Post-Project Appraisal for the Winter Creek Restoration Redwood Grove, UC Botanical Gardens at Berkeley

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Abstract

In fall 2009, the UC Botanical Gardens completed a restoration project on Winter Creek, a tributary to Strawberry Creek. The creek is located in the Redwood Grove on the north side of Centennial Drive, opposite the main gardens. The project was completed in response to severe erosion caused by a pipe culvert that carried runoff from the Lawrence Berkeley Laboratory (LBL) and other development in Strawberry Canyon. For this term project we conducted a post-project appraisal of the Winter Creek restoration to determine whether the restoration achieved its objectives. We obtained relevant project information from the project proponents via interviews and email communication. On three days in October and November 2010, we conducted cross sections, longitudinal profiles, and vegetation surveys. In order to learn more about the Winter Creek watershed upstream of our project site, we conducted a hydrological analysis. Although we only received draft pre-project data, our results show that the cross sections and longitudinal profile have not changed significantly over the first winter since the project construction was completed. Furthermore, we did not detect any significant erosion within the project site. These results are not surprising due to the substantial rock armoring that was utilized in this restoration plan. The planting plan we received from the project partners was preliminary and the UC Botanic Gardens negotiated changes in order to balance the restoration effort with its educational goals to teach visitors about California's redwood ecosystems in this part of the Botanical Gardens. Our vegetation assessment was inconclusive. Our survey revealed that some species of plants, such as California azalea (Rhododendron occidentalis), were experiencing low survival at the project site. Other species, such as alumroot and wild ginger are annual species, which could not be observed in November. In conclusion, as of its first winter after installation, this project has been successful in reducing erosion and bank failure on Winter Creek in the Redwood Grove. As development continues upstream of the project site with the LBL's continued expansion, additional runoff may cause additional erosion problems in the future. We would recommend that the UC Botanical Gardens and Campus Capital Projects continue on-going monitoring as well as work with LBL to mitigate its stormwater runoff through the implementation of low-impact design, such as bioswales, retention basins, and flow-through planters.

Figure 1. Culvert on Winter Creek in 2005.

Introduction

In fall 2009, the UC Botanical Gardens completed a restoration project on Winter Creek, a tributary to Strawberry Creek. The creek is located in the Mather Redwood Grove on the north side of Centennial Drive, opposite the main gardens (Fig. 2).

Figure 2. Project Location - Botanical Gardens location marked by the red tree (From Google Earth)

The project was completed in response to severe erosion caused by a pipe culvert that carried runoff from the Lawrence Berkeley Laboratory (LBL) and other developments in Strawberry Canyon (Carmichael, 2010). According to the 'Save Strawberry Canyon' citizens' group, LBL has expanded its footprint in the canyon from 134 to 200 acres over the past 20 years (Save Strawberry Canyon, 2010). Recent expansion of parking areas at LBL (Fig. 3) increased the flashiness of the stream creating a scour pool and 12-foot drop in grade immediately downstream of the pipe (USACE, 2007). In 2004, the walls of the scour pool collapsed, and adjacent banks began slumping into the pool. Continued erosion of the channel was likely to undermine the outlet of the culvert, several large redwoods along creek bank, and the sole access road to the Redwood Grove (RWQCB, 2006). In addition to the threat to trees and infrastructure, continued erosion would have contributed excess sediment to the Strawberry Creek watershed. The UC Botanical Garden worked in conjunction with Campus Capital Projects and LBL to complete a restoration plan, which was prepared by Philip Williams and Associates (PWA). The design objectives of the project were to use rock grade control structures to stabilize and raise the streambed, creating a series of step pool and riffle sequences. The unstable creek banks were to be regraded, stabilized, and revegetated with vegetated soil lifts and brush mats in combination with specific native planting and seeding plans. An outfall dissipation gabion basin was created to absorb some of the energy flowing out of the culvert. Design for the project began in 2004, but due to permitting and funding constraints, the restoration was not implemented until 2009. Hanford A.R.C. was responsible for restoration construction.

Figure 3. Recent Development at LBL (LBL 2006)

Research Questions

For this term project we conducted a post-project appraisal of the Winter Creek restoration to determine whether the restoration achieved its objectives. In our analysis, we answered the following questions:

1. What might the channel have looked like prior to development in Strawberry Canyon?
2. Has the restoration stopped or decreased erosion in this reach of Winter Creek?
3. How did construction differ from the designs and what are the implications of those changes?
4. What is the percent of plant survival? Were the plantings in accordance with the educational/ botanical goals established by the Botanical Gardens for the Redwood Grove?
5. How did the goals of restoration conflict with the mission of Botanical Gardens?
6. How did funding or permitting constraints affect the solution, which was ultimately selected?
7. What caused the delay in the permitting process and how could this be streamlined?

Figure 4. Pre-restoration. Winter Creek, looking upstream. 2005.

Figure 5. Pre-restoration. Winter Creek, looking downstream. 2005.

Methods

We began by obtaining project information from Chris Carmichael, Associate Director of the UC Botanic Gardens; Kate Bolton, Project Manager for Campus Capital Projects; and Jorgen Blomberg, Design Team Manager, PWA. We received the following draft planning documents: revegetation plan, technical specifications, cross sections and plans for the restoration design, photomonitoring locations and pre-, during, and post-project photographs.

Channel and vegetation surveys

During three fieldwork days we completed channel and vegetation surveys in three distinct reaches of the project designated as the gabion, upstream and downstream reaches (Fig. 9). On October 23, we surveyed nine cross sections at the 'gabion reach' of the project site, replicating cross sections A-J designated on the plan figures provided to us by PWA personnel (Fig. 6 and Fig. 10). On October 31, we completed a longitudinal survey of the project site (Fig. 7). We were not provided detailed longitudinal profile figures in time for them to inform our fieldwork and therefore we completed our longitudinal profile by taking survey points in the thalwag of the channel based on obvious changes in slope and feature. On November 5, we completed two cross sections in the 'downstream reach' (Fig. 11) and two cross sections in the 'upstream reach' of the project site, replicating cross sections designated in the planning documents as 1 and 2 and 3 and 4 respectively (Fig. 8 and Fig. 12). Lastly, we completed an assessment of vegetation survival within all three reaches.

Figure 6. Surveying cross sections in the 'gabion reach,' October 23, 2010.

Figure 7. Surveying the longitudinal profle, October 31, 2010.

Figure 8. Surveying cross sections in the 'downstream reach,' November 5, 2010.

In order to compare the built cross sections and longitudinal profile with the data collected in the field, we overlaid our data on to the cross section and longitudinal profile design figures provided by PWA. In order to assess vegetation survival, counted the numbers and species of plants observed at the site for one planting location in the ‘gabion reach,’ two planting locations in the ‘upstream reach’ and one planting location in the ‘downstream reach.’ We then compared these counts with the preliminary planting plan provided to us by the project partners. We also took photos at photomonitoring points provided by PWA (Fig. 9).

