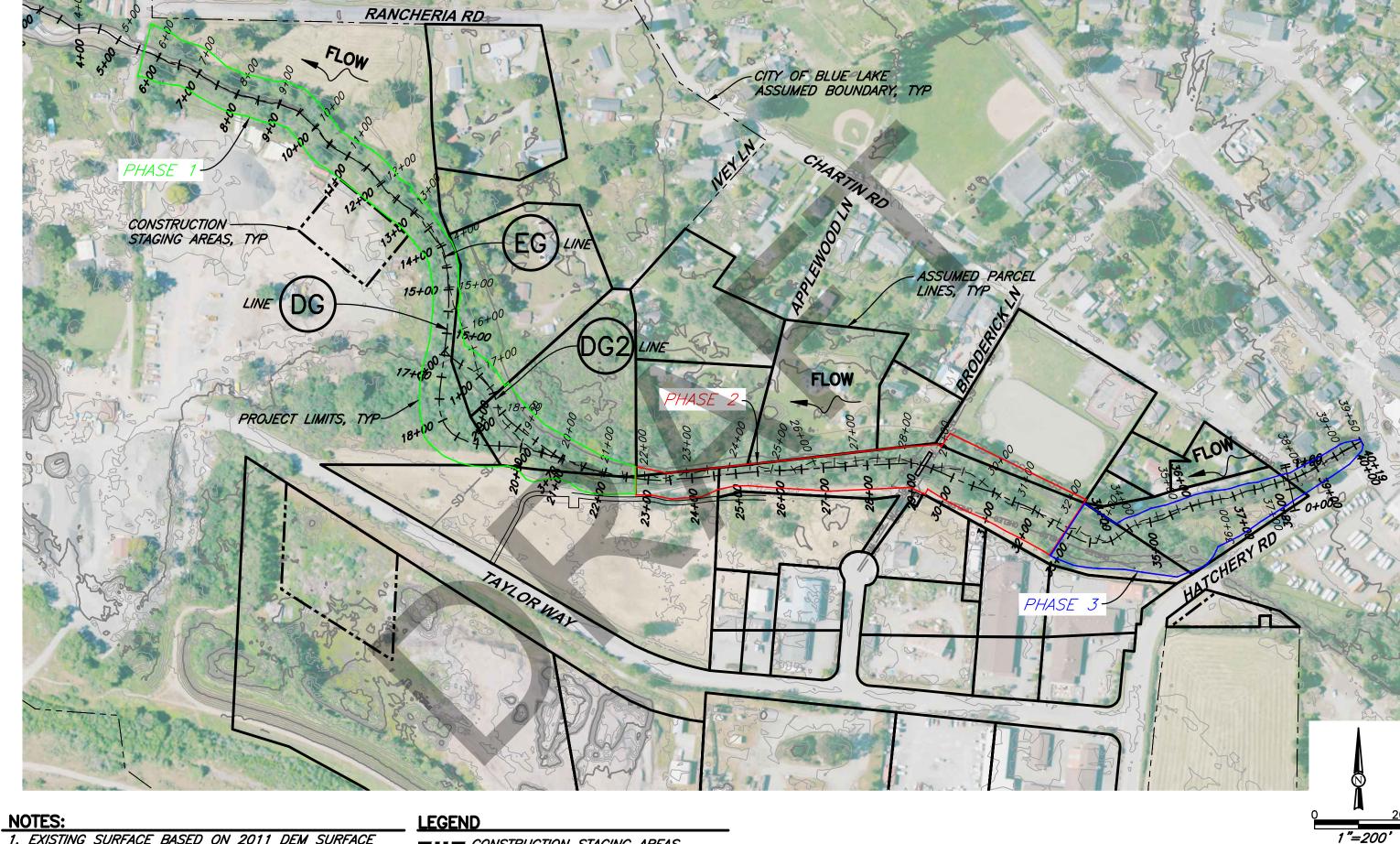


Baduwa't Watershed Council Powers Creek Fish Habitat Restoration Project Blue Lake, California

Site Location Map

Figure

March 2025 - 022105



1. EXISTING SURFACE BASED ON 2011 DEM SURFACE AND SELECT SURVEY AREAS; EXISTING SURVEY REQUIRED

BEFORE CONSTRUCTION.
2. AERIAL IMAGE SOURCE: 2022 USDA NAIP 4—BAND 8
BIT IMAGERY; NAD83 CA STATE PLANE ZONE 1.

--- CONSTRUCTION STAGING AREAS



Baduwa't Watershed Council Powers Creek Fish Habitat Restoration Project Blue Lake, California

Site Plan | Figure

March 2025 - 022105

- Baduwa't Watershed Council (BWC); formally Mad River Alliance
 - o Basis of Design report (July 2018)
 - o Environmental Setting & Project Description Report (March 2022)
 - o Sieve Analysis (June 2023)

Site Characterization and Preliminary Design

This section presents supplemental data that has been collected since the original July 2018 BOD report (Greenway Partners, 2018).

Site Characterization

LiDAR Data 2011

The project base topography is LiDAR data, flown by Sousa in 2011. The LiDAR data covers the creek floodplain; however, data was removed from most of the channel area, where elevations could not be measured under the dense riparian corridor that flanks the channel banks. To reconcile the lack of channel topography, the project team collected cross-sectional topography along 24 transects, perpendicular to the channel, as well as feature topography. In addition, a survey of the Monda Way pedestrian bridge, conducted by SHN in 2018, was included in the existing ground surface.

Project topography is reported in U.S. survey feet and referenced to the North American Datum of 1983 (NAD83), California State Plane Zone 1 (2011). Elevations are reported in feet (ft), referenced to the North American Vertical Datum of 1988 (NAVD88).

Field Surveys (2018, 2023, and 2024)

SHN conducted topographic surveys of the existing conditions at the project site, in accordance with the following coordinate systems:

Coordinate System: State Plane Coordinate Zone 1–401, US Survey Feet
 Horizontal Datum: California Coordinate System of 1983 (CCS83) Zone 1
 Vertical Datum: North American Vertical Datum of 1988 (NAVD88)

Results of the recent surveys indicate that the channel has aggraded approximately 1 foot in elevation at the upstream end, near the S. Railroad Avenue open arch culvert, in comparison to survey efforts conducted by the Humboldt State University (Cal Poly Humboldt) Environmental Engineering Applied Hydraulics class in 2011. The university survey was consistent with the in-channel LiDAR data (Sousa, 2011).

Geotechnical and Geological Investigation

The July 2018 BOD report summarizes and cites previous geotechnical investigations conducted in the vicinity of the project location. These studies include:

- 2013 Geotechnical Site Investigation for Lower Powers Creek Bridge (SHN, May 2013)
- 2013 Monda Way Memorandum #2, Proposed 4,000 Square Foot Building, Monda Way (SHN, June 2008)



2013 Brownfield Site Investigation Report of Findings (SHN, December 2013)

Since the 2018 report, the following additional studies include:

- 2017 Geotechnical Site Investigation for Proposed Powers Creek Footbridge (SHN, September 2017)
- 2023 Sieve Analysis for Powers Creek Fish Habitat Restoration Project (BWC, June 2023)

Geotechnical reports are presented in Attachment 2.

Site Geology

Published literature and geologic maps of the region indicate that the lower Powers Creek site is underlain by Holocene aged alluvial sediments. This area's alluvial deposits are generally composed of inter-fingered layers of unconsolidated sand, gravel, silt, and clay. As a result of their depositional diversity, alluvial deposits are often laterally discontinuous and can have variable compositions over very short distances (SHN, 2017).

Subsurface Conditions

The stratigraphy exposed in the stream banks of the lower reach of Powers Creek (near the lower bridge) consists of a fine-grained cap of silts and sands ranging from 5 to 6 feet in thickness which overlie dense, well-consolidated sandy gravels. The upper fine-grained soils are interpreted to be overbank deposits associated with the Mad River, whereas the coarse sandy gravels is interpreted to be fluvial deposits associated with an ancient Mad River alignment (SHN, May 2013).

Materials encountered in the exploratory test pits near the footbridge indicate the presence of fill, with thicknesses ranging from 0.75 to 2.0 feet. Fill materials are generally loose to medium dense and consist of silty sand with gravel (SM). Native materials underlying the fill are coarse-grained and generally loose to medium dense, consist of well-graded sand with silt and gravel (SW), silty sand (SM), and well-graded gravel with silt and sand (GW-GM) to the maximum depth explored of 9 feet. We interpret the coarse-grained soils encountered within the exploratory test pits to be associated with deposits of Powers Creek and/or the Mad River (SHN Sept 2017)

It should be noted that groundwater levels fluctuate in response to seasonal variations, storm events, and other factors.

Hydrology and Hydraulic Analysis

Basin Description

The Mad River drains approximately 497 square miles in Northern California. The river drainage basin elongates in the south-southeast direction and is approximately 100 miles long and 6 miles wide (Mad River Watershed Assessment, 2010). Watershed elevations range from 6,000 ft at the Coast Range headwaters in Trinity County, to sea level at the mouth through a small estuary located west of the unincorporated community of McKinleyville, approximately 6 miles north of Humboldt Bay. Matthews Dam impounds Ruth Lake, and a natural boulder falls barrier to anadromous salmonids is located on the



mainstem river near Bug Creek. Vegetation in the watershed is composed of early to late seral coniferous forests, hardwoods, and grasslands (Mad River Watershed Assessment, 2010).

Powers Creek is an ungauged, intermittent tributary of the Mad River, which is consistently dry summer through fall. The Powers Creek tributary flows south from its watershed into the floodplains of the Mad River, and meanders west, through the City of Blue Lake to its confluence with the Mad River (Figure 2). The Powers Creek sub-basin is approximately 3.3 square miles. The drainage area upstream of the project is approximately 2.7 square miles.

Hydrology

Annual peak flood flows in for Powers Creek were estimated using the United States Geological Survey (USGS) spatial analytical tool, StreamStats. These data are summarized in Table 1.

Table 1. Summary of Flood Frequency Estimates for Powers Creek and Mad River

Station Name	Peak Discharge Estimate		stimates 1	or Percen	t Chance	Exceedance (cfs) ^a	
	50	20	10	4	2	1	0.2
Powers Creek at S. Railroad Avenue ^b	233	437	583	774	920	1,070	1,410
Mad River upstream of NF Mad River confluence ^c	22,024	34,620	42,916	53,117	60,462	67,572	83,308
Mad River downstream of NF Mad River Confluence ^c	24,461	38,376	47,533	58,790	66,889	74,719	92,056

- a. cfs: cubic feet per second
- b. StreamStats (USGS, 2024)
- c. NHE and Manhard Consulting (2013a)

Peak flood flow estimates of the Mad River, upstream and downstream of the North Fork Mad River confluence, were published in a report to Humboldt County Public Works Department to be used by the Federal Emergency Management Agency (FEMA) to update the Digital Flood Insurance Rate Map (DFIRM) and Flood Insurance Study (FIS) report for Humboldt County (NHE and Manhard Consulting, 2013a). These data were used for the upstream boundary condition for Mad River design flows (Table 1).

Analytical Methods

The following section describes the methods and data used to develop the hydraulic model and conduct the hydraulic analysis.

Two-dimensional Hydraulic Model

A two-dimensional hydraulic model (model) was developed for this study using the U.S. Army Corps of Engineers (COE) HEC-RAS modeling system (COE, 2020). The HEC-RAS model calculates one- and two-dimensional unsteady flow river hydraulics calculations, water surface profiles and average channel velocities for both steady and gradually varied flow and unsteady flow through a channel. For this analysis, steady flow modeling was used to predict flood levels within the project area/reach for the 10-, 4-, 1-, and 0.2-percent annual chance discharges for the Mad River and the NF Mad River (Table 1). Reference can be made to the HEC-RAS manual for information specific to steady state modeling.



Model Parameters

Manning's Roughness Coefficients

Land use was generalized into six categories and Manning's roughness coefficients (*n* values) were assigned to each land use polygon (Table 2). Manning's *n* values ranged from 0.025 to 0.15 and were estimated based on prior modeling experience, professional judgement, and field observations. These *n* values are consistent with the hydraulic analyses performed for Humboldt County Public Works Department to be used by FEMA to update the DFIRM and FIS report for Humboldt County (NHE and Manhard Consulting, 2013b).

Table 2. Manning's Roughness Coefficient Values

Land Use	Manning's Roughness Coefficient
River Channel	0.032
Post-project Creek Channel	0.05
Pasture	0.05
Forest	0.15
Sand	0.025
Grass Shrub/Light Urban	0.02

Boundary Conditions

Located as a transect across the Mad River, approximately 3,000 ft downstream of the Powers Creek confluence, the downstream boundary condition (BC) was set to normal depth using friction slope of 0.01. To simulate the 100-year flood flow event in the Mad River, the BC was set to a stage hydrograph with a maximum elevation of 64 ft, consistent with the approximate FEMA Base Flood Elevation (BFE) at that location.

Existing Channel Geometry

Due to a dense riparian corridor, the existing ground channel topography was not well defined by the LiDAR data (Sousa, 2011). In 2023 and 2024, the project team improved the channel topography by surveying reach-by-reach channel cross-sections. Cross-sectional geometry was incorporated into the existing ground LiDAR base map by generating an interpolated digital elevation model (DEM) with HEC-RAS. The existing conditions cross-section interpolation surface is in-progress of being updated with the 65% design model.

Results

Overbank Flooding:

The existing conditions model demonstrates that overbank flooding is occurring annually, originating from a low point in the channel-to-floodplain north bank connection at Chartin Road, flowing northwest down the road and flooding. As flood waters rise, the south bank across from Chartin Road is overtopping into an area that is not an historical area of flooding. More frequent flooding is observed in Powers Creek due to channel aggradation that is likely caused by instream vegetation, reducing the conveyance of flood flows.

Scour Analysis:

The project team does not anticipate the need for a scour analysis and have discussed and resolved this task with DWR staff.



Log Stability Calculations:

The project team does not anticipate the need for large wood stability calculations because the design will incorporate large (key) wood elements and pinning logs. These methods have proven to be appropriate for a project of this size and the site conditions, based on experience.

Design Development

The project team developed the 30% designs to meet the goals and objectives of the project, without imposing many of the project's constraints. The purpose of this phase was to look at the potential of the landscape and create an ideal design. However, Powers Creek is an urban stream, bound by private, public, and Tribal lands, and limited by utility and infrastructure restrictions. The primary channel was historically realigned to accommodate a mill pond, straightening and lengthening the channel to discharge much further downstream into the Mad River. The project team developed the 65% designs with the intent to meet the goals and objectives of the project within these constraints and conditions. The resulting 65% design is essentially the 30% design fit into the constraints of the landscape listed above. There are still a few unknown constraints that are in the process of being resolved that will be considered as we move into the next phase of the design; specifically, any additional reductions to the project footprint.

Design Considerations

The design criteria for the hydraulic analysis were to establish a meandering channel that provides velocities and depths sufficient for fish passage low flows associated with the winter season. Hydraulic modeling of the existing and design conditions has been completed during the 30% design phase and is in-progress for the 65% design. Main elements of the proposed restoration design include the following:

- Inform the 65% designs with the results of the 30% design model analyses.
- Lower the channel bed to tie the elevation of downstream buried riprap control to historical elevations at the Railroad Avenue arch culvert.
- Create bar/pool morphology, where the channel footprint allows, riffle-pool morphology and pool-run morphology elsewhere. These features are to be built with the addition of large wood habitat structures to promote channel bed sorting and pool scour.
- Over-excavate finished grade and backfill with appropriately sized stream bed material (that is, based on sediment mobility analysis with hydraulic model).
- Include coarsened riffle material at key riffle locations (i.e., based on sediment mobility analysis with hydraulic modeling). These may provide temporary grade control as the project becomes established, post-construction.
- Incorporate biotechnical bank protection, as needed to stabilize banks for native plant revegetation establishment.
- Build an inset channel, with the ability to convey annual peak flood events. Where feasible, include inset floodplains to accommodate shallow, slow-moving water along the edges of the channel.
- Lower utilities that are located beneath the footbridge to accommodate lowering the channel bed through this reach. The plans allow for a provision to lower the existing water and sewer lines that cross under Powers Creek.



- Add floodplain improvements around a proposed development along the left bank of the upstream reach of the project.
- Increase channel conveyance capacity through the project reach.

Stream Profile

The Powers Creek channel was historically realigned to accommodate the construction of the MacIntosh Mill log pond in the 1940s. Review of historical photos indicate that the channel was straightened and lengthened, discharging into the Mad River much further downstream from its original confluence with what was historically the North Fork Mad River. The channel longitudinal profile was surveyed in 2011 by the Humboldt State University (Cal Poly Humboldt) Environmental Engineering Applied Hydraulics class. These surveys are consistent with the stream profile data collected the same year for the Blue Lake LiDAR Mapping project for the County of Humboldt (Sousa, 2011). Data collected by the project team in 2023-2024 indicate that the channel is in the process of aggradation. The project proposes to lower the channel profile to the 2011 channel bed elevation at the upstream end, realign the channel to create a large meander bend and high flow channel split, and connect to existing buried grade control at the downstream end (Figure 3).

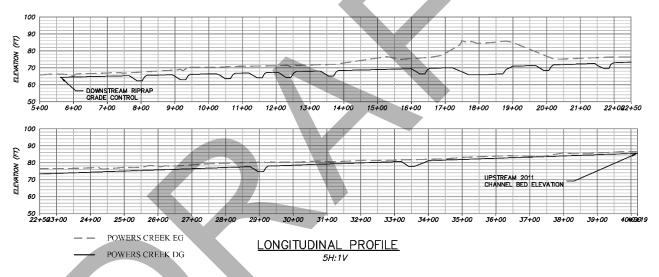


Figure 3. Powers Creek Channel Bed Profile

Upstream Reference

A reference reach with similar channel gradient and bed grain size was not found upstream of the City of Blue Lake on Powers Creek. In lieu of this method, analytical methods were used to design channel geometry.

Design Channel Geometry

Project channel geometry was designed using the University of British Columbia Regime Model (Eaton, 2007). These methods use formative discharge, average channel slope, median grain size (D50), and bank stability index to estimate channel geometry. These methods were used to size the inset channel through the project reach. The inset channel is designed to convey the 1.11-year flood flow event (69.2 cfs), which has a bottom width of 14.6 ft, 50% side slopes, and a depth of 1.9 ft. Inset floodplains are designed into



the greater flood channel, ranging from 0-15 ft, based on project constraints and channel morphology (for example, meander bends, and so on). Typical cross sections are shown on the 65% plan set on sheets C5.0 and C5.1.

Phasing

Due to the limited timeframe to conduct work within the channel this project will be broken up into 3 phases. Assuming the project is funded in 2025, construction for project is anticipated to be starting with the lower reach in summer of 2026, the middle reach in summer of 2027, and the upper reach in the summer of 2028. The construction phasing is presented on the site plan (Figure 2).

Disposal Sites

It is anticipated the overall excess material generated from all three phases of this project will be approximately 35,000 to 40,000 cubic yards. It is anticipated this material which is estimated to predominantly be comprised of silty sand. BWC And the City of Blue Lake are working with local farmers to add material to build up their pastureland. An alternate disposal location will be the former Blue Lake Power site which is owned by the City and located near the project site in the Powers Creek District.

Location for construction staging and disposal is located on Figure 2.

Irrigation Plan

The proposed irrigation plan will be to provide water via water truck to fill temporary tanks and non-permanent irrigation piping located along the southern bank to irrigate plants during the dry months. Elevated sprinkler heads will be located approximately every 100 feet. The irrigation plan is shown on Figures 4-7.

Revegetation Monitoring and Reporting Plan

A revegetation monitoring and reporting plan will be provided under separate cover. This plan includes a maintenance plan, identifies percent survival, and an irrigation plan.

100% Design Plans

Attached are the 65% design plans. Final bid documents will include specifications, which will have a bid sheet accompanied with a measurement and payment section describing each bid item.

References Cited

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Powers Creek Fish Habitat Restoration Project Blue Lake, California

March 2025 - 022105

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Baduwa't Watershed Council
Powers Creek Fish Habitat Restoration Project
Blue Lake, California

Irrigation Plan | Figure

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Baduwa't Watershed Council
Powers Creek Fish Habitat Restoration Project
Blue Lake, California

Irrigation Plan | Figure

March 2025 - 022105

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Baduwa't Watershed Council
Powers Creek Fish Habitat Restoration Project
Blue Lake, California

Irrigation Plan | Figure

March 2025 - 022105

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Basis of Design Report

Basis of Design Report for Powers Creek Fish Habitat Restoration Project



July 2018









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Project Goal and Objectives

The Powers Creek Fish Habitat Restoration Project is funded by the California Department of Fish and Wildlife's Fisheries Restoration Grant Program. The overall goal of this project is to help increase the abundance of Coho salmon and Steelhead in the Mad River. To that end, the objectives of this restoration project are: to widen, deepen, and realign the downstream reach of Powers Creek; to create a self-maintaining creek channel with abundant, healthy spawning and rearing habitat for Coho salmon, Steelhead, and other fish species; to develop viable over-wintering habitat for salmonids; and to replace non-native vegetation with a healthy assemblage of native riparian species for cover, food, shade, and eventual wood recruitment. Wood and rock structures will be installed to protect the banks and to create refuge and rearing habitat.

This Basis of Design Report (BOD) provides information and guidelines that will be used by the design team in preparing the plans and specifications for the restoration Project. The BOD establishes the physical constraints that will dictate the alignment of the channel and describes the design elements and enhancements that may be incorporated. The BOD and a set of plans will constitute the 100% Design package. The constraints and design elements may be modified as the design progresses through the agency and stakeholders review process to the 100% complete version.



Historical and Current Conditions

Powers Creek discharges into the Mad River approximately 12 miles upstream from the Pacific Ocean. The watershed of Powers Creek covers approximately 3.2 square miles (Figure 1). Of that, 68% is zoned timber production, 10% is owned by the City of Blue Lake, 6% is zoned for grazing/timber, 10% as rural residential, 5.2% is the 299 highway and other public roads. The remaining 1% is residential, church and tribal. Approximately 48% of the City is within the basin.

At one time, the watershed was heavily forested with redwood and fir but most of the watershed was logged in the late 1800's. The upper half of the watershed is steep grasslands and forested hillsides. About 1000' downstream of its crossing under Highway 299, the creek becomes a steep cascade. This waterfall represents the upstream migration barrier to anadromous salmonids. At this point, at creek mile 1.4, it then flattens and flows at a reduced gradient (1% to 2% slope) through several forested parcels and then through a long culvert under Blue Lake Blvd. The stream daylights at creek mile 1.1 and becomes a highly constrained urban stream that flows through the middle of the City of Blue Lake. This reach of the creek is tightly constrained by buildings, bridges, concreted channels and culverts. The gradient flattens to less than 1% as it leaves the urban area around creek mile 0.7 and flows across the historic flood plain of the Mad River.

The main project reach is this lowest section where it flows across the floodplain and into the Mad River. In a 1941 aerial photo, the floodplain appears to be farmland with Powers Creek near its present-day location (Figure 2). In the late 1940's, a lumber mill was developed and the creek was relegated to function as a drainage ditch along their northern property edge. In air photos from around 1950, a log pond along the south edge of the creek reached its maximum extent at nearly 10 acres. By 1954, it appears that the flood control levee separated the mill and Blue Lake from the Mad River (Figure 2). Reportedly the mill did not use wood treatment chemicals, dip tanks or spray systems. By the late 1970's, the mill had shut down, the log pond had been mostly backfilled and in a 1981 air photo, the pond appears to be completely filled in (Figure 2).

Approximately 500' upstream of the mouth of Powers Creek, a road crossing bridge had been placed in the early 1980's to replace an undersized culvert. When the bridge abutments began to erode, the landowner poured concrete to harden the creek bed. Over the following years, this artificial grade control caused upstream aggradation as well as downstream scour and created a partial barrier to fish passage and likely caused the creek to dry up earlier in the summer. In October, 2016, the Blue Lake Rancheria along with CalTrout and the National Marine Fisheries Service (NMFS) replaced the undersized bridge and restored better access (Figure 3). The creek is in the process of readjusting to the removal of this grade control.

Within the NMFS SONCC Coho salmon recovery plan (NMFS, 2014), Powers Creek is identified as one of the highest valued restoration targets for the Mad River population of Coho salmon. An electrofishing survey in 2011 found Coho salmon and Steelhead juveniles in the creek and Steelhead juveniles were observed in the spring of 2018.

Figure 1: Powers Creek Watershed.

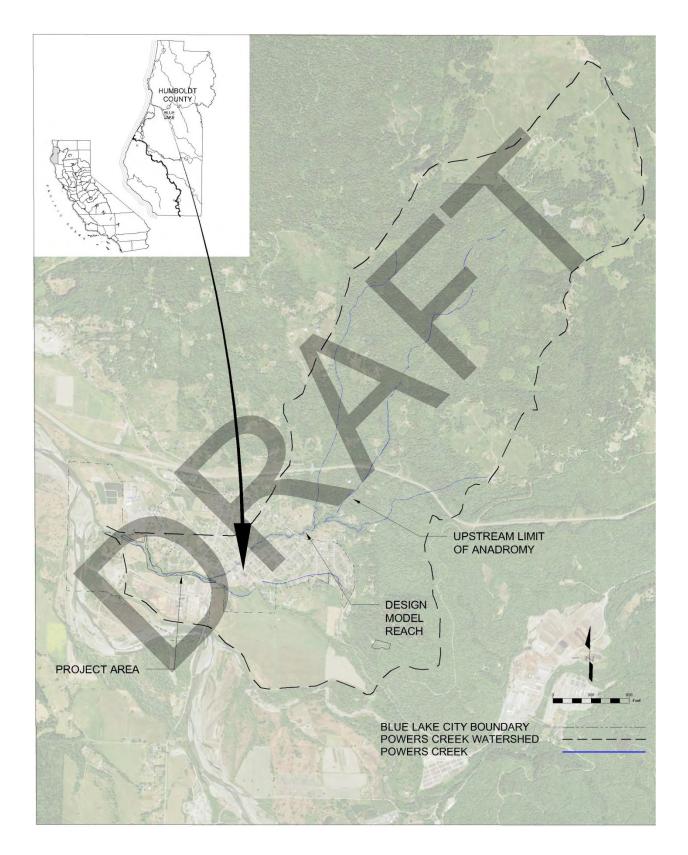


Figure 2: Powers Creek Air Photos from 1941, 1954, and 1981.



Figure 3: Powers Creek Rancheria Bridge Before and After Replacement.



Background Resources

Fish Habitat Assessment

In July, 2011, California Department of Fish and Game (CDFG) conducted a stream inventory of Powers Creek from the mouth at the Mad River upstream to the culvert under Blue Lake Blvd at River mile 1.1. The general recommendations were that:

- Powers creek should be managed as an anadromous, natural production stream.
- Pool enhancement structures should be designed to increase pool numbers and add high quality complexity with woody cover.
- Native vegetation like willows, alders, redwoods and firs should be planted to increase canopy cover.
- The bridge crossing at 504' is a partial fish access barrier and should be improved.
- Fish presence was observed from the stream banks during the habitat survey. In addition, two pools were sampled by electrofishing. Fifteen juvenile steelhead and three Coho salmon juveniles were caught and released in the effort.

Although most of Powers Creek dries up in the spring and through the summer, there is a short section of Powers Creek that maintains a few residual pools throughout the year between the U.S. Post Office and Blue Lake Blvd, probably fed by springs. There were several anecdotal sightings of Steelhead spawning adults within this reach in winter, 2016/2017 and young of the year and several 1+ juveniles were observed in summer, 2017. Steelhead young of the year were observed in the same reach during spring, 2018.

Project Base Map

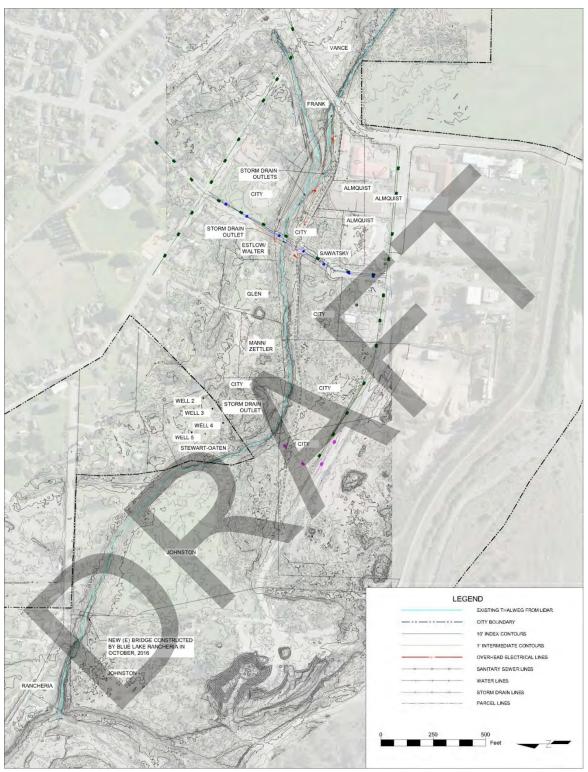
The project base map was created using a variety of maps that already existed and new surveys filled in the gaps. In 2006, a longitudinal profile survey using a total station was conducted by Humboldt State University (HSU) and National Marine Fisheries Service (NMFS). The survey began at the confluence of Powers Creek with the Mad River and continued upstream to the culvert under Hatchery Road and demonstrated the stream slope through this reach as approximately 0.5%.

A topographic base map was developed from an aerial LiDAR flight of Blue Lake and surroundings conducted in 2011 by Humboldt County to meet FEMA's requirements for certification of the Mad River levee. The flight also produced high resolution aerial photographic coverage of the project reach.

In 2016, additional supplemental surveys were required to: define the as-built topography of bridge replacement project completed in October 2016 by the Blue Lake Rancheria, and to better define the upstream end of the project reach on the main stem and the South Fork Powers Creek tributary.

In 2017, SHN Engineering was subcontracted by Greenway Partners to provide accurate benchmarks for survey control, as well as surrounding property corners and parcel lines. During the summer Greenway Partners conducted supplemental total station surveys using those benchmarks. These surveys were added to the LiDAR, to create the final project base map (Figure 4). The supplemental surveys also helped to verify the accuracy of the LiDAR, which in most cases was found to be within one or two tenths of a foot of the ground surveyed elevation.

Figure 4: Powers Creek Base Map of Existing Conditions.



Geotechnical Investigation

In 2013, a geotechnical investigation was conducted by SHN for the replacement of the Rancheria Bridge and is safely assumed that it is typical of most of the project reach. The project reach is situated on a broad fluvial terrace surface on the north side of the Mad River and is entirely within the 100-year flood zone of the Mad River. Geologic maps indicate the reach is underlain by Holocene aged alluvial sediments, generally composed of inter-fingered layers of unconsolidated sand, gravel, silt, and clay Basis of Design Report

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which are often laterally discontinuous and thus the composition of these sediments can be variable over short distances.

Two borings from this investigation consisted of a fine-grained cap of silts and sands around five feet thick overlying dense, well-consolidated sandy gravels (Figure 5). The upper soils were interpreted as overbank deposits of the Mad River while the gravels are likely fluvial deposits associated with an earlier Mad River alignment. Groundwater was encountered approximately 16' below grade during these March 27, 2013 borings. This investigation recommends that cut slopes not exceed 1.5H:1V. But, since the project reach is extensive, it is recommended that site conditions be carefully monitored during the construction phase by the engineer and cut slopes adjusted as necessary.

In April, 2008, a site soils investigation was performed by Whitchurch Engineering for the Trevor Estlow property along the right bank (looking downstream) of Powers Creek in the upstream part of the project reach. Four test holes (TH-1 through 4) were excavated by a backhoe 7' to 9' deep (Figure 5). Generally, the top 6' or so was sandy silt and below that was sandy gravel which is fairly consistent with the SHN borings. No groundwater was encountered in these four borings.

There have been various geotechnical and soils investigations in the left bank region of the creek due to the development of the Blue Lake Industrial Park. For this project, we have focused on the sample locations that were nearest the creek to discover what we may encounter when excavating along the left bank of the new design channel. In 2011, an Environmental Site Assessment (ESA) was prepared by SHN. They report on an initial soil investigation for the industrial park in 1981 at which time most of the log pond had been filled in with only a small remnant pond about 10 feet deep but not full of water. The 1.5'W x 7'L soil pits excavated by a backhoe and nearest the creek (EH-6, 7, 9, and 10) are shown on Figure 5. Most of those near-creek pits were in the former log pond area and encountered what they reported as river-run gravel fill (rounded sandy gravel with some silt) also containing organic material (wood, bark, and chips) down to about 6'-8'. A few pits contained about 50% each of river-run gravel and bark, found at EH-6 (mid-reach left bank) and EH-10 (upper reach left bank). The 1981 report also revealed a well in the eastern section of the log pond (near Monda Way circle). The well log indicated fill to a depth of 14 feet, on top of gravel and clay soils to a depth of 50 feet. It also noted hitting groundwater somewhere between 14' and 24'.

In 2008, five borings were made for a proposed building near Monda Way within the backfilled log pond footprint (Figure 5). The report indicated that log pond backfill extended down to about 13 feet and mostly consisted of sandy and clayey layers containing variable amounts of silt, gravel, and a small amount of woody debris. No groundwater was observed down to 16 feet.

In 2013, SHN conducted a site investigation for the Blue Lake Industrial Park. Twenty test pits were excavated with a backhoe to observe shallow soils between 4'-10' deep and five soil borings were drilled to characterize deeper soil and identify groundwater depths (Figure 5). Temporary well points were used in the soil borings to collect groundwater samples to sample for petroleum hydrocarbons, metals, dioxins, volatile and semi-volatile organic compounds. The test pits encountered mostly fill material comprised of rounded gravels with sand and fines down to 8'-10' with some wood and metal fragments. The well points struck groundwater between 17' and 20' below ground surface. All of the findings for metals, hydrocarbons, etc were below toxic levels with the risk to human health and the environment is very low.

TP-14 TP-15 TP-16 TP-13 TP-09 TP-10 TH-4 WP-4 П П WELL WP-3 B-3 B-4 WELL 4 7 TP-04 APPROXIMATE FOOTPRINT OF OLD TP-01 EH-6 LEGEND TP-10 O WP-1 2013 WELL POINTS O B-1 2008 BORINGS O EH-6 1981 BACKHOE PITS GROUNDWATER WELLS

Figure 5: Powers Creek Geotechnical Sample Sites and Wells.