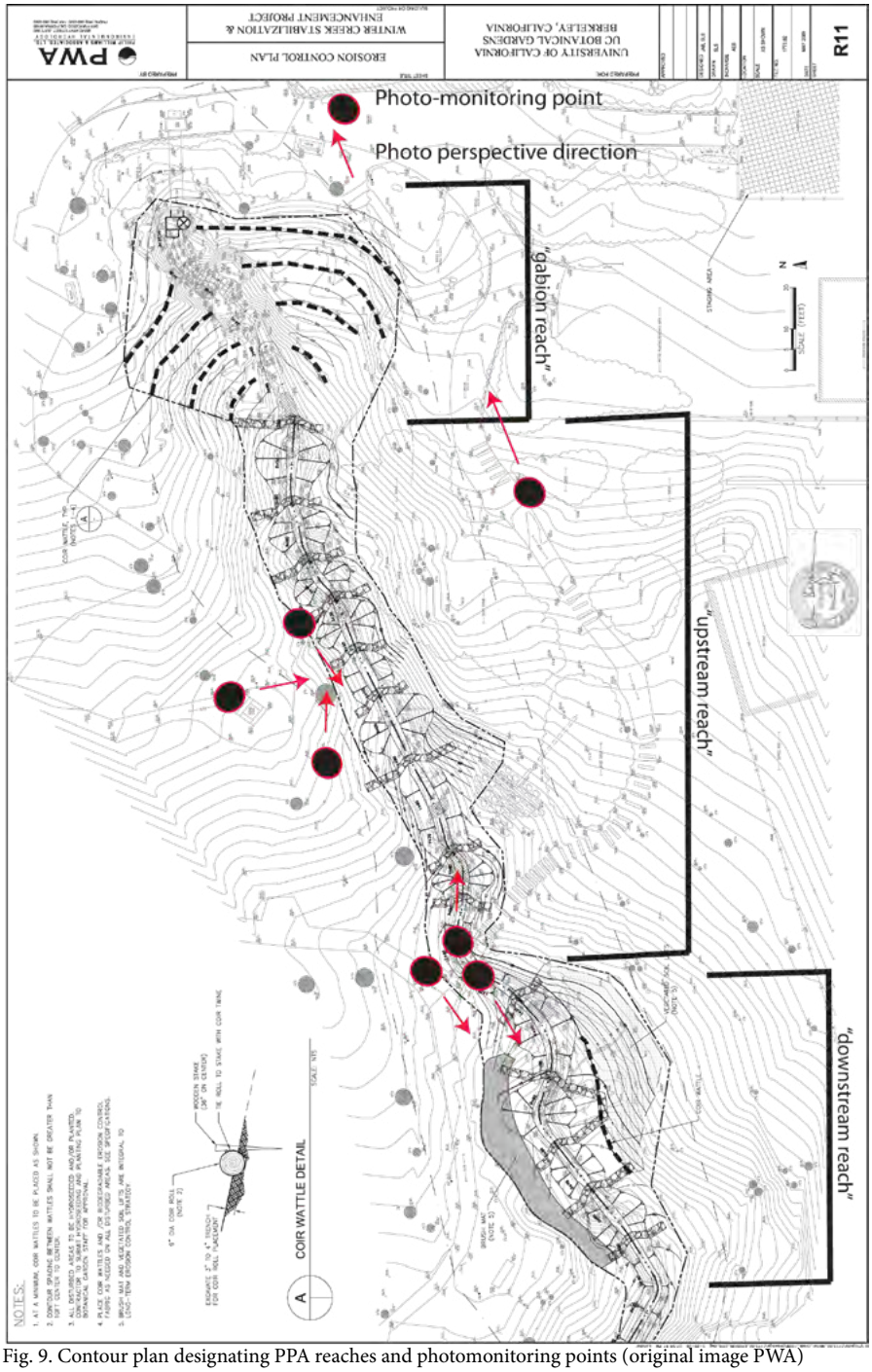


Fig. 9. Contour plan designating PPA reaches and photomonitoring points (original image PWA)

Fig. 10. Gabion reach cross sections (original image PWA)

Fig. 11. Upstream reach cross sections (original image PWA)

Fig. 12. Downstream reach cross sections

Hydrological analysis

In order to understand how development of impermeable surfaces upstream impact peak flow at the site it is important to know the time it takes for precipitation upstream to reach the site, typically referred as lag time. In order to determine the approximate lag time to peak flow at the downstream end of our site we used USGS 7.5" topo maps to estimate the area of the drainage upstream of our site, the length of the channel upstream of the site, the length to the center of the watershed, and the elevation difference or slope from the downstream end of the site to watershed boundary. The following formula incorporated this information to determine the approximate lag time of peak flow.

TL = ([Channel Length (L) x Drainage Area(Lca)]/[Slope]^1/2)^.38 x 24 x Roughness (n)

Additionally, we calculated the regional regression using Waananen and Crippen method and calculated the Curve Numbers and infiltration rates for the watershed under pre-development, current, and 50% development conditions.

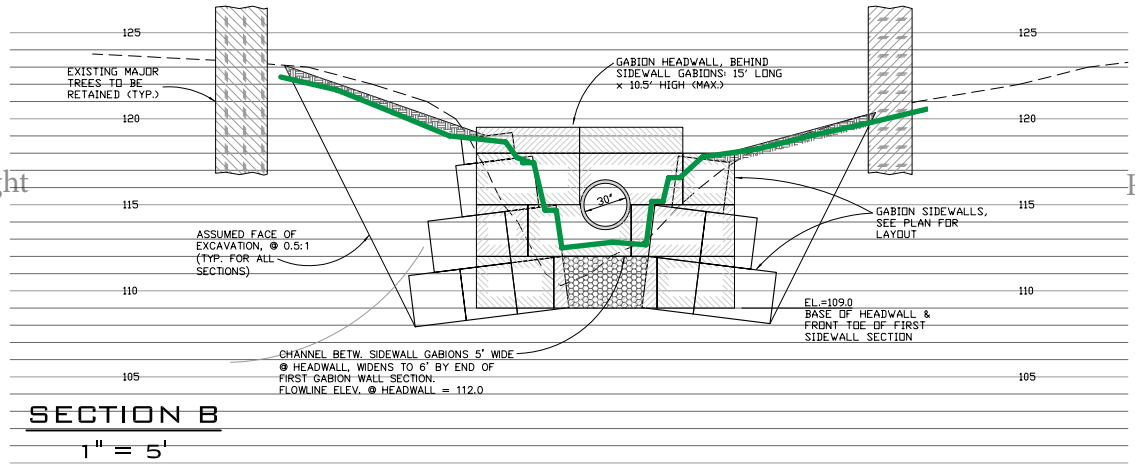
Results

Cross section channel surveys

Figures 13 through 17 below are the results of our cross section surveys. Each cross section has been overlaid in green onto the original cross sections provided by PWA. The design cross sections also include the pre-project conditions of the creek designated by the dashed line. This overlay allows for the comparison between the pre project conditions, the project design, and the final construction. This comparison shows whether or not the project stopped or decreased erosion as well as displays where the project construction may have deviated from the original design. By comparing the pre-project conditions, the design, and the construction we are able to answer the second and third research questions. In each cross section the banks are labeld to oriented the observer.The cross sections are organized from upstream to downstream (gabion reach, upstream reach, downstream reach).

Gabion reach cross sections

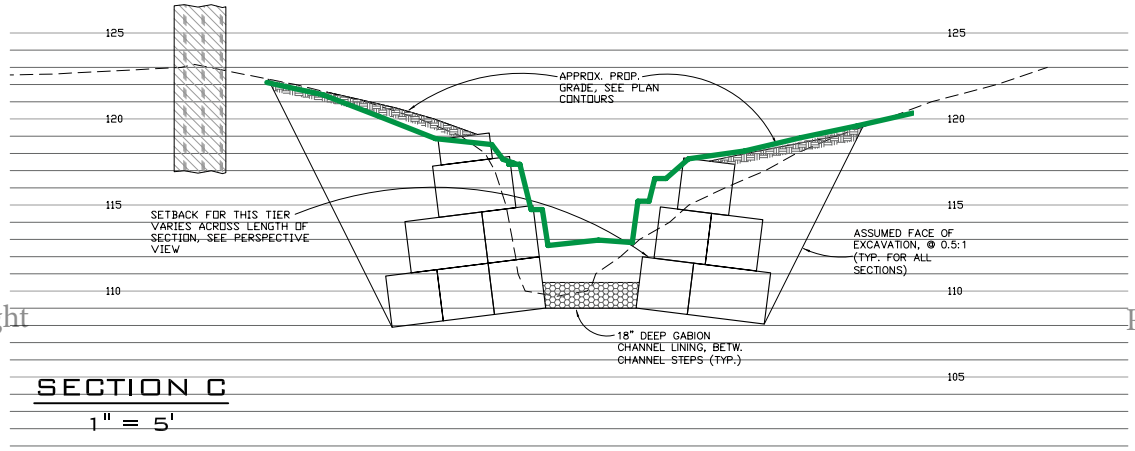
It appears the designed bank cuts were not constructed was applied to the slope than originally designed for in the following cross sections in the gabion reach: cross section D, high on the right bank (Fig. 13), cross section G, beyond the highest gabion on the left bank (Fig. 14), cross sections H and I beyond the highest gabion on the left bank and cross section J, high on the right bank (Fig. 15). It can be observed on the plan drawing (Fig. 10) that at least one large redwood tree (designated by the dark circles) remains near each of these cross sections. In order to maintain the trees, the contractors may not have been able to apply the cuts proscribed by the design documents. As the slopes in these areas are steeper than the design slopes they may experience erosion in the future a if not monitored.



SECTION B

1" = 5'

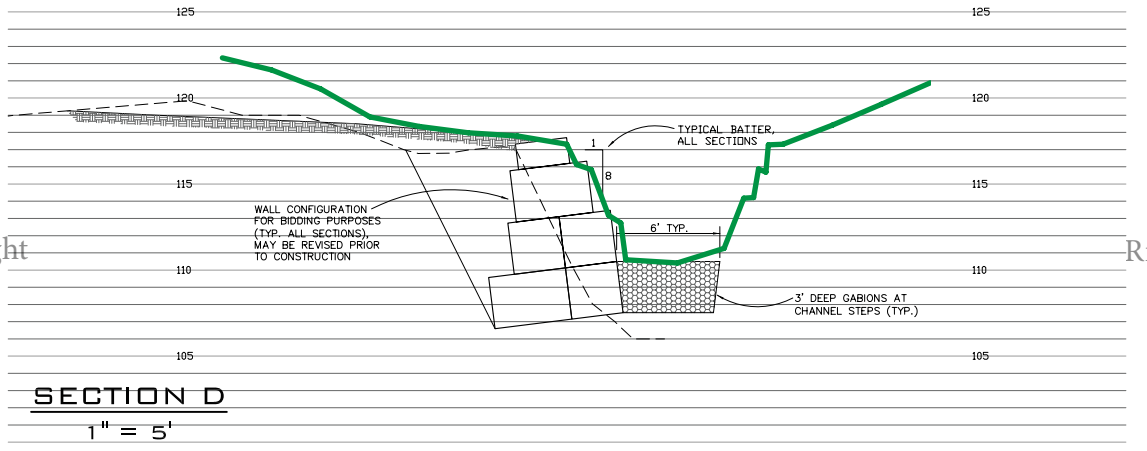
River Right River Left



SECTION C

1" = 5'

River Right River Left



SECTION D

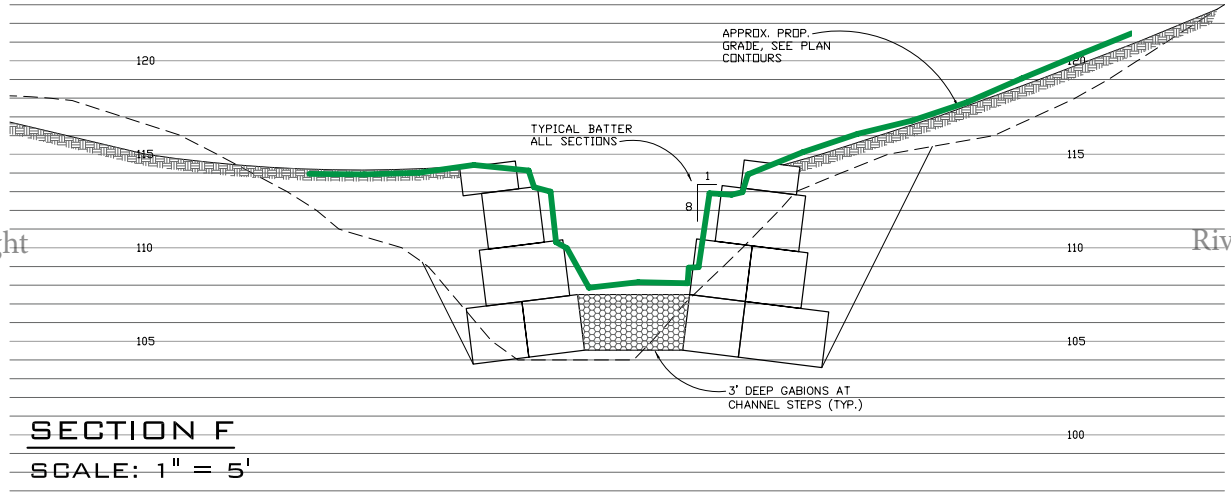
1" = 5'