It should be noted that from the photos and maps, it appears that the log pond, even at its full build-out was south of the existing trail/fire access. Since the City has requested that the new design channel remain north of the trail, it seems very unlikely that any of the fill areas will be contacted by the creek channel either during or after construction.

City Utility Lines

The Powers Creek project reach is intersected and affected by several city utilities (Figure 4). Overhead electric lines run between three power poles along the upstream left bank, each with one guyline, and overhead lines which cross the creek just downstream of the Monda Way stream crossing. Five known storm drain lines discharge into the creek within the reach, all from the left bank. Three of these empty into the South Fork Powers Creek tributary between the Hatchery Road culvert and the confluence with

mainstem Powers Creek. The upstream storm drain is a 16" pipe with concrete headwall and a flapper gate and may drain from a drop inlet (DI) on Hatchery Road. Two 12" corrugated plastic pipes also drain into the tributary from unknown sources. On mainstem Powers Creek, two 10" storm drains empty into the creek at concrete outfalls from the left bank: one just downstream of the Monda Way stream crossing; and the second at the major right hand bend across from the City owned parcel which used to be a City dump.

A 4" force main sanitary sewer pipe runs under Monda Way and into the pump station near the creek's left bank. From the pump station, a 6" PVC pipe runs under the creek, protected by a concrete cap with an elevation of 75.65' (NAVD88). Parallel to and between the sewer pipe and the storm drain, an 8" ACP water line crosses under the creek at an elevation of 75.43'. Both the sewer and water lines drop in elevation from around 78' somewhere near the pump station to get below the streambed.

Project Hydrology

In 2016, a bridge replacement and channel grading project were designed and hydraulically modeled for Powers Creek by SHN using HECRAS. Powers Creek hydrology was developed from various sources to determine design flows for the modelling (Table 1). Since Powers Creek is not gaged, Table 1 shows the percent exceedance design flows for 50%, 35%, 10%, and 1% estimated using the Humboldt County Regional Flow Duration Curve (Figure 6). These same percent exceedance flows were applied to the current design project.

Peak flows for the bridge replacement were analyzed using several different methods: Log Pearson III, Rational Method and the USGS Streamstats tool. The Log Pearson III results were based on three local gaged streams - Little River, North Fork Mad River, and Jacoby Creek and presented in Table 2. For the Rational Method, which is typically used for predicting peak flow rates for urban watersheds, the variable values and predicted 2 year and 100 year peak flows are shown in Table 3. Results from the USGS Streamstat tool were generated three times with slightly different results as shown in Table 4. The first time, on June 26, 2015, the results were based on a 3.3 square mile basin and a mean annual precipitation of 54.7" to generate peak flows for the Rancheria Bridge replacement. The second Streamstat analysis was conducted on September 11, 2017 for the current design project and was based slightly upstream of the mouth of Powers Creek to take into account two small tributaries that had been diverted from Powers Creek, thus reducing the drainage area to 2.8 square. A third Streamstat analysis was run on January 19, 2018 based on the same 3.3 square mile watershed used in 2017. The more recent Streamstat analyses resulted in considerably lower values for the 2, 5, and 10 year peak flows than the 2015 results (Table 4). Apparently, the formulas have been updated since the 2015 version.

The various design and peak flow values are summarized in Table 5 with the values used for HECRAS modelling for this project in bold text. On January 9, 2015, the Federal Emergency Management Agency (FEMA) preliminary results for the Humboldt County Flood Insurance Study published their results for the 100 year peak flow for Powers Creek as 1000 cfs downstream of the South Fork Powers Creek tributary. This was the flow used for the HECRAS modelling.

Table 1: Powers Creek Channel Design Flows.

Drainage Area (sq mi)	Mean Annual Precip (in/yr)	Potential Evapotranspiration (in/yr)	Mean Annual Runoff (in/yr)	Q avg (predic ted)
3.3	54.7	35	31.6	7.7
Exceedence	Exceedence flow unitized by Q/Qavg from Regional Flow Duration Curve	Powers Cr (cfs)		
50%	0.22	1.7		
35%	0.52	4		
10%	2.4	18.4		
1%	10.05	77.2		

Table 2: Log Pearson III Analysis for Powers Creek 2 Year and 100 Year Peak Flow.

						Powers	Powers
CREEK	AREA (sq mi)	Q2 (cfs)	Q2/AREA	Q100 (cfs)	Q100/AREA	Q2 (cfs)	Q100 (cfs)
Little River	40.5	2620	64.69	9750.00	240.74	181.1	647.1
NF Mad	40.4	5728	141.78	11865.00	293.69	397.0	822.3
Jacoby Creek	5.8	730	125.86	3440.00	593.10	352.4	1660.7
Average			110.78		375.84	310.2	1052.36

Table 3: Rational Method Analysis for Powers Creek 2 Year and 100 Year Peak Flow.

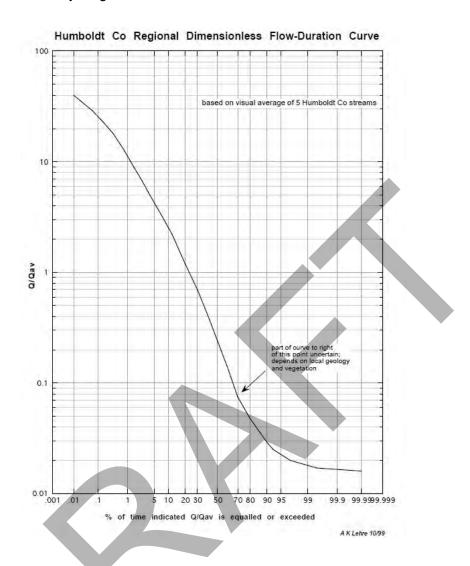
	Runoff Coefficient "C"	Rainfall Intensity "i" (in/hr)	Area, A (acres)	Peak Q, Q=CiA (cfs)
2 year Peak Flow	0.35	0.42	1792	263.4
100 year Peak Flow	0.35	1.5	1792	940.8

Run Date	6/26/2015	9/11/2017	1/19/2018
Area (sq mi)	3.3	2.8	3.3
Mean Precip (in/yr)	54.7	55.5	54.7
Q2	429	239	274
Q5	631	449	514
Q10	808	599	686
Q25	987	797	911
Q50	1160	947	1080
Q100	1270	1100	1260
Q200		1250	1430
Q500	1640	1450	1660

Table 5: Powers Creek Hydrology Results and HECRAS Flows.

	Regional				Log			
	Curve	Stı	eamstats		earson F	Rational	FEMA	HECRAS
50% Exc	1.7							1.7
35% Exc	4							4
10% Exc	18.4							18.4
1% Exc	77.2							77.2
Q2		429	239	274	310	263		239
Q10		808	599	686				599
Q100		1270	1100	1260	1052	941	100	0 1000

Figure 6: Humboldt County Regional Flow Duration Curve.



Groundwater

Several groundwater monitoring wells were established by the Blue Lake Rancheria (BLR) in the Stewart-Oaten property on the right bank about midway through the project reach (Figure 5). The groundwater depth was measured monthly by the Rancheria personnel between 2010 and 2015 and adjusted to the project vertical datum (NAVD88, ft). Based on the five years of available data, the average groundwater elevation was calculated at very near 65'. It should be noted that design pool depths in the same section are at elevations 69'-70'. The well points drilled in 2013 (Figure 5) showed groundwater ranged from 17' to 20' below ground surface which was roughly 64' to 67' elevation. Thus it appears that the design channel is unlikely to ever intercept groundwater (which is controlled by the Mad River) enough to maintain flow in the stream during the dry season.

Development of Restoration Design

Stakeholder Meetings

Early in the design process, several stakeholder meetings were facilitated by Greenway Partners and Mad River Alliance/Trees Foundation to introduce the design process and to identify design constraints. The City of Blue Lake owns the property that the upstream half of the restoration reach occupies and

they immediately revealed that there was a major effort to develop the City's industrial park into a revitalized commercial/residential district. They recognized the potential value of a restored stream channel to the district, as well as the fish. The City of Blue Lake provided clear design guidelines for the creek near their property:

- The new creek channel should not encroach on the existing left bank pedestrian trail, which is also used for emergency fire vehicle access.
- A pedestrian/equestrian bridge within the restoration reach is funded and is currently being designed.
- There were negotiations underway for potential land acquisitions at the upstream end of the design reach and others in the middle of the design reach with the downstream land owner Gary Johnston.

Owners of four parcels bordering the creek on the right bank (looking downstream) also attended the stakeholder meetings. They voiced their support for the project and appreciated the aesthetic improvements as well as the increased flood water capacity. Concerns and constraints expressed by the landowners include:

- Construction and invasive plant removal could potentially open the area to transient and trespasser access onto their property.
- They did not want the restored creek channel to encroach onto their property.
- Some wanted to avoid fencing to keep out trespassers because it could also disturb wildlife access to the creek corridor.

Existing Riparian Vegetation

The riparian vegetation along Powers Creek is dominated by thickets of Himalaya berries and willow. Some groves of mixed age cottonwood trees and native conifers also exist. Some landowners have begun to supplement the riparian banks with native trees such as redwoods and alders, which this project will support and expand.

A site investigation by the Greenway Partners landscape architect, assisted with overhead drone videos, revealed a fair number of established native willow trees along with some mature cottonwood, alder, and redwood trees. A strategy of clearing vegetation prior to excavation and design channel construction was introduced. All brush (including native species) will be cut to the ground in preparation for construction. Prior to the clearing, any native trees with a minimum trunk diameter of 8" DBH will be clearly marked for leaving intact. During removal of brush, care will be taken to avoid removal or damage of large native trees, even if not marked.

Design Support Information

Design Channel Alignment and Width

The design channel alignment and width are influenced by City utilities, adjacent private property lines, existing large vegetation and two bridge locations. These two bridge locations effectively dictate the cross section and the design channel alignment at these locations (Figure 7). One is located approximately 600' upstream of the mouth of Powers Creek, and was installed in October 2016 by the Blue Lake Rancheria as a replacement for an existing bridge that was a partial fish passage barrier. The other bridge, located approximately 2800' upstream of the mouth of Powers Creek, is being designed

and will be installed by the City at the Monda Way crossing. Under-channel water, sewer and storm drain lines exist at this crossing location.

The creek channel that is within the scope of this project passes through four properties. They are owned by the City of Blue Lake, the Stewart-Oatens', Gary Johnston, and the Blue Lake Rancheria. Adjoining property owners include Frank, the City, Almquist, Sawatsky, Estlow and Walter, Glen, and Mann and Zettler. The upstream limit of the Project is the parcel line separating the City property from the Frank property. The four neighboring property owners on the right bank (facing downstream) include the City, Estlow/Walter, Glen, and Mann/Zettler. All properties are delineated on Figures 4 and 7.

Additionally, three power poles and two large Cottonwood tree clumps limit the realignment in this upper reach. These factors will create an approximately 800 foot long pinch point at which the channel will only be about 60'wide. Past the western end of the Mann/Zettler property, the channel veers away from the industrial park and passes through Johnston, the City, and Stewart-Oaten properties.

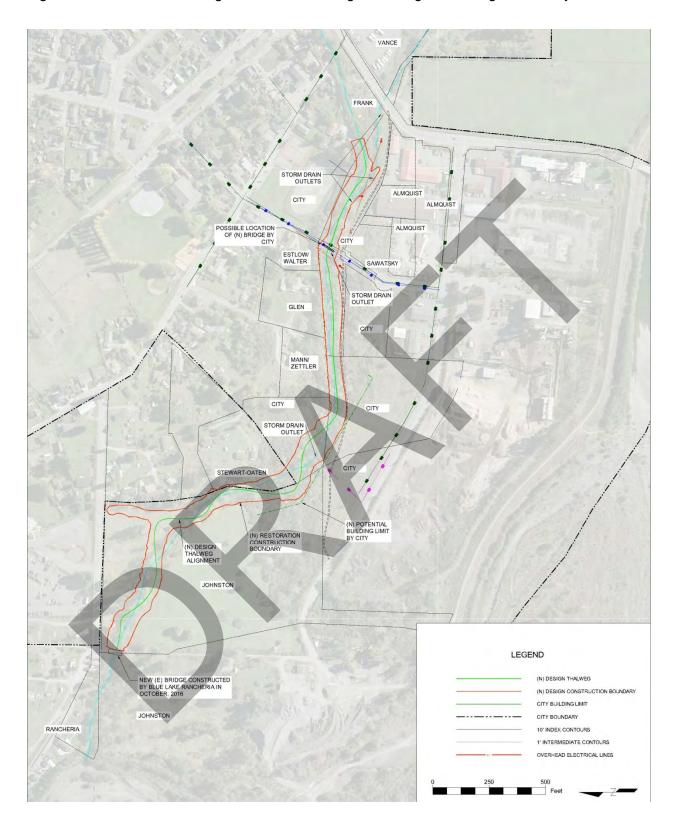
Design Thalweg

Upper Powers Creek was used as an analogous model for this project. The reach immediately upstream of the culvert underneath Blue Lake Blvd is a relatively unrestrained channel with a slope only slightly steeper than the project reach. From this stream section we established a rough bankfull width of 45', a 500' meander wavelength, with a 100' radius of curvature. Using these rough criteria, the low flow meandering channel was established within the "floodway" which ranges from approximately 50' wide at the two bridge sites to almost 120' wide in the downstream section (Figure 7).

In the upstream 1250' section, constraints by the right bank landowners and the City's "Powers Creek District" development steered the design to a fairly straight low flow channel within a relatively straight "floodway." Downstream of the City parcels, the design is relatively unconstrained and the thalweg meanders within an 80' to 100+' floodway.

The resulting design thalweg alignment is 2974' long, reaching from under the upstream edge of the Rancheria Bridge to the existing thalweg at the City property line with Nick Frank. The thalweg for the 570' reach downstream of the bridge begins at 64.1' and joins the Mad River at elevation 60.1'

Figure 7: Powers Creek Design Constraints, Design Thalweg, and Design Boundary.



Design Profile

The Blue Lake Rancheria Bridge project includes restoration design plans for the approximately 600' reach downstream of the bridge replacement. The restoration design for the reach upstream of the Rancheria Bridge starts at the bridge at elevation 65' (1' above the boulder grade control of 64') and extends to the upstream boundary of the project reach at the City parcel line adjoining the Nick Frank property where it rejoins the existing creek thalweg at 82.2'. The resulting design grade over the 2974' thalweg distance is thus 17.2/2974 = 0.0058 or .58% slope (Figure 8). This is only slightly lower than the 0.65% slope surveyed in 2007 by HSU/NOAA.

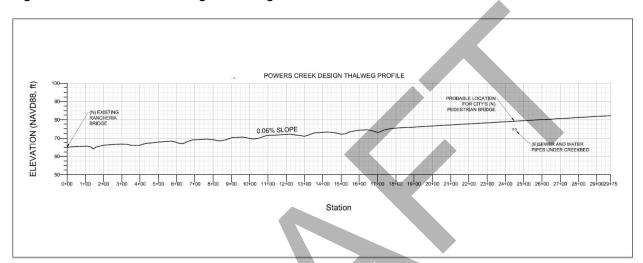


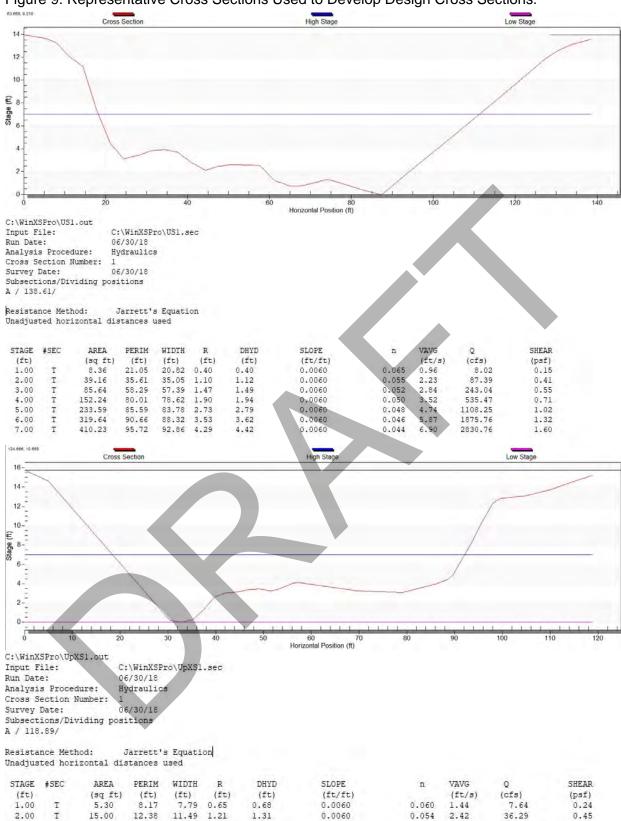
Figure 8: Powers Creek Design Thalweg Profile

As mentioned previously, another main constraint within the project reach is the elevation of a waterline and sanitary sewer force main under the gravel bed of the stream where a new pedestrian bridge is being planned near Monda Way (Figure 7). SHN potholed and surveyed the two pipe crossings and established the elevation in the creekbed of the 8" water main as 75.43' and the concrete cap over the sewer line as 75.65'. The thalweg elevation from the design profile at that location (Station 2452) is 79'. In order to contain the 100-year flood volume of 1000 cfs, the design thalweg has been lowered to 78' which still provides well over 2' of clearance.

Representative Design Cross Section

The existing typical cross section of the restoration reach of Powers Creek is a remnant of the drainage ditch constructed in the late 1940's during development of the lumber mill. The stream section upstream of the restoration reach is a highly constrained channel through tight, urban development. As such, there is very little from which to model a new channel design until the section immediately upstream of Blue Lake Blvd., where the creek is relatively unconstrained. As mentioned earlier, this reach was used as a rough analog for the design alignment. Several cross sections in the 400'-500' reach were generated at pool and riffle areas from the existing LiDAR topography and analyzed using WinXSPro (Figure 9). These were used to develop general channel widths (80'-100'), depths and cross-sectional area values.

Figure 9: Representative Cross Sections Used to Develop Design Cross Sections.



T

28.49

70.14

135.62

204.90

277.12

17.72

61.53

70.08

73,66

77.24

16.36

59.71

67.80

70.75

73.70 3.59

1.61

1.14

1.94

2.78

1.74

1.17

2.00

2.90

3.76

3.00

4.00

5.00

6.00

7.00

0.0060

0.0060

0.0060

0.0060

0.0060

0.052

0.055

0.050

0.047

0.045

3.06

2.30

3.57

4.82

5.95

87.14

161.25

483.73

987.69

1650.09

0.60

0.43

0.72

1.04

1.34

Figure 10: Powers Creek First Design Cross Sections.

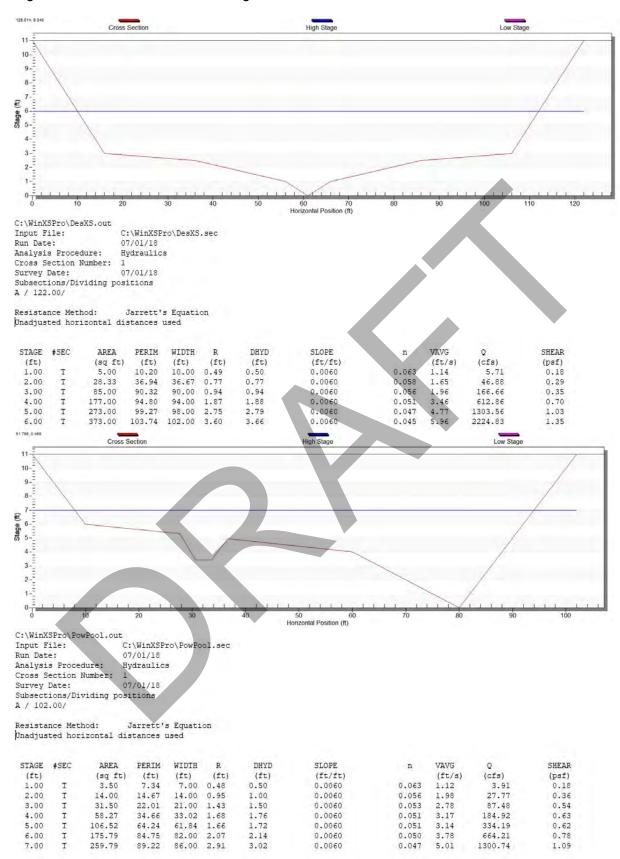
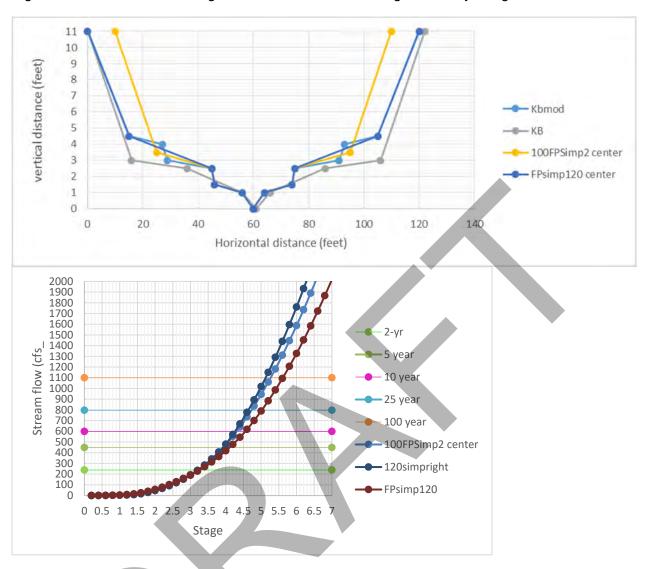


Figure 11: Powers Creek Design Cross Sections and Rating Curves by Margaret Tauzer.



Fish-related parameters were added based on a hydrologic analysis by SHN and Margaret Tauzer (NMFS) for the replacement of the Rancheria bridge and channel restoration downstream of it to the confluence of Powers Creek and the Mad River. The 50% exceedance flow is considered the lowest fish passage flow and was determined as 1.7 cfs. A 10% exceedance flow is the upper juvenile fish passage flow and was determined to be 18.4 cfs for Powers Creek. The upper adult fish passage is defined as the 1% exceedance flow determined to be 77.2 cfs. Other hydraulic targets were the 2-year flow of 239 cfs, the 10-year flow of 599 cfs, and the 100-year flood flow of 1000 cfs.

From these parameters, two typical cross section designs were established, one for riffles at crossovers and one for pools at the apex of meander bends (Figure 10). The general (typical) riffle cross section comprised a 10' wide, 1' deep, low flow channel, and then a 15:1 slope up 1.5' on both banks and finally a 40:1 slope up another 0.5' to the toe of the bank. From there, the channel bank daylighted to the existing surface at a 2:1 slope (Figure 6). The typical pool cross section was 4' deep and daylighted to the existing surface at a 2:1 slope on the outside bend side. On the inside of the bend, it sloped at a 5:1 grade up 4' and then at a 25:1 grade for 50' to the toe of the slope and then at a 2:1 slope to daylight. Basis of Design Report

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When these design cross sections were analyzed using WinXSPro and HECRAS 1D and 2D, it was decided that the velocities were too low, creating some concern that the newly designed channel would tend to aggrade (Margaret Tauzer, pers. com.). A thorough iterative hydraulic analysis yielded a cross section that was developed by Margaret Tauzer in WinXSPro to better meet estimated natural hydraulic conditions at fish passage flows and at flood flows. The detailed cross section is shown in Figure 11 and is labeled as KBmod. Changes were made based on the KBmod cross section to simplify the geometry while maintaining hydraulic conditions. The simplified cross sections are also shown in Figure 11. Cross sections with a narrower 5-100 year flow were also developed. Hydraulic capacity of all simplified cross sections was calculated using WinXSPro. The rating curves for the cross sections are shown in Figure 11. From there, an improved, narrower cross section design was further refined with a narrower (7' wide) active channel, shallower pools, a clearly defined step to a bankfull bench, and daylighting to existing ground at 3:1 slopes to accommodate more successful riparian plantings. It still fully contains the 100 year flow (1000 cfs) with somewhat higher velocities (Figure 12).

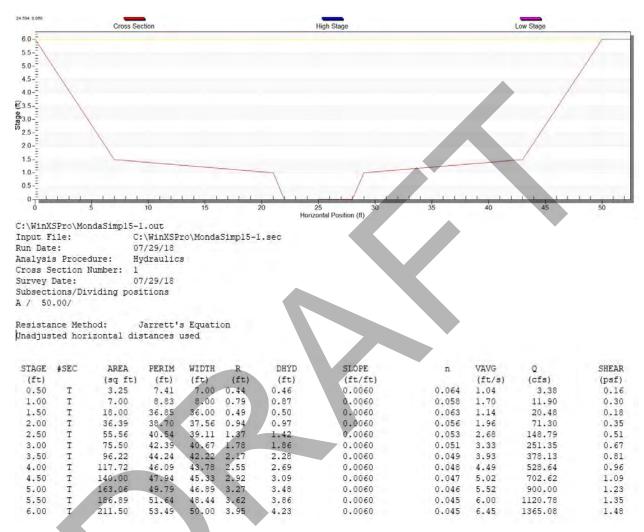




In the upstream, constrained reach of the project, the design cross section, of course, is narrower and simplified. There is still a 7' wide by 1' deep active channel with no defined pools, and a step up to a bankfull bench. Along the left bank, the daylighting from the design channel toe to existing ground was reduced to 2:1 slope in order to fit within the City constraint of not encroaching on the existing trail. Also the daylighting was reduced to 2:1 where the right bank encounters the old City dump site, in order to reduce the likelihood of exposing old waste.

The section of channel where the new pedestrian/equestrian bridge will be built (by the City) required a further change in the design cross section. The active channel depth was lowered by a foot and the bank slope steepened to a 1:1 slope which will be armored with riprap (Figure 13). This is very similar to the already approved and built cross section used for the Rancheria Bridge.

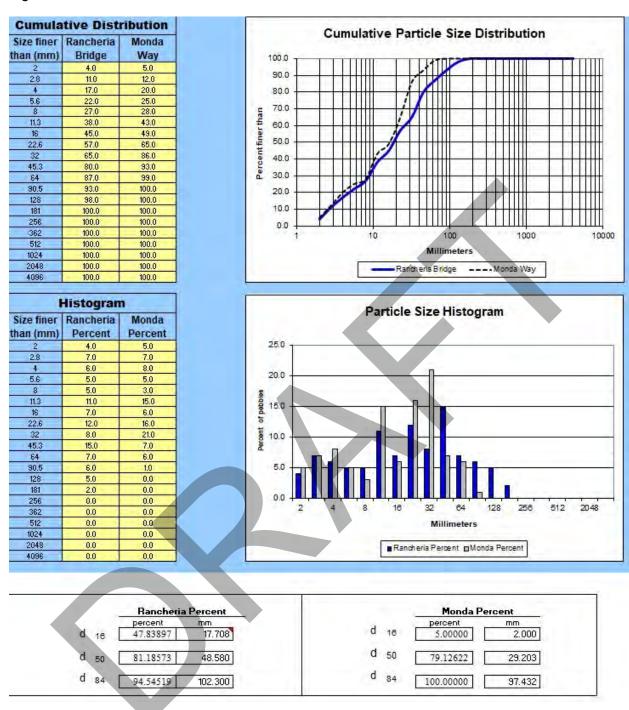
Figure 13: Powers Creek Monda Way Bridge Design Cross Section.



Pebble Counts

The particle size of the bed substrate was estimated using two Wolman pebble counts near the main access sites of the project reach. One was approximately 100' upstream of the new Rancheria Bridge and the second was about 140' downstream of the Monda Way crossing. Figure 12 shows the analysis for the two sites.

Figure 14: Powers Creek Pebble Counts.



Boulders

Boulders will be used to anchor large woody debris (LWD) habitat features, set grade control and provide bank stabilization for the pedestrian bridge crossing. Typical applications would suggest that rock sizes should be at least twice the diameter of the largest naturally occurring rocks in the channel, but there are very few boulders in the Powers Creek restoration reach. Therefore boulders will be sized to not move at maximum velocities expected during a 1000 cfs flood. The Rancheria bridge replacement boulder calculations specified using ¼ ton rock which has a D50 of 23" (CalTrans riprap size).

The approach for boulder sizing for this project was to analyze boulders independent of riprap so they do not rely on inter-stone contact. Accordingly, the Ishbash (1936) equation for determining the minimum velocity necessary to remove loose stones was rearranged to solve for the minimum rock diameter necessary to withstand a given design velocity. Thus:

$$V_{min} = 0.86 \{2g[(SGs-SGw)/SGw]\}^{.5*D^{.5}} \text{ becomes } D_{min} = V^2/\{1.479g[(SGs-SGw/SGw]\}\}$$

where V_{min} =minimum velocity, V=design velocity, g=gravity, SGs=specific gravity of rock, SGw=specific gravity of water, D=diameter of stone.

Costa (1983) developed an equation that combined four common methods for computing stream velocity and rearranging it to solve for Dmin yields:

$$V_{avg}$$
=9.571D^.487 becomes D_{min} =(Vavg/9.571)^2.05

where V_{avg} =average velocity and D=diameter of stone. Conservatively, the design velocity used for these calculations was 7.5 f/s which is much higher than any velocities generated in the HECRAS model or the WinXSPro analyses. The minimum diameter of rock calculated was 0.72' for the Ishbash equation and 0.61' for the Costa equation. Since ¼ ton rock easily meets those criteria, this design will continue to use the same ¼ ton rock specified for use in the Rancheria Bridge replacement.

Large Woody Debris

Redwood rootwad structures will be installed at each of the outside bend pools in the downstream Gary Johnston design reach to provide some bank armoring, scour in pools, direction of velocity away from steeper banks and mainly for overhead habitat cover, in particular for Coho salmon adults and rearing juveniles. Three rootwads per pool will be placed with the rootwad end facing upstream and touching the water surface at the 35% exceedance flow (4.0 cfs) elevation. For each rootwad, a trench will be excavated in the finished outside bank to place the rootwad trunk, boulder ballast laid over the trunk, and then the trench will be filled with native soil.

Installation of rootwad structures shall be completed in the following sequence: a) The waterbody bank shall be excavated to accommodate the entire length of the rootwad trunk. The excavation shall be slightly angled to become deeper further inland from the edge of the waterbody. b) The excavated bank materials shall be reused for the final layer when backfilling. c) The rootwad trunk shall be placed in the excavation so that it is embedded into the waterbody bank up to the rootfan. The rootwad trunk shall be angled slightly in the excavation so that the rootwad structure is facing upstream at an angle, as specified in the Contract Documents, to the waterbody bank. d) Anchoring boulder ballast shall be installed on the rootwad trunk to secure the rootwad structure in place. e) The previously excavated bank material shall be placed over the rootwad trunk and anchoring ballast, packed down with the excavator bucket and graded to finish design grade. f) Vegetative cover shall be applied to the graded area as specified in the landscaping plans.

A single log stability analysis was performed using a spreadsheet developed by Michael Rafferty, P.E. for the U.S. Forest Service to determine if the trench spoils would be enough weight to counteract the various vertical, horizontal, and moment forces acting on each rootwad structure. Variables included the bank soil properties derived from the stream bed counts and soil samples referred to above (d50 = 29.2 mm), properties of young Coast Redwood rootwad material, the average design depth (at bankfull,

239 cfs), the design velocity (overestimated at 10 fps), the general design cross section at the pools, and the angles of the rootwads to the flow vectors and the horizontal. The analysis revealed that the trench spoils alone were adequate to stabilize the structure to the different forces (Figure 15). As an extra precaution and to help armor the banks underneath each structure, an additional ballast constructed from 2×10^{12} ton boulders connected by a 1/2 "cable epoxied to the boulders and draped over the rootwad collar was recommended for each structure. The riparian planting of the design channel will further stabilize the rootwads.

Final Design and Construction

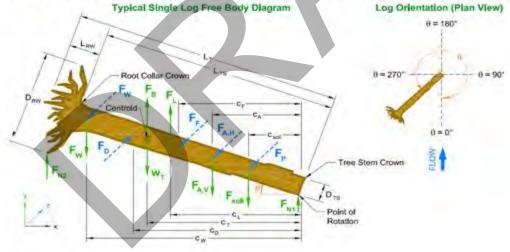
The proposed restoration design construction should adhere to the following construction sequence:

- 1. All phases of preparation and construction should proceed in an upstream direction so the creek remains contiguously accessible to upstream migrating fish at all times. All construction should occur only when the channel is naturally dry (usually from late spring to mid-autumn).
- 2. The outside boundaries of construction should be surveyed and staked out.
- 3. Any native riparian plants (including cottonwoods, willows, alders, maples, redwoods, firs, spruces) within the construction boundaries that have a trunk diameter of 8" DBH or greater should be identified and well-marked by qualified personnel.
- 4. All unmarked brush within the construction boundaries should be mechanically cleared close to the ground using CCC hand crews, moving cleared brush out of the construction boundaries.

 Only clear the design section that can be completed in the first construction season.
- 5. Survey and stake out the design construction "breaklines" to guide construction of thalweg and active channel, bankfull step, and toe of slope.
- 6. Excavate a 3:1 or more gradual slope on the left bank to allow access for excavators and dump trucks to enter the newly constructed channel.
- 7. Excavate according to construction staking from within the design channel area and load spoils directly into a dump truck, also located within the channel area.
- 8. When the dump truck is full, remove spoils to spoil disposal area.
- 9. After completion of excavation of a 100' to 200' section of design channel, excavate trenches for the three rootwad structures in each pool (between Station 0+00 to Station 17+50) and place rootwads, boulder ballast and refill trenches with the spoils, compacting with the excavator.
- 10. Leave the reach, putting the access "road" to bed, and leaving the left bank at it's finished 3:1 grade.
- 11. Move upstream, create an access route for the excavator and dump trucks from the left bank and continue construction.
- 12. Near the end of the construction season in early October remove final access route and finish left bank to a 3:1 slope.
- 13. Hydroseed the entire newly excavated design section using grass seed specified by landscape architect or qualified botanist.
- 14. Plant the new construction area with prescribed native riparian plants according to the planting design.
- 15. Maintain an access trail/road along the left bank for use by watering trucks. Water at least weekly (or as recommended by landscape architect or other qualified personnel) by a water truck with a spray nozzle, or by other irrigation means.
- 16. As soon as the rains begin, put the access road to bed.

Figure 15: Powers Creek LWD Analysis.