River Right River Left

Figure 13. Cross Sections B-D

0 2.5 5 7.5 10

2010 Survey results



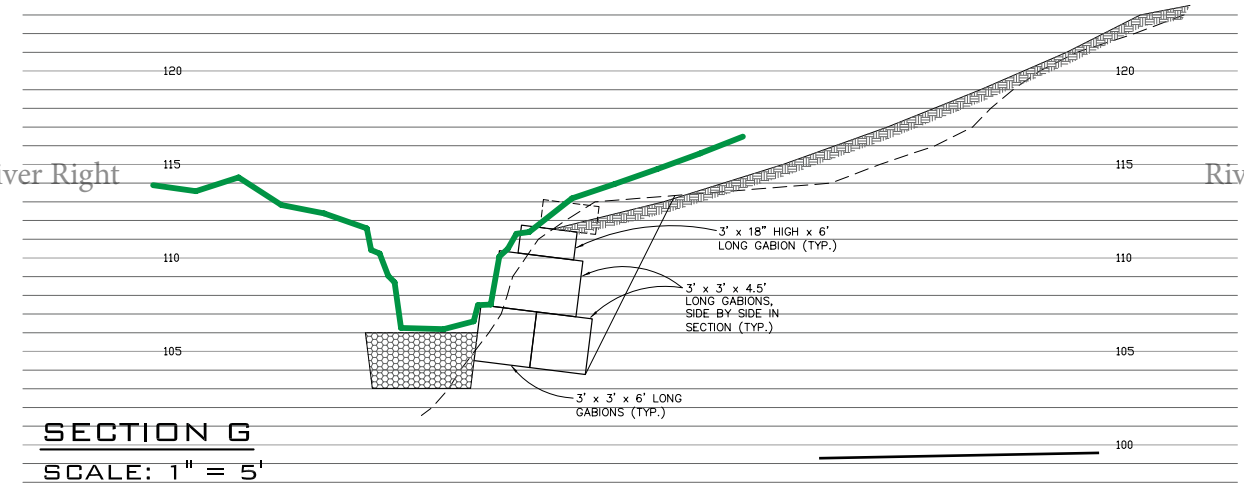
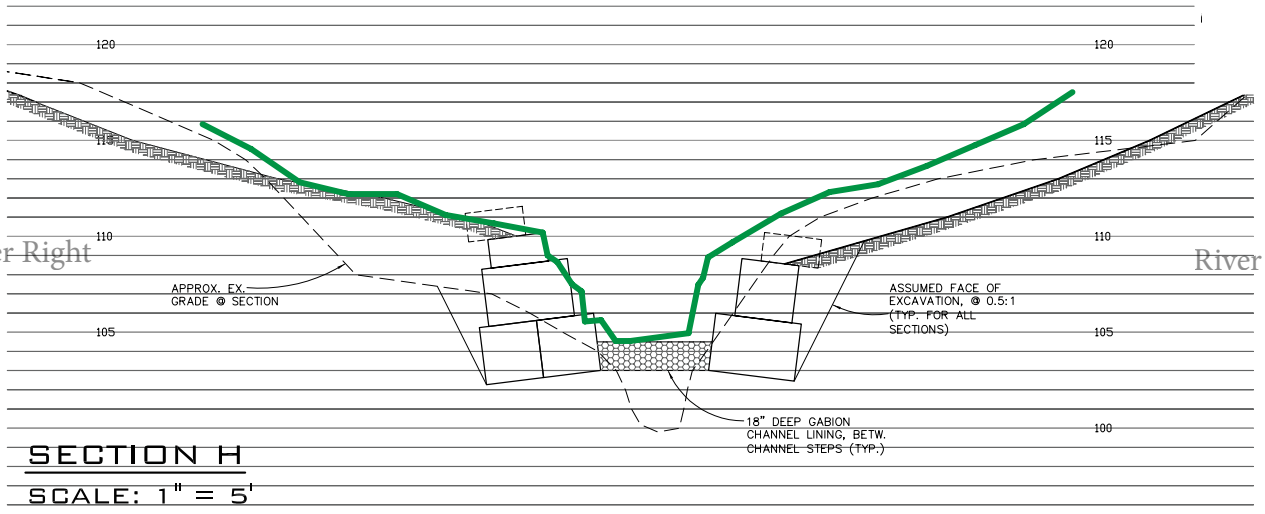
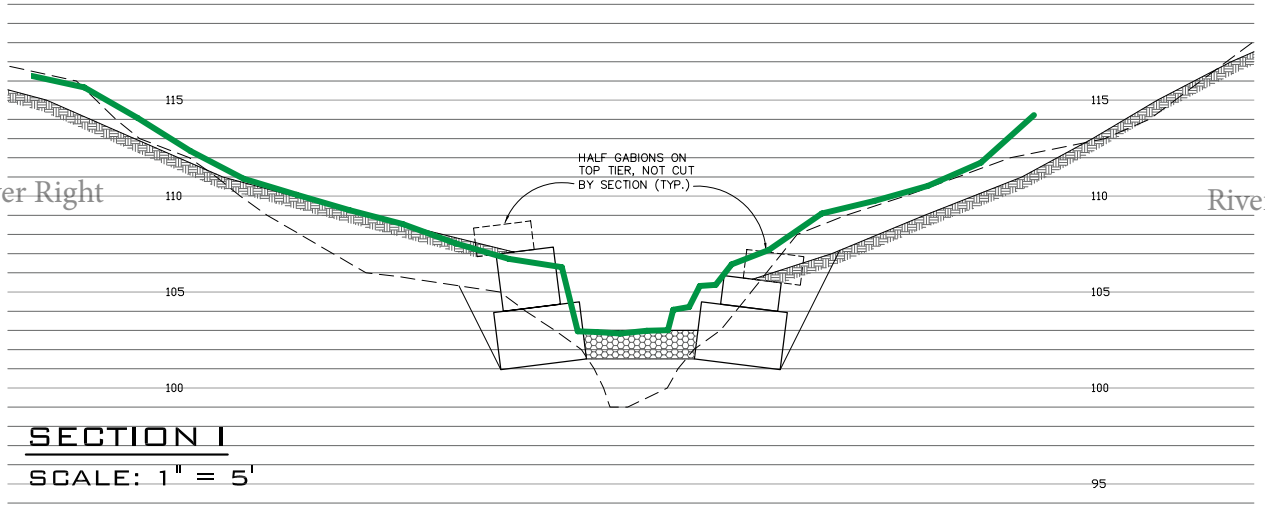
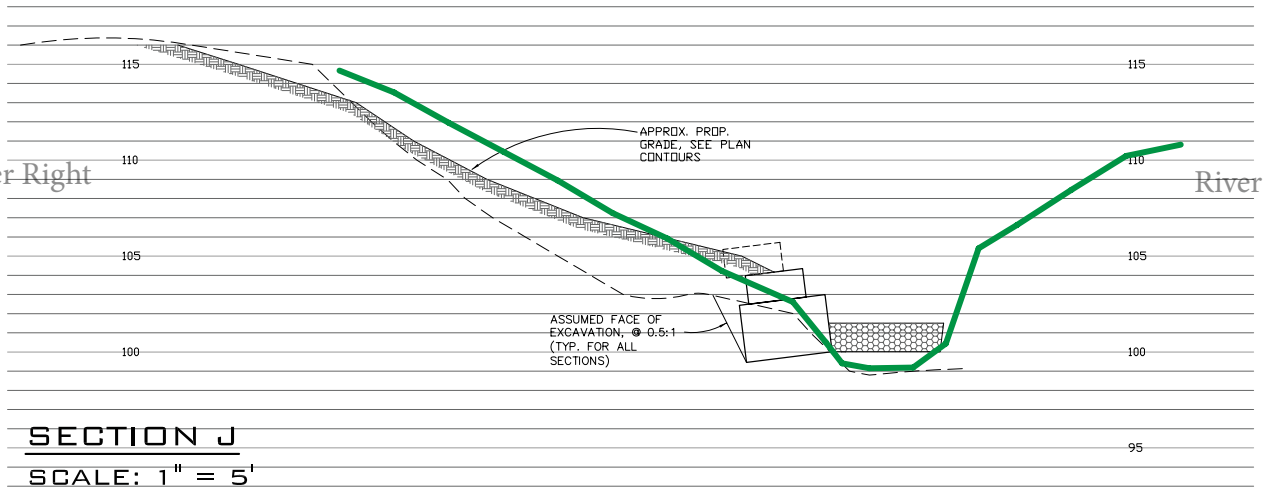


Figure 14. Cross Sections E-G







River Right

River Left

Figure 15. Cross Sections H-J

0 2.5 5 7.5 10

2010 Survey results

Upstream reach cross sections

Similar to the gabion reach, it appears the designed bank cuts were not constructed and more fill was applied to the slope than originally designed for on the right bank in cross section 3 and dramatically on the left bank in cross section 4. Again, this may be due to large redwood trees the contractors were forced to maintain during constriction. As these slopes are steeper than originally designed for they may experience erosion and contribute to bank failure if not monitored appropriately in the future.