Spreadth est developed by Michael Rafferty, P.E. Powers Creek Restoration Single Log Stability Analysis Model Inputs Structure Position | Meander | Station | U_{des} (ft/s) Site ID Structure Type dw (ft) R/W_s Left bank Rootwad Outside 4.00 0.11 Multi-Log Log ID Layer Proposed Cross-Section and Structure Geometry (Looking D/S) Structures N/A Channel Geometry Coordinates Proposed x (ft) y (ft) Fldpin LB 0.00 10.00 2.00 10.00 Top LB 32.00 0.00 Toe LB 35.50 0.00 Thalweg 80.00 2.00 Toe RB 104.00 10.00 Top RB Fldpln RB 106.00 10.00 Litty (ft) Yrar (lb/ft3) **Wood Species** Rootwad L, (ft) Dts (ft) Dew (ft) The (lb/ft²) Redwood, Coast (young) Yes 1.95 X1 (ft) Define Fixed Point y_{T,max} (ft) Ans (ft2) Structure 6 (deg) B (deg) y, (ft) y_{1,mm} (ft) Geometry Root collar: Bottom 60.0 30.00 1.00 -0.20 3.70 11.21 ス (lb/ft') | デ。(lb/ft') Material Soils o(deg) Soil Class Liam (ft) dhimax (ft) doare (ft) Stream Bed Coarse gravel 79.3 38.0 0.00 0.00 0.00 Gra vel/sand 69.5 Bank 111.7 39.0 13.32 4.54 2.27



Rootwad Page 2

Vertical Force Analysis

Net Buoyancy Force

Wood	V 15 (ft3)	V _{rew} (ft ³)	V ₁ (ft ³)	W _r (lbf)	Fs (lbf)		
↑WSE	0.0	0.0	0.0	0	0		
↓WS↑Thw	24.0	9.0	32.9	805	2,053		
↓Thalweg	0.0	0.0	0.0	1	1		
Total	24.0	9.0	32.9	806	2,055		

Lift Force CLT 0.06 F_L (lbf) Vertical Force Balance Fs (lbf) 2,055 F, (lbf) 69 W_T (lbf) 806 F_{sol} (lbf) 3,069 Fwx (lbf) 0 FAY (lbf) 0 ΣF_v(lbf) FS, 1.82

Soil Ballast Force

Soil	Vacy (ft ³)	Vant (ft3)	V _{xod} (ft ³)	F _{set} (lbf)
Bed	0.0	0.0	0.0	0
Bank	8.1	31.2	39.3	3,069
Total	8.1	31.2	39.3	3,069

Horizontal Force Analysis

Drag Force

A _{Tp} / A _W	Fr	Coi	C _w	C _D *	Fo (lbf)
0.22	1.58	1.19	0.01	2.02	2,223

	Horizonta	al Force E	Balance
	Fo (lbf)	2,223	-
	F, (lbf)	6,745	+
	F, (lbf)	1,413	4
	Fw.st (lbf)	0	
	FAH (lbf)	1,450	+
1	EF, (lbf)	7,386	6

Passive Soil Pressure	
-----------------------	--

Passiv	Passive Soil Pressure			Friction Force			
Soil	K,	F _e (lbf)	L _{tt} (ft)	μ	F, (lbf)		
Bed	4.20	0	2.00	0.78	143		
Bank	4.40	6,745	17.15	0.81	1,270		
Total	1020	6,745	19.15		1,413		

		Mome	nt For	ce Bal	ance

Driving Moment Centroids			Resisting Moment Centroids			Moment Force Balance			
Cra (ft)	CL (ft)	co (ft)	Cr,w (ft)	Carol (ft)	CRAM (ft)	C, (ft)	M _a (lbf)	62,609	2
11.8	18.1	16.7	11.8	8.7	8.6	8.9	M, (lbf)	142,725	6
Distances are from the stem tip		Point of Rotation:		Stem Tip		FS _M	2.28	9	

Anchor Forces

Additional Soil Ballast

V _{Adry} (ft ³)	V _{Auxet} (ft) C _{Auxet} (ft)	FANNE (Ibf)	FAMP (Ibf)				
		0	- 0				

Macha	looin	Anchors	

Type	C _{Am} (ft)	Soils	F _{Am} (lbf)		
		2	0		
			0		

Boulder Ballast

Position	D, (ft)	CA (ft)	V _{r,my} (ft ³)	V _{r,wat} (ft ³)	W, (lbf)	FL, (lbf)	F _{D,r} (lbf)	FAVr (lbf)	FAH (lbf)
Deadman	3.00	18.0	0.0	14.1	1,450	0	0	0	1,450
								0	0
						J		0	0



Historical Geotechnical Reports

Geotechnical Investigation

Proposed Replacement of Powers Creek Bridge Blue Lake, California

Prepared for:

Five Counties Salmonid Conservation Program



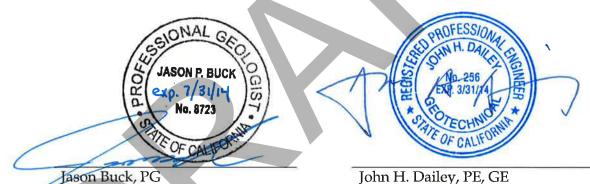
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Geotechnical Investigation

Proposed Replacement of Powers Creek Bridge Blue Lake, California

Prepared for:

Five Counties Salmonid Conservation Program



Jason Buck, PG Project Geologist

Senior Geotechnical Engineer

Prepared by:

Consulting Engineers & Geologists, Inc. 812 W. Wabash Ave. Eureka, CA 95501-2138

707-441-8855

May 2013

QA/QC:GDS___

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Figure 1	Boring Locations	Follows Page 1

Abbreviations and Acronyms

ASTM American Society for Testing and Materials-International

B-# machine-drilled boring-number

H horizontal NR no reference

SHN Consulting Engineers & Geologists, Inc.

USGS United States Geological Survey

V vertical



Introduction

This report presents the results of a geotechnical investigation performed by SHN Consulting Engineers & Geologists, Inc. (SHN) for the proposed replacement of a bridge across Powers Creek Bridge located near the intersection of Rancheria Road and Blue Lake Ranch Road in Blue Lake, California (Figure 1). It is our understanding that the proposed new bridge will be a 16-foot wide, 60-foot span steel bridge (manufactured by Kernan Construction). The primary purpose of our investigation is to assess existing and potential geologic and geotechnical hazards that may affect the proposed new bridge, and to develop foundation plans and specifications.

Site Conditions

The project site is situated within a broad fluvial terrace surface on the north side of the Mad River. The existing bridge is a railcar with a 40-foot long steel deck. It appears that each end of the bridge was founded on logs interlayered with sandy fill. The channel below the bridge has been armored with a concrete apron, and a plunge pool has developed on the downstream side of the concrete.

The channel banks are heavily vegetated and range from moderate to very steep. The channel banks significantly widen immediately downstream of the concrete apron and are locally very steep and unstable in places, particularly around the northern abutment.

Geologic Setting

Published literature and geologic maps of the region indicate that the bridge site is underlain by Holocene aged alluvial sediments. This area's alluvial deposits are generally composed of interfingered layers of unconsolidated sand, gravel, silt, and clay. As a result of their depositional diversity, alluvial deposits are often laterally discontinuous and can have variable compositions over very short distances.

No active faults are mapped in the immediate vicinity of the site; however, the site is susceptible to strong to very strong levels of seismic shaking from multiple distant sources. Seismic effects produced by large earthquakes from distant sources may not be severe, but could have an impact on the site. Strong seismic shaking should be anticipated during the design life of the new bridge.

The project site is located within the 100-year flood zone associated with the Mad River and the flood elevation should be considered in the project design.

Humboldt County General Plan maps detail the broader Mad River Valley as an area of potential liquefaction. Liquefaction is a secondary seismic effect of earthquake shaking that can cause loose, water-saturated, weakly cohesive or non-cohesive earth materials to lose shear strength due to an increase in pore-fluid pressures. At this site, liquefaction is considered a moderate to high risk under rare, major seismic earthquake events. The effects of liquefaction include co-seismic lateral spreading (collapse of the channel walls), and ground settlement induced by soil boils and/or other seismically induced soil distortions. The risk at this location is similar to the existing infrastructure within the area.

Field Investigation

We conducted a field reconnaissance and subsurface investigation on March 27, 2013, to characterize the geologic and geotechnical conditions at the site. Our field investigation was limited to a reconnaissance of the creek banks in and adjacent to the bridge site, and also focused on the drilling and sampling of two geotechnical borings (B-1 and B-2; see Figure 1). The borings were located at the approximate location of the proposed bridge abutments and were extended to a depth of 21.5 feet below existing road grade.

Soils exposed in the borings were logged in general accordance with the Unified Soil Classification System. We collected relatively undisturbed drive soil samples from each of the borings. Representatives of these samples were subjected to laboratory testing to determine physical properties of the soils that underlie the project site. Laboratory testing included in-place moisture content, dry density, and triaxial shear strength testing.

Subsurface Conditions

The stratigraphy exposed in the stream banks consist of a fine-grained cap of silts and sands ranging from 5 to 6 feet in thickness which overlie dense, well-consolidated sandy gravels. The upper fine-grained soils are interpreted to be overbank deposits associated with the Mad River, whereas the coarse sandy gravels is interpreted to be fluvial deposits associated with an ancient Mad River alignment.

Within our boring B-1, located on the north side of the bridge, we encountered approximately 8 feet of medium dense sand and silty sand overlying medium dense to dense sands and gravels.

Within our boring B-2, located on the south side of the bridge, we encountered approximately 6 feet of loose sandy fill and wood (logs?). The fill was likely placed during the initial installation of the rail car bridge. The wood encountered may have been installed to stabilize the ground beneath the bridge abutments. Medium dense to dense sands and gravels were encountered below this woody layer, extending to the total depth of the boring (21.5 feet below grade).

Dry density for soils exposed in the two test pits ranged from 97 to 115 pounds per cubic foot, with unconfined strengths of approximately 275 and 1,150 pounds per square foot.

We encountered groundwater in each boring at approximately 16 feet below grade. It should be noted that groundwater levels fluctuate in response to seasonal variations, storm events, and other factors. Groundwater levels could be significantly higher than levels observed at the time of this investigation during and after periods of heavy precipitation.

Conclusions and Discussion

Based on the results of field observations, it is our opinion that the project site can be developed as proposed, provided that our recommendations provided below are adopted, and that noted conditions and risks are acknowledged. The primary geotechnical considerations for the proposed bridge are the presence of non-engineered fill material beneath the south abutment, and stability of the adjacent stream banks.

Non-engineered fill materials, including logs, concrete, or organic fills, may be encountered during the excavation for the new abutments. To support the bridge abutments properly, we recommend two options:

- 1. Remove the existing unsuitable fill, including the large woody debris, reconstruct the bank slope with engineered fill or other stabilized earth methods, and support on conventional spread footings.
- 2. Leave the fill in-place and support the new bridge on drilled piers.

We understand that establishing conventional spread footing foundations is the preferred option for bridge support. The following recommendations support this option.

Recommendations

Site Preparation and Grading

We understand that the channel will undergo modifications to enhance the restoration effort. We believe that the concrete apron will be removed, and the channel will be widened. Our site preparation and grading recommendations are associated with developing a support condition for a conventional spread footing bridge foundation.

Following the demolition of any existing improvements, areas to be graded should be cleared of brush, rubbish, and debris and the cleared material should be removed from the site. Any non-engineered fill materials encountered should be removed entirely from beneath the new footings, and for a zone five feet beyond their perimeters. Up to six feet of non-engineered fill materials were encountered on the south side of the existing bridge. Following required excavations, all exposed soils should be scarified to a depth of six inches, moisture conditioned or aerated to near optimum moisture content, and recompacted to at least 90 percent relative compaction. If weak or saturated soil zones are encountered during the recompaction process, they should be removed through further excavation to expose firm natural soil, and replaced with engineered fill. This compaction procedure and overexcavation should be observed and approved in the field by the Geotechnical Engineer or qualified representative.

Fill that is placed in areas that will support the proposed bridge foundations should meet the requirements for select engineered fill. Engineered fill should have less than 2 percent by dry weight of vegetation and deleterious material and should meet the gradation requirements presented in Table 1.

¹ Relative compaction refers to the in-place dry density of a soil expressed as a percentage of the maximum dry density of the same soil, as determined by the ASTM D1557 Test Method. Optimum moisture content is the water content (percentage by dry weight) corresponding to the maximum dry density.

	Table 1 Gradation Criteria Ige Replacement, Blue Lake, CA
Sieve Designation	Percent Passing by Dry Weight
4-inch square	100
2.5-inch square	85 minimum
0.75-inch square	70 minimum
U.S. No. 4	60 minimum
U.S. No. 200	5 minimum, 50 maximum

Fine-grained soil with a liquid limit greater than 40 and a plasticity index greater than 15 should not be used as engineered fill. If clayey soils do not meet the plasticity requirements, the mixing of the clayey soils combined with sandier soils may be required. Crushing and/or removal of rock particles greater than 4 inches in size may be required. The Geotechnical Engineer or qualified representative should approve all fill prior to placement.

Engineered fill that meets the established requirements should be uniformly moisture-conditioned or aerated to near optimum moisture content and compacted to at least 90 percent relative compaction. Engineered fill should be placed in horizontal lifts that are less than 8 inches in uncompacted thickness, and each lift should be compacted to the aforementioned requirements prior to placing subsequent lifts.

Cut slopes should not exceed a gradient of 1.5H:1V (1.5 horizontal and 1 vertical) and fill slopes should not exceed a gradient of 2H:1V. Fills should be placed on a benched surface.

Where fill is placed on an existing slope steeper than 5H:1V, a keyway should be constructed below the toe of the fill and the fill should be benched into competent soil. The width of the keyway should be at least one-half of the fill height or 10 feet, whichever is greater, and embedded at least 2 feet into firm soil. The fill should be benched at least 4 feet horizontally into firm soil/rock, as it is brought up in layers to remove all loose or soft material beneath the fill. Keying and benching of fills should be observed by the Geotechnical Engineer or qualified representative.

To reduce the possibility of surficial failures (slope failures which occur in material within 2 to 3 feet of the finished face of slope), the fill material should be uniformly compacted to the finished face of the fill slope. This will ensure that the strength of material will be as high and the permeability as low near the surface of the slope face, as it is in the well compacted core of the fill. Alternatively, the slope should be overbuilt and then cut back to an adequately compacted finish slope. Proper temporary and permanent erosion protection should be provided on all fill and cut slopes.

It must be the contractor's responsibility to select equipment and procedures that will accomplish the aforementioned grading process. The contractor must organize their work in a manner that the Geotechnical Engineer can test and/or observe each element of grading.

Foundation Recommendations

After the site is prepared, the bridge can be founded on shallow spread footings. Foundations should be sized, embedded, and reinforced to at least the minimum standards presented in the current edition of the California Building Code.

Foundations may be designed using an allowable bearing pressure of 2,500 pounds per square foot for dead-load plus live-loads, assuming for a minimum footing depth of 18 inches. However, the footings should be set back from the channel slopes to ensure that the base of the footing is a minimum of 7 feet from the slope face (measured horizontally). The allowable bearing pressure includes a factor of safety greater than 3, and is a net value; therefore, the weight of the foundation extending below the subgrade level may be neglected when computing dead loads. The allowable bearing pressures may be increased by one-third for support of short term loading conditions such as from wind and/or seismic loading.

A sliding friction coefficient of 0.30 may be used for the footing/soil contact area. Frictional resistance may be calculated in conjunction with an allowable lateral passive pressure represented by an equivalent fluid weighing 250 pounds per cubic foot. The recommended lateral passive pressure should only be considered where footings bear laterally against competent undisturbed native soil or structural fill material. The provided lateral resistance parameters are ultimate values; therefore, a suitable factor of safety should be applied to these values for design purposes.

Recommendations for the proposed foundation design are based on the conditions observed at the boring locations. In order to assess construction conformance with the intent of our recommendations, we recommend that a SHN representative observe footing excavations prior to pouring concrete, and monitor placement of structural fill, if any.

Seismic Design

We recommend that proposed bridge should be designed and constructed to withstand strong seismic shaking. The minimum standard for construction of the structure should be in accordance with the latest edition of the applicable building code for the most seismically active areas.

Drawing from our understanding of site geology, we estimate that the site can be categorized as a Site Class D (stiff soil profile) for determining earthquake loads outlined in the 2010 California Building Code.

We calculated the design spectral response acceleration parameters S_S , S_1 , F_a , F_v , S_{MS} , S_{M1} , S_{DS} , and S_{D1} for the project Based on a Site Class D (stiff soil profile), Occupancy category I or II, and a latitude and longitude of $40.882643^{\circ}N$ and $-124.000295^{\circ}W$, respectively. We used the United States Geological Survey (USGS) seismic calculator software program, "Seismic Hazard Curves, Response Parameters, Design Parameters: Seismic Hazard Curves, and Uniform Hazard Response Spectra, v. 5.1.0," dated February 10, 2011. The calculated values are presented in the following Table 2, Seismic Design Criteria.

Table : Seismic Design Powers Creek Replacement, Blu	n Criteria c Bridge
S _S	2.692
S_1	1.054
Fa	1.0
F_{v}	1.5
S_{MS}	2.692
S_{M1}	1.581
$S_{ ext{DS}}$	1.795
S_{D1}	1.054
Seismic Design Category	E

Limitations

The analyses, conclusions, and recommendations detailed in this report are based on site conditions that we observed at the time of our investigation, data from our subsurface explorations and laboratory tests, our current understanding of proposed project, and on our experience with similar projects in similar geotechnical environments. We have assumed that the information obtained from our limited subsurface explorations is representative of subsurface conditions throughout the site.

We recommend that a SHN representative confirm site conditions during the construction phase. If subsurface conditions differ significantly from those disclosed by our investigation, we should be given the opportunity to re-evaluate the applicability of our conclusions and recommendations. Some alteration of recommendations may be appropriate.

If the scope of the proposed construction, including the proposed loads, grades, or structural locations, changes from that described in this report, our recommendations should also be reviewed.

If there is a substantial lapse of time between the submission of our report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, we should review our report to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse. This report is applicable only to the project and site studied.

The conclusions and recommendations presented in this report are professional opinions derived in accordance with current standards of professional practice. Our recommendations are tendered on the assumption that design of the improvements will conform to their intent. No representation, express or implied, of warranty or guarantee is included or intended.

We conducted the field and laboratory work to investigate the site characteristics specifically addressed by this report. Assumptions about other site characteristics, such as hazardous materials contamination, or environmentally sensitive or culturally significant areas, should not be made from this report.

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California Building Standards Commission. (2010). 2010 California Building Code–Title 24 Part 2, Two-Volumes. Based on International Building Code (2009) by the International Code Council. Sacramento, CA:California Building Standards Commission.

United States Geological Survey. (February 10, 2011). "Seismic Hazard Curves, Response Parameters, Design Parameters: Seismic Hazard Curves, and Uniform Hazard Response Spectra, v. 5.1.0," NR:USGS.

Geotechnical Investigation

Proposed Powers Creek Footbridge Blue Lake, California

Prepared for:

Humboldt Fish Action Council



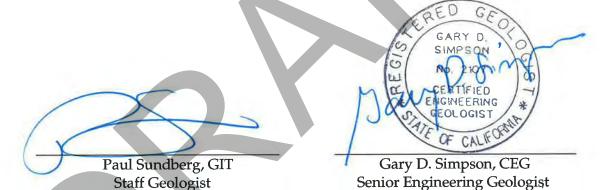
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Geotechnical Investigation

Proposed Powers Creek Footbridge Blue Lake, California

Prepared for:

Humboldt Fish Action Council



Prepared by:

Engineers & Geologists 812 W. Wabash Ave. Eureka, CA 95501-2138 707-441-8855

September 2017

QA/QC:GDS205

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Abbreviations and Acronyms

Mm millimeter μm micrometer

ASTM American Society for Testing and Materials-International

H horizontal

GW-GM well-graded gravel with silt and sand

NR no reference

RSP rock slope protection

SHN Engineers & Geologists

SM silty sand with gravel

SW well-graded sand with silt and gravel USGS United States Geological Survey

TP-# test pit-number

USGS U. S. Geological Survey

V vertical



1.0 Introduction

This report presents the results of a geotechnical investigation performed by SHN Engineers & Geologists (SHN) for the proposed construction of an equine and pedestrian footbridge across Powers Creek, located between Monda Way and Broderick Lane in Blue Lake, California (Figure 1). The bridge will consist of pre-cast footings, steel girders, and pre-cast concrete deck panels. Surficial fill will be placed on the interior channel banks to accommodate a total bridge length of 60 feet. The channel slope under the footbridge, as well as any fill protruding into the channel, will be protected with rock slope protection (RSP). The primary purpose of our investigation was to assess existing and potential geologic and geotechnical hazards that may affect the proposed new footbridge, and to develop foundation plans and specifications.

2.0 Field Investigation

We conducted a field reconnaissance and subsurface investigation on November 18, 2015, to characterize the geologic and geotechnical conditions at the site. Our field investigation was limited to a reconnaissance of the site and overseeing the excavation of two geotechnical test pits (TP-1 and TP-2; see Figure 2). The field geologist oversaw the excavation of the test pits and evaluated the soils at the anticipated locations of the proposed bridge abutments. Test pit depths ranged from 8.5 to 9 feet below existing grade.

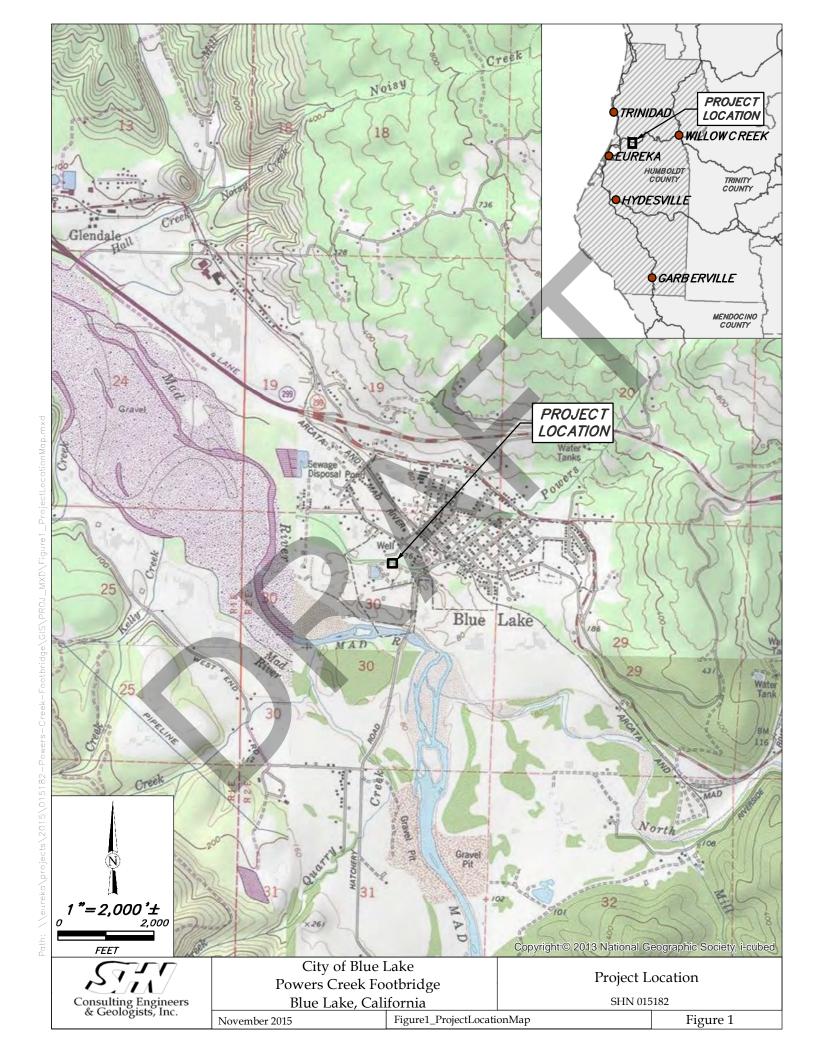
Soils encountered in the test pits were logged and field-classified in general accordance with the Manual-Visual Classification Method (ASTM -International [ASTM] D 2488). During excavation, the project geologist evaluated the in situ soil consistency based on equipment performance and the level of effort required to advance the test pit. After the test pits were logged, they were backfilled with the excavation spoils; however, the backfill was not compacted to the requirements for structural fill. Final test pit logs, presented in Appendix A, were prepared based on the field logs. Bulk samples were collected for qualitative analysis.

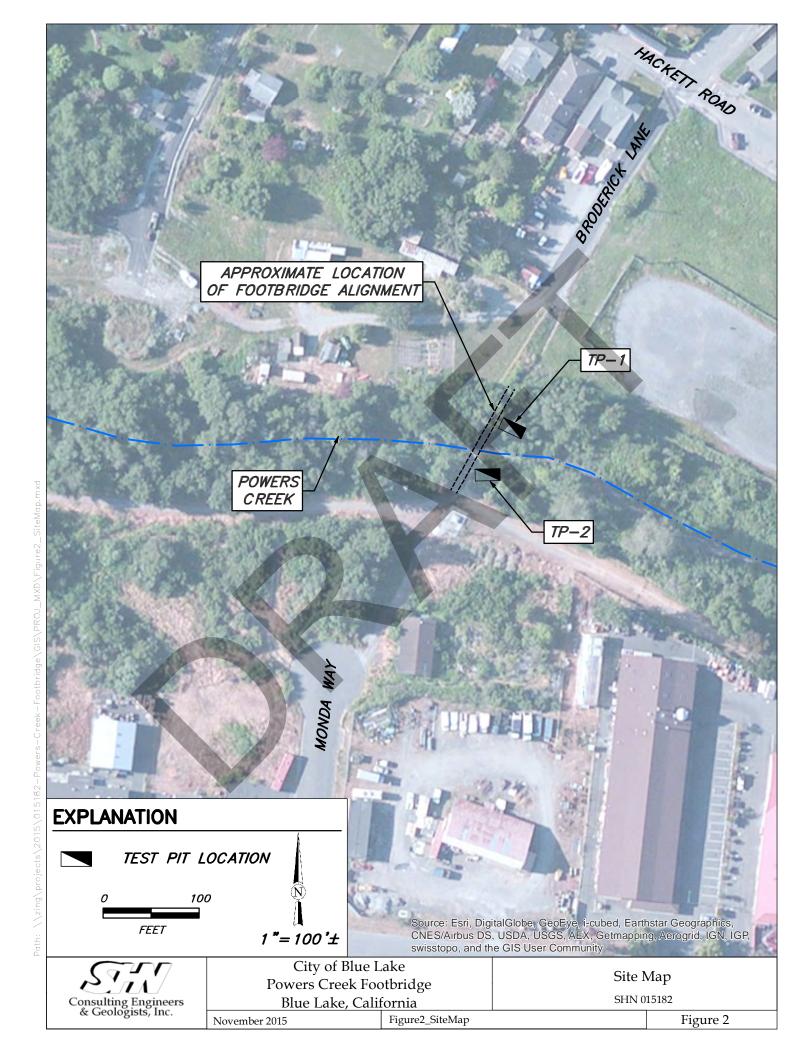
3.0 Site Conditions

The project site spans Powers Creek between Monda Way and Broderick Lane. The site is located on the broad alluvial terrace surface associated with the Mad River, in which Powers Creek has incised. Powers Creek is approximately 1,400 feet north of the Mad River at the project site. A dirt footpath currently crosses the creek through the channel. The channel banks are heavily vegetated and have slopes that range from moderate to steep. The channel width (approximately 24 feet) is relatively uniform upstream and downstream of the proposed footbridge location.

4.0 Geologic Setting

Published literature and geologic maps of the region indicate that the materials underlying the bridge site are late Pleistocene-aged alluvial sediments. These alluvial sediments are characterized as slightly- to moderately-weathered fluvial cobbles, gravels, sands and silt; raised terrace deposits with weak to moderate soils. Due to the depositional variability, the alluvial deposits are often laterally discontinuous and can have variable compositions over very short distances.





The site is susceptible to strong to very strong levels of seismic shaking from multiple sources. Seismic effects produced by large earthquakes from distant sources may not be severe, but could have an impact on the site. Strong seismic shaking should be anticipated during the design life of the new bridge. No active faults are present in the immediate vicinity of the project site; however, the McKinleyville fault, part of the Mad River fault zone and considered active by the state of California, is present approximately 1.13 miles to the southwest.

The flood elevation should be considered in the project design due to the project site being located within the 100-year flood zone associated with the Mad River.

Humboldt County General Plan maps detail the broader Mad River Valley as an area of potential liquefaction. Liquefaction is a secondary seismic effect of earthquake shaking that can cause loose, water-saturated, weakly cohesive or non-cohesive earth materials to lose shear strength due to an increase in pore-fluid pressures. The effects of liquefaction include co-seismic lateral spreading (collapse of the channel walls), and ground settlement induced by soil boils and/or other seismically induced soil distortions. We anticipate that there is a moderate to high risk for liquefaction to occur under rare, major seismic earthquake events.

4.1 Subsurface Conditions

Materials encountered in the exploratory test pits indicate the presence of fill, with thicknesses ranging from 0.75 to 2.0 feet. Fill materials are generally loose to medium dense and consist of silty sand with gravel (SM). Native materials underlying the fill are coarse-grained and generally loose to medium dense, consist of well-graded sand with silt and gravel (SW), silty sand (SM), and well-graded gravel with silt and sand (GW-GM) to the maximum depth explored of 9 feet. We interpret the coarse-grained soils encountered within the exploratory test pits to be associated with deposits of Powers Creek and/or the Mad River.

Groundwater was not encountered in our test pits during our investigation. Because our fieldwork was completed during the drought year of 2015, groundwater levels were likely lower than normal. We anticipate that groundwater conditions will change following and during an average rainfall year. During a normal rainfall year, groundwater levels are expected to fluctuate seasonally and on the order of several feet in elevation. Groundwater may be encountered during excavations for foundation elements due to the proximity of the proposed footbridge abutments to the active channel of Powers Creek. The risk associated with encountering high groundwater conditions at the site during excavation of shallow foundation elements or site grading can be mitigated assuming this work is conducted during the dry season.

5.0 Conclusions and Discussion

Based on the results of our geotechnical investigation, it is our opinion that the project site can be developed as proposed, provided our recommendations are adopted, and that noted conditions and risks are acknowledged. The primary geotechnical consideration for the proposed footbridge is the presence of up to 2.0 feet of non-engineered fill material beneath the anticipated footings. The primary geohazards at the site are associated with its location within the 100-year flood zone and a mapped liquefaction zone.

Based on the materials encountered in our exploratory test pits, we believe that non-engineered fill materials will be encountered during the excavation for the footbridge foundations. We recommend removing the existing unsuitable fill, replacing with engineered structural fill or other stabilized earth materials, and supporting on the proposed pre-cast footings.

6.0 Recommendations

6.1 Seismic Design

We recommend that the proposed footbridge be designed and constructed to withstand strong seismic shaking. The minimum standard for construction of the structure should be in accordance with the latest edition of the applicable building code for the most seismically active areas.

Based on the subsurface conditions encountered at our exploration locations, laboratory test results, and our interpretation of soil conditions within 100 feet of the ground surface, we classify the site as a Site Class D consisting of a "stiff soil profile" in accordance with Chapter 20 of ASCE 7-10. On this basis, the mapped and design spectral response accelerations were determined using the *U.S. Seismic Design Map*, dated July 27, 2017, available on the U. S. Geological Survey (USGS) website in conjunction with the site class and the site coordinates (40.88014° N, -123.99373° W). Calculated values for ASCE 7-10 are presented in Table 1.

T 11	1
Table	
Seismic Design	n Criteria
Powers Creek F	ootbridge
Blue Lake, Ca	ılifornia
Ss	3.026
S_1	1.169
Fa	1.0
$F_{\rm v}$	1.5
S _{MS}	3.026
S_{M1}	1.754
$S_{ ext{DS}}$	2.017
S_{D1}	1.169
Seismic Design	E
Category	E

6.2 Site Preparation and Grading

Areas to be graded should be cleared of brush and woody debris and the cleared material should be removed from the site. Non-engineered fill materials at the footing locations are to be over-excavated to a uniform depth of at least 12 inches below the base of the footing. Following the required excavations, the subgrade surface should be scarified to a depth of 6 inches, moisture conditioned or aerated to near optimum moisture content, and re-compacted to at least 90 percent relative compaction¹. This compaction procedure and over excavation should be observed and approved in the field by the geotechnical engineer or qualified representative.

New cut slopes outside of the stream channel should not exceed a gradient of 1.5:1 (horizontal to vertical [H:V]). Cut slopes within the stream channel may also be graded at 1.5:1 H:V provided they are armored with rock riprap. Unarmored cut slopes within the stream channel should not exceed a gradient of 2:1 (H:V).

STA

¹ Relative compaction refers to the in-place dry density of a soil expressed as a percentage of the maximum dry density of the same soil, as determined by the American Society for Testing and Materials-International (ASTM) D1557 Test Method. Optimum moisture content is the water content (percentage by dry weight) corresponding to the maximum dry density.

6.2.2 Engineered Fill

Fill placed in areas that will support the bridge foundations should meet the requirements for select engineered fill.
Engineered fill should have less than 2 percent by dry weight of vegetation and deleterious material and should meet the gradation requirements presented in Table 2.

Table 2 Fill Gradation Criteria								
Sieve Designation	Percent Passing by Dry Weight							
2-in (50 mm) ¹	100							
1-1/2-in (37.5 mm)	97-100							
3/4-in (19 mm)	60-90							
No. 10 (2 mm)	25-45							
No. 60 (250 μm) ²	5-30							
No. 200 (75 μm)	4-11							
1. mm: millimeters								
2. μm: micrometers								

Engineered fill that meets the specified requirements should be uniformly moisture-conditioned or aerated to near optimum moisture content and compacted to at least 90 percent relative compaction. Engineered fill should be placed in lifts that are less than 8 inches in uncompacted thickness, and each lift should be compacted to the aforementioned requirements prior to placing subsequent lifts.

Fill slopes (if any) should not exceed a gradient of 2:1 (H:V). Fills are to be placed on a benched subgrade surface. Where fill is placed on an existing slope steeper than 5:1 (H:V), a keyway should be constructed below the toe of the fill and the fill should be benched into competent soil. The width of the keyway should be at least one-half of the fill height or 10 feet, whichever is greater, and embedded at least 2 feet into firm soil. Subgrade areas to receive the fill are to be benched at least 4 feet horizontally into firm undisturbed soil. Keying and benching of subgrade soils is to be observed by the geotechnical engineer or a qualified representative.

Fill material should be uniformly compacted to the finished face of the fill slope to reduce the possibility of surficial failures. To accomplish a compacted finished face, the slope should be overbuilt and then cut back to the desired slope gradient. Temporary and permanent erosion protection is to be provided on all fill and cut slopes.

It is the responsibility of the contractor to select the equipment and procedures required to accomplish the aforementioned grading process. The contractor shall be required to organize their work in a manner that the Geotechnical Engineer can test and/or observe each element of grading.

6.3 Foundations

After the site is prepared, the bridge can be founded on pre-cast footings. Foundations should be sized, embedded, and reinforced to at least the minimum standards presented in the current edition of the California Building Code.

The proposed bridge footings should be no less than 18 inches wide and bottomed a minimum of 18 inches below existing grade; however, footings located adjacent to slopes should be bottomed a minimum of 7 feet from the face of adjacent slopes (measured horizontally) in order to provide adequate lateral confinement. The minimum 7-foot setback applies only to slope faces that are

armored with RSP backed with a high-strength woven geotextile. Footing setbacks from unconfined or unarmored slopes shall be a minimum of 10-feet with the slopes graded at a maximum steepness of 2:1 (H:V). The final footing excavations should be reviewed by the project geotechnical engineer, or their designated representative, to verify that the recommended setback has been achieved.

Foundations may be designed using an allowable bearing pressure of 2,500 pounds per square foot for dead-load plus live-loads, assuming for a minimum footing depth of 18 inches. The allowable bearing pressures may be increased by one-third for support of short-term loading conditions such as from wind and/or seismic loading.

A sliding friction coefficient of 0.30 may be used for the footing/soil contact area. Frictional resistance may be calculated in conjunction with an allowable lateral passive pressure represented by an equivalent fluid weighing 250 pounds per cubic foot. The recommended lateral passive pressure should only be considered where footings bear laterally against competent undisturbed native soil or structural fill material. The provided lateral resistance parameters are ultimate values; therefore, a suitable factor of safety should be applied to these values for design purposes.

Recommendations for the proposed foundation design are based on the conditions observed at the test pit locations. In order to assess construction conformance with the intent of our recommendations, we recommend that a SHN representative observe footing excavations prior to pouring concrete, and monitor placement of structural fill, if any.

7.0 Limitations

The analyses, conclusions, and recommendations detailed in this report are based on site conditions that we observed at the time of our investigation, data from our subsurface explorations and laboratory tests, our current understanding of proposed project, and on our experience with similar projects in similar geotechnical environments. We have assumed that the information obtained from our limited subsurface explorations is representative of subsurface conditions throughout the site

We recommend that a SHN representative confirm site conditions during the construction phase. If subsurface conditions differ significantly from those disclosed by our investigation, we should be given the opportunity to re-evaluate the applicability of our conclusions and recommendations. Some alteration of recommendations may be appropriate.

If the scope of the proposed construction, including the proposed loads, grades, or structural locations, changes from that described in this report, our recommendations should also be reviewed.

If there is a substantial lapse of time between the submission of our report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, we should review our report to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse. This report is applicable only to the project and site studied.

The conclusions and recommendations presented in this report are professional opinions derived in accordance with current standards of professional practice. Our recommendations are tendered on the assumption that design of the improvements will conform to their intent. No representation, express or implied, of warranty or guarantee is included or intended.

We conducted the field and laboratory work to investigate the site characteristics specifically addressed by this report. Assumptions about other site characteristics, such as hazardous materials contamination, or environmentally sensitive or culturally significant areas, should not be made from this report.

8.0 References Cited

American Society of Civil Engineers. (October 1, 2013). "ASCE 7-10: Minimum Design Loads for Buildings and Other Structures, Third Printing (Includes Errata)." Reston, VA:ASCE.

ASTM-International. (NR). Annual Books of ASTM Standards (Revision issued annually). Conshohocken, PA:ASTM-International.

United States Geological Survey. (July 27, 2017). "Seismic Hazard Curves, Response Parameters, Design Parameters: Seismic Hazard Curves, and Uniform Hazard Response Spectra," NR:USGS.

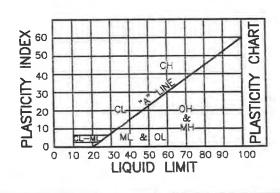




METHOD OF SOIL CLASSIFICATION

MAJ	OR DIVISIONS	SYMBOLS	TYPICAL NAMES		
		GW	WELL GRADED GRAVELS OR GRAVEL—SAND MIXTURES, LITTLE OR NO FINES		
LS.	GRAVELS (MORE THAN 1/2 OF	GP	POORLY GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES		
SIZE)	COARSE FRACTION > NO.4 SIEVE SIZE)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES		
GRAINED HAN 1/2 OF 00 SIEVE SIZ		GC	CLAYEY GRAVELS, GRAVEL—SAND—CLAY MIXTURES		
GRA THAN 1 200 SI		SW	WELL GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	E	
ARSE (MORE T	SANDS (MORE THAN 1/2 OF	SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	CHART	
COARSE (MORE >NO.	COARSE FRACTION < NO.4 SIEVE SIZE)	SM	SILTY SANDS, SAND-SILT MIXTURES		
		SC CLAYEY SANDS, SAND—CLAY MIXTURES			
10		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	CLASSIFICATION	
SOILS OF SOIL SIZE)	SILTS & CLAYS	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	징	
INED SOF 1/2 OF SIEVE SIZ	LESS THAN 50	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
GRAINED THAN 1/2 200 SIEVE	CILTS & CLAVE	МН	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS		
	SILTS & CLAYS LIQUID LIMIT GREATER THAN 50	СН	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
FINE (MORE <no.< td=""><td>GREATER THAN 50</td><td>ОН</td><td>ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTY CLAYS, ORGANIC SILTS</td><td></td></no.<>	GREATER THAN 50	ОН	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTY CLAYS, ORGANIC SILTS		
HIGHLY	ORGANIC SOILS	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS		

CLASSIFICATION	U.S. STANDARD SIEVE SIZE	T
BOULDERS	ABOVE 12"	CHART
COBBLES	12" TO 3"	- 1
GRAVEL COARSE FINE	3" TO NO. 4 3" TO 3/4" 3/4" TO NO. 4	N SIZE
SAND COARSE MEDIUM FINE	NO. 4 TO NO. 200 NO. 4 TO NO. 10 NO. 10 TO NO. 40 NO. 40 TO NO. 200	GRAIN
SILT & CLAY	BELOW NO. 200	



CONSISTEN			TY OF PAINED SOILS
CLASSIFICATION	COHESION (P	SF) CLASSIFICATION	STANDARD PENETRATION (BLOW COUNT)
VERY SOFT SOFT MEDIUM STIFF STIFF VERY STIFF HARD	0-250 250-500 500-1000 1000-2000 2000-4000 4000+	VERY LOOSE LOOSE MEDIUM DENSE VERY DENSE	0-4 4-10 10-30 30-50 50+

MOISTURE SSIFICATIONS
DRY
DAMP
MOIST
WET

BASED ON UNIFIED SOILS CLASSIFICATION SYSTEM

(RETAINED)

BORING LOG KEY

SAMPLE TYPES SYMBOLS INITIAL WATER LEVEL DISTURBED SAMPLE (BULK) STABILIZED WATER LEVEL HAND DRIVEN TUBE SAMPLE GRADATIONAL CONTACT 1.4" I.D. **STANDARD** PENETRATION TEST SAMPLE WELL DEFINED CONTACT (SPT) 2.5" i.D. **MODIFIED** CALIFORNIA SS SPLIT SPOON SAMPLE (SOLID WHERE RETAINED) CORE BARREL SAMPLE (NOT RETAINED) CORE BARREL SAMPLE



Consulting Engineers & Geologists, Inc.

812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877

PROJECT: Powers Creek Footbridge

LOCATION: North Side of Powers Creek

GROUND SURFACE ELEVATION: 87 Feet

EXCAVATION METHOD: Backhoe

LOGGED BY: PRS

JOB NUMBER: 015192

DATE EXCAVATED: 11/18/15

TOTAL DEPTH OF TEST PIT: 9.0 Feet

SAMPLER TYPE: Bulk

TEST PIT NUMBER

TP-1

DEPTH (FT)	BULK SAMPLES TUBE SAMPLES	nscs	PROFILE	DESCRIPTION	% Moisture	Dry Density (pcf)	Unc. Com. (psf)	U.C. (pst) by P.P.	% Passing 200	REMARKS
-1.0		SM		SILTY SAND with GRAVEL; Very dark brownish-gray, loose to medium dense, moist, roots through out, fine to coarse, sub-rounded gravel.						FILL
	\boxtimes	sw		WELL GRADED SAND with SILT AND GRAVEL; Dark gray, loose to medium dense, moist to wet, fine to coarse sand, fine to coarse, sub-rounded gravel.						NATIVE
	X	sw	0.00	WELL GRADED SAND with SILT AND GRAVEL; Brownish-gray, medium dense, moist, fine to coarse sand, fine to coarse, sub-rounded gravel.						
5.0		GW- GM	000000000	WELL GRADED GRAVEL with SILT AND SAND; Gray, medium dense, moist, fine to coarse, sub-rounded gravel and cobbles.						
6.0 7.0			000000000000000000000000000000000000000							
8.0			000000000000000000000000000000000000000							
— -9.0			D-70	Excavation terminated at a depth of 9.0 feet. Groundwater not encountered. Test pit backfilled with spoils						



7 Consulting Engineers & Geologists, Inc.

812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877

PROJECT: Powers Creek Footbridge

LOCATION: South Side of Powers Creek

GROUND SURFACE ELEVATION: 87 Feet

Backhoe **EXCAVATION METHOD:**

JOB NUMBER: 015192

DATE EXCAVATED: 11/18/15

TOTAL DEPTH OF TEST PIT: 9.0 Feet

SAMPLER TYPE: Bulk

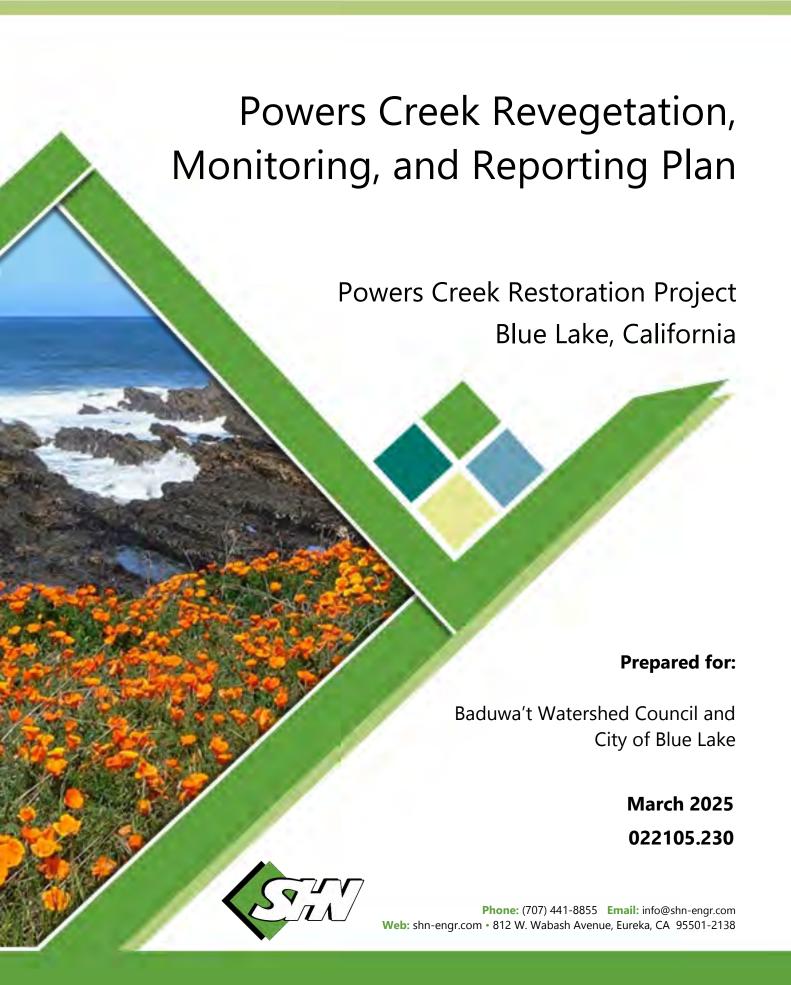
TEST PIT NUMBER

TP-2

DEPTH (FT)	BULK SAMPLES TUBE SAMPLES	nscs	PROFILE	DESCRIPTION	% Moisture	Dry Density (pcf)	Unc. Com. (psf)	U.C. (psf) by P.P.	% Passing 200	REMARKS
- 0.0		SM		SILTY SAND with GRAVEL; Very dark gray, loose to medium dense, wet, ~10% sub-rounded gravel.						FILL
— -1.0		SM		SILTY SAND; Grayish-brown, lose to medium dense, moist, fine to medium sand.						NATIVE
— -2.0		sw	0.0.	WELL GRADED SAND with SILT AND GRAVEL; Brownish-gray, medium dense, moist, fine to coarse sand and gravel.						
— -3 .0		SM		SILTY SAND; Grayish-brown, medium dense, moist, fine to medium sand.						
4.0 5.0		GW- GM	000000000	WELL GRADED GRAVEL with SILT AND SAND; Brownish-gray, medium dense, moist, fine to coarse, sub- rounded gravel.						
-6.0			0000000							
— -7.0 — -8.0		sw		dense, moist, fine to coarse sand, sub- rounded gravel.						
9,0			0 0	Excavation terminated at a depth of 8.5 feet. Groundwater not encountered.						

Attachment 3

Revegetation, Monitoring, and Reporting Plan



Powers Creek Revegetation, Monitoring, and Reporting Plan

Powers Creek Restoration Project Blue Lake, California

Prepared for:

Baduwa't Watershed Council and City of Blue Lake

Prepared by:



812 W. Wabash Ave. Eureka, CA 95501-2138 (707) 441-8855

March 2025

QA/QC:JLS

Reference: 022105.230

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Abbreviations and Acronyms

Terms of Measurement

Term	Definition
Term	Definition

DBH diameter at breast height

gal gallon in inches lbs pound

Additional Terms

SONCC

USFWS

Term	Definition
BMPs	best management practices
CalIPC	California Invasive Plant Council
CDFW	California Department of Fish and Wildlife
City	City of Blue Lake
GPS	global positioning system
LW	Large Wood
NMFS	National Marine Fisheries Service
OHWM	Ordinary High Water Mark
Plan	Revegetation, Monitoring, and Reporting Plan
poly	flexible polypropylene
PSE	Plans, Specifications, and Estimates

U.S. Fish and Wildlife Service

Southern Oregon/Northern California Coast



1.0 Introduction

This Revegetation, Monitoring, and Reporting Plan (Plan) has been written by SHN on behalf of the Baduwa't Watershed Council and the City of Blue Lake (City) and outlines the revegetation effort for the Powers Creek Restoration Project (see Figure 1) including species lists, planting zones and densities, success criteria, monitoring methods, reporting requirements, and an adaptive management approach. The goals of this Plan are to:

- 1) Develop self-sustaining riparian habitat along the restored reach of Powers Creek including tree, shrub, and herbaceous stratums.
- Revegetate all areas of soil disturbance and vegetation removal along the restored reach of Powers Creek.
- 3) Remove invasive species cover and minimize the potential for re-invasion through strategic planting and regular maintenance.
- 4) Develop a mosaic of riparian hardwood and conifer overstory for shading of the stream channel and introduction of large wood (LW) to the stream.
- 5) Develop a suitable monitoring schedule and methods to adequately determine the success of the mitigation effort over time.
- 6) Develop suitable maintenance requirements that will aid in the success of the revegetation effort, including adaptive maintenance strategies.

2.0 Project Background

The overall goal of this project is to help increase the abundance of coho salmon and steelhead in the Mad River. To that end, the objectives of the Powers Creek restoration project are to widen, deepen, and realign the downstream reach of Powers Creek; to create a self-maintaining creek channel with abundant, healthy spawning and rearing habitat for coho salmon, steelhead, and other fish species; to develop viable over-wintering habitat for salmonids; and to replace non-native vegetation with a healthy assemblage of native riparian species for cover, food, shade, and eventual wood recruitment. Wood and rock structures will be installed to protect the banks and to create refuge and rearing habitat. Within the National Marine Fisheries Service (NMFS) Southern Oregon/Northern California Coast (SONCC) Coho Salmon Recovery Plan (NMFS, 2014), Powers Creek is identified as one of the highest value restoration targets for the Mad River population of coho salmon.

2.1 Project Description

Specific goals of the Powers Creek restoration project include:

- 1) Enhance rearing and spawning habitat for coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*O. mykiss*) in the Project reach.
- 2) Decrease nuisance flooding within the project reach.
- 3) Enhance riparian habitat.
- 4) Encourage stewardship of the creek through public outreach and participation in project activities.

Project Objectives include:

1) Excavate and remove up to 40,600 cubic yards of aggraded sediment within the project reach.



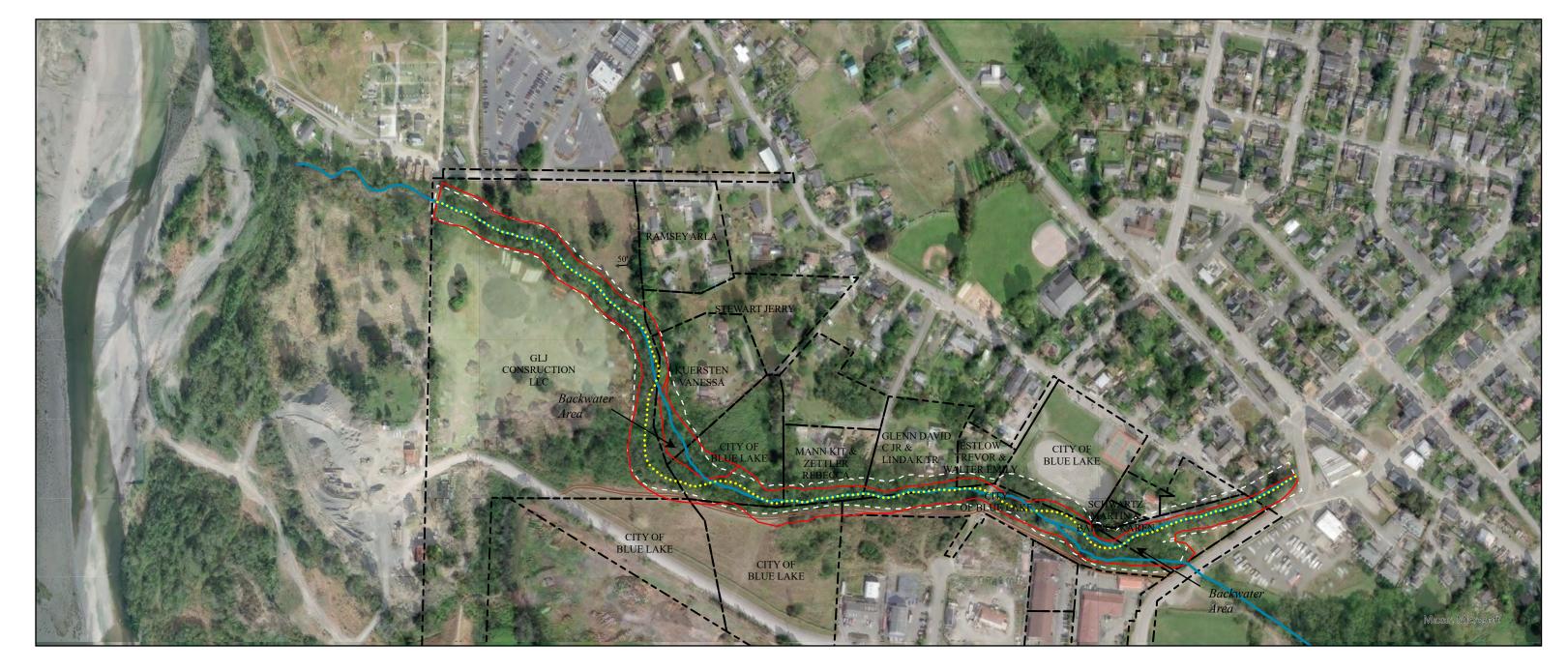
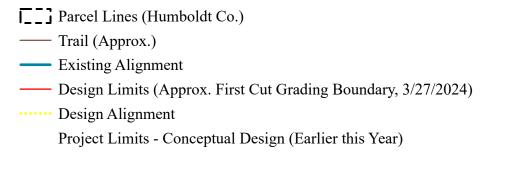
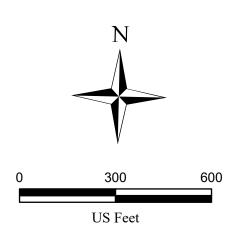


Figure 1. Powers Creek Restoration Project Design Layout 3/27/24





- 2) Re-establish a meandering channel, with enhanced pools, within the project reach to the extent that adjacent land uses allow.
- 3) Install large wood structures to enhance scour and provide instream refugia in excavated pools for salmonids and other aquatic organisms.
- 4) Replace instream gravel at three identified riffles with a specified blend of gravel and cobble sizes suitable to coho and steelhead spawning.
- 5) Remove invasive plants from the riparian area.
- 6) Re-establish a riparian forest of native vegetation, including forbs, shrubs, and trees over a total estimated area of 6.3 acres.
- 7) Engage volunteers to participate in work days to plant and maintain native vegetation within the riparian zone within the project area.

Vegetation removal and grading limits will be clearly defined and identified on the final construction plans but are estimated to be 6.26 acres with a total project area of 7.86 acres that includes revegetation areas outside of the grading limits and unvegetated stream channel areas. Project work areas currently vegetated with native plants will be protected unless they are in areas slated for excavation, fill, or other essential items of work that involve ground disturbance. Trees greater than 8 inches in diameter at breast height (DBH) will be retained during the restoration process. Installation of temporary protective fencing around existing trees to remain shall be at the edge of the canopy or greater, unless fencing closer to the trunk is approved by a qualified biologist or arborist as not harmful to the survival/health of the tree. If excavation near very large trees encounters large roots (greater than 3 inches in diameter), a qualified biologist or arborist will be consulted to determine the least harmful manner of cutting and treating the large roots.

Restoration work will be conducted in phases (likely three), starting at the downstream end of the restoration reach and moving upstream. As such, revegetation efforts will be conducted in phases following ground disturbing activities. This Plan specifically addresses the revegetation aspect of the project, including the establishment of a riparian forest and long-term monitoring and maintenance. Background to the revegetation component of the project is described below.

3.0 Restoration Goals

The goal of this revegetation plan is to re-establish a riparian forest of native vegetation, including trees, shrubs, and forbs by:

- a. planting native trees, shrubs and forbs in suitable hydrologic zones as indicated by elevation and distance from the stream bed;
- b. planting native trees, shrubs, and forbs in suitable locations as indicated by other environmental considerations such as proximity to existing mature trees, or other existing infrastructure;
- c. remove invasive species and develop a management plan and plant palette that minimizes the potential for reinvasion; and
- d. develop a monitoring and maintenance plan, including irrigation intervals, to ensure the survival and long-term success of the planted trees, shrubs, and forbs.

The goal of this revegetation plan is to create native riparian forest in the area of stream restoration along Powers Creek for a total stream length of approximately 3,455 linear feet. The design includes an upland conifer component and a streamside hardwood component with associated understory and edge



shrubs and forbs in each forest type. The project area will be protected either with a conservation easement or a planning designation that will prevent development in the Powers Creek riparian zone. This designation will also protect the planted riparian trees, shrubs and forbs.

Additionally, the goal of this revegetation plan is to remove invasive species and limit their re-invasion potential. Invasive species removal shall occur prior to and during ground disturbing activity and stream realignment before trees, shrubs, and forbs are planted. Ongoing maintenance will improve the likelihood of survival of planted trees and will reduce the potential for reinvasion by invasive species. Lastly, ongoing monitoring will record conditions and success of the revegetation effort and will document conditions needing adaptive maintenance. See Section 4.0 Powers Creek Revegetation Plan for a detailed description of the revegetation effort and intended outcome.

4.0 Powers Creek Revegetation Plan

4.1 Existing Conditions

4.1.1 Powers Creek Riparian Vegetation Pre-restoration

Powers Creek currently supports a disturbance-related vegetation community that likely originated in historical large-scale disturbance of the stream channel and surrounding vegetation, such as the realignment and channelization of Powers Creek in the 1940s. This has resulted in a species poor, low growing willow dominated canopy, primarily arroyo willow (*Salix lasiolepis*), with a significant invasive species component, specifically Himalayan blackberry (*Rubus armeniacus*). Scattered black cottonwood, conifers, and red alder occur infrequently along the streams reach. The current riparian vegetation has choked the stream channel, making it impassible to most wildlife species, and resulting in serious aggradation of sediment, which has over time reduced channel capacity and has made the stream less suitable for salmonid species and more prone to flooding. Without targeted removal, this vegetation community is relatively stable with the dense growth of Himalayan blackberry and willows preventing the establishment of other tree or shrub species. Furthermore, the rapid regrowth of Himalayan blackberry and willow following damage, ensures that this vegetation community remains even following large scale disturbance if there is no targeted removal and ongoing maintenance.

See Appendix 1, Photos 1-6 for existing conditions within Powers Creek.

4.1.2 Adjacent Upland Existing Conditions

Upland areas surrounding Powers Creek vary widely reflecting the development and adjacent use. Powers Creek flows through the town of Blue Lake, and the lands directly adjacent to the stream range from completely developed in the downtown area just upstream of the restoration area, to low-density residential development on the north bank, and gravel stockpiling and light industrial on the south bank of the restoration reach. Extensive Himalayan blackberry thickets flank the riparian vegetation for long stretches of the stream, and there are patches of non-native sweetbriar (*Rosa rubiginosa*) and native California blackberry (*Rubus ursinus*). Portions of the stream along the Powers Creek District (for Blue Lake Industrial Park) have a pedestrian trail that separates willow and blackberry from mowed non-native grassland and forbs. Residential development along the stream varies widely, but most locations have mowed non-native grasslands extending to the edge of willow and Himalayan blackberry canopy with different assemblages of vegetation and planted cultivars.

See Appendix 1, Photo 2 for existing conditions adjacent to Powers Creek.



4.2 Invasive Species Removal

Prior to revegetation, the restoration area must be cleared of invasive vegetation. Most of the invasive species removal will occur with heavy equipment during the grading of the channel and removal of aggraded material. In addition, the top 12 inches of soil will be removed within the restoration area to remove invasive species rooting structures, specifically those of Himalayan blackberry. It is anticipated that this will remove the majority of invasive species material within the restoration area; however, islands of invasive species may persist where minimal grading is occurring. This is most likely in the vicinity of large trees that are being preserved, or along banks that are being only partially altered. In these areas, follow-up removal treatment is required which may involve the use of hand tools such as loppers and a shovel to remove aboveground and underground material. Failure to remove invasive species from all areas within the restoration footprint can lead to increased rates of reinvasion and significantly higher maintenance requirements following completion of restoration activities. Ongoing maintenance requirements are described in Section 6.1.

4.3 Powers Creek Riparian Revegetation

Powers Creek revegetation, when completed, will create native riparian hardwood forest and upland conifer forest in the restoration area along Powers Creek for a total stream length of approximately 3,455 linear feet. Urban stream restoration poses significant challenges to successful habitat restoration. This includes altered hydrologic regimes with flashier flows and varied water table depths, increased levels of human disturbance, (incursion, physical damage, dumping, development, unsanctioned camping, and so on), and increased levels of invasive species with the potential for new introductions. As such, revegetation of the area will be designed as much as is possible to address these challenges, and ongoing maintenance will be essential for the long-term success of the revegetation effort.

Plantings will be divided roughly into five zones with similar assemblages of species reflecting the distance from and elevation above the active channel with increasingly dry conditions away from the stream toward the top of bank. Species composition will gradate between the zones with herbaceous species and hardwoods dominant along the stream being replaced by conifers toward the top of bank. The design includes an upland conifer component and a streamside hardwood component with associated understory and edge shrubs and forbs in each forest type. Conifers and other evergreen shrub species will be planted along the upper bank and top of bank to create a visual barrier for residents along the stream, as well as for wildlife that will use the riparian corridor. Additionally, the conifer and other evergreen shrub plantings will create deeper year-round shading that will greatly limit the growth of Himalayan blackberry within the riparian forest. Lastly, deep year-round shade will provide stability for water temperature within Powers Creek needed for salmonid health. Hardwood dominated forest along the stream channel surrounded by conifer forest also closely resembles what would have been along Powers Creek historically, and what is observed along smaller perennial and intermittent streams in the vicinity. A wildlife friendly fence will be installed between the pedestrian path on the south bank and the edge of revegetation planting as described in Section 4.6. This will alleviate some of the potential incursion and physical damage that may otherwise occur. In all zones, trees, shrubs, and forbs shall be installed according to the detail shown in Appendix 2 and described below.

In summary:

- Trees, shrubs and forbs shall be planted with the root flare flush with the finish grade.
- Roots should not be crumpled, and the hole shall be deep enough to fit the entire root without crumpling or folding.



- Roots should be inoculated with mycorrhizal fungi immediately prior to planting.
- Compost shall be added to each hole to promote healthy root growth.
- Each tree shall have a sturdy wood stake installed adjacent to the tree to aid in stability, monitoring, and protecting from physical damage. Trees within the active channel of the stream (stream bed and stream bank zones) shall have a metal stake.
- Each tree and shrub should have a browse protector cage, except those in the active channel (stream bed and stream bank planting areas).
- Trees shall be planted randomly throughout the planting area, and the clustering of trees is encouraged where spacing can be less between trees.

Planting shall occur in the late fall months after the first soaking rains to enhance the likelihood of survival. This allows soil to settle around the roots and allows the trees to adjust to their planted location prior to growth in spring.

The Planting Plan Specifications in Appendix 2 provide the planting palettes for the different planting zones, relative proportions, on-center spacing, and container sizes. The plant numbers shown are preliminary estimates and assume that in most areas extensive planting will be utilized in combination with natural recruitment to establish vegetation and meet success criteria. This plan was developed in concert with the geomorphic and hydraulic design of the corridor and provides short-term erosion/sediment control while promoting long-term habitat benefit.

A conceptual representative cross-section showing all the planting zones is included in Appendix 4.

4.3.1 Stream Bed Planting

Stream bed planting is restricted to specific distinct planting areas along the edge of the stream bed. Stream bed planting is limited to herbaceous riparian species that can handle periods of flooding and drought and abrasion from flows. Stream bed planting is located adjacent to pools, on the outside edge of bends, and at the confluence of secondary channels as these locations are more susceptible to erosion. Plants will be planted at 3-foot centers, and many are rhizomatous, allowing for rapid infill of interstitial space. No browse protectors or staking shall be installed as the stream bed planting areas will be subject to regular and continuous flows during the wet season. The stream bed planting area totals 6,104 square feet and is located in 42 distinct planting locations as shown on the planting plan design sheets. A total of 677 herbaceous plants are needed to properly revegetate these areas as shown in Appendix 3, Planting Plan Specifications.

4.3.2 Stream Bank Planting

Stream bank planting is restricted to the short steep bank between the stream bed and the floodplain. This bank is typically less than 2 feet tall, is subject to regular flows, and is considered part of the active channel. Stream bank planting includes a diverse assemblage of hardwood tree species, minimal shrubs, and herbaceous riparian species that can handle periods of flooding and drought and abrasion from flows. Stream bank planting will occur on both banks along the entire length of Powers Creek that occurs within the restoration footprint. Stream bank planting is essential for reducing erosion of stream banks. Riparian hardwood tree root growth holds the stream bank in place, thereby reducing large scale bank failure, while herbaceous species minimize surface erosion and slow water movement along the immediate bank. Plants will be installed at varied densities with trees at 8-foot centers, shrubs at 7-foot centers, and herbaceous plants at 5-foot centers. Dense plantings will greatly reduce the potential for



bank erosion and re-invasion by invasive species. No browse protectors or staking shall be installed as the stream bed planting areas will be subject to regular and continuous flows during the wet season. If browse damage is heavy, staking and wire cages can be used; however, these should be removed prior to high flows and reinstalled in late spring. The stream bank planting area totals 21,171 square feet and is located on both sides of the stream as shown on the planting plan design sheets. A total of 1,614 plants including 331 trees, 436 shrubs, and 847 herbs are needed to properly revegetate this area as shown in Appendix 3, Planting Plan Specifications.

4.3.3 Floodplain Planting

Floodplain planting includes the relatively flat bench above the active channel that receives irregular flooding that is typically of short duration. Flows are potentially less abrasive, and sediment deposition is likely in this area; however, it will be dry and elevated during the dry season. Floodplain planting includes a diverse assemblage of hardwood and conifer tree species, shrubs, and herbaceous species that can handle a high water table during the winter, irregular and short duration flooding, and drought conditions during the summer. Floodplain planting will occur on both sides of the stream with varying widths along the entire length of Powers Creek that occurs within the restoration footprint. Floodplain planting is essential for slowing water velocities along the upper bank, shading the stream channel, and reducing the potential for invasive species re-establishment. Riparian hardwood and conifer tree root growth holds the stream bank in place, thereby reducing large scale bank failure, while herbaceous species minimize surface erosion and slow water movement along the immediate bank. Plants will be installed at varied densities with trees at 8-foot centers, shrubs at 7-foot centers, and herbaceous plants at 5-foot centers. Dense plantings will greatly reduce the potential for bank erosion and re-invasion by invasive species. Browse protectors and staking shall be installed within the floodplain planting area as shown on the detail sheet in Appendix 2. The floodplain planting area totals 65,695 square feet and is located on both sides of the stream as shown on the planting plan design sheets. A total of 4,993 plants including 1,025 trees, 1,340 shrubs, and 2,628 herbs are needed to properly revegetate this area as shown in Appendix 3, Planting Plan Specifications.

4.3.4 Upper Bank Planting

Upper bank planting includes the sloping bank above the floodplain and is the largest planting area in the restoration project. The upper bank planting area is elevated above most regular flood events, is sloping, and is increasingly separated from the water table with increased elevation resulting in drier conditions. Upper bank areas are susceptible to invasive species encroachment and dominance that will require perennial shade and a much higher percentage of conifer trees. This will also more closely resemble conditions that would have occurred prior to clearing and development of the area which would have had riparian corridors dominated by hardwoods surrounded by upland conifer forest with coast redwood dominant. Additionally, dense plantings of shrubs and herbaceous species in the understory will reduce the potential for invasive species re-establishment and will act as a visual barrier. Upper bank planting will occur on both sides of the stream with varying widths along the entire length of Powers Creek that occurs within the restoration footprint. Upper bank planting is essential for shading the stream channel, keeping water temperatures down, and for introducing woody debris into the riparian habitat. Plants will be installed at varied densities with trees at 8-foot centers, shrubs at 7-foot centers, and herbaceous plants at 5-foot centers. Dense plantings will greatly reduce the potential for bank erosion and re-invasion by invasive species. Browse protectors and staking shall be installed within the upper bank planting area as shown on the detail sheet in Appendix 2. The upper bank planting area totals 127,004 square feet and is located on both sides of the stream as shown on the planting plan



design sheets. A total of 9,654 plants including 1,982 trees, 2,597 shrubs, and 5,075 herbs are needed to properly revegetate this area as shown in Appendix 3, Planting Plan Specifications.