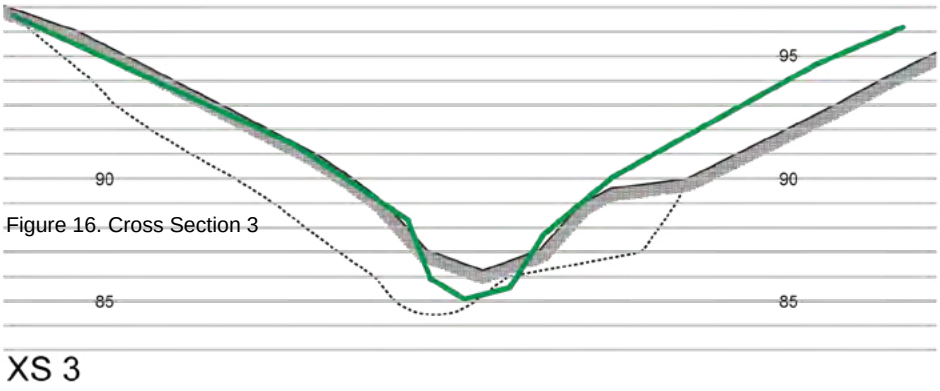


Figure 16. Cross Section 3

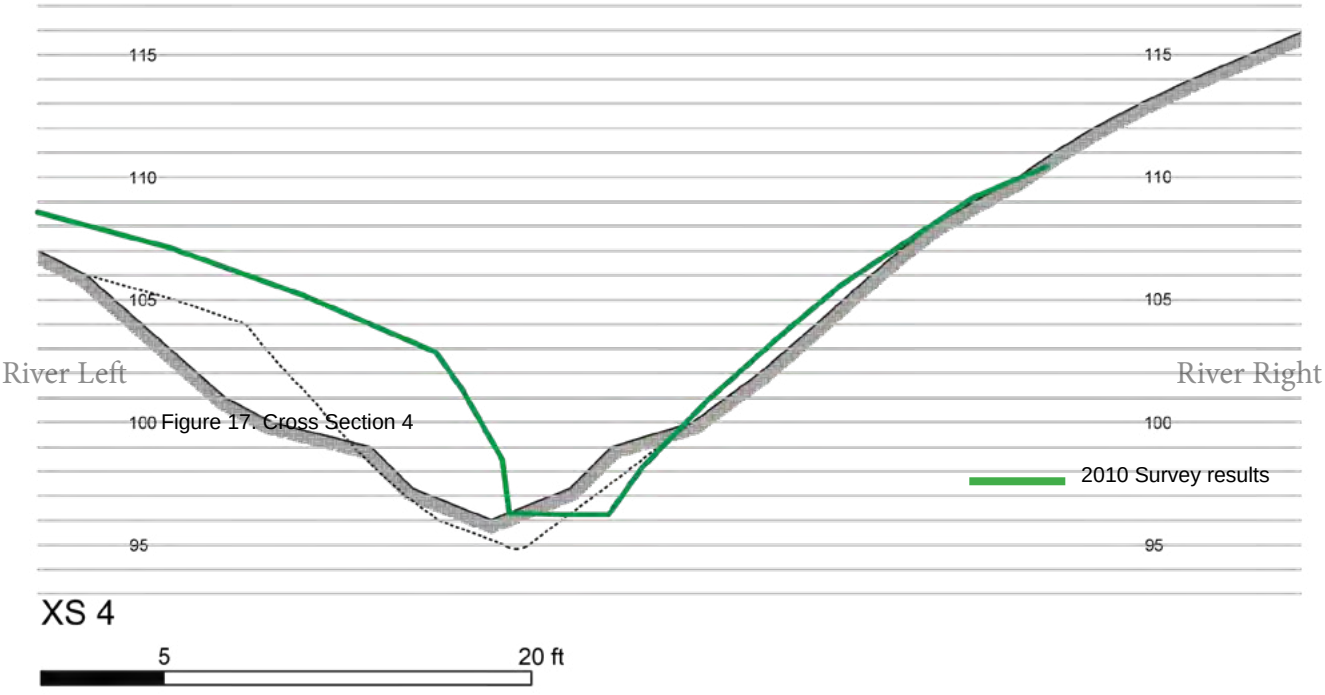


Figure 17. Cross Section 4

Downstream reach cross sections

Cross-sections 1 and 2 (Fig. 17) correspond fairly well with the topography designed for the site.

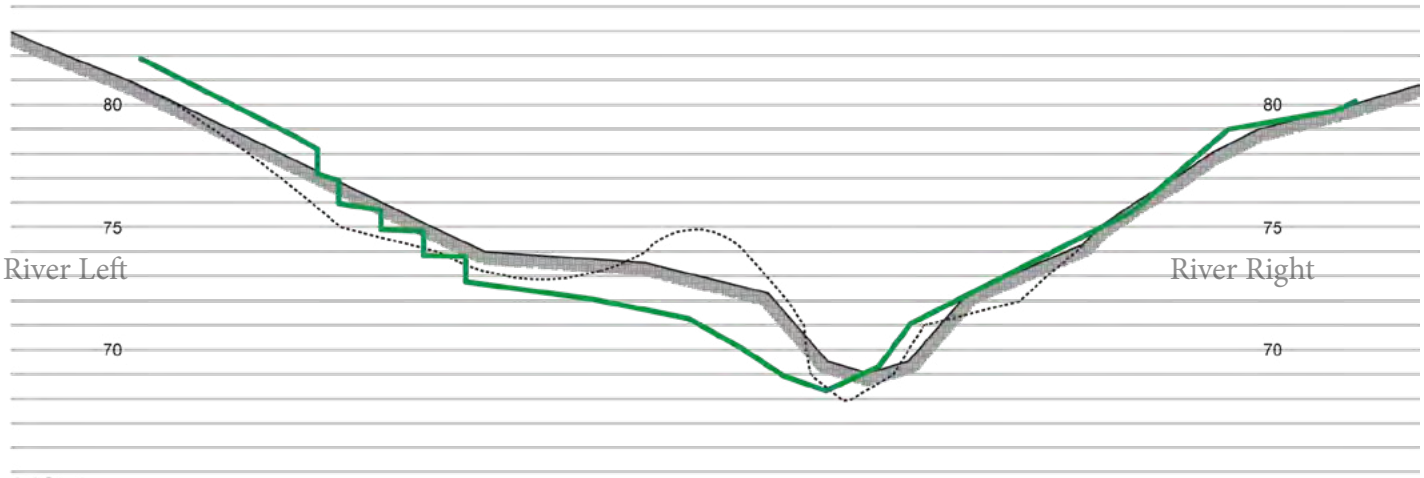


Figure 18. Cross Section 1

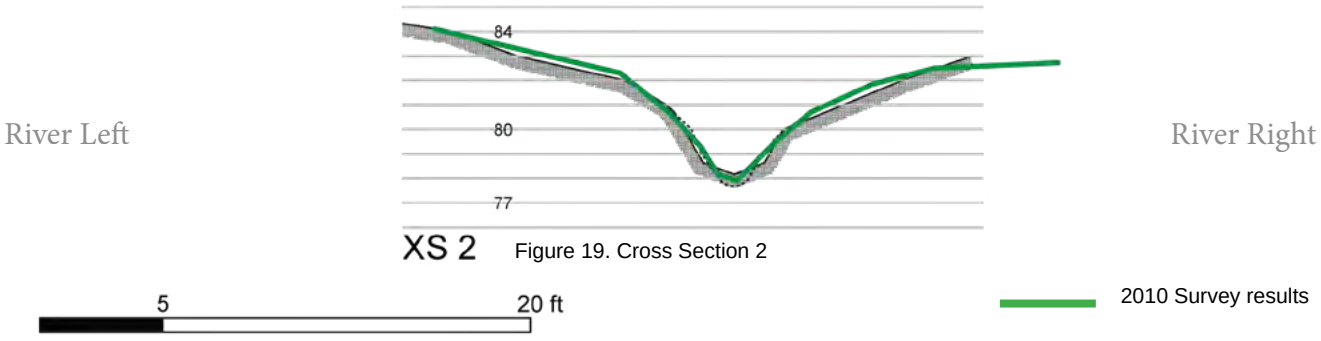


Figure 19. Cross Section 2

Longitudinal profile (from downstream culvert to upstream culvert) channel survey

The longitudinal profile (Fig. 18) correspond with the topography designed for the site. The longitudinal profile in the designs shows the step pools at a coarser level of detail than the data collected in the field (Fig. 18).

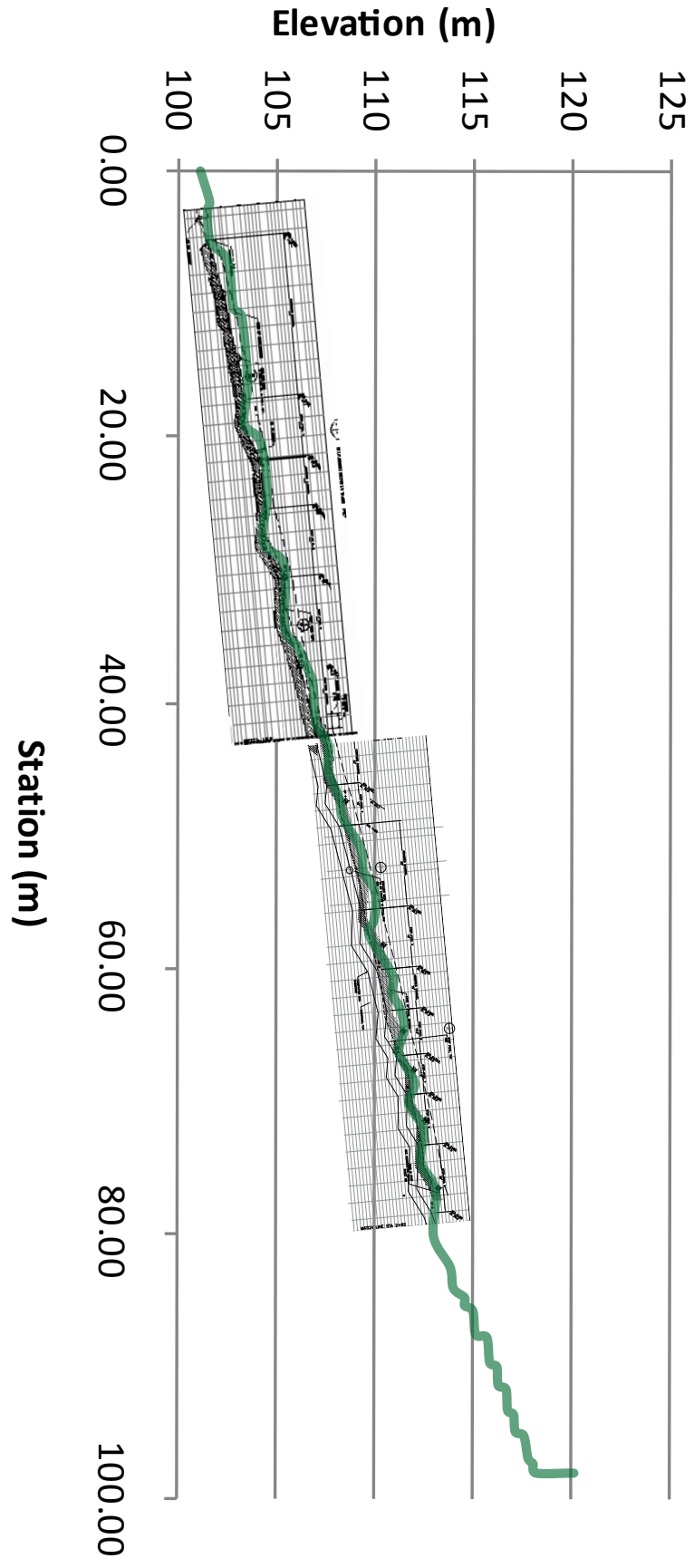


Figure 20 shows the surveyed logitudinal profile overlaid in green on top of the designed longitudinal profile.

Vegetation survey

Planting plan species survival

For each reach, the number and species of plants in each sampling location matched the planting plan to a certain extent. California azalea (Rhododendron occidentalis) was the only species that did not have good survivorship and did not seem to be in good health. For instance, in the gabion reach (Table 1) only 8 of the 10 planted have survived and in the upstream reach only 2 of the 6 planted survived (Table 2). The surviving plants had few leaves and the leaves that were present were spotted and appeared diseased. As we were sampling in November, we did not observe herbaceous species, such as alumroot (Heuchera micrantha) or wild ginger (Asarum caudatum). In the gabion reach, it was particularly difficult to distinguish between individuals of redwood sorrel (Oxalis occidentalis because individual plants were mingled together and were mixed in with annual grasses.

Table 1. Gabion Reach

Botanical Name	Common Name	Number in plan	Number found in field
Fragaria vesca	Woodland strawberry	30	30
Woodwardia fimbrata	Giant chain fern	4	3
Polystichum munitum	Western swordfern	20	20
Heuchera micrantha	Alum root	8	N/A
Rhododendron occidentalis	California azalea	10	8
Oxalis occidentalis	Rewood sorrel	80	80
Asarum caudatum	Wild ginger	20	N/A
Rubus spp.	California blackberry	20	10
Iris douglasiana	Douglas iris	6	6

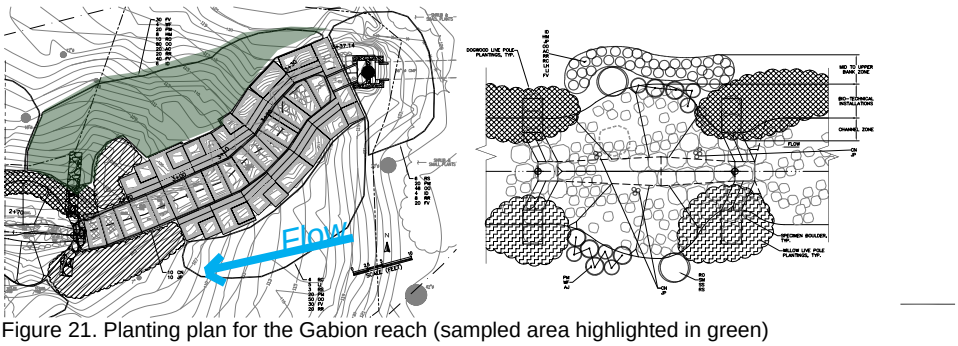


Figure 21. Planting plan for the Gabion reach (sampled area highlighted in green)

Table 2. Upstream reach

Botanical Name	Common Name	Number listed in plan	Number found in field
Polystichum munitum	Western swordfern	12	8
Heuchera micrantha	Alum root	8	N/A
Rhododendron occidentalis	California azalea	6	2
Juncus patens	Common rush	8	8

Blackberry (*Rubus spp*.), giant chain fern (*Woodwardia fimbrata)*, douglas iris (*Iris douglasiana*), and redwood sorrel (*Oxalis occidentalis*) were present, but not listed in the plan.

Table 3. Downstream reach

Botanical Name	Common Name	Number listed in plan	Number found in field
Polystichum munitum	Western swordfern	14	5
Oxalis occidentalis	Redwood sorrel	40	40
Asarum caudatum	California azalea	12	N/A
Carex nudata	Torrent sedge	10	2
Woodwardia fimbrata	Giant chain fern	6	1
Juncus patens	Common rush	16	8

Black twinberry (*Lonicera involucrata*), douglas iris (*Iris douglasiana*), and flowering current (*Ribes sanguineum*) were present, but not listed in the plan.

Live pole planting survival

We found leaves growing on many of the dogwood and willow live pole plantings to be evidence that the live pole plantings were out of dormancy. Therefore, we counted all bare live pole plantings observed as dead. It is evident from these counts that the dogwood and willow live pole plantings did not have a high survival ratio (Table 4). It was observed that the plantings located on the left bank (looking downstream below the footbridge) were more successful. The only observable difference between the left and right banks was the greater amount of shading caused by the redwoods above the right bank.

Table 4. *Live pole planting survival*

Live pole planting	Gabion		Upstream		Downstream	
	Live	Dead	Live	Dead	Live	Dead
Willow	2	5	3	3	11	36
Dogwood	2	4	4	5	N/A	N/A

Figure 22 Successful willow planting in sunnier conditions compared to shaded willow live pole planting that did not survive.