4.3.5 Top of Bank Planting

Top of bank planting includes the flat upland area beginning at the edge of the top of bank and extending to the edge of the restoration area. The top of bank planting area is elevated above the water table in all but the largest flood events, is flat, and has upland well-drained conditions present. Top of bank areas are most susceptible to invasive species due to the location at the edge of the planting area that in many cases is adjacent to large swaths of invasive vegetation on adjacent parcels that will not be removed as part of this project. Reducing the encroachment and dominance of invasive species will require perennial shade necessitating a much higher percentage of conifer trees similar to what was planted in the upper bank planting area. This will also more closely resemble conditions that would have occurred prior to development of the area, which would have had upland areas dominated by conifer forest with coast redwood dominant. Additionally, dense plantings of shrubs and herbaceous species in the understory will reduce the potential for invasive species re-establishment and will act as a visual barrier. Top of bank is the third largest planting area and will occur on both sides of the stream in distinct locations where there is space between the grading limit and adjacent property lines, or in locations where adjacent landowners are willing to have invasive species removed and native plants installed. This will result in top of bank planting areas that are disjunct and of varying widths and sizes along the entire length of Powers Creek that occurs within the restoration footprint. Top of bank planting is essential for creating wildlife movement corridors and connecting riparian habitat with adjacent upland conditions. Plants will be installed at varied densities with trees at 8-foot centers, shrubs at 7-foot centers, and herbaceous plants at 5-foot centers. Browse protectors and staking shall be installed within the top of bank planting area as shown on the detail sheet in Appendix 2. The top of bank planting area totals 55,353 square feet and is located in distinct locations on both sides of the stream as shown on the planting plan design sheets. A total of 4,560 plants including 865 trees, 1,129 shrubs, and 2,566 herbs are needed to properly revegetate this area as shown in Appendix 3, Planting Plan Specifications.

4.4 Erosion Control Seeding

Ground disturbing activity will result in an estimated 6.3 acres of exposed, erosion-prone soils within the restoration area that may need erosion control seeding in addition to the stormwater best management practices (BMPs) developed for this project. Ideally, seeding of the restored areas needs to occur before the placement of straw, jute netting, and fiber roles or other stormwater BMPs. Erosion control seeding would be conducted in addition to the planting detailed in the above sections and would serve to revegetate areas between the planted trees, shrubs, and forbs. Native erosion control seed mix will improve habitat conditions, reduce erosion levels, and reduce the potential for invasive species reestablishment.

Native seeds shall be broadcast spread on top of exposed soils at a high density to promote adequate growth of herbaceous vegetation for soil stabilization. A suitable species mix including pounds per acre required for adequate ground cover is included in Table 1.



Table 1. Erosion Control Seed Mix

Species	Seeding Rate Ibs ^a /acre	lbs needed for 6.3 acres	
Grass			
Agrostis pallens (dune bentgrass)	35	221	
Bromus sitchensis var. carinatus (California brome)	22	139	
Bromus vulgaris (common brome)	18	113	
Danthonia californica (California oat grass)	30	189	
Deschampsia elongata (slender hairgrass)	4	25	
Elymus glaucus (blue wildrye)	12	76	
Festuca californica (California fescue)	10	63	
Hordeum brachyantherum ssp. brachyantherum (meadow barley)	22	139	
Melica subulata (California melic grass)	15	96	
Herbs			
Achillea millefolium (common yarrow)	6	38	
Clarkia amoena (farewell to spring)	12	76	
Eschscholzia californica (California poppy)	8	50	
Lupinus rivularis (riverbank lupine)	6	38	
Navarretia squarrosa (skunkweed)	3	19	
Lupinus bicolor (annual lupine)	16	101	
Silene laciniata ssp. californica (Cardinal catchfly)	3	19	
Sisyrinchium bellum (blue eyed grass)	4	25	
Trifolium willdenovii (tomcat clover)	12	76	
Total lbs needed for 6.3 acres	1,503		

^a lbs: pound

4.5 Irrigation

Planted trees, shrubs, and forbs will require irrigation for the first 3 years following installation to ensure their survival and health. Given the size of the revegetation area, irrigation can be accomplished in one of two ways. The first is through regularly scheduled irrigation using a water truck with sprinkler nozzles; the other is via a temporary irrigation system that will be removed after a period of 5 or more years. These methods are described below.

4.5.1 Water Truck Irrigation

Water truck irrigation would require weekly irrigation using a water truck with a spray nozzle or other irrigation nozzle. This would necessitate the development and maintenance of an access trail/road along



the left (south) bank that would be used by the water truck. The water truck would need to visit the revegetation area for a time span such that plants are watered sufficiently; that is, the water truck will need to move very slowly so that every plant receives enough water to maintain health and growth. Irrigation will need to be scheduled for the duration of the dry season, typically from May 1 through the end of October; however, this may be adjusted depending on climatic conditions. Following the onset of the rainy season and cessation of irrigation for the year, the access road would need to be stabilized using straw. The access road would also need to be behind a gate, bollard, or other secured feature so that unsanctioned access is prevented.

Water truck-based irrigation of the revegetation plants may have the initial benefit of limited setup, but there are several drawbacks to this method. The first is that this method requires the maintenance of an access road which will create an artificial boundary along the left (south) bank of Powers Creek. This would be susceptible to invasive species establishment following the cessation of irrigation if this area is not planted. The temporary access road is also vulnerable to unsanctioned use which could lead to damage to the plantings, illegal dumping, or camping if it is not secured properly. Water truck irrigation is more susceptible to missed watering due to schedule conflicts, access issues, or operator availability. Missed watering greatly increases the risk of plant mortality, especially in the first year of establishment. Lastly, water truck irrigation is prone to surficial irrigation resulting in runoff and does not promote the growth of deep roots, which may make the plants more dependent on irrigation. This can make plants less likely to thrive after the cessation of irrigation. Additionally, water truck irrigation is typically completed during the day, which can lead to increased evaporation and less infiltration of water. It is also unlikely that water truck irrigation would be able to access large portions of the revegetation area, making these areas susceptible to high levels of plant mortality.

4.5.2 Temporary Irrigation System

The installation of an irrigation system will be temporary in nature and all components will be removed following completion of the monitoring and establishment period. All lines including primary and secondary irrigation lines shall be placed on the ground surface to aid in repairs and removal prior to the completion of monitoring.

The irrigation system will be comprised of rotary sprinklers spaced evenly along a 2-inch flexible polypropylene (poly) line that will run along the entire length of the left (south) bank. Rotary sprinklers will be attached directly to the line to minimize installation cost and maintenance requirements. They can be elevated using stub-ups attached to metal T-posts to prevent breakage and provide stability. Rotary sprinklers will be positioned such that all areas of the restoration area are irrigated. This may require rotary sprinklers that can reach across the stream if the 2-inch poly line is located on the top of the opposite bank. It also may require a secondary line that crosses the stream channel in the widest section of the revegetation area so that additional sprinklers can be installed that can reach the opposite bank. Any line that crosses Powers Creek will need to be removed prior to winter flows to prevent damage.

A filter and timer valve shall be installed at the head of the 2-inch poly line where it connects with the water source. The filter shall be placed before the pump or timer valve to maintain the timer valve. The water source is still being determined; however, it is likely that fire suppression water will be used to fill temporary storage tanks. Temporary water storage tanks will have a pump attachment that will then feed the irrigation lines.



Irrigation shall occur weekly in the first year following planting. Irrigation should be set for a 1-hour period, ensuring that plants receive appropriate soaking during each irrigation event. Irrigation shall be reduced yearly as trees become established. Further irrigation rate reductions shall be determined by the project biologist and can be tailored by irrigation zones so that areas requiring more water can be irrigated more than areas requiring less water. This will be determined by the project biologist on a year-by-year basis.

4.6 Wildlife Friendly Fencing and Browse Protection

A wildlife friendly fence shall be installed between the pedestrian path and the revegetation area concurrently with or immediately following the completion of planting activities. Specifically, the fence will occur between the restoration and the pedestrian pathway that occurs between Hatchery Road and Taylor Way for a total length of 2,303 feet along the south bank and 126 feet along the north bank where the pedestrian bridge crosses Powers Creek at Broderick Lane. The wildlife friendly fence shall be a two or three rail split rail fence or similar. An example is shown in Figure 2 below:



Figure 2: Example of a split rail fence suitable for use along the pedestrian path.

Browse protectors will be installed around every planted tree. This should at a minimum consist of a plastic mesh tube and stake (available from Tubex at: https://tubex.com/products/tubex-treeguard-recyclable-mesh-tubes/) but could consist of a wire cage with a metal stake; see Appendix 2 for tube and staking details. The more robust wire cage and metal stake are suitable in the floodplain where flows may occur that could knock over or uproot small trees in plastic tubes. Deer are common within the vicinity of the restoration area and will likely present significant challenges to the health and growth of planted material without adequate browse protection. An example of browse protector tubes and wire cages are shown below in Figure 3.







Figure 3: Suitable browse protectors for use within the restoration area. The wire cage on the right provides the highest level of protection from damage. Note both are staked.

4.7 Deed Restriction

The project proponents will protect the restoration area with a deed restriction or similar mechanism that will require protection of the revegetation area and will protect the revegetation plants and resulting riparian habitat.

4.8 Schedule

The proposed revegetation will be initiated in concert with grading and ground disturbing activities; however, the majority of revegetation work will be conducted after grading and soil stabilization work is completed. The proposed restoration project schedule is unknown at the time of writing; however, restoration work will likely occur in two to three phases beginning at the downstream end of the Powers Creek restoration project and working upstream. Phase length and timing have not been finalized at this time. This revegetation plan has multiple tasks that need to be completed in a specific order and timeframe so that restoration activities are effective, comprehensive, and do not cause further damage to the environment. Each of these tasks may be repeated for each phase of the project. A brief schedule of implementation is included in Table 2.



Table 2. Revegetation Implementation Timeline

Tube 2. Revegention implementation rimeme		
Task Description and Order	Task Schedule	
Stream grading and re-alignment	All ground disturbance must be completed prior to planting.	
Invasive species removal	Removal will occur concurrently with grading, with spot	
	treatment for remaining individuals after grading is completed.	
 Revegetation planting Stream bed, and streambank planting Floodplain, upper bank and top of bank planting Wildlife friendly fence installation 	Stream bed, stream bank, and floodplain planting are dependent on stream flows. Installation will occur in spring after the risk of high winter flows are past, but prior to the cessation of flows so that tree, shrub, and forb roots can adjust to the lowering of the water table. Browse protectors should be installed concurrently. Floodplain, upper bank and top of bank plantings should occur in December or January to allow for soil to settle around roots and	
	for plants to become acclimated to the area prior to spring growth. Browse protectors should be installed concurrently Wildlife friendly fence installation should occur concurrently with or immediately following plant installation	
As-built Report	To be submitted within three months of the completion of planting.	
Annual monitoring	To be completed annually for 10 years. Annual reports to be submitted to applicable agencies by January 31.	
Conduct maintenance activities across the entire restoration area	To be conducted regularly following completion of restoration activities as needed depending on recommendations from the annual monitoring reports.	

5.0 Monitoring and Reporting Program

5.1 Performance Standards

Success of the revegetation effort is defined as creating self-sustaining riparian forest along the restored reach of Powers Creek, such that the stream is shaded, invasive species cover is minimal, and streambank geomorphology is stabilized through root growth and woody debris introduction. A total of 6.3 acres of revegetation will occur consisting of 0.14 acres of riparian herbaceous species, 1.99 acres of self-sustaining riparian hardwood forest, and 4.14 acres of adjacent self-sustaining upland conifer forest will be created. The success of the revegetation effort will be determined using the following combination of success criteria:

- A total of 6.3 acres of riparian forest (comprised of 0.14 acres of riparian herbaceous species, 1.99 acres of riparian hardwood and 4.14 acres of upland conifer forest) is created, as defined by intermittent to continuous canopy or developing canopy with trees planted at 8-foot centers throughout the revegetation area and shrubs planted at 7-foot centers with forbs planted at 5-foot centers and in clusters where appropriate.
- Riparian woodland is on a clear trajectory towards a multi-tiered canopy consisting of conifer and hardwood trees in the overstory, a robust shrub stratum, and a native-dominated herb stratum, specifically along the stream bank and in openings as documented using qualitative visual assessment and quantitative plant survival metrics.



- Greater than 85-percent survival of planted trees within the revegetation area.
- Greater than 75-percent survival of planted shrubs within the revegetation area.
- Greater than 65-percent survival of planted forbs within the revegetation area.
- Live vegetation throughout all revegetated areas (some minor gaps are expected).
- The average diameter of tree species planted in the riparian restoration area will show a trend of increasing size between sampling years during years 3, 5, and 10.
- Revegetation plants are not substantially suppressed from herbivory, competition from weeds, or drought stress.
- Supplemental irrigation, or replacement plantings have not been needed in any of the restoration areas in the final 2 years of monitoring to meet the survival thresholds.
- Invasive species cover has been reduced to less than 10-percent cover at year 10 and is showing stable or decreasing cover across the restoration area over the 10 years of monitoring.

5.2 Construction Monitoring

The Baduwa't Watershed Council and the City of Blue Lake will be responsible for providing suitable monitoring during construction to confirm that all project regulatory permits and environmental conditions of approval are complied with; sensitive habitat and species, and water quality are protected; and that the final construction plans, specifications, and estimates (PSE) and this planting plan are properly implemented.

Regular monitoring visits by a qualified ecologist/biologist shall be conducted during the construction and installation of the Powers Creek restoration project, specifically during the invasive species removal and planting detailed within this Plan. Project biologist monitoring visits will vary between daily and weekly inspection depending on the activity, with more frequent inspection during installation to ensure proper installation of plants, to confirm that plants are located in the proper zones, and to allow for adaptive placement of plants to reflect actual conditions post-grading. Additionally, all plant material must be inspected by a qualified ecologist/biologist prior to installation for quality of the plant material provided and to ensure that species specified in the planting plan are properly sourced.

An "as-planted" report will be produced after completion of the invasive species removal and native planting to document that the invasive species removal and native species planting were conducted according to the details within this plan. This may require a three-part report to address the three phases of the project, with each phase requiring its own distinct section added to a comprehensive as-planted report. The as-planted report will be created immediately after the completion of restoration activities across each phase of the project site and will be used to document baseline conditions to assess percent survival and success of restoration efforts. The as-planted report will also aid in monitoring in the future as vegetation grows and site conditions change. Significant deviations in planting or species will be recorded in monitoring summaries that will be included in an as-planted report. The as-planted report will include the establishment of monitoring transect locations and photo stations that will be used in annual monitoring to develop data and photo records of conditions from the same location immediately post-construction until the completion of monitoring. Monitoring methods are described in more detail in Section 5.3 below.



5.3 Monitoring and Reporting Program

The monitoring plan for this revegetation plan is focused on ensuring the long-term viability of vegetated habitats created and restored as part of the project's revegetation goals. Monitoring measures for other project features, including channel geomorphology, erosion, water quality, and salmonid or other wildlife or plant species, will be addressed in other documents prepared for this project. Annual monitoring of the Powers Creek restoration area is designed to determine whether the site is progressing along a trajectory that will meet the habitat goals of creating native riparian hardwood and upland conifer forest along Powers Creek as it flows through the City downstream of Hatchery Road.

The following monitoring plan describes success criteria and monitoring methods for measuring these criteria to assess the degree to which the habitat restoration goals are being met. Given the scale of the changes proposed for the ecosystem, the riparian hardwood and upland conifer forest habitat areas will be monitored for 10 years after project completion. Progress towards performance criteria, or lack thereof, will provide a basis for any remedial action recommendations (if needed). The results of the wetland and riparian habitat monitoring in Year 5 will be compared to the final success criteria to determine if these criteria have been met. If the final success criteria have not been met, remedial actions and monitoring will continue until they have been met. Given the size of the project, its linear nature, and the likely distinction between specific hydrologic zones, certain reaches may achieve their final success criteria before other areas. With agency coordination and approval, it may be possible that segments of the project are deemed successful, while targeted monitoring and remedial measures may be necessary for other specific areas. Attainment of the final success criteria will indicate that the project will likely meet the project's long-term habitat goals.

The project will be making landscape scale changes within the project footprint, and the result will be a dynamic and shifting mosaic of habitats that will be difficult to monitor using methods typically used on smaller mitigation sites. Given the moderate scale and complexity of this project, the following monitoring elements are proposed to attempt to capture the ecosystem benefits of the project:

- Quantitative Habitat Monitoring composed of:
 - o Percent survival of planted material using representative samples
 - o Percent cover by native plant species using representative samples
 - o Percent cover by invasive species using representative samples
 - o Planted tree DBH measurements in representative sampling locations
- Annual Qualitative Assessments composed of:
 - o Photo-documentation
 - o Invasive species occurrences
 - Natural recruitment
 - o Health of planted material
 - o Evidence of damage due to browsing, herbivory, or anthropogenic causes

5.3.1 Quantitative Sampling

Quantitative sampling will be used to assess the success of riparian planting, vegetation establishment, native species cover, and invasive species encroachment and cover. Specifically, quantitative sampling will be used to determine the trajectory and success of planted material and invasive species removal. Quantitative vegetation data will be collected annually in the late spring/early summer. The annual quantitative data collection site visit will be timed so that observation of native vegetation occurs near



maximum foliar extent and to assess the health of planted material during the growing season. Additionally, this will allow for invasive species observations to occur prior to seed set for many of the problem species that currently occur within the project area, such as Himalayan blackberry, allowing for more effective treatment. Quantitative data collection methods will be described in greater detail within the as-planted report, including the exact number of sampling plots, final transect and plot locations, statistical analysis, and target metrics. A summary of quantitative data collection methods is described below that will allow for adequate monitoring of the restoration project.

Plant survival will be calculated using two sampling methods. The first will involve the use of semi-permanent transects that will be placed at the location of the cross-section transects shown on the design plans. This will result in the establishment of 14 transects spaced semi-randomly along the restored stream length. Each vegetation monitoring transects beginning and end point will be marked with a poly pipe driven in the ground for the duration of the 10-year monitoring period. During monitoring, a tape measure shall be strung between the two poly pipes and all planted material shall be counted and the condition recorded. This includes tree DBH within a 4-meter-wide area centered on the transect (2 meters on the upstream side of the transect, and 2 meters on the downstream side of the transect). In addition, an estimate of native vegetation cover; invasive species cover; invasive species occurrence observations; and planted tree, shrub, and herb health shall be recorded at each transect.

The second sampling method will involve the use of randomly placed semi-permanent plots throughout the revegetation area. An equal number of plots will be situated randomly in each planting zone at a density of 4 plots per acre for a total of 25 plots throughout the revegetation area. Semi-permanent plots shall be 2x2 meters, and locations will be recorded using a submeter global positioning system (GPS) unit. A poly pipe shall be installed in the northwest corner of the plot to aid in relocating the plot from year to year. Plot locations will be established immediately after post-construction and will be recorded within the as-planted report using sub-meter GPS points. Vegetation species composition, cover, invasive species occurrence and cover, plant survival, species richness, and health of planted material including planted tree DBH will be measured in each plot. Special attention will be given to planted species cover, invasive species cover, and encroachment, as well as overall native species cover (which includes natural recruits). Plot data will also include notes on soil condition, erosion, or other conditions potentially affecting the quality of the restoration effort.

Results of annual monitoring visits will determine if the revegetation effort along Powers Creek Restoration meets the prescribed success criteria as described in Section 5.1 Performance Standards. Additionally, annual monitoring will be critical in identifying necessary adaptive management activities that may be needed to meet the success criteria.

5.3.2 Qualitative Visual Assessment

During each monitoring event, visual observations of habitat, plant health, natural recruitment, invasive species establishment, and evidence of damage will be recorded. The qualitative visual assessment will be the primary tool by which overall habitat development and the need for any remedial measures are identified. Qualitative visual assessment will help assess the overall functioning of the site as a whole and will help to identify localized or low-level trends, such as new invasive species encroachment, localized changes in species abundance, erosion, slope stability, stream reach conditions, and other changes that might be overlooked by simply counting planted trees and shrubs or looking at specific monitoring transects and plots.



Particular attention will be paid to the following:

- Condition of the wildlife friendly fence
- Presence of garbage, or any other evidence of encroachment that may negatively impact the restoration area
- Condition of the restored riparian hardwood and upland conifer forest including growth of woody vegetation, erosion, invasive species encroachment, health and conditions of planted trees, shrubs, and herbs, and overall habitat quality
- Damage to planted trees, shrubs, and herbs from herbivory, trampling, or drought stress
- Condition of the irrigation system including leaks, broken pipes, timers, timing of watering, and any other issues that may impact the effectiveness of the system
- The presence of birds and other wildlife in the mitigation areas
- Introduction and infestation of exotic species, species encroachment, and spread
- Evidence of other factors negatively impacting the health of planted trees or quality of the restoration effort

5.4 Photo Documentation

In addition to the general qualitative assessment and permanent plot sampling, permanent stations for photo documentation will be established at each of the semi-permanent transect start points. Photos will be taken prior to implementation and following installation of the proposed project. Photo stations will be established during the first site visit, and the locations will be recorded in the as-planted report to be used in each successive monitoring report, including GPS location using a submeter GPS unit. Photos will include direction of view and a reference to the photo monitoring location, and these will be included within each annual monitoring report.

5.5 Annual Reports

Vegetation monitoring shall be conducted within the restoration area for a total of 10 years of monitoring reflecting the scale of the changes proposed for the ecosystem.

Annual monitoring will be conducted every year for the full 10 years and will record the condition of the restoration area using the above-mentioned methods.

Annual reports will include all the data from the monitoring effort including the results from the quantitative and qualitative monitoring as well as an analysis of conditions, trajectory of plantings and habitat development, other observations, and problems that may need to be addressed. Recommendations for any corrective action necessary to ensure the continued success of the restoration will be included in each annual report. Photos from the established photo stations will be included within each annual monitoring report. Monitoring results will be compiled into annual reports and submitted following each yearly monitoring effort. Monitoring reports, including an evaluation of success, will be due annually by January 31 and will be submitted to applicable regulatory agencies.



6.0 Maintenance Plan

6.1 Maintenance During the 10-Year Monitoring Period

6.1.1 Restoration Vegetation Maintenance Plan

This maintenance plan section details maintenance activities that will take place during the plant establishment period, which lasts for 5 years following restoration/planting implementation. Following the plant establishment period, the maintenance requirements are expected to diminish but will continue to be conducted as needed. Should unforeseen challenges arise that threaten the success of the revegetation effort, then an adaptive management plan will be implemented that will govern all site maintenance and management activities. The ultimate responsibility for all maintenance activities rests with the City of Blue Lake, who may contract out various activities to qualified second parties or collaborate with other qualified entities to accomplish maintenance activities.

If during the 5-year plant establishment period the target habitat is not establishing properly and the success criteria outlined above are not being met, then a qualified biologist or restoration ecologist will conduct a site visit and determine the cause of the problem. Remedial measures will then be proposed in a technical memo, and if appropriate, submitted to the regulatory agencies for approval prior to implementation. Any remedial actions implemented will be accompanied by monitoring to determine if they are successful. Possible future remedial measures may include, but are not limited to, active replanting, increased weed abatement activities, supplemental irrigation, and changes to the fencing and browse protection plan.

Irrigation

Although the irrigation system design is simple to reduce installation and maintenance costs, regular maintenance will be required to keep it in working order for the first 3 years after installation of revegetation (or longer depending on the survival of planted material and the need for supplemental planting). This will include proper irrigation timing, duration, and frequency. The entire irrigation system should be inspected monthly to ensure that rotary sprinklers are operating properly and with the proper reach so that all plants are being irrigated. The entire pipeline should be inspected monthly for leaks, breaks, or other damage. Any screens or filters should be inspected monthly for blockage or semiblockages that could reduce water pressure. Portions of the system that cross the stream channel will need to be set up at the onset of the dry season and taken down in the late fall after the first rains.

Weed Control around Woody Plantings during Plant Establishment Period

Weeds will be controlled around all installed woody plants during the first 3 years following planting. During the growing season, all weeds within 3 feet of the base of the plantings will be manually controlled (hand weeding, weed-eaters, mowers, and so on) whenever the average height of the weeds exceeds 4 inches. Special care will be taken to train weed control crews to recognize and protect all desirable native plants recruiting into the project area, and even to weed carefully around natural recruits to encourage their rapid establishment. This is particularly important, since the large scale of this project requires that it rely to some degree on natural recruitment to establish substantial native habitat cover.

Plant Replacement

All required plantings shall be maintained in good growing condition throughout the life of the project and whenever necessary shall be replaced with new plant materials to ensure continued compliance with the restoration goals and success criteria. This can include planting a different species than what was



initially planted to better reflect the conditions of the site and to increase the likelihood of survival; however, any species substitutions will need to be made in consultation with the project biologist.

Invasive Species Control

Freshly disturbed and newly restored sites typically provide a suitable environment for invasive species to colonize unless an active maintenance program is in place to ensure that these species do not colonize during the plant establishment period. Invasive species which have the potential to invade the Powers Creek restoration area and could impede success of the restoration goals are described below. Active maintenance and eradication will be necessary to ensure that these species do not establish in the revegetated area. Brief methods to control these species are included here. It should be noted that it is possible that additional invasive species could be introduced or become a problem after the completion of revegetation efforts. If new invasive species become established, their removal and management will be described in annual monitoring reports as a part of Adaptive Management. Invasive species cover varies within the area immediately outside of the restoration project. Some of these areas are characterized by dense invasive species cover that may act as future reinvasion points. It is anticipated that portions of the restoration project within close proximity to these locations will require additional follow up treatment and regular maintenance.

Poison hemlock

Poison hemlock (*Conium maculatum*) is a biennial herb that occurs in disturbed areas where it can grow into dense infestations that prevent the growth of other species (DiTomaso and others, 2013). It is found along the banks of streams and rivers, roadsides and wastelands, woodlands, and meadows and pastures where it prefers moisture soil conditions (Bossard and others, 2000). The entire plant is toxic to humans and animals when ingested and can cause dermatitis in some people when handled (CalIPC, 2024). This species is tall and branching with erect hollow stems that support the inflorescence. Plants only reproduce by seed and seed dispersal occurs from late summer through winter, and seeds readily germinate. This species is best removed by hand prior to seed set, at which time the entire root should be removed by digging or hand pulling. Soil disturbance is likely to initiate germination of dormant seeds so follow-up treatments are almost always needed. Cutting, grazing, and burning are ineffective at controlling this toxic plant (DiTomaso 2013). The establishment of fast-growing native shrubs or trees will aid in preventing colonization as shading can limit establishment and growth. See Appendix 5 for detailed information on eradication and control methods for this species.

English ivy

English ivy (*Hedera helix*) is a fast growing perennial evergreen vine that vigorously climbs other vegetation and on structures and commonly invades riparian corridors, moist woodlands, forest margins, coastal habitats and disturbed sites (DiTomaso 2013, CalIPC 2024). It is especially prevalent in the suburban/wildland interface as it is an ornamental plant that has escaped cultivation, so it is often found near towns and along roadsides in areas such as the Powers Creek restoration area. English ivy's berries are consumed and spread by birds which can transport this species to uninfected areas (Bossard et al. 2000). Plants spread invasively and can develop a dense cover that outcompetes other vegetation in natural areas. English ivy grows over natural vegetation in an area, including trees, and eventually kills most resident plants by shading them out with its dense foliage. English ivy will often carpet the ground that can lead to serious bank erosion due to its weak rooting and the simultaneous reduction of other plant growth. This combination is especially deleterious in riparian habitat. Effective control can be achieved through hand removal by pulling all material off the ground and grubbing out rooted material at the base of trees. Repeated efforts will be needed to completely eradicate this species. Mechanical removal consisting of large equipment for large infestations is effective for control, however care must



be taken to prevent leaving fragments or rooted segments on site that can then regrow and become established. Cutting followed by repeated grazing to control resprouts is less effective, and fire is not suitable (DiTomaso 2013). See Appendix 5 for detailed information on eradication and control methods for this species.

Cherry plum

Cherry plum (*Prunus cerasifera*) is a deciduous tree that commonly invades along roadsides, streambanks, and in chaparral or other shrub dominated areas. It is an ornamental plant that has escaped cultivation, so it is often found near towns and along roadsides in areas such as the Powers Creek restoration area. Cherry plum's yellow to dark red fruits are distributed widely by people, birds, raccoons, and other wildlife. Although cherry plum trees may crowd out some native trees and shrubs, they usually grow quite sparsely and so have a lesser impact than plants that grow in dense patches (CalIPC 2024), even still it negatively impacts riparian habitat and its removal and control is warranted. Control cannot be achieved by simply cutting trees down, as the plant will resprout from trunks and roots. Mechanical removal consisting of large equipment for full grown trees or hand pulling for seedlings is effective for control. Cutting followed by repeated grazing to control resprouts is less effective, and fire stimulates regrowth and is not suitable (DiTomaso 2013). See Appendix 5 for detailed information on eradication and control methods for this species.

Sweetbriar

Sweetbriar (*Rosa rubiginosa*) is a large deciduous shrub that can develop dense impenetrable thickets. It is found along roadsides, in pastures, fallow fields, and natural areas including riparian habitat. It is an ornamental species that has escaped cultivation and is commonly found at the edge of towns and along roadsides. Plants reproduce sexually by seed and vegetatively by layering and suckering which can lead to large infestations (USDA 2013). This species is not listed as a formally recognized invasive species by CalIPC, however it forms extensive thickets along Powers Creek within the footprint and vicinity of the restoration project and is therefore a significant risk to the success of the revegetation effort and establishment of riparian habitat. Sweetbriar rose is difficult to control due to its large size and regeneration from sprouts. Control often requires a combination of mechanical and chemical treatments and/or multiple years of treatment (USDA 2013). See Appendix 5 for detailed information on eradication and control methods for this species.

Himalayan Blackberry

Himalayan blackberry is a sprawling, evergreen shrub that occurs along disturbed areas and streambanks. It is commonly found in riparian areas, where it forms dense thickets (CaIIPC 2024). It can tolerate periodic inundation in both fresh and brackish conditions. It also can readily colonize disturbed areas. Once it is established, it can form impenetrable thickets that shade and outcompete native vegetation, especially along streams and in riparian areas (DiTomaso and others, 2013). Mechanical removal or burning are potential methods of removing the plants, but these methods require persistent treatment to be successful. Removing only the aboveground growth will stimulate the growth of root sprouts (DiTomaso and others, 2013). Repeated cutting, particularly while the plant is flowering, can help in exhausting the root stores. The canes and the roots also need to be removed as Himalayan blackberry can easily resprout from any remaining roots, in addition to regenerating from seed. In areas where mature plants have been removed, regrowth may be successfully controlled by grazing sheep and goats, particularly when the plants are exhibiting new growth. The establishment of fast-growing native shrubs or trees will aid in preventing colonization as shading can limit establishment and growth of Himalayan blackberry (Bossard et al. 2000). This will be the primary long-term means by which this species is managed. See Appendix 5 for detailed information on eradication and control methods for this species.



Fencing and Browse Protectors

Wildlife friendly split rail fencing shall be kept in good condition through bi-annual monitoring and maintenance activities as needed. This may include replacing broken or missing rails and posts, resetting posts should they be damaged, and mowing/weed whacking along the fence line.

Browse protectors shall be kept in good condition through regular maintenance as needed and detailed during annual monitoring. Browse protectors shall remain upright with solid staking. Tipped or damaged browse protectors shall be replaced and new stakes installed. Browse protectors shall be removed when trees are over 6 feet tall. Any browse protectors installed within the active channel will need to be removed prior to winter flows, and re-installed in the spring if browse damage is significant.

6.1.2 Maintenance Schedule

Maintenance activities will be most intensive during the 5-year plant establishment period and as native habitat develops within the mitigation area, the need for maintenance activities (for example, watering and weed control) should decrease. Maintenance will be conducted as necessary to meet final performance standards and will be conducted based on the findings and recommendations contained within the annual monitoring reports. The maintenance schedule will vary depending on weather conditions but will be most intense during the spring and summer months. The actual schedule for maintenance will be determined by the biologist monitoring the revegetation area.

6.1.3 Adaptive Management Approach to Maintenance

Adaptive management maintenance is proposed to ensure the successful establishment and persistence of riparian hardwood and conifer forest within the restoration area along Powers Creek.

Adaptive management is used to better achieve success within restoration areas. It allows for the inherent changes and instability experienced in natural habitats and the ecological processes that define them. Adaptive management allows the results and observations of the monitoring visits to drive the maintenance plan and the solutions to problems that may arise. This allows the project proponent and project biologist to learn by experience within site-specific environments and apply solutions to remedy deficiencies using a controlled and scientific approach.

Adaptive management procedures will be recommended on a case-by-case basis and will be reported within the annual monitoring reports. Adaptive management actions could include:

- Supplemental planting in areas that are displaying higher mortality rates with species that were not originally specified in this planting plan
- Supplemental watering or change in watering schedule
- Changes to invasive species management to address new infestations, new species introductions, or expanding cover by existing invasive species indicating that current management measures are insufficient
- Changes to fencing and browse protection

Unpredictable natural conditions could potentially alter the revegetation areas and necessitate changing the goals, objectives, strategies, and actions set forth in this plan. Unpredictable natural conditions that could impact the revegetation areas include:

• Unusual weather patterns, such as extended drought, or excessive rainfall



- Serious/destructive flooding along Powers Creek
- Fire or other serious disturbance within the restoration area
- Changes in plant compositions, such as through invasion of a new non-native invasive plant or wildlife species to the site
- Erosion or deposition of sediments
- Excessive human encroachment or disturbance of the revegetation areas

Should any changes be deemed necessary to achieve the creation of riparian hardwood and conifer forest habitat, then the project biologist shall meet with the project proponent to revise the adaptive management plan. Any changes will be recorded within the annual reports submitted to the applicable permitting and funding agencies. Should required changes be significant, then they will be documented in a supplemental technical memo to be provided to applicable permitting and funding agencies. Ideally, adaptive management will fix problems as they arise, so that at year 5, all success criteria have been met, and the restoration is on a trajectory of continued maturation and improvement.

7.0 Completion of Monitoring

The revegetation effort shall not be considered complete until the entire restoration area is protected by a deed restriction or similar mechanism. Furthermore, all irrigation lines, browse protectors, plastics, or other similar products related to the establishment of the restoration shall be removed prior to the completion of the final monitoring report, and their removal shall be documented within the final report, including photos.

The Baduwa't Watershed Council and the City of Blue Lake will notify applicable regulatory agencies upon completion of the 10-year monitoring program through the submittal of a final monitoring report. If the project meets performance standards at the end of the 10-year monitoring period, the revegetation will be considered a success. Should the revegetation fail to meet the success criteria, problems will be evaluated and further addressed, and the maintenance and monitoring program may be extended. Monitoring extensions will be done only for areas that fail to meet final success criteria. This process will continue until all standards are met or until the agencies determine that other adaptive management measures are appropriate. If the restoration effort meets all goals prior to the end of the 10-year monitoring period, and the trajectory of the site is such that riparian habitat is solidly established and will continue to become established, applicable regulatory agencies may terminate the monitoring effort at their discretion.

8.0 Responsible Parties

The following participants are responsible for the conservation easement/planning designation, revegetation and establishment of riparian habitat, maintenance, and monitoring of the revegetation area. The responsibilities of each party are described below.

8.1 Project Proponent

The project proponents, Baduwa't Watershed Council and the City of Blue Lake, will be ultimately responsible to ensure that the approved revegetation plan is implemented and successful. The project proponents will be responsible for developing deed restrictions to protect the restoration area and financing the preparation, maintenance, and monitoring of the restoration areas.



8.2 Project Biologist

Monitoring the revegetation areas will be the responsibility of a qualified biologist. Baduwa't Watershed Council and the City of Blue Lake are responsible for retaining the project biologist. The project biologist will coordinate with Baduwa't Watershed Council and City of Blue Lake staff to assist with interpreting restoration goals and performance standards.

After each annual monitoring event, the project biologist will provide the Baduwa't Watershed Council and the City of Blue Lake with a written list of items in need of attention. The project biologist will be responsible for identifying habitat areas requiring remedial measures and for directing the implementation of such measures.

9.0 References

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- DiTomaso, J.M., G.B. Kyser and others (2013). Weed Control in Natural Areas in the Western United States. Weed Research and Information Center, University of California.
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- USDA. (2013). Technical Note: Roses of the inland Pacific Northwest, Native and Invasive Species Identification, Biology and Control. United States, Natural Resources Conservation Service, Spokane Washington.





Photo 1: Existing conditions within Powers Creek, looking upstream from the downstream end of the restoration project. Note dense willow cover with Himalayan blackberry making an impenetrable thicket. Very few trees exist along the stream like those shown in the background. Photo taken November 29, 2024.



Photo 2: Looking west along the south bank of Powers Creek near Hatchery Road. Note mowed conditions which abruptly transition to willows and Himalayan blackberry. Photo taken April 29, 2024.





Photo 3: Looking upstream within the Powers Creek active channel. Note aggraded condition and thick Himalayan blackberry on the left side of the photo. Photo taken in spring; exact date unknown.



Photo 4: Looking downstream within the existing vegetation along Powers Creek. Note extremely dense Himalayan blackberry and willow growth that prevents wildlife movement and flood water from moving through the stream. Photo taken December 30, 2022 during a high flow event.





Photo 5: Looking across Powers Creek. Note extremely dense Himalayan blackberry completely chokes the stream reducing floodwater movement and preventing wildlife access to the stream. Photo taken December 30, 2022 during a high flow event.



Photo 6: Looking north across Powers Creek at a location where some Himalayan blackberry was removed from the south bank (similar location to Photo 3). Note extremely dense Himalayan blackberry in surrounding area and abundant willow cover. Photo taken December 30, 2022 during a high flow event.





Photo 7: Looking downstream (west) across the lower reach of Powers Creek which was restored in 2021. Note free flowing channel, abundant herbaceous ground cover, and absence of Himalayan blackberry. Planted trees are present in wire cages. Photo taken November 29, 2024.



Photo 8: Looking downstream (west) across the lower reach of Powers Creek which was restored in 2021. Note high flows are able to pass through the restored channel. Planted trees are present in wire cages. Photo taken December 30, 2022.





Photo 9: A similar restoration project conducted on Janes Creek, Arcata in the year 1995. Note trees are maturing and there is little Himalayan blackberry along the stream. Also note dense Himalayan blackberry in the left side of the photo at the tree canopy edge. Photo taken spring; exact date unknown.



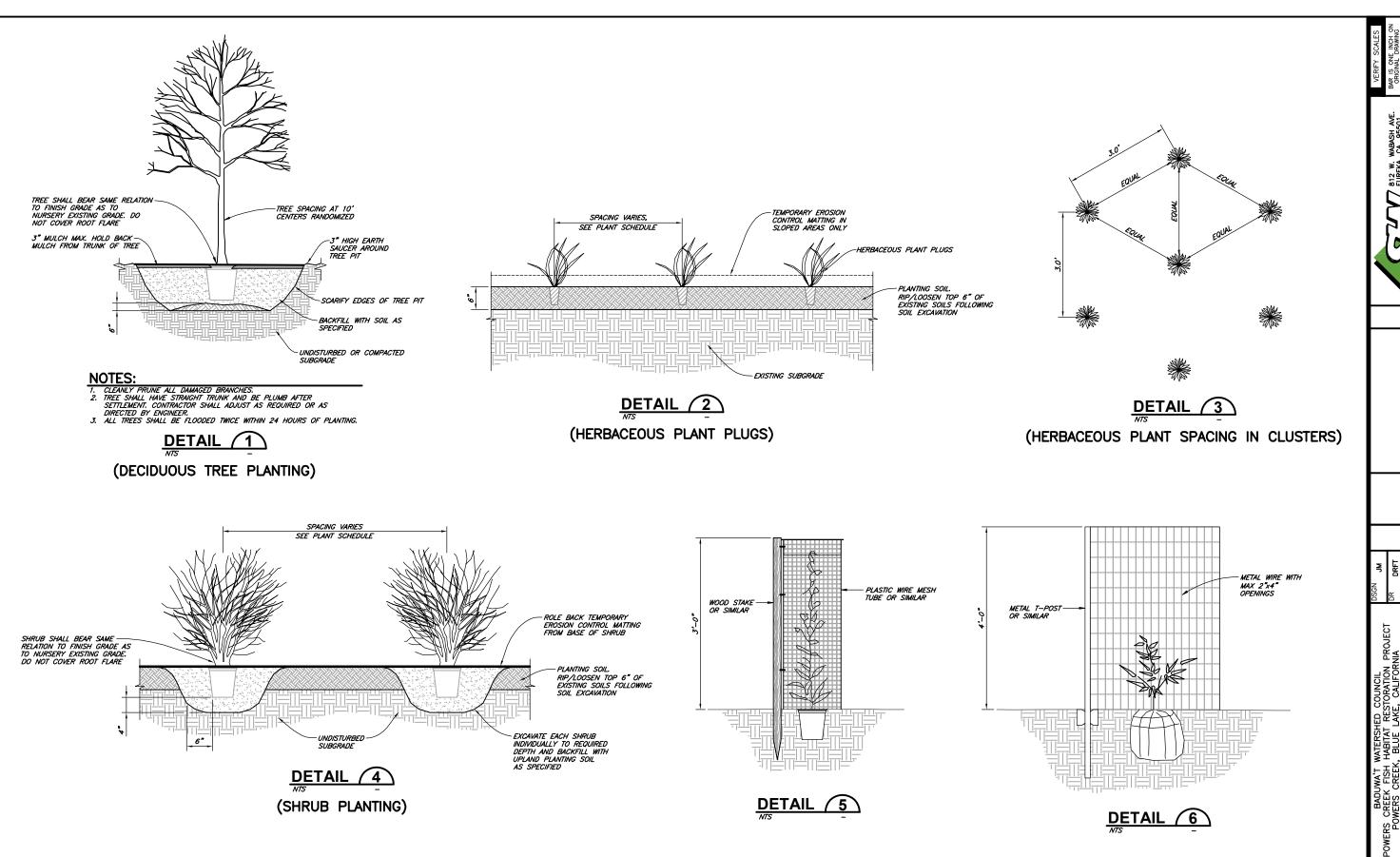
Photo 10: Representative riparian habitat along a similar unnamed stream. Note mixed hardwood conifer canopy and well-developed understory. Photo taken spring; exact date unknown.

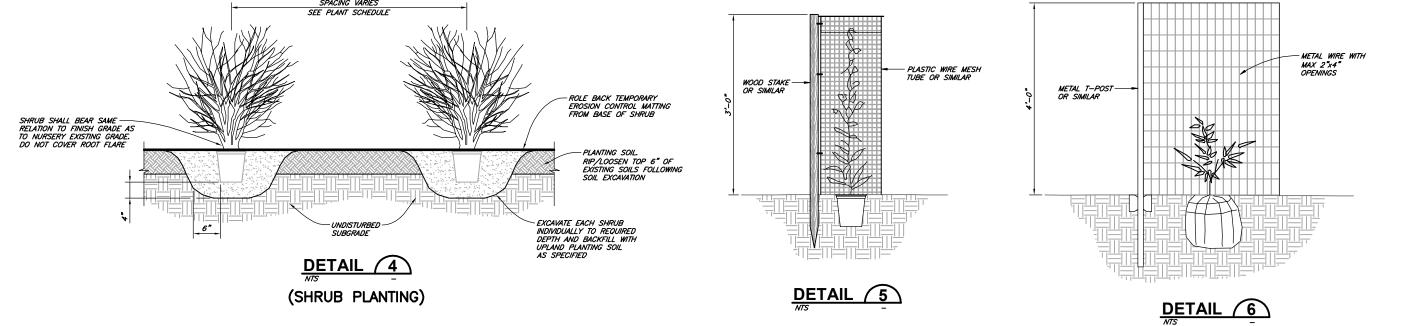




Photo 11: Representative riparian habitat along a similar sized urban stream. Note hardwoods along stream, conifers on upper bank and well-developed understory. Photo taken spring; exact date unknown.





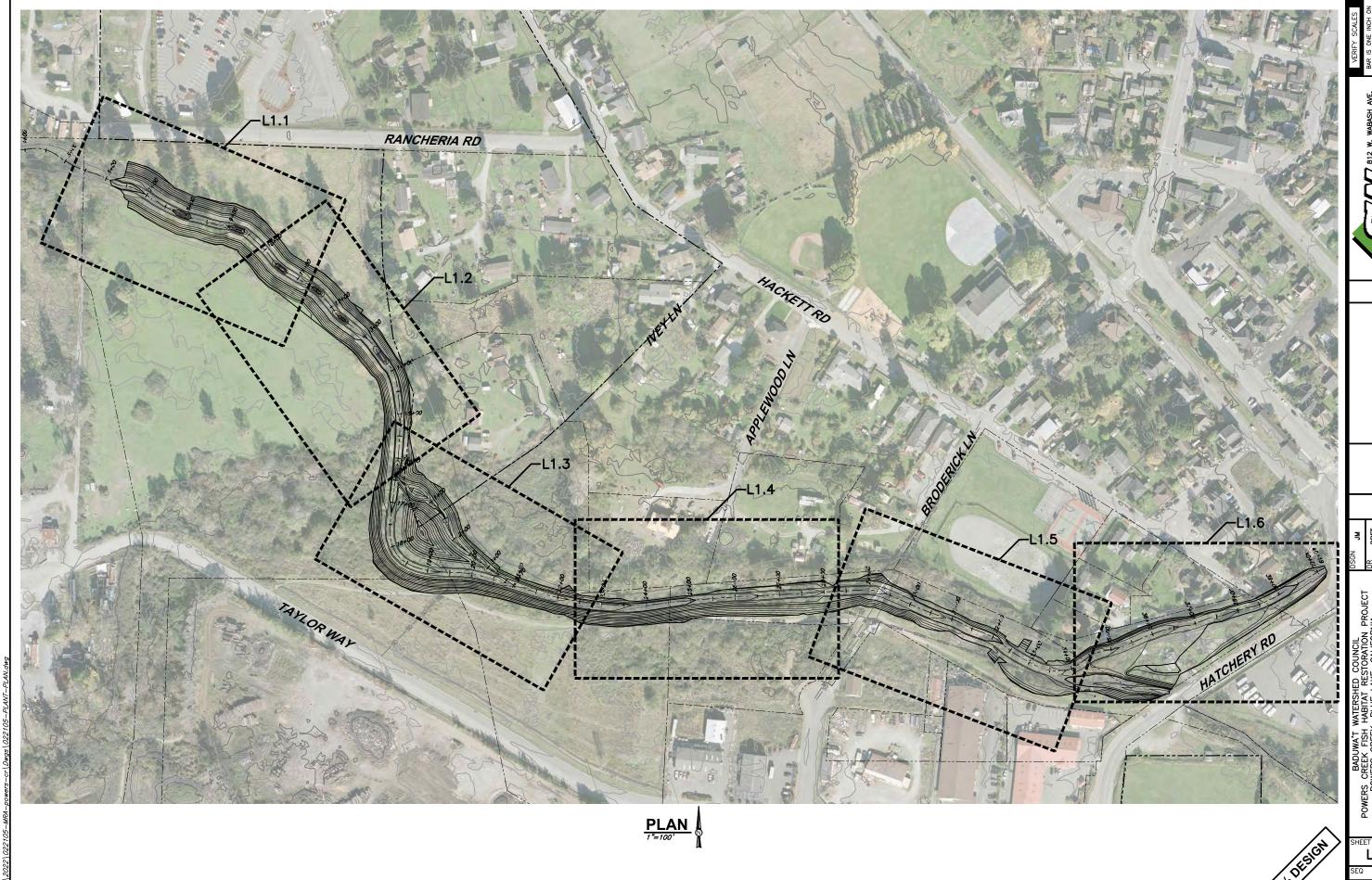


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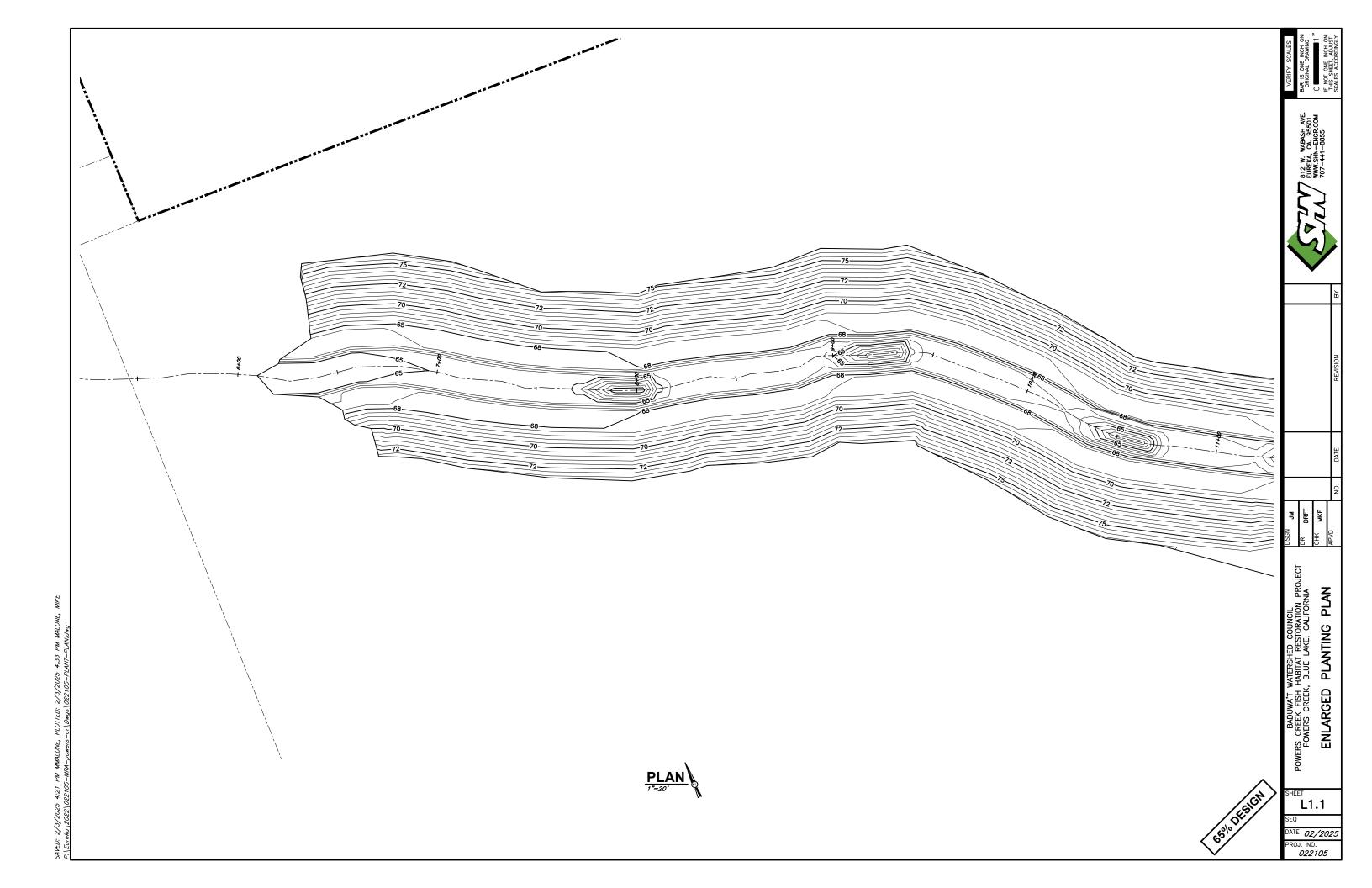
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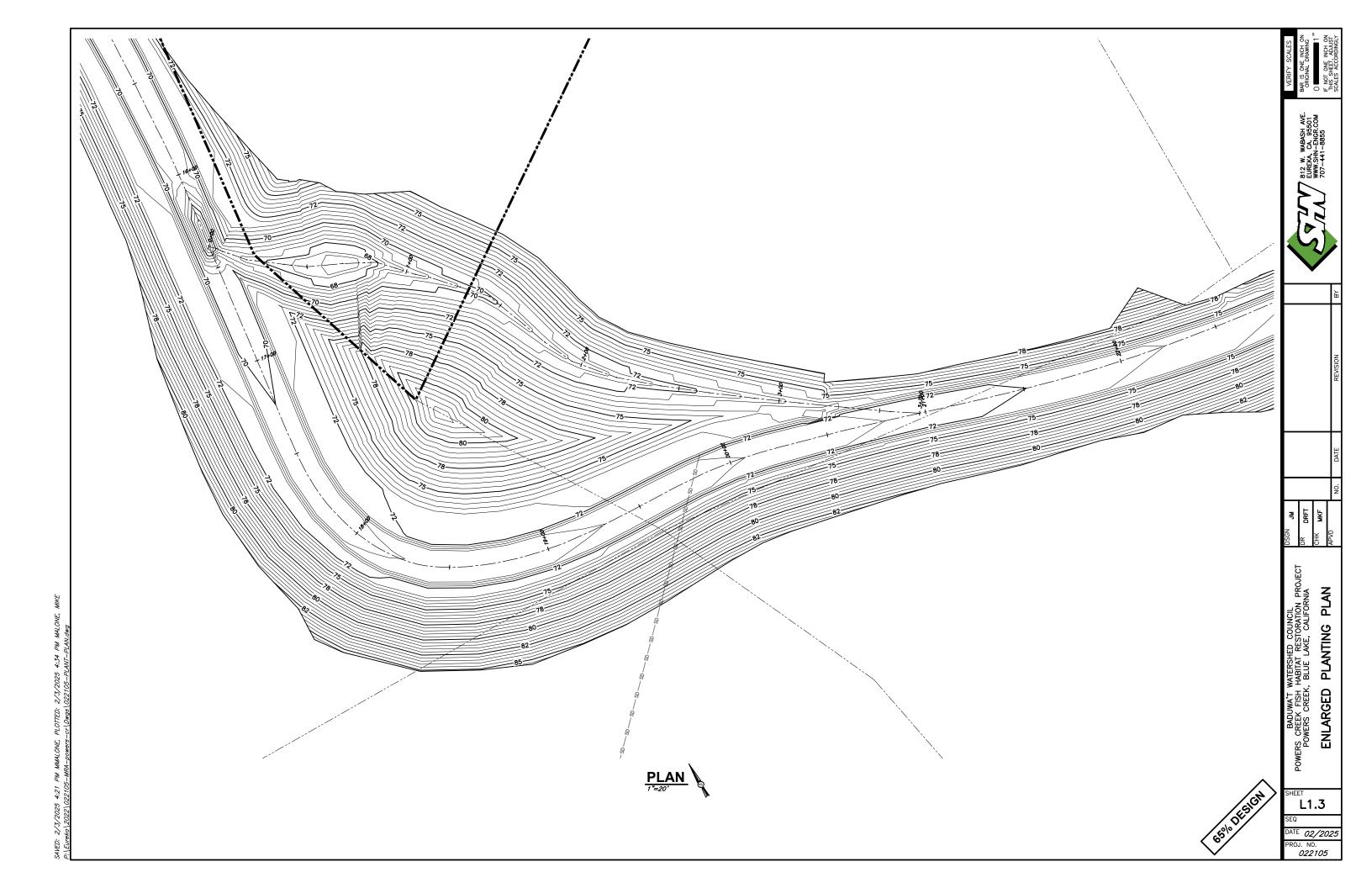


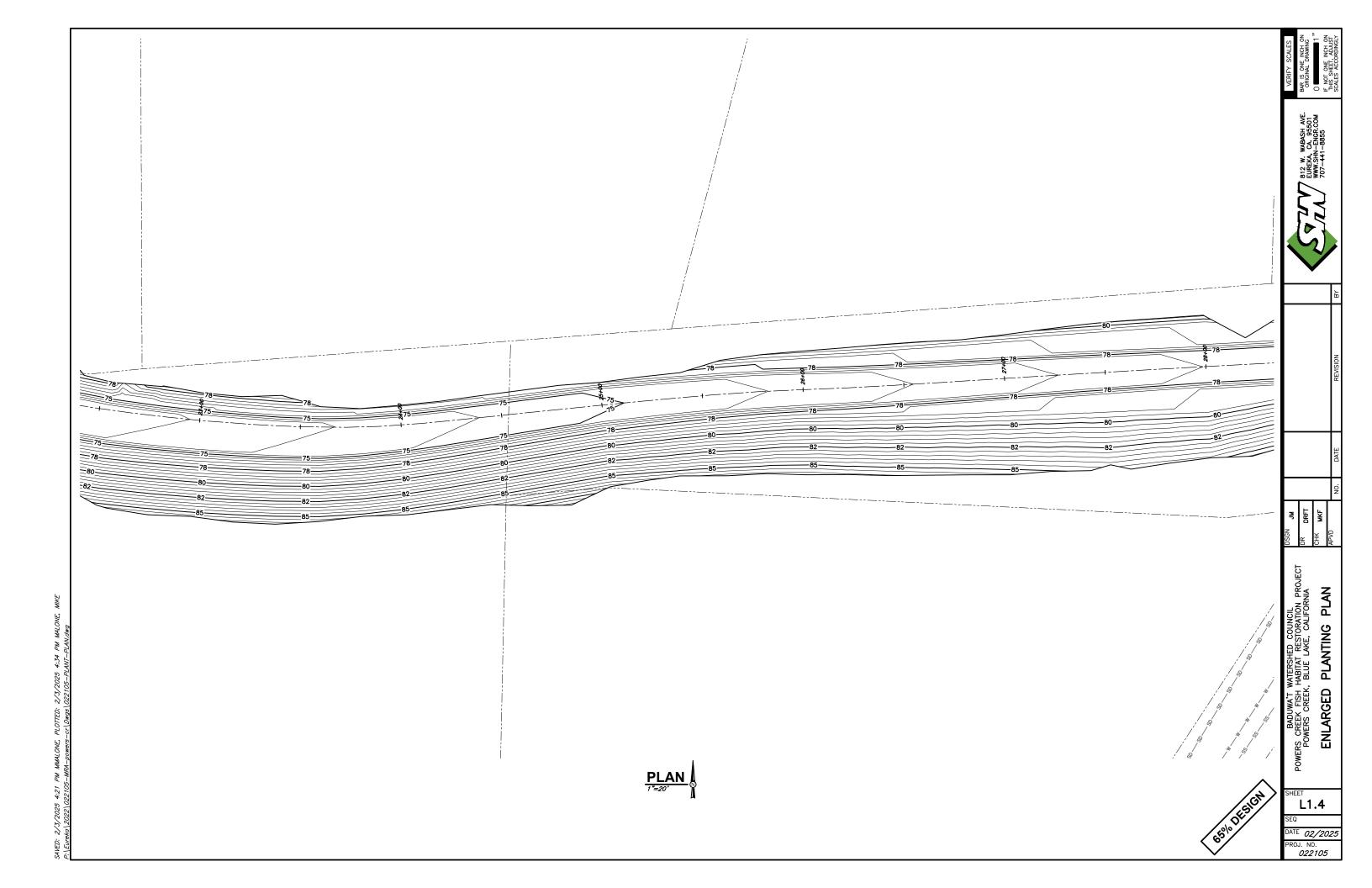
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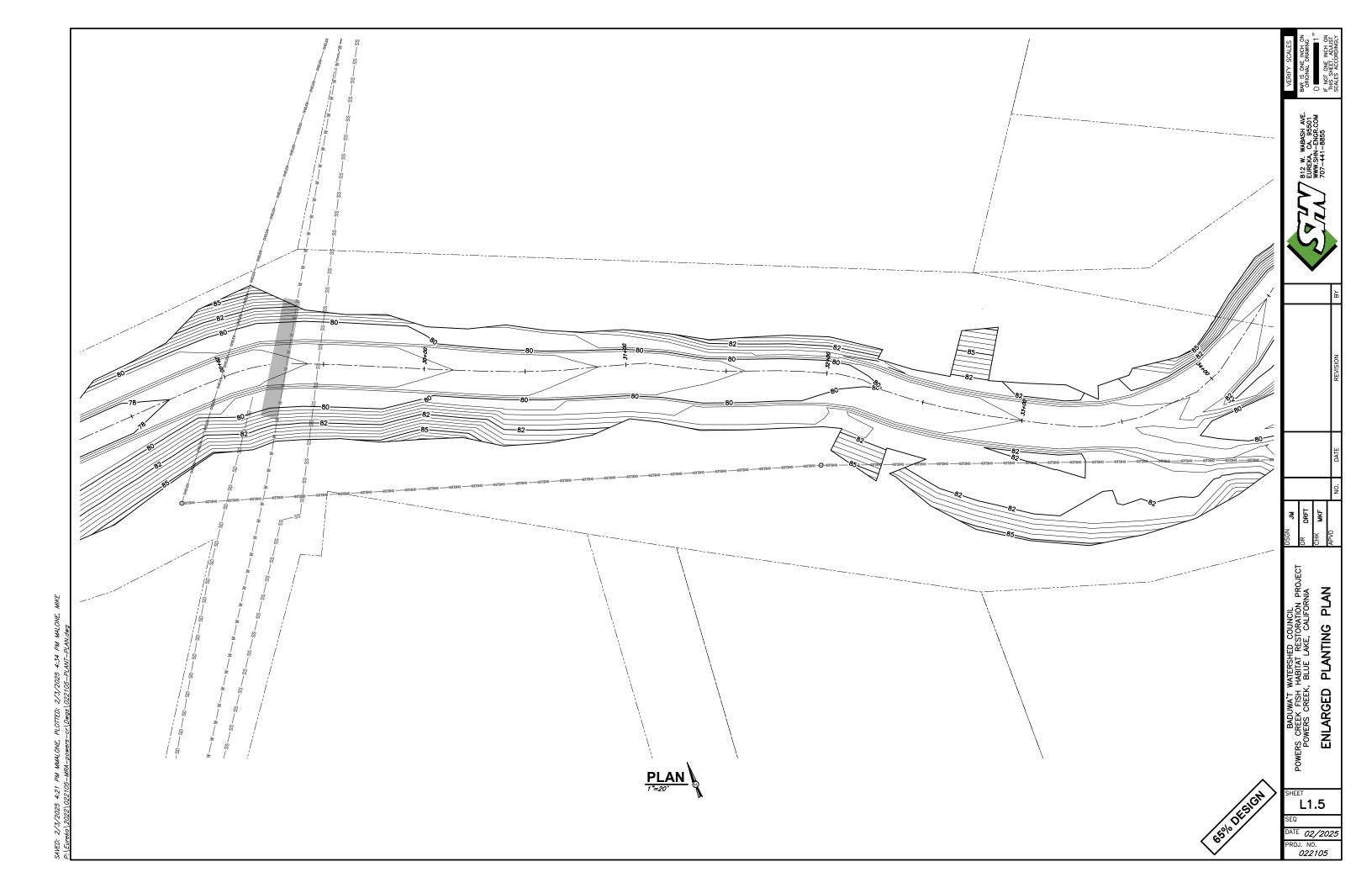
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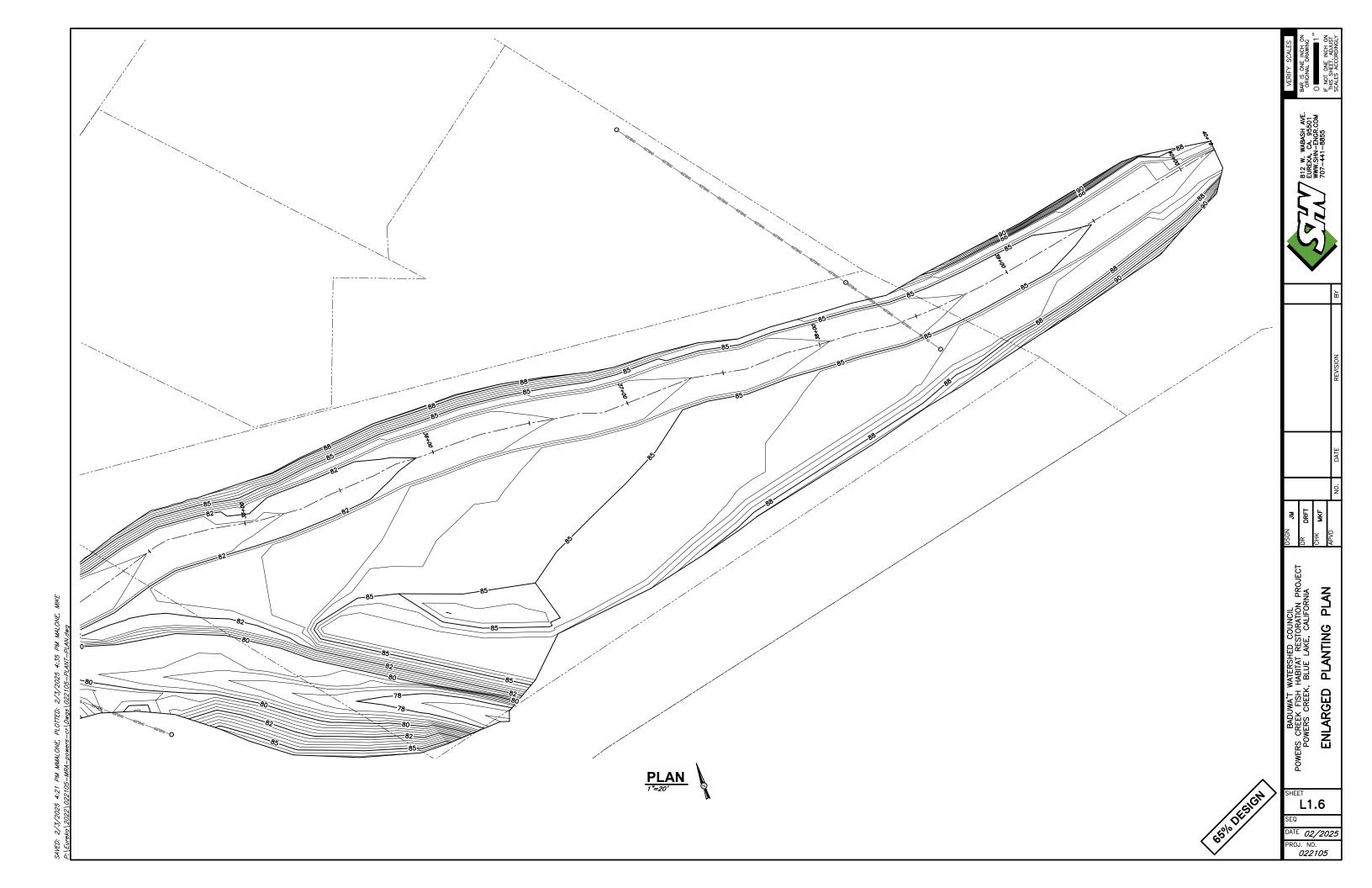












Planting Plan Specifications

Powers Creek Planting Plan Specifications							
PLANTING ZONE (Sqft)	VEGETATION TYPE	COMMON NAME	SCIENTIFIC NAME	ON-CENTER PLANT SPACING (ft)	PROPAGULE TYPE	COMPOSITION (%)	ESTIMATED TOTAL NUMBER
		slough sedge	Carex obnupta	* Plants in clusters of 3	Deep pot	30	203
		rusty broomsedge	Carex subfusca	* Plants in clusters of 3	1-gallon pots	10	68
Streambed (6,104)	Herbs	scouring horsetail	Equisetum hyemale	10	1-gallon pots	30	203
(0,104)		Pacific rush	Juncus effusus	* Plants in clusters of 3	1-gallon pots	10	68
		common rush	Juncus patens	* Plants in clusters of 3	1-gallon pots	20	135
Total Plants in	Streambed Planting	g Zone				100%	677
		bigleaf maple	Acer macrophyllum	8	1-gallon pots	15	50
	Trees	red alder	Alnus rubra	8	1-gallon pots	30	99
		Oregon ash	Fraxinus latifolia	8	1-gallon pots	10	33
		black cottonwood	Populus trichocarpa	8	1-gallon pots	40	132
		Pacific willow	Salix lasiandra var. lasiandra	8	1-gallon pots	5	17
	Shrubs	cascara	Frangula purshiana ssp. purshiana	7	1-gallon pots	55	240
Streambank		spirea	Spiraea douglasii	7	1-gallon pots	45	196
(21,171)		Western yarrow	Achillea millefolium ssp. occidentale	* Plants in clusters of 5	1-gallon pots	12	102
		California mugwort	Artemisia douglasiana	* Plants in clusters of 3	1-gallon pots	8	68
	Herbs	California hairgrass	Deschampsia cespitosa ssp. holciformis	5	1-gallon pots	3	25
		scouring horsetail	Equisetum hyemale	10	1-gallon pots	20	169