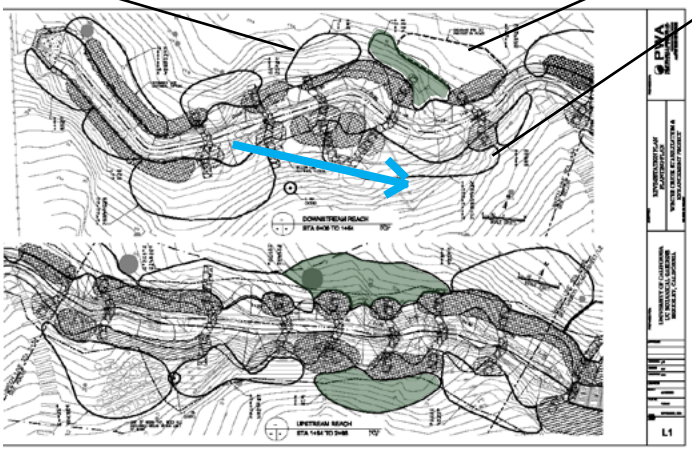


Figure 23. Planting plan for Upstream and Downstream reaches (sampled area highlighted in green).

Figure 24. Photomonitoring Point 1. November 5, 2010.

Figure 25. Photo-monitoring Point 1. October 2009.

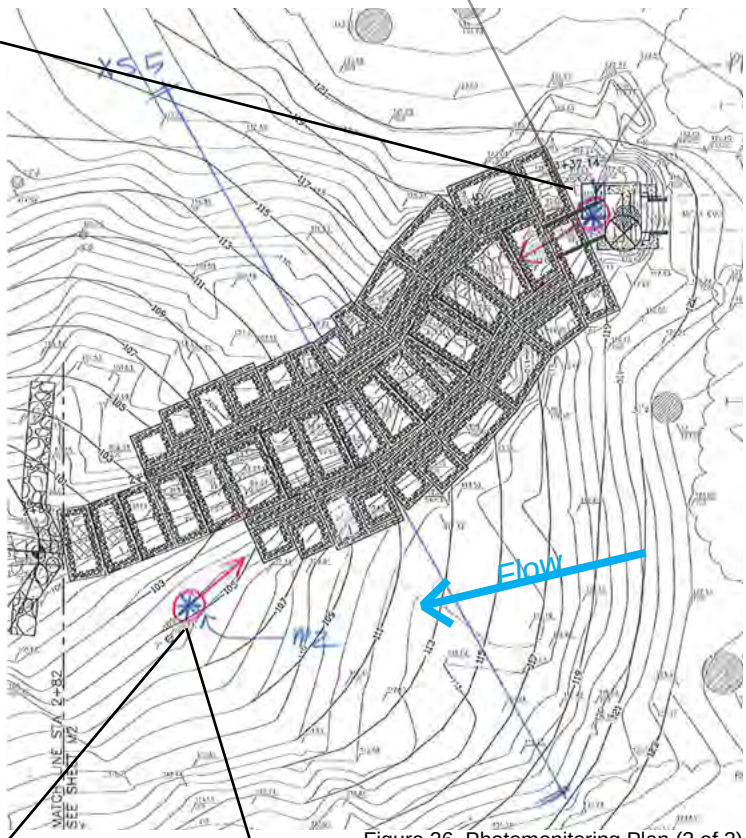


Figure 26. Photomonitoring Plan (3 of 3)

Figure 23. Photomonitoring Point 2. November 5, 2010.

Figure 27. Photomonitoring Point 2. October 2009.

Figure 28. Photomonitoring Point 3a. November 5, 2010 (no earlier photo available)

Figure 29Photo-monitoring Point 3c. November 5, 2010 (no earlier photo available)

Figure 30. Photomonitoring Plan (2 of 3) (below)

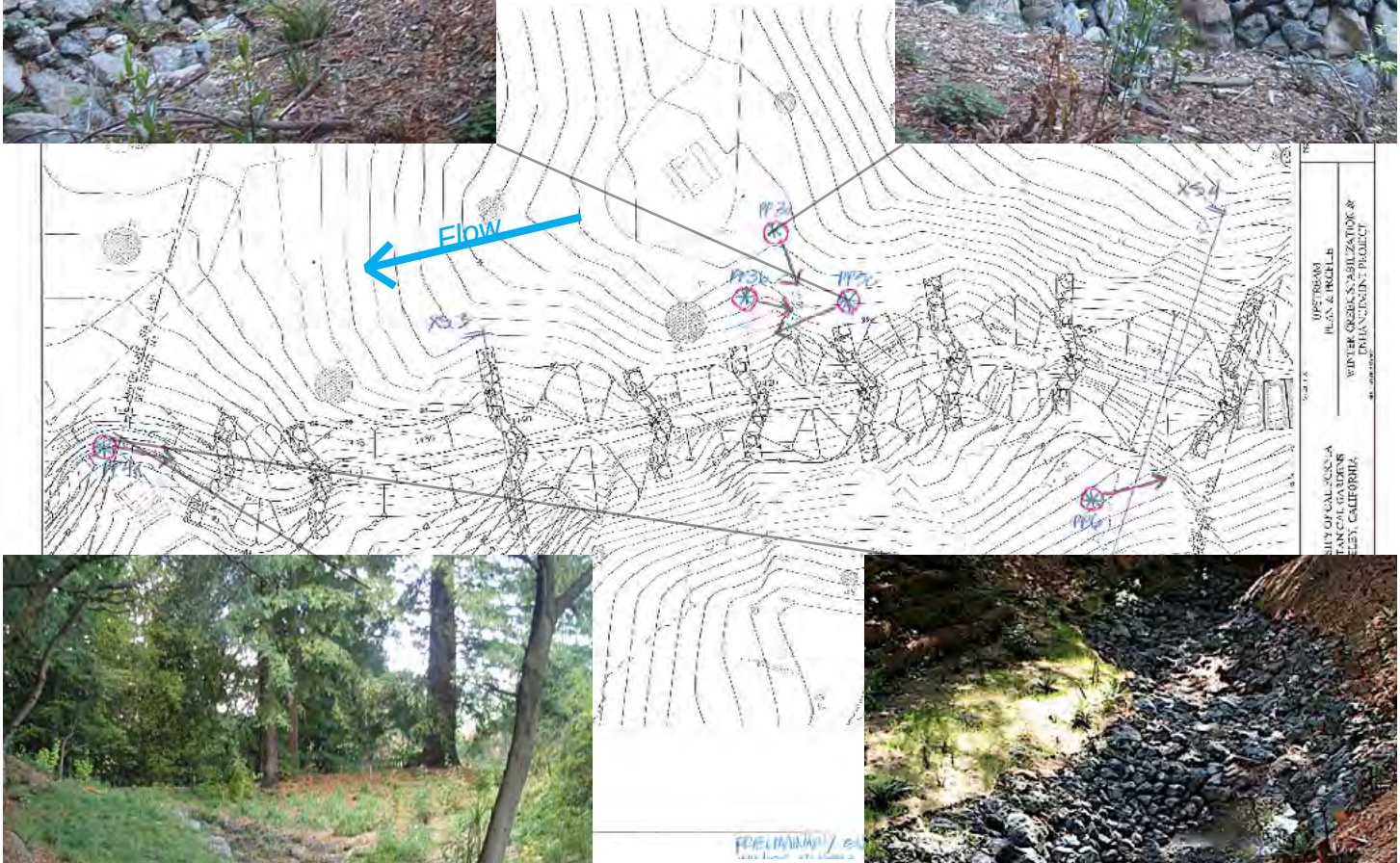


Figure 31. Photomoni-toring Point 3b. November 5, 2010.

Figure 32. Photomoni-toring Point 3b October 2009.