	Powers Creek Planting Plan Specifications							
PLANTING ZONE (Sqft)	VEGETATION TYPE	COMMON NAME	SCIENTIFIC NAME	ON-CENTER PLANT SPACING (ft)	PROPAGULE TYPE	COMPOSITION (%)	ESTIMATED TOTAL NUMBER	
		sword fern	Polystichum munitum	* Plants in clusters of 3	1-gallon pots	1	8	
		California bee plant	Scrophularia californica	* Plants in clusters of 3	1-gallon pots	2	17	
		California goldenrod	Solidago velutina ssp. californica	* Plants in clusters of 3	1-gallon pots	10	85	
Streambank (21,171)	Herbs continued	slough sedge	Carex obnupta	* Plants in clusters of 3	Deep pot	20	170	
continued	Continued	rusty broomsedge	Carex subfusca	* Plants in clusters of 3	1-gallon pots	3	25	
			Pacific rush	Juncus effusus	* Plants in clusters of 3	1-gallon pots	8	68
			small fruited bulrush	Scirpus microcarpus	* Plants in clusters of 5	1-gallon pots	8	68
		Mexican hedgenettle	Stachys mexicana	* Plants in clusters of 3	1-gallon pots	5	42	
Total Plants in	Streambank Plantin	ng Zone				100%	1,614	
		bigleaf maple	Acer macrophyllum	8	1-gallon pots	12	123	
		red alder	Alnus rubra	8	1-gallon pots	20	205	
		Oregon ash	Fraxinus latifolia	8	1-gallon pots	16	164	
	Trees	Sitka spruce	Picea sitchensis	8	1-gallon pots	12	123	
		black cottonwood	Populus trichocarpa	8	1-gallon pots	26	267	
		Western hemlock	Tsuga heterophylla	8	1-gallon pots	4	40	
Floodplain		Western redcedar	Thuja plicata	8	1-gallon pots	10	103	
(65,695)	Shrubs	cascara	Frangula purshiana ssp. purshiana	7	1-gallon pots	15	201	
		twinberry	Lonicera involucrata ssp. ledebourii	7	1-gallon pots	20	268	
		red elderberry	Sambucus racemosa var. racemosa	7	1-gallon pots	40	536	
		wax myrtle	Morella californica	7	1-gallon pots	25	335	

Powers Creek Planting Plan Specifications							
PLANTING ZONE (Sqft)	VEGETATION TYPE	COMMON NAME	SCIENTIFIC NAME	ON-CENTER PLANT SPACING (ft)	PROPAGULE TYPE	COMPOSITION (%)	ESTIMATED TOTAL NUMBER
		Western yarrow	Achillea millefolium ssp. occidentale	* Plants in clusters of 5	1-gallon pots	10	263
		California mugwort	Artemisia douglasii	* Plants in clusters of 3	1-gallon pots	10	263
		scouring horsetail	Equisetum hyemale	10	1-gallon pots	18	473
		California fescue	Festuca californica	5	1-gallon pots	10	263
	Herbs	cow parsnip	Heracleum maximum	* Plants in clusters of 3	1-gallon pots	2	53
		sword fern	Polystichum munitum	* Plants in clusters of 3	1-gallon pots	1	26
Floodplain		California bee plant	Scrophularia californica	* Plants in clusters of 3	1-gallon pots	5	131
(65,695) continued		California goldenrod	Solidago velutina ssp. californica	* Plants in clusters of 5	1-gallon pots	10	263
		rough hedgenettle	Stachys rigida	* Plants in clusters of 3	1-gallon pots	3	79
		Pacific aster	Symphyotrichum chilense	* Plants in clusters of 5	1-gallon pots	5	131
		rusty broomsedge	Carex subfusca	* Plants in clusters of 5	1-gallon pots	5	131
		slough sedge	Carex obnupta	* Plants in clusters of 5	Deep pot	12	315
		Pacific rush	Juncus effusus	* Plants in clusters of 3	1-gallon pots	6	158
		Mexican hedgenettle	Stachys mexicana	* Plants in clusters of 3	1-gallon pots	3	79
Total Plants in	Floodplain Planting	g Zone				100%	4,993
		bigleaf maple	Acer macrophyllum	8	1-gallon pots	4	79
Upper Bank		red alder	Alnus rubra	8	1-gallon pots	3	59
(127,004)	Trees	Oregon ash	Fraxinus latifolia	8	1-gallon pots	3	59
(127,004)		Sitka spruce	Picea sitchensis	8	1-gallon pots	12	238
		black cottonwood	Populus trichocarpa	8	1-gallon pots	5	100

	Powers Creek Planting Plan Specifications							
PLANTING ZONE (Sqft)	VEGETATION TYPE	COMMON NAME	SCIENTIFIC NAME	ON-CENTER PLANT SPACING (ft)	PROPAGULE TYPE	COMPOSITION (%)	ESTIMATED TOTAL NUMBER	
	Trees	Douglas fir	Pseudotsuga menziesii var. menziesii	8	1-gallon pots	12	238	
	continued	coast redwood	Sequoia sempervirens	8	1-gallon pots	57	1,130	
		California laurel	Umbellularia californica	8	1-gallon pots	4	79	
		hairy manzanita	Arctostaphylos columbiana	7	1-gallon pots	10	260	
		Oregon grape	Berberis aquifolium	7	1-gallon pots	5	130	
	Shrubs	blue blossom	Ceanothus thyrsiflorus	7	1-gallon pots	15	390	
		coffeeberry	Frangula californica	7	1-gallon pots	10	260	
		coast silktassel	Garrya elliptica	7	1-gallon pots	10	260	
Upper Bank (127,004)		toyon	Heteromeles arbutifolia	7	1-gallon pots	5	130	
continued		wax myrtle	Morella californica	7	1-gallon pots	20	518	
		red flowering currant	Ribes sanguineum	7	1-gallon pots	15	390	
		red elderberry	Sambucus racemosa	7	1-gallon pots	5	130	
		snowberry	Symphoricarpos albus	7	1-gallon pots	2	52	
		evergreen huckleberry	Vaccinium ovatum	7	1-gallon pots	3	77	
		Western yarrow	Achillea millefolium ssp. occidentale	* Plants in clusters of 5	1-gallon pots	25	1,269	
	Herbs	California mugwort	Artemisia douglasiana	* Plants in clusters of 3	1-gallon pots	15	761	
		California fescue	Festuca californica	5	1-gallon pots	15	761	
		sword fern	Polystichum munitum	* Plants in clusters of 3	1-gallon pots	5	254	

	Powers Creek Planting Plan Specifications								
PLANTING ZONE (Sqft)	VEGETATION TYPE	COMMON NAME	SCIENTIFIC NAME	ON-CENTER PLANT SPACING (ft)	PROPAGULE TYPE	COMPOSITION (%)	ESTIMATED TOTAL NUMBER		
I I an an Danis		California bee plant	Scrophularia californica	* Plants in clusters of 3	1-gallon pots	15	761		
Upper Bank (127,004) continued	Herbs continued	California goldenrod	Solidago velutina ssp. californica	* Plants in clusters of 5	1-gallon pots	15	761		
continued		rough hedgenettle	Stachys rigida	* Plants in clusters of 5	1-gallon pots	10	508		
Total Plants in	Upper Bank Plantin	ng Zone				100%	9,654		
		Sitka spruce	Picea sitchensis	8	1-gallon pots	10	87		
	Trees	Douglas fir	Pseudotsuga menziesii var. menziesii	8	1-gallon pots	20	173		
	Hees	coast redwood	Sequoia sempervirens	8	1-gallon pots	60	519		
		California laurel	Umbellularia californica	8	1-gallon pots	10	87		
		hairy manzanita	Arctostaphylos columbiana	7	1-gallon pots	5	56		
		Oregon grape	Berberis aquifolium	7	1-gallon pots	5	56		
Top of Bank		blue blossom	Ceanothus thyrsiflorus	7	1-gallon pots	25	282		
(55,353)		coffeeberry	Frangula californica	7	1-gallon pots	10	114		
	Shrubs	toyon	Heteromeles arbutifolia	7	1-gallon pots	15	169		
		wax myrtle	Morella californica	7	1-gallon pots	25	282		
			red flowering currant	Ribes sanguineum	7	1-gallon pots	10	114	
		evergreen huckleberry	Vaccinium ovatum	7	1-gallon pots	5	56		
	Herbs	Western yarrow	Achillea millefolium ssp. occidentale	* Plants in clusters of 5	1-gallon pots	34	872		
	Herbs	Californica bee plant	Scrophularia californica	* Plants in clusters of 5	1-gallon pots	33	847		

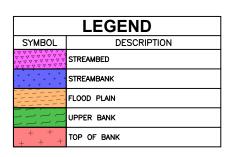
	Powers Creek Planting Plan Specifications						
PLANTING ZONE (Sqft)	VEGETATION TYPE	COMMON NAME	SCIENTIFIC NAME	ON-CENTER PLANT SPACING (ft)	PROPAGULE TYPE	COMPOSITION (%)	ESTIMATED TOTAL NUMBER
Top of Bank (55,353) continued	Herbs continued	California goldenrod	Solidago velutina ssp. californica	* Plants in clusters of 3	1-gallon pots	33	847
Total Plants in	Total Plants in Top of Bank Planting Zone					100%	4560
Total Trees for	Total Trees for Powers Creek Revegetation					4,203	
Total Shrubs for Powers Creek Revegetation					5,502		
Total Herbs for Powers Creek Revegetation						11,793	
TOTAL plants for Powers Creek Revegetation						21,498	

^{*} Individual plants within clusters spaced nine inches apart. Place clusters randomly within zone, no less than 10 feet apart.

^{1.} Spacing on center. Size or species substitutions ARE NOT acceptable, if specified size or species are not available contact project biologist. Any substitutions are per project biologist discretion.

Conceptual Representative Cross-section





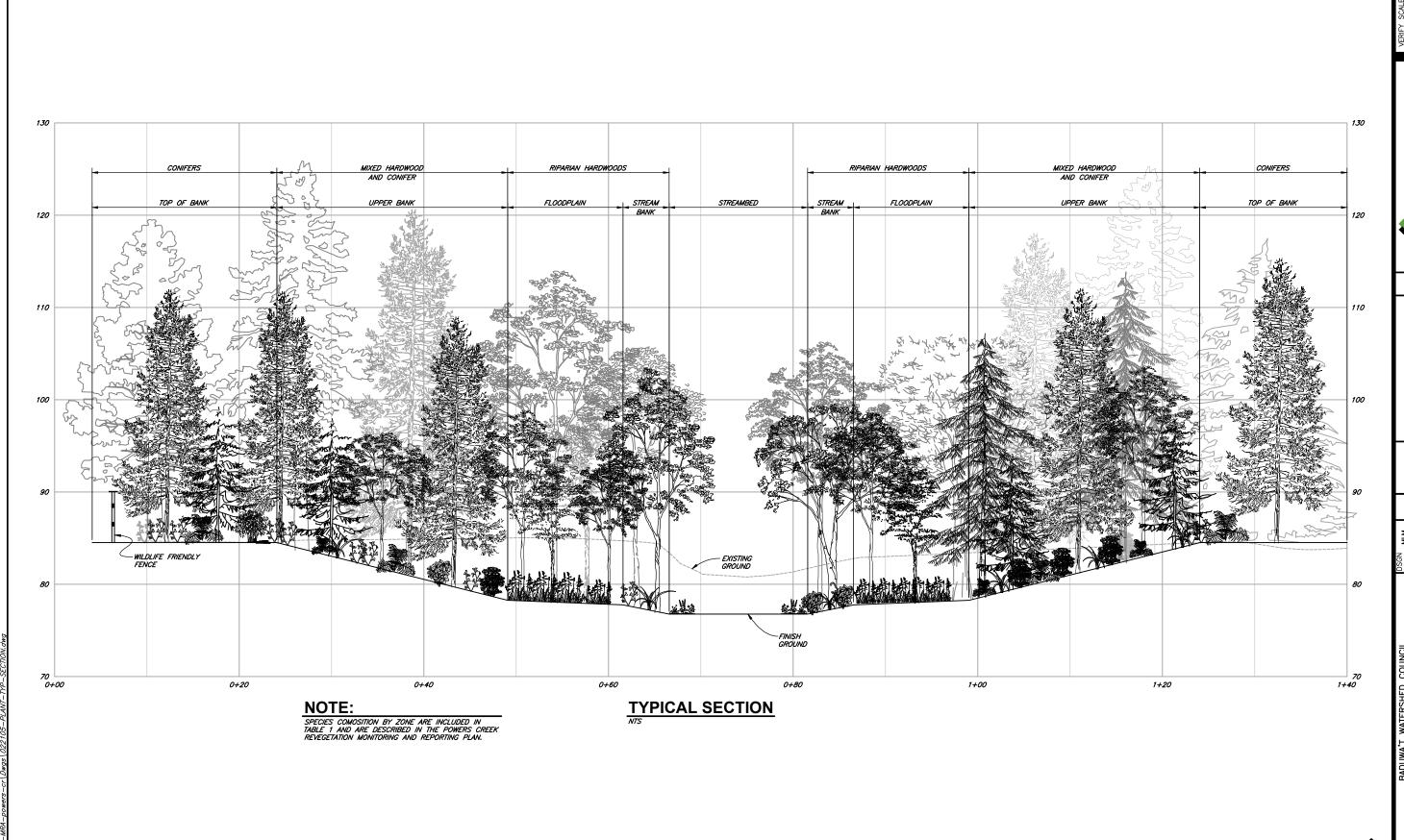


L1.0 DATE *02/2025* PROJ. NO. *022105*

AND LEGEND

PLANTING MAP

BADUWA'T WATERSI POWERS CREEK FISH HABITAT POWERS CREEK, BLUE



L1.1

DATE *02/2025* PROJ. NO. 022105

SECTION

PLAN TYPICAL

PLANTING

Invasive Species Control Specifications

INVASIVE ROSES

Introduction to Invasive Roses

Our invasive roses, dog rose and sweetbriar rose, first appeared on the landscapes of the Inland Northwest when they escaped from home gardens and were planted for wildlife habitat, fences, and soil protection. The invasive roses continue to be planted intentionally or accidentally in our landscape to this day. Many people mistakenly identify all roses as being beneficial and are not aware of the differences between species. Introduced rose species do provide benefits to wildlife in the form of food and cover. However, they spread very rapidly and are able to out-compete native and other desirable vegetation. They eventually reduce the diversity and function of a landscape.



Invasive roses (the dark green mounds) taking over a hillside in Columbia County, WA. Pamela Pavek, NRCS

Environmental Concerns

According to the Center for Invasive Species and Ecosystem Health (2010), dog rose and sweetbriar rose are weedy species that can be invasive in some regions. The Inland Northwest is one of those regions. The roses spread by suckers and layering, and birds and other wildlife consume the fruit and spread the seed. Areas invaded with dog and sweetbriar rose can become dominated by the plants after several years, resulting in a decline in desirable vegetation. The forage value of pastures diminishes rapidly following the invasion and spread of the roses. Plants can be very large, up to 9 to 10 feet tall, and impede the movement of livestock, wildlife and vehicles.

Control of Invasive Roses

Dog and sweetbriar rose are difficult to control due to their large size and regeneration from sprouts. Control often requires a combination of mechanical and chemical treatments and/or multiple years of treatment.

Biological: No biocontrol agents are available for invasive roses because they are closely related to native roses and horticultural varieties.

Cultural: Fire does not effectively control invasive roses because the plants will regrow the following year.

Mechanical: Plants can be removed by extracting with a chain and ATV or other vehicle in the spring, but regrowth will need to be killed with an herbicide. In a large area, mowing the plants with a brush machine will facilitate herbicide application. Mowing alone will not kill the plants unless repeated multiple times. Three to six mowings per year for two to four years may provide control (DiTomaso et al., 2013). Repeated cultivation will prevent rose seedlings from establishing.

Chemical: Herbicides are effective for controlling invasive roses. The following herbicides are from the Pacific Northwest Weed Management Handbook (Peachey, 2012) and Weed Control in Natural Areas in the Western United States (DiTomaso et al., 2013). Contact your local agricultural extension specialist or county weed specialist to learn what works best in your area and how to use it safely. Always read label and safety instructions for each control method. Trade names and control measures appear in this document only to provide specific information. USDA NRCS does not guarantee or warranty the products and control methods named, and other products may be equally effective.

Table 2. Herbicides for Controlling Invasive Roses – from Weed Control in Natural Areas in the Western United States (DiTomaso et al., 2013)

Chemical Name	Timing	Remarks
Aminopyralid (Milestone)	Postemergence after full leaf expansion, around flowering time. Also a preemergent.	Broadleaf-selective herbicide; will kill most plants in Sunflower or Legume families. Can be mixed with 2,4-D or Triclopyr.
Aminopyralid + metsulfuron (Opensight)	Spring leaf development through plant senesence in fall; optimum time is during flowering.	Broadleaf-selective herbicide; will kill most plants in Sunflower or Legume families.
Dicamba (Banvel, Clarity)	Postemergence foliar spot treatment. Optimum time is during flowering.	Add 0.5% v/v non-ionic surfactant. Will injure or kill other broadleaf species.
Glyphosate (Roundup, Accord XRT II, others)	Foliar and cut stem treatments most effective when leaves are expanded and flowers are in full bloom. Cut stem treatments should be applied immediately after cutting.	Add 0.5% v/v non-ionic surfactant. Can be mixed with dicamba for foilar applications. Will injure or kill all other plant species.
Hexazinone (Velpar L)	Preemergence in late winter through spring before bud break.	Mobile in the soil and has a long soil residual. Should not be used in areas with high water table.

Table 2 continued

Chemical Name	Timing	Remarks			
Imazapyr (Aresenal, Habitat, Stalker, Chopper, Polaris)	Postemergence foliar spot treatment in mid to late summer.	Requires special mixing and a hand applicator or applicator mounted on a spray boom. Use a low-volume application without runoff to reduce the non-target effects.			
Metsulfuron (Escort)	Postemergence foliar application when leaves are fully expanded.	Will injure or kill non-target broadleaf species. Available in premixes with aminopyralid (Opensight) or 2,4-D and dicamba (Cimarron Max).			
Picloram (Tordon 22K)	Postemergence to fully expanded leaves in spring through late summer.	Add 0.5% v/v non-ionic surfactant. Most effective when mixed with 2,4-D or fluroxypyr. Will injure or kill other broadleaf species.			
Tebuthiuron (Spike)	Preemergence anytime except when soil is frozen or saturated. Most effective time of application is just before active spring growth.	Applied as a pellet at the base of each plant. Has long soil residual and will prevent growth of all plant species. Rainfall is necessary to move herbicide into root zone.			
Triclopyr (Garlon 3A, Garlon 4 Ultra)	Postemergence spot treatment. Can be applied to foilage when leaves are fully expanded, to bark when plants become dormant after fall frost, or to cut stems in the fall.	Add 0.5% v/v non-ionic surfactant for foilar application. Can be mixed with fluroxypyr or aminopyralid. Will injure or kill other broadleaf species. Application during fall dormant period will minimize non-target effects.			
v/v = volume of procuct per total spray volume					

Pests of Invasive Roses

Numerous galls are often found on dog and sweetbriar rose stems. The galls are caused by a gall-forming wasp (*Diplolepis rosae*) which, like the plant, is a European species (Looney, 2012). The galls do not cause any harm, and are hosts for parasitoid wasps. The plant is also susceptible to fungal diseases such as powdery mildew (*Sphaerotheca pannosa* var. *rosae*) and downy mildew (*Perenospora sparsa*). Neither of these diseases severely limits the plants' ability to reproduce.



Gall caused by the gall-forming wasp *Diplolepis* rosae. Pamela Pavek, NRCS

Cultivars, Improved, and Selected Materials

Dog rose and sweetbriar rose are sold by many garden nurseries. However, **they should not be planted in the Inland Northwest** due to their aggressive nature. Native rose species are available as alternatives that have similar aesthetic attributes and pose no threat to surrounding plant communities.



Comparison of stems and thorns of (left to right) Nootka rose, Woods' rose, and sweetbriar rose. A branch of the sweetbriar rose stem has a *Diplolepis rosae* gall [red mass]. Pamela Pavek, NRCS

INVASIVE ROSE SPECIES DESCRIPTIONS

DOG ROSE

Rosa canina L.

Plant Symbol = ROCA3



Rosa canina. Robert Videki, Bugwood.org

Dog rose flowers. Robert Videki, Bugwood.org

Distribution

Dog rose is found on the east coast of North America, from Quebec to North Carolina and west to Kansas. It is also found on the west coast, from British Columbia to California and east to Utah.

Description

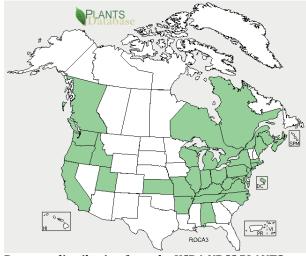
Rose family (Rosaceae). Dog rose is a shrub introduced from Eurasia. It grows up to 9 feet tall and has multiple arching stems. Stems are covered with thorns that are stout, flattened, downward-curving and unequal in size. Leaves are alternate and pinnately divided into 5 to 7 leaflets with serrated margins. Both sides of the leaves are glandless and smooth. Flowers are solitary or in small clusters at the ends of branches and bloom in June to July. Flowers have five white to pink petals 0.8 to 1 inch long, five sepals, usually 10 or more pistils, and multiple stamens. Sepals are glandless, often have slender lateral lobes, curve backward at the time of anthesis and are deciduous. The fruit is an elliptic to pear-shaped hypanthium (hip). Fruits ripen in September to October, are smooth, bright red and 0.6 to 0.8 inches long. Fruits persist on the plant for several months and become black. Plants reproduce sexually by seed, and vegetatively by suckering and layering. (Hitchcock and Cronquist 1973; Young and Young, 1992; Burke Museum of Natural History and Culture 2012).

The genus name *Rosa* is an ancient Latin name for rose (St. John, 1963; Hitchcock and Cronquist, 1973). The plant's species name *canina* is attributed to a belief that the root could cure the bite of a mad dog (Haas, 1995).

Habitat: *Rosa canina* grows along roadsides, in pastures, Conservation Reserve Program fields, and natural areas.

Adaptation

Rosa canina is adapted to a variety of soil types in areas with more than 16 inches annual precipitation at low elevations.



Dog rose distribution from the USDA NRCS PLANTS Database



Dog rose thorns. Richard Old, XIDservices.com

SWEETBRIAR ROSE

Rosa rubiginosa L. Plant Symbol = RORU82



Rosa rubiginosa. Richard Old, XIDservices.com



Rosa rubiginosa flowers. Richard Old, XIDservices.com

Alternate Scientific Names

Rosa rubiginosa L. was previously known as Rosa eglanteria L.

Distribution

Sweetbriar rose may have been one of the first ornamental plant species brought to North America by European colonists (Mack, 2003). It may also have been brought for a utilitarian purpose, to be grown as a hedge row. The botanist Josselyn documented the plant's presence in New England in the late 1600s (Mack 2003). Sweetbriar rose now grows in most states and provinces throughout the U.S. and Canada.

Description

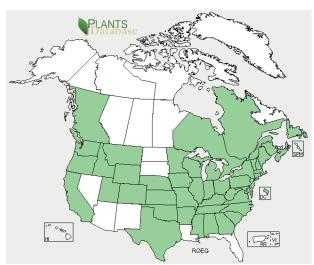
Rose family (Rosaceae). Sweetbriar rose is a shrub introduced from Europe. It grows up to 10 feet tall and has multiple arching stems. Stems have thorns that are stout, flattened, downward-curving and unequal in size. Leaves are alternate and pinnately divided into 5 to 7 leaflets with doubly serrated margins and gland-tipped teeth. The undersides of leaves have hairs and stalked glands that impart a sweet aroma when crushed. Flowers are solitary or in small clusters at the ends of branches and bloom in June to July. Flowers have five pale to dark pink petals 0.6 to 0.8 inches long, five sepals, usually 10 or more pistils, and multiple stamens. Sepals have slender lateral lobes and stalked glands, curve backward at the time of anthesis and are deciduous. The fruit is an elliptic to pear-shaped hypanthium (hip). Fruits ripen in September to October, are smooth, bright red, 0.4 to 0.6 inches long, and persist on the plant after ripening. Plants reproduce sexually by seed and vegetatively by layering and suckering (Hitchcock and Cronquist 1973; Young and Young, 1992; Burke Museum of Natural History and Culture 2012).

The genus name *Rosa* is an ancient Latin name for rose (St. John, 1963; Hitchcock and Cronquist, 1973). The species name *rubiginosa* is a Latin word meaning rusty.

Habitat: This plant is found along roadsides, in pastures, Conservation Reserve Program fields, and natural areas.

Adaptation

Sweetbriar rose is adapted to all soil types with moderate fertility, and can tolerate moderate saline conditions (USDA NRCS, 2013). It requires 18 to 45 inches of annual precipitation. It is not shade tolerant (USDA NRCS, 2013).



Sweetbriar rose distribution from the USDA NRCS PLANTS Database.



Fruit (rose hips) of *Rosa rubiginosa*. Pamela Pavek, NRCS

This WEED REPORT does not constitute a formal recommendation. When using herbicides always read the label, and when in doubt consult your farm advisor or county agent.

This WEED REPORT is an excerpt from the book Weed Control in Natural Areas in the Western United States and is available wholesale through the UC Weed Research & Information Center (wric.ucdavis.edu) or retail through the Western Society of Weed Science (wsweedscience.org) or the California Invasive Species Council (cal-ipc.org).

Hedera helix L.; English ivy
Hedera canariensis Willd.; Algerian ivy
(= H. helix L. ssp. canariensis (Willd.) Cout.)
Hedera hibernica (G. Kirchn.) Bean; Irish or Atlantic ivy

English, Algerian and Atlantic ivy

Family: Araliaceae

Range: Many western states, including Washington, Oregon,

California, Idaho, Arizona, and Utah.

Habitat: Riparian corridors, moist woodlands, forest margins, coastal habitats, and disturbed sites such as cleared forests, urban waste places, and old homesteads. Requires some moisture year-round. Tolerates deep shade, but thrives where plants receive some summer shade and direct winter sun.

Origin: Native to Europe and introduced to the United States as an ornamental. English ivy is still a common landscape ornamental of which there are numerous cultivars.

Impacts: Under favorable conditions, plants spread invasively and can develop a dense cover that outcompetes other vegetation in natural areas. Infestations around old homesteads have been present for many years and serve as nursery sites for further spread. It has escaped from cultivation in many places, especially near the coast and along riparian corridors. English ivy grows over the natural vegetation in an area, including trees, and eventually kills most resident plants by shading them out with its dense canopy of foliage. It thrives in deciduous trees, which allow plants to receive more light and to continue upward growth during winter months. Trees covered with ivy are more susceptible to wind damage from the extra weight. English ivy berries and leaves can be toxic to humans and cattle when ingested in quantity, and the sap can cause contact dermatitis in sensitive individuals, which includes about 10% of the population.

Western states listed as Noxious Weed: H. helix, Oregon, Washington; H. canariensis and H. hibernica, Washington

California Invasive Plant Council (Cal-IPC) Inventory: High Invasiveness

English ivy and other closely related *Hedera* species are fast growing, perennial, evergreen vines that vigorously climb other vegetation and on structures. Plants have two growth forms. The juvenile form has viny stems to about 12 inches long with leaves that are usually three-lobed. The adult reproductive form has erect shrubby stems with ovate to diamond-shaped leaves. Juvenile stems are vine-like, growing both on the ground and vertically into canopies. Juvenile stems develop adventitious roots along the ground and aerial root-like structures that enable stems to cling to objects such as trees and buildings. Juvenile leaves are palmately three to five lobed and vary in size, up to 12 inches long. Adult reproductive stems are erect, shrubby, lack aerial roots, and are non-climbing. Adult leaves are ovate to diamond-shaped and up to 6 inches long. Leaves of both forms have smooth upper surfaces, often slightly glossy, and usually dark green. Leaf stalks and lower leaf surfaces are sometimes glabrous but usually covered with grayish star-shaped hairs.

Unlike most plants in the region that flower in spring or summer, ivy flowers in fall. The shrubby adult form develops flowers in racemes or panicles of simple umbels. The juvenile stage may last for 10 years or more before reproducing by seed. Fruits are berrylike, dark blue to black, about 4 to 8 mm wide. Fruits mature in spring with an individual plant producing tens of thousands of fruit each year. Fruits are consumed and dispersed primarily by birds. English ivy also reproduces vegetatively from juvenile stems. Stem fragments of juvenile and adult plants left in contact with moist soil can regenerate into a new plant. Plants can live 100 years or more.

NON-CHEMICAL CONTROL

Mechanical (pulling, cutting, disking) When the plant carpets the forest floor, individual stems can be readily pulled off the ground; however, it is essential to remove all runners. If off-site removal is not possible, all plant parts must be placed off the ground in such a way that they can dry out. Repeated removal efforts over multiple years may allow desirable vegetation to colonize the area. Because ivy can resprout and establish from stem fragments, mowing or cutting is not recommended. Small or young ivy plants can be pulled off supporting structures or trees, and roots dug out. The roots of young plants can be easily dug out, particularly when the soil is moist, from the ground around the base of infested trees. Older individuals generally do not resprout. Gloves should be worn as many people are sensitive to the dermatitis-causing agents in the plant.

Cutting ivy off before it flowers will reduce seed production and deplete the plant's energy reserves.

Resprouts are common after treatment. Cutting should be combined with an herbicide treatment or with multiple cuttings over a period of years. Cut ivy at ground level with power or manual saws, and then pry the vines from the tree or structure. Once the vines are cut they will eventually die and fall from the tree, usually after the first extended hot and dry period. Occasionally vines will be embedded in the trunk of the tree, which makes control by both hand and chemicals very difficult.

Cultural

Grazing and burning are not considered effective control options. The leaves and fruit can be toxic to livestock. Deer have been shown to feed on ivy in its native range.

Although prescribed burning is not an effective control option, the use of a blowtorch can be successful. To be successful, plants and resprouts must be repeatedly burned until the plant's resources are exhausted.

Biological

Because *Hedera* species are still widely used as ground covers and ornamentals, there is no biological control program established for their management.

CHEMICAL CONTROL

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

GROWTH REGULATORS

Picloram

Tordon 22K

Rate: Broadcast foliar treatment: 3 to 4 pt product/acre (0.75 to 1 lb a.e./acre) plus 0.25 to 0.5% v/v surfactant to thoroughly wet all leaves

Timing: Postemergence foliar treatments are best when plants are growing rapidly at or beyond early to full bloom stage.

Remarks: High levels of picloram can give long-term soil activity for broadleaves. Picloram has proved successful in Australia. Picloram is a restricted use herbicide. It is not registered for use in California. Do not apply near trees, or damage may occur through root uptake.

Triclopyr

Garlon 3A, Garlon 4 Ultra, Pathfinder II Rate: Spot treatment: 2 to 5% v/v solution of *Garlon 4 Ultra* and water plus 0.25 to 0.5% v/v surfactant to thoroughly wet all leaves. Low volume/thinline treatment: 10% v/v solution of *Garlon 4 Ultra* plus a 20% v/v basal oil concentrate in water. Basal cut stump treatment: 20% v/v *Garlon 4 Ultra* in water. Cut stump treatment: undiluted *Garlon 3A* or 33% *Garlon 3A* in water. Stem injection treatment: drill and fill the stem of large mature plants that are climbing up other trees with 100% *Garlon 3A* or 4 *Ultra*. Basal bark treatment: 20% v/v *Garlon 4 Ultra* in 20% v/v basal oil and water, or *Pathfinder II* as a ready-to-use formulation.

Timing: Postemergence when plants are growing rapidly. Cut stump and basal bark treatments can be applied anytime as long as the ground is not frozen.

Remarks: Triclopyr is a selective herbicide for broadleaf species. In areas where desirable grasses are growing under or around ivy, triclopyr can be used without non-target damage. For cut stump treatments, cut stems horizontally at or near ground level. Apply herbicide solution immediately after the stump is cut. Suckering from the roots typically occurs after cutting, but the treatment should control most resprouts. Basal bark treatment: spray the lower trunk, including the root collar, to a height of 12 to 15 inches from the ground; the spray should thoroughly wet the lower stem but not to the point of runoff. When making bark treatments, be careful not to get the spray solution on the bark of desirable trees. Plants should not be cut for at least one month after basal bark treatments. Spraying triclopyr immediately after the removal of most leaves and young shoots with a string trimmer has also proved successful.

AROMATIC AMINO ACID INHIBITORS

Glyphosate Roundup, Accord XRT II, and others Rate: Spot treatment: 2 to 4% v/v solution of Roundup ProMax (or other trade name with similar concentration of glyphosate) in water to thoroughly wet all leaves. Low volume/thinline treatment: 10% v/v solution of Roundup (or other trade name) in water. Cut stump treatment: 25% v/v Roundup (or other trade name) in water.

Timing: Postemergence when plants are growing rapidly. Foliar treatments should be made in late summer or early fall. For cut stump treatment, application in late summer, early fall or dormant season provides best control. Treatment should occur immediately after cutting.

Remarks: Glyphosate is a nonselective systemic herbicide with no soil activity. It gives good control with some resprouts. Plants should not be cut for at least 4 months after foliar treatments. Cut stump applications are made as described for triclopyr. Glyphosate has also proved successful in Australia.

BRANCHED-CHAIN AMINO ACID INHIBITORS

Imazapyr Arsenal, Habitat, Stalker, Chopper, Polaris Rate: Spot treatment: 1 to 2% v/v solution of Stalker plus 0.25 to 0.5% surfactant v/v in water to thoroughly wet all leaves. Low volume/thinline treatment: 10% v/v solution of Stalker plus a 20% v/v ethylated crop oil in water. Cut stump treatment: 20% v/v solution of Stalker plus a 20% v/v ethylated crop oil in water or 20% Habitat v/v in 80% water carrier. Basal bark treatment: 20% v/v solution of Stalker plus a 20% v/v ethylated crop oil in water.

Timing: Postemergence when plants are growing rapidly. Best when used in late summer to early fall.

Remarks: Imazapyr is a soil residual herbicide and may result in bare ground around plants for some time after treatment. Cut stump and basal bark applications are made as described for triclopyr. Plants should not be cut for at least 4 months after basal bark treatment. Another ALS inhibitor, metsulfuron, has proved successful in Australia.

RECOMMENDED CITATION: DiTomaso, J.M., G.B. Kyser et al. 2013. Weed Control in Natural Areas in the Western United States. Weed Research and Information Center, University of California. 544 pp.

This WEED REPORT does not constitute a formal recommendation. When using herbicides always read the label, and when in doubt consult your farm advisor or county agent.

This WEED REPORT is an excerpt from the book Weed Control in Natural Areas in the Western United States and is available wholesale through the UC Weed Research & Information Center (wric.ucdavis.edu) or retail through the Western Society of Weed Science (wsweedscience.org) or the California Invasive Species Council (cal-ipc.org).

Conium maculatum L.

Poison-hemlock

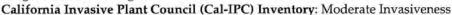
Family: Apiaceae

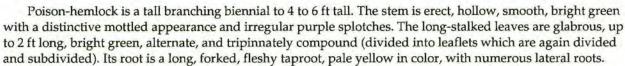
Range: Throughout the contiguous U.S., including every western state. Habitat: Moist soil along hedgerows, along the banks of streams and rivers, roadsides and wastelands, woodlands, meadows, and pastures.

Origin: Native to Europe.

Impact: Produces piperidine alkaloids which are highly toxic to humans and animals. Domestic animals such as swine, cattle, goats, horses, and sheep can be poisoned by the toxin coniine after ingesting any portion of the plant. Poison-hemlock is the most toxic to cattle. Symptoms can include vomiting, nausea, trembling, rapid respiration, joint and movement problems, slow, weak and rapid pulse, increased salivation and urination, convulsions, paralysis, coma, and death from respiratory paralysis. Ingestion during fetal development can result in severe birth defects.

States listed as Noxious Weed: Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, Washington





The inflorescence is a compound umbel with 12 to 16 rays, and numerous small white flowers located at the terminal positions. Each flower produces two gray-brown seeds with five wavy longitudinal ridges. The seeds have the highest concentration of coniine. Poison hemlock smells like mouse urine when crushed, a characteristic of the poisonous alkaloids. Plants reproduce only by seed. Most seeds fall near the parent plant. Seed dispersal is prolonged and occurs from late summer through winter. Most seeds germinate almost immediately if conditions are favorable, but a small proportion remains dormant. Dormant seeds require a period of high summer and/or low winter temperatures before they can germinate. Seeds survive up to about 3 years under field conditions.

NON-CHEMICAL CONTROL

Mechanical (mowing, plowing,	Hand removal is recommended for small infestations. When pulling the plants, dig down and remove the entire taproot. Wear gloves and wash hands after working with poison-hemlock. Manual control
and cultivation)	efforts can be successful, but can cause soil disturbance encouraging further germination of seeds. Solid carpets of hemlock seedlings are not uncommon following soil disturbance. Cutting is ineffective; the plants send up new seed stalks in the same season the cutting occurs. Establishment of populations can be prevented with repeated cultivation and plowing.
Cultural	Due to the plant's toxicity, grazing is not recommended for control. Even dried plant parts are not safe as the toxins take several years to dissipate. Use certified weed-free hay to prevent the poisoning of livestock.
Biological	Do not burn, as toxins can be released into the air through the smoke. There are no known biological controls. Since its introduction to North America, only a few native
Biological	insects have been able to overcome its toxic defenses. These attack the seedhead, but do very little damage to the rest of the plant.

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CHEMICAL CONTROL

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

GROWTH REGULATORS	
2,4-D Several names	Rate: 1 to 4 pt product/acre (0.48 to 1.9 lb a.e./acre) Timing: Postemergence in seedling to rosette stage. Remarks: Broadleaf-selective, most effective when applied soon after plants emerge. Adding a wetting agent may enhance control. Also effective tank mixed with dicamba.
Aminocyclopyrachlor + chlorsulfuron Perspective	Rate: 4.75 to 8 oz product/acre Timing: Postemergence in seedling to rosette stage. Remarks: Broad-spectrum control of many broadleaf species. Although generally safe to grasses, it may suppress or injure certain annual and perennial grass species. Do not treat in the root zone of desirable trees and shrubs. Do not apply more than 11 oz product/acre per year. At this high rate, cool-season grasses will be damaged, including bluebunch wheatgrass. Not yet labeled for grazing lands. Add an adjuvant to the spray solution. This product is not approved for use in California and some counties of Colorado (San Luis Valley).
Aminopyralid + metsulfuron Opensight	Rate: 2.5 to 3.3 oz product/acre Timing: Preemergence in fall, or postemergence in the seedling to rosette stage. Remarks: Not registered for use in California.
Triclopyr Garlon 4 Ultra, Remedy Ultra	Rate: 5 to 8 pt product/acre (2.5 to 4 lb a.e./acre) Timing: Postemergence in seedling to rosette stage. Remarks: Broadleaf-selective, safe on most grasses. Most effective on smaller plants. Garlon 4 Ultra and Remedy Ultra are low volatile esters. However, in warm temperatures, spraying onto hard surfaces such as rocks or pavement can increase the risk of volatilization and off-target damage. Also effective in a premix with 2,4-D (Crossbow) or tank mixed with clopyralid (Transline).
AROMATIC AMINO ACID	
Glyphosate Roundup, Accord XRT II, and others	Rate: Broadcast treatment: 1.33 to 2.67 qt product (Roundup ProMax)/acre (1.5 to 3 lb a.e./acre). Spot treatment: 1 to 1.5% v/v solution Timing: Best when applied postemergence to rapidly growing plants before bolting. However, higher rates can control plants at the bud to full bloom stage. Remarks: Glyphosate is a nonselective herbicide that has no soil activity. Add a non-ionic surfactant.
BRANCHED-CHAIN AMING	11.000,000,000
Chlorsulfuron Telar	Rate: 1 to 2.6 oz product/acre (0.75 to 1.95 oz a.i./acre) Timing: Postemergence to rapidly growing plants. Remarks: Desirable grasses should be well established before application.
Imazapic <i>Plateau</i>	Rate: 8 to 12 oz product/acre (2 to 3 oz a.e./acre) Timing: Preemergence. Remarks: Mixed selectivity, favors members of the Asteraceae and some grasses. Some soil residual activity. In postemergence applications, use methylated seed oil at 1.5 to 2 pt/acre. Not registered for use in California.
Imazapyr Arsenal AC, Habitat, Stalker, Chopper, Polaris	Rate: 2 pt product (Arsenal AC)/acre (1 lb a.e./acre); 4 pt product (Habitat)/acre (1 lb a.e./acre) + 1 qt/acre methylated seed oil Timing: Preemergence or early postemergence in the rosette stage. Remarks: Nonselective. Long soil residual, leaves more bare ground than other treatments, even a year after application. Do not apply more than 3 qt product/acre. Habitat is an aquatic registered formulation for use close to water.
Metsulfuron Escort	Rate: 1 oz product/acre (0.6 oz a.i./acre) Timing: Postemergence to rapidly growing plants. Remarks: Use a non-ionic surfactant or silicone surfactant. Prevent drift to sensitive plants. Apply only to pastures, rangeland, and non-crop sites. Metsulfuron can also be used in a premix with dicamba + 2,4-D (Cimarron Max). Metsulfuron and its formulations are not registered in California.

RECOMMENDED CITATION: DiTomaso, J.M., G.B. Kyser et al. 2013. Weed Control in Natural Areas in the Western United States. Weed Research and Information Center, University of California. 544 pp.

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Prunus cerasifera

Cherry plum

Family: Rosaceae (rose)

NON-CHEMICAL CONTROL

Cultural: grazing	NIA	
Cultural: prescribed burning	P	will resprout
Mechanical: hand removal, weed wrench, cutting	G	small plants can be hand pulled, young plants pulled with a weed wrench, adult plants will resprout
Mechanical: heavy equipment removal	G	bulldozer can uproot plants

CHEMICAL CONTROL

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use.

2,4-D	G-E*	FOL mixed with picloram; BB with ester, Su; CS or INJ, Su
Glyphosate	E*	FOL, Fa
Hexazinone	E*	
Imazapyr	E	FOL
Picloram	G-E*	FOL mixed with 2,4-D
Tebuthiuron	E*	may need high labeled rate
Triclopyr	E	FOL, CS, INJ, BB, Fa

Control includes effects within the season of treatment. E = Excellent control, generally better than 95% Control is followed by best timing, if known, when efficacy is **E** or **G**. G = Good control, 80-95% = Likely based on results of observations of related species = Fair control, 50-80% = Poor control, below 50% Possible application methods FLW = flowering BB = basal bark NIA = No information available CS = cut stump Fa = Fall FOL = foliar = Spring Sp INJ = stem injection = Summer

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Rubus armeniacus Focke

Himalaya blackberry

Family: Rosaceae

Range: Common throughout the western United States, except in Wyoming, North and South Dakota.

Habitat: Disturbed, open, moist sites such as canals, ditch banks, fencerows, roadsides, open fields, and riparian zones, in a variety of plant communities. It can also tolerate periodic flooding with brackish water.

Origin: A cultivar introduced from Eurasia, originating from Armenia, quickly spread throughout Europe and the rest of the world.

Impact: Himalaya blackberry is a highly competitive plant with a growth form that allows it to quickly crowd out native species. Its thickets have dense canopies allowing little light penetration and reducing the growth of understory plants. In riparian areas it can prevent access to water sources for livestock and wildlife.

Western states listed as Noxious Weed: California, Oregon

California Invasive Plant Council (Cal-IPC) Inventory: High



Himalaya blackberry is an evergreen erect shrub that grows up to 10 ft tall and is climbing, mounded, or trailing. The aboveground canes are usually biennial while the roots are perennial. The roots are found in the top 20 inches of the soil but may grow down to a depth of 7 ft in loose soil. The roots can sprout new shoots from root buds, and in good conditions root fragments may sprout a new plant. The stems are green to purplish-red, woody, strongly angled, and are protected against predation by straight or curved pickles with a thick base. The leaves are pinnately compound with 3 to 5 leaflets that are dark green with a white underside covered with dense short hairs. The leaflets are broadest above the middle, toothed and sometimes shallowly lobed.

The flowers of Himalaya blackberry are white to pinkish and numerous in non-glandular panicles. They are self-fertile with 5 petals, and numerous stamens and pistils. The fruit are edible and an aggregate of drupelets that adhere to a fleshy receptacle. The mature berries are ovoid to oblong, black, 0.75 inch long, glossy, and glabrous or slightly pubescent. They typically ripen later in the season than the native berries. Seeds are dispersed primarily by birds. In addition to seeds, plants reproduce by root sprouts and stem tip rooting. Seeds likely only survive a few years in the soil.

NON-CHEMICAL CONTROL

Mechanical (pulling, cutting, disking)

Invasiveness

Hand pulling can be an effective control method for small populations. To successfully control populations with mechanical removal, it is important to remove the canes, roots and the root crowns to prevent resprouting. A Pulaski, mattock or similar device can be used to remove plants. Bulldozing may cause resprouting and can spread the weed by fragmenting roots and stems.

Cutting and removing only the aboveground biomass will result in the stimulated growth of root sprouts. The root sprouts must be controlled and repeated cutting of the above-ground biomass during flowering time will exhaust the root stores.

Tillage can be effective if the canes are raked and removed from the site. However, this will cause significant soil disturbance and is unsuitable in riparian areas.

Cultural

Goats will readily consume Himalaya blackberry and could help to control new populations. It is a common

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method of management in Australia and New Zealand. Their consumption is indiscriminate and could result in the loss of other desirable species. This is particularly true in riparian areas.

Burning is only effective if the root sprouts are controlled by other methods, such as chemicals, when they resprout after the burn.

Biological

Blackberry leaf rust fungus (*Phragmidium violaceum*) was discovered in 2005 on the coast of Oregon and has since spread through most of the counties. It appears to have been accidentally introduced. It partially to fully defoliates Himalaya blackberry and evergreen blackberry (*Rubus laciniatus*) and also reduces tip rooting. The fungus is native to Europe, the Middle East and Africa and has been used for years to control native blackberry plants in Australia and New Zealand. It is not an approved biocontrol agent yet and has not shown sustained control of Himalaya blackberry over a wide region.

CHEMICAL CONTROL

The following specific use information is based on reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference. Excellent control information, both chemical and non-chemical, can be obtained

at http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7434.html#MANAGEMENT and http://extension.oregonstate.edu/catalog/pdf/em/em8894.pdf.

GROWTH REGULATORS

Dicamba Rate: 1 to 2 pt product/acre (0.5 to 1 lb a.e./acre)

Banvel, Clarity Timing: Postemergence, to weed regrowth in the late summer or fall following a mowing or tillage

treatment.

Remarks: Dicamba provides only suppression of growth. It is a broadleaf-selective herbicide often combined with other active ingredients, particularly 2,4-D. Tank mix combinations with glyphosate are also more effective. It may injure grasses at higher rates. Do not apply when outside temperatures exceed 80°F. Do not exceed 64 oz product/acre per year.

Fluroxypyr Rate: 22 oz product/acre (7.7 oz a.e./acre)

Vista XRT Timing: Postemergence when target plants are growing rapidly.

Remarks: Reduced control occurs if plants are under stressed growth conditions.

Triclopyr Garlon 3A, Garlon 4 Ultra, Pathfinder Rate: Broadcast foliar treatment: 4 pt product (*Garlon 4 Ultra*)/acre (2 lb a.e./acre). Spot treatment: 0.75 to 1% *Garlon 4 Ultra* or 1% *Garlon 3A*; thoroughly cover the foliage. Basal bark treatment: 20% *Garlon 4 Ultra* mixed with basal oil or seed oil; *Pathfinder II* is a ready-to-use triclopyr/oil mix. Dormant stem and leaf treatment: 1% v/v solution of *Garlon 4 Ultra* with 2 to 3% v/v crop oil concentrate or seed oil. For *Capstone* use 8 to 9 pt product/acre.

Aminopyralid + triclopyr (Capstone) Timing: Postemergence in mid-summer or early fall after flowering and start of fruit set. Basal bark applications can be made almost any time of the year, even after leaves have senesced (aged, dried, and fallen from plant). In areas where people frequently harvest the fruit of wild blackberries, a mid-fall basal bark treatment might be desirable to avoid human contact with the chemical. For dormant stem and leaf treatment apply to dormant leaves and stems in late fall and winter in a 3% crop oil concentrate mixture. Spray the plant until it is thoroughly wet but not to the point of runoff. Like basal bark treatments, the timing of this technique prevents human contact with the herbicide during berry-picking season.

Remarks: Foliage or stems (dormant stem application) must be thoroughly wet. Triclopyr is broadleaf-selective and safe on most grasses. It is most effective on smaller plants and has little or no residual activity. For basal bark treatment, thoroughly cover a 12 to 15-in basal section of the stem with spray but not to the point of runoff. *Garlon 3A* and other amine formulations are registered for aquatic use. Ester formulations (e.g., *Garlon 4 Ultra*) may volatilize if applied in warm temperatures. Application in some counties and grape-growing areas may be restricted. Sometimes aminopyralid + triclopyr (*Capstone*) or glyphosate and triclopyr (1% solution each) are used to achieve better control.

AROMATIC AMINO ACID INHIBITORS

Glyphosate

Roundup, Accord

XRT II, and others

Rate: Broadcast foliar treatment: 2 to 3 qt product (Roundup ProMax)/acre (2.25 to 3.4 lb a.e./acre). Spot treatment: 0.5 to 1.5% v/v solution.

Timing: Postemergence in late summer to early fall when canes are growing rapidly, have reached full

leaf maturity, and after berries are formed. Fall treatments must be made before a killing frost.

Remarks: Fall treatment symptoms may not show before frost. Retreatment may be necessary for complete control. Trailing blackberry is more difficult to control. Glyphosate controls grasses in the treated area as well as other vegetation. To obtain good control complete foliage coverage (spray-to-wet) is essential. Burning or mowing 40 to 60 days after spraying with glyphosate increases the level of control and also contributes to pasture establishment by removing stem debris. Shoots recovering from sublethal glyphosate treatment tend to die more quickly when subjected to heavy grazing. Sometimes glyphosate and triclopyr (1% each in solution) are used in combination to achieve better control.

BRANCHED-CHAIN AMINO ACID INHIBITORS

Metsulfuron

Rate: 0.5 to 1 oz product/acre (0.3 to 0.6 oz a.i./acre)

Escort

Timing: Postemergence, to fully leafed-out vegetation before fall leaf coloration.

Remarks: Metsulfuron is primarily active on broadleaf species. Apply only to pasture, rangeland, and noncrop sites. Do not apply when plants are under stressed growing conditions. Metsulfuron can be used in a premix with aminopyralid (*Opensight*) or a tank mix with triclopyr for better control. Metsulfuron and its formulations are not registered for use in California.

Sulfometuron

Rate: 3 to 4 oz product/acre (2.25 to 3 oz a.i./acre)

Oust and others

Timing: Early postemergence when target plants are germinating or actively growing. Will only be effective on very small plants and not on fully mature plants.

Remarks: Add a surfactant at 0.25% v/v for improved control.

PHOTOSYNTHETIC INHIBITORS

Hexazinone Velpar L Rate: 3 to 4 gal product/acre (6 to 8 lb a.i./acre)

Timing: Preemergence or postemergence when plants are germinating or actively growing.

Remarks: Hexazinone is used as a nonselective herbicide in non-cropland areas and as a selective herbicide in reforestation practices. It only suppresses the growth of Himalaya blackberry. Use higher rates on fine textured soils and soils with high organic matter. Do not apply to frozen ground. Non-target plants may be adversely affected from drift and run-off. Apply when there is adequate moisture for activation. Hexazinone can be mixed with triclopyr for better control. High rates of hexazinone can create bare ground, so only use high rates in spot treatments.

Tebuthiuron Spike Rate: 20 lb product (Spike 20P)/acre (4 lb a.i./acre)

Timing: Preemergence before the start of spring growth or before expected seasonal rainfall.

Remarks: Do not apply tebuthiuron at more than 20 lb/acre. Do not apply more than 10 lb/acre in areas that receive 20 inches or less of annual rainfall. May injure non-target species. Follow restrictions on the label for use around desirable plants.

ECOMMENDED CITATION: DiTomaso, J.M., G.B. Kyser et al. 2013. Weed Control in Natural Areas in the Western United States. Weed Research and Information Center, University of California. 544 pp.



Attachment 4

CEQA Documentation for SRGO PEIR Coverage

State Water Resources Control Board - Statewide Restoration General Order California Environmental Quality Act - Programmatic Environmental Impact Report Consistency Determination - Powers Creek Restoration Project

To:	Blue Lake Planning Commission
From:	Garry Rees, City Planner
Project Title: Project Subtitle: Project Applicant:	Powers Creek Restoration Project Not applicable Baduwa't Watershed Council (Dave Feral)
Project Location:	The project is located in the Mad River watershed in Humboldt County along a tributary to the Mad River (Powers Creek), The project is located along 3,515 linear feet of lower Powers Creek from just upstream of the bridge above the confluence with the Mad River to the culvert at South Railroad Avenue near the City's Downtown. The approximate mid-point along the restoration reach is Latitude 40.880184 and Longitude 123.995808. The project would occur on 12 properties, 6 of which are owned by the City of Blue Lake (APNs 025-076-003, 025-077-005, 025-141-001, 025-161-015, 025-171-001, and 025-201-001) and 5 of which are under private ownership (025-076-008, 025-077-007, 025-141-007, 312-161-020, 312-161-022). The project location can be viewed on the "Blue Lake Quadrangle" (USGS 7.5-minute Quad).
Project Description:	Powers Creek is an ungauged, intermittent tributary of the Mad River, which is consistently dry summer through fall. The Powers Creek tributary flows south from its watershed into the floodplains of the Mad River, and meanders west, through the City of Blue Lake to its confluence with the Mad River. The Powers Creek sub-basin is approximately 3.3 square miles. The Powers Creek channel was historically realigned to accommodate the construction of the McIntosh Mill log pond in the 1940s. Review of historical photos indicate that the channel was straightened and lengthened, discharging into the Mad River, Powers Creek currently supports ad isturbance-related vegetation community that likely originated in historical large-scale disturbance of the stream channel and surrounding vegetation, such as the realignment and channelization of Powers Creek in the 1940s. This has resulted in a species poor, low growing willow dominated canopy, primarily arroy willow, with a significant invasive species component, specifically Himalayan blackberry. Scattered black cottomwood, confiers, and red alder occur infrequently along the streams reach. The current riparian vegetation has choked the stream channel, making it impassible to most wildlife species, and resulting in serious aggradation of sediment, which has over time reduced channel capacity and has made the stream less suitable for salmonid species and more prone to flooding. The Powers Creek Restoration Project proposes restoring approximately 3,515 linear feet of lower Powers Creek from just upstream of the bridge above the confluence with the Mad River to the culvert at South Railroad Avenue near the City's Downtown. The grading limits for the restoration reach would be approximately 5,15 acres and there would also be approximately 1.46 acres of additional revegetation are unstabled of the grading limits (total of ~7.61 acres). Project implementation is anticipated to occur in 2 to 3 phases depending on the availability of implementation funding. The goals of the projec
	This restoration project is within the scope of the CEQA Programmatic EIR for the State Water Resources Control Board Statewide Restoration General Order (SRGO PEIR). All impacts are covered by the PEIR; no supplemental EIR is needed. https://www.waterboards.ca.gov/water issues/programs/cwa401/generalorders/2022/srgo-final-peir-combined.pdf
Signature (Lead Agency):	Derry Roch
Name; Title:	Garry Rees, City Planner
Date:	16-May-25

Use PEIR documents listed: https://www.waterboards.ca.gov/water_issues/programs/cwa401/generalorders.html				
Issue areas	List all Impact Statements and #s from the PEIR applicable to Proposed Restoration Activities	List all PEIR Mitigation Measures required for LTS Determination to be Implemented	Are there any Significant Unmitigated Impacts from the Proposed Activities? (No / Yes)	If Yes, list additional Mitigation Measures required for LTS Determination
3.2 Aesthetics	Not applicable	Not applicable	Not applicable	Not applicable
5.2 Acothetics	пот аррисавіе	тот аррисавіе	ног аррпсавіе	пос аррисавіе
3.3 Ag and Forestry Res.	Not applicable	Not applicable	Not applicable	Not applicable
3.4 Air Quality and GHGs	3.4-1: Implementing future restoration projects permitted under the Order could conflict with an applicable air quality plan.	Mitigation Measure AIR-1: Minimize Conflicts with Applicable Air Quality Plans.	No	Not applicable
3.5 Biological Res. Terrestrial	3.5-1: Implementing restoration projects permitted under the Order could adversely affect habitat for special-status plant species.; 3.5-2: Implementing restoration projects permitted under the Order could result in adverse direct effects on special-status wildlife species.; 3.5-3: Implementing restoration projects permitted under the Order could result in adverse effects on riparian habitat or sensitive natural communities.; 3.5-4: Implementing restoration projects permitted under the Order could result in adverse effects on state and federally protected wetlands through direct removal, hydrological interruption, or other means.; 3.5-5: Implementing restoration projects permitted under the Order could interfere with the movement of native resident and migratory wildlife species.	Section 3.5.4, Impacts and Mitigation Measures, in Section 3.5, Biological Resources - Terrestrial, and Appendix F for applicable species protection measures.	No	Not applicable
3.6 Biological Res. Aquatic	3.6-1 : Implementing future restoration projects permitted under the Order could result in substantial adverse effects to special-status fish species directly, or indirectly through habitat modifications.; 3.6-2 : Implementing future restoration projects permitted under the Order could result in substantial adverse direct effects on the movement of native resident or migratory fish.	Section 3.6.4, Impacts and Mitigation Measures, in Section 3.6, Biological Resources - Aquatic, and Appendix F for applicable species protection measures.	No	Not applicable

3.7 Cultural Res.	3.7-1: Implementing future restoration projects permitted under the Order could cause a substantial adverse change in the significance of a historical resource pursuant to State CEQA Guidelines Section 15064.5.; 3.7-2: Implementing future restoration projects permitted under the Order could cause a substantial adverse change in the significance of an archaeological resource pursuant to State CEQA Guidelines Section 15064.5.; 3.7-3: Implementing future restoration projects permitted under the Order could disturb any human remains, including those interred outside of dedicated cemeteries.	Mitigation Measure CUL-1: Conduct Inventory and Significance Evaluation of Architectural Resources; Mitigation Measure CUL-2: Conduct Inventory and Significance Evaluation of Archaeological Resources; Mitigation Measure CUL-3: Implement Measures to Protect Archaeological Resources during Project Construction or Operation; Mitigation Measure CUL-4: Implement Measures to Protect Human Remains during Project Construction or Operation.	No	Not applicable
3.8 Energy Res.	Not applicable	Not applicable	Not applicable	Not applicable
3.9 Geology and soils	3.9-2: Implementing future restoration projects permitted under the Order could directly or indirectly result in adverse effects on people or structures related to risk of loss, injury, or death due to strong seismic ground shaking.; 3.9-3: Implementing future restoration projects permitted under the Order could directly or indirectly cause adverse effects on people or structures from unstable soil conditions.	Mitigation Measure GEO-3: Conduct Individual Restoration Project Geotechnical Investigation and Report; Mitigation Measure GEO-4: Adhere to International Building Code; Mitigation Measure GEO-6: Implement Measures for Waterway Construction Activities; Mitigation Measure GEO-7: Implement Measures for Levee Construction and Other Fill Embankment Designs.	No	Not applicable
3.10 Hazards and Haz materials	3.10-2: Ground-disturbing activities for construction of future restoration projects permitted under the Order could encounter previously unidentified contaminated soil and/or groundwater, potentially exposing construction workers, the public, and the environment to risks associated with hazardous materials.	Mitigation Measure HAZ-2: Notify Appropriate Federal, State, and Local Agencies if Contaminated Soils are Identified, and Complete Recommended Remediation Activities; Mitigation Measure HAZ-3: Notify Appropriate Federal, State, and Local Agencies if Accidental Discharges of Hazardous Materials.	No	Not applicable
3.11 Hydrology and Water Quality	3.11-1: Implementing restoration projects permitted under the Order could result in the release of pollutants into surface water and/or groundwater that could violate water quality standards or waste discharge requirements, substantially degrade water quality, or obstruct implementation of a water quality control plan.;	Section 3.11.4, Impacts and Mitigation Measures, in Section 3.11, Hydrology and Water Quality, and Appendix E for applicable general protection measures.	No	Not applicable
3.12 Land Use and Planning	Not applicable	Not applicable	Not applicable	Not applicable

3.13 Mineral Res.	Not applicable	Not applicable	Not applicable	Not applicable
3.14 Noise	3.14-1: Implementing future restoration projects permitted under the Order could result in a temporary or permanent increase in ambient noise levels in excess of standards established in applicable plans and ordinances.	Mitigation Measure NOISE-1: Minimize Noise Conflicts; Mitigation Measure NOISE-2: Minimize Operations and Maintenance Noise Conflicts.	No	Not applicable
3.15 Population and Housing	Not applicable	Not applicable	Not applicable	Not applicable
3.16 Recreation	3.16-1: Implementing future restoration projects permitted under the Order could directly impair, degrade, or eliminate recreational resources, facilities and opportunities.; 3.16-2: Future restoration projects permitted under the Order could alter recreational resources or facilities or require the construction or expansion of recreational facilities that could result in environmental impacts.	Mitigation Measure REC-1: Minimize Impairment, Degradation, or Elimination of Recreational Resources.	No	Not applicable
3.17 Transportation	3.17-1: Future restoration projects permitted under the Order could conflict with a plan, ordinance, or policy addressing the circulation system including transit, roadways, bicycle, and pedestrian facilities.	Mitigation Measure TRA-1: Prepare Construction Traffic Management Plan.	No	Not applicable
3.18 Tribal Cultural Res.	Not applicable	Not applicable	Not applicable	Not applicable
3.19 Utilities and Service Sustems and Public Services	Not applicable	Not applicable	Not applicable	Not applicable
3.20 Wildfire	Not applicable	Not applicable	Not applicable	Not applicable

Attachment 5

Resolution No. 1-2025

RESOLUTION NO. 1-2025

RESOLUTION OF THE PLANNING COMMISSION OF THE CITY OF BLUE LAKE APPROVING A CONDITIONAL USE PERMIT APPLICATION FOR BADUWA'T WATERSHED COUNCIL TO ALLOW THE RESTORATION OF A PORTION OF LOWER POWERS CREEK IN THE OPPORTUNITY, PUBLIC FACILITY, OPEN SPACE/RECREATION, MIXED USE, AND RESIDENTIAL TWO-FAMILY ZONES

WHEREAS, Baduwa't Watershed Council (formerly Mad River Alliance) filed a Conditional Use Permit (CUP) application, dated March 10, 2022, to allow the restoration of an approximately 3,515 linear foot section of lower Powers Creek from just upstream of the bridge above the confluence with the Mad River to the culvert at South Railroad Avenue near the City's Downtown. The project would occur on 12 properties, 6 of which are owned by the City of Blue Lake (APNs 025-076-003, 025-077-005, 025-141-001, 025-161-015, 025-171-001, and 025-201-001) and 5 of which are under private ownership (025-076-008, 025-077-007, 025-141-007, 312-161-020, 312-161-022). These properties have a variety of General Plan Designations including MU – Mixed Use, F – Public Facility, OS – Open Space, and MF – Multi-Family Residential. The corresponding Zoning Districts include O – Opportunity, PF – Public Facility, X – Open Space/Recreation, MU – Mixed Use, and R2 – Residential Two-Family;

The grading limits for the restoration reach would be approximately 6.15 acres and there would also be approximately 1.46 acres of additional revegetation areas outside of the grading limits (total of ~7.61 acres). Project implementation is anticipated to occur in 2 to 3 phases depending on the availability of implementation funding. Design, permitting, and environmental review for the project is funded by a planning grant from the California Department of Water Resources Urban Streams Restoration Program (USRP). Implementation funding is being sought from the California Department of Water Resources and the CDFW Fisheries Restoration Grant Program (FRGP);

The goals of the project are to restore salmon and riparian habitats in lower Powers Creek and increase the abundance of Coho salmon and steelhead populations in the Mad River. To accomplish these goals, the project proposes to widen, deepen, and/or realign this section of Powers Creek and remove invasive, non-native vegetation. After grading and vegetation removal activity, revegetation is proposed to re-establish a riparian forest of native vegetation, including trees, shrubs, and forbs. The Project will benefit fish populations through habitat improvements including the excavation of pools, installation of woody debris structures, and the construction of side channels, a high flow bypass channel, and coarsened riffles. It is estimated that the project would remove approximately 40,000 cubic yards of aggraded sediment from the creek channel. To minimize the potential for bank erosion downstream of the South Railroad Avenue culvert, the project also proposes to install rock slope protection between the culvert outlet and the confluence with South Fork Power Creek. To accommodate the proposed restoration design, modifications are proposed to existing infrastructure in the restoration reach including the following: 1) due to the shallow depth of the water and sewer lines near the pedestrian bridge connecting Broderick Lane and Monda Way, the project would include lowering the utility lines to allow for the proposed depth of channel excavation; and 2) the pedestrian bridge connecting Broderick Lane and Monda Way would be raised by up to 1 foot to provide additional freeboard during a 100-year flood event;

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Application materials provided by the applicant include the 65% Design Plans, 65% Basis of Design Report, and Revegetation, Monitoring, and Reporting Plan;

- **WHEREAS**, City planning staff has reviewed the submitted application and evidence and has referred the application and evidence to involved reviewing City departments, Tribes, and regulatory agencies for comments and recommendations; and
- **WHEREAS,** the project requires permit approval from several State and federal agencies including the California Department of Fish and Wildlife, North Coast Regional Water Quality Control Board, and U.S. Army Corps of Engineers;
- **WHEREAS,** the project is eligible for coverage under the State Water Resources Control Board Statewide Restoration General Order (SRGO) including coverage under the CEQA Programmatic Environmental Impact Report adopted for the SRGO;
- **WHEREAS**, after due notice of public hearing, the matter came on for consideration before the Blue Lake Planning Commission at their regularly scheduled meeting on May 19, 2025;
- **NOW, THEREFORE**, be it resolved by the Planning Commission of the City of Blue Lake as follows:
- 1. The Planning Commission finds that the Powers Creek Restoration Project is within the scope of the CEQA Programmatic Environmental Impact Report for the State Water Resources Control Board Statewide Restoration General Order (SRGO PEIR). All impacts are covered by the PEIR; no supplemental EIR is needed.
- 2. The project, as proposed and subject to existing laws and regulations, is consistent with the City of Blue Lake General Plan and Municipal Code.
- 3. The proposed project is consistent with the goals and policies of the Creeks & Wetlands section of the Blue Lake General Plan Element because it includes a collaboration between the City of Blue Lake, Baduwa't Watershed Council, and various funding and regulatory agencies to restore a portion of lower Powers Creek.
- 4. Per Section 17.28.030.F of the Blue Lake Municipal Code, the Planning Commission finds as follows:
- A. That the proposed location of the creek restoration project is in accord with the purpose and intent of the Opportunity, Public Facility, Open Space/Recreation, Mixed Use, and Residential Two-Family zones and the proposed use is similar to and compatible with existing conditions in the project footprint and the uses permitted in the zones.
- B. That the proposed location of the creek restoration project and the conditions under which it would be operated or maintained will not be detrimental to the public health, safety, or welfare, or materially injurious to properties or improvements in the vicinity.

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5.

The Planning Commission of the City of Blue Lake hereby grants and approves

	on for Baduwa't Watershed Council to allow the restoration subject to the terms and conditions contained in Exhibit "A", of.
INTRODUCED, PASSED, following vote:	AND ADOPTED this 19 th day of May 2025, by the
AYES:	
NAYS:	
ABSENT:	
ABSTAIN:	
	Chairman, Planning Commission, City of Blue Lake
	City of Blue Lake
ATTEST:	
Secretary, Planning Commission	

EXHIBIT "A" To Resolution 1-2025

Conditions of Approval

General

1. The applicant shall reimburse the City for all fees involved in processing this application including any costs incurred ensuring compliance with the conditions of approval.

City Manager-Floodplain Administrator

2. The applicant must obtain a floodplain development permit pursuant to Blue Lake Municipal Code Chapter 13.20 – Floodplain Management.

Building Department

3. The applicant must obtain a grading permit for the project pursuant to Blue Lake Municipal Code Chapter 15.12 – Grading, Erosion, and Sediment Control.

Blue Lake Rancheria THPO

4. For any portion of the project that will occur within the boundary of the Blue Lake Rancheria Tribal lands, the Tribe's Protocol for Inadvertent Archaeological Discoveries must be implemented during construction and monitoring activities.