Figure 33-34. Photomonitoring Point 5. November 5, 2010 (left); Photomonitoring Point 4a. (right) (no earlier photos available)

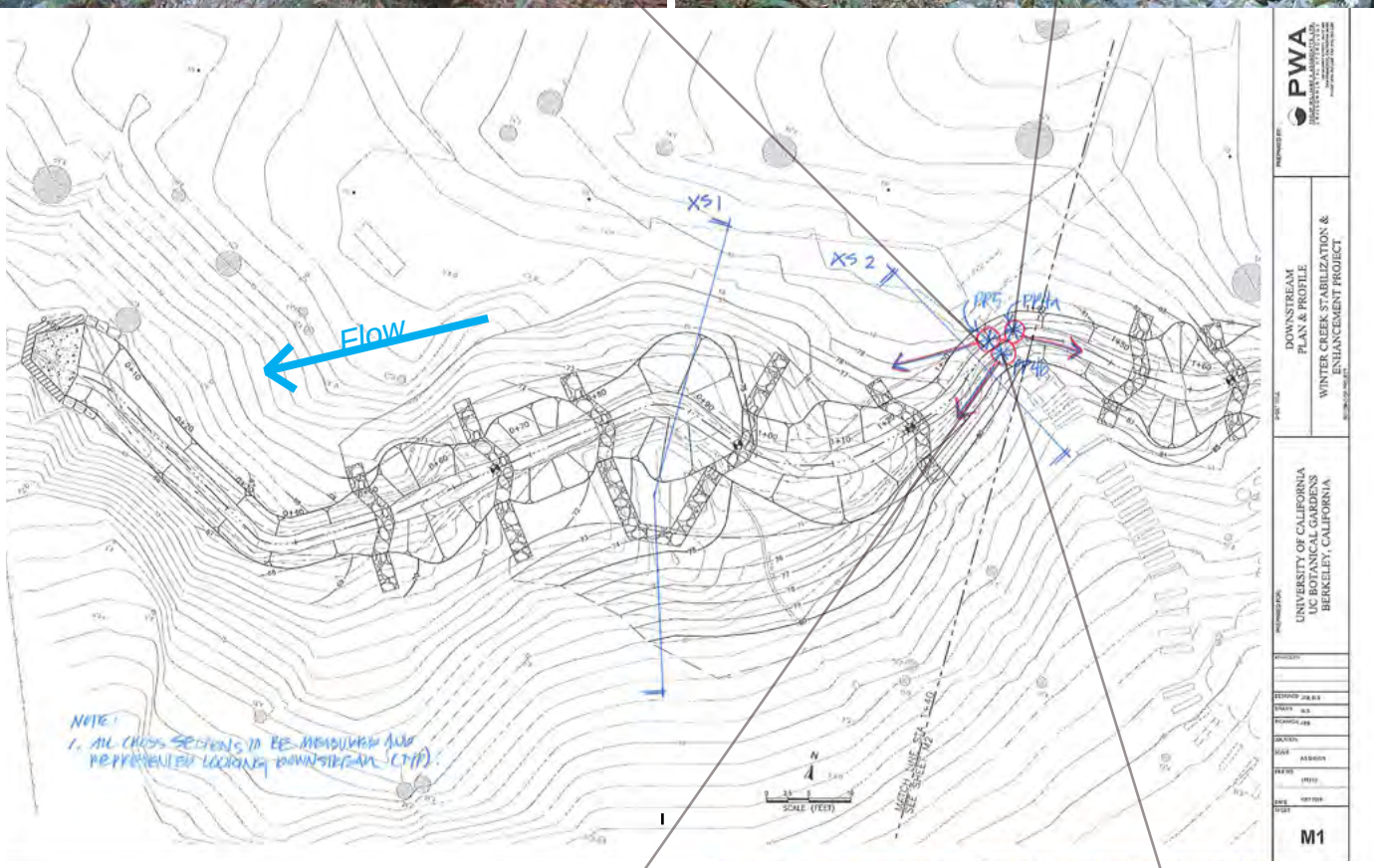


Figure 35-37. Photomonitoring Plan (3 of 3; above); Photomonitoring Point 4b. November 5, 2010. (below left); October 2009 (below right).

Hydrological analysis

Upstream of our site, Winter Creek drains an area of approximately 160 acres. We estimated lag time to peak flow at approximately 8 minutes, which was confirmed by our observations on October 23, when it began to rain while we were surveying at the site. Runoff appeared at the culvert at the upstream end of the project site approximately 10 minutes after it began to rain. This runoff also carried trash into the project site and foam began to collect at the drop under the pipe culvert and in the pools downstream (Fig. 38-39).

Time Lag (TL) = ([Channel Length (L) x Drainage Area(Lca)]/[Slope]1/2).38 x 24 x Roughness (n)

Time Lag to Peak Flow:
L = .66 mi
Lca = .47 mi
Elevation difference = 100 ft
Slope (ft/mi) = 100/.66 =151
n = 0.075
TL = ([.66x.47]/[151]1/2).38x 24 x .075
TL = 8 min

Figure 40. USGS 7.5"quadrangle with watershed area outlined in black, project site highlighted in green and Winter Creek outlined in blue.


Figure 38. Foam in project site during precipitation, October 23, 2010.


Figure 39. Trash in project site following precipitation, October 31, 2010.

Using the Waananen and Crippen method for the Central Coast Region for, where A is watershed area (in acres), p is mean annual precipitation (in inches) and H is average watershed altitude (in thousands of feet), we calculated that:

Q2 = 0.0061(A^.92)(p^2.54)(H^-1.10) = 0.0061(160^.92)(25^2.54)(700^-1.10) = 1.71 cfs

Q100 = 19.7(A^0.88)(p^.84)(H^-.33) = 19.7(160^.88)(25^.84)(700^-.33) = 26.71 cfs

Although these number reflect the small size of the watershed, this calculation is oversimplified and does not address the increased impermeable surfaces in the watershed. As a result, the current Q2 and Q100 at the site would be much higher.

In an effort to capture those changes in permeability upstream, we also calculated the relative infiltration rates prior to development, under the current level of development (estimated at 30% of the watershed area), and with a 20% increase in development. The soils in the Winter Creek watershed are primarily poorly-drained C and D class soils. We estimated that under pre-development conditions, the watershed had a Curve Number (CN) of 84 and that 6% of precipitation became run-off. Under current conditions, we estimated that the CN had increased to 88 and 13% runoff and likewise we estimate that there was a 20% increase in development in the watershed (50% of the total area) the CN would be 90 with 17% of precipitation as runoff.

Discussion

It was difficult to answer many of our research questions because we did not receive all the detailed planning documents for the project. We received only draft plan views of the three reaches described, design plans for each of the reaches, and design cross sections for the gabion reach as well as preliminary vegetation plans and maps. Later on in the post project appraisal, we received a design profile in the form of Auto cad files from PWA. However, these were still draft versions and only provided new information on the draft design of cross sections 1-4. This meant that we were only able to interpret the data we collected in the field as compared to preliminary and draft data from the project without the detail and precision we would have with final plans and as-built data. In our email communications with PWA it was mentioned that they only spot checked the contractor's (Hanford ARC's) work and they anticipated that we might find some discrepancies between the design and what was built.

Channel surveying

Our analysis comparing the preliminary designs with our current surveying data did find discrepancies between the design and what was built. As discussed in the results, the cross sections show that in many places the designed bank cuts were not constructed and more fill was applied to the slope than originally predicted. Cross section D (Fig. 13) in the gabion reach is a good example of this variation between design and construction. At each cross section location which dememonstrated this discrepancy one or several redwood trees were present. It may be assumed that the contractors deviated from the design plan in order to maintain these trees. This is not surprising as one of the goals of the project was to reach a balance between the restoration effort and the Botanical Garden's educational goals to teach visitors about California's redwood ecosystems. Precipitation data aquired throught the California Department of Water Resources California Data Exchange website shows that 2009 in this area was the dryest year in the last five (California Data Exchange, 2010). By the time we performed this assessment in October of 2010 the area had only received approximatly 25 inches of precipitation, the area's mean annual rainfall (California Data Exchange, 2010). The project therefore has proven to be able to withstand an average water year but has yet to experience an extreme event. Furthermore, on October 23, during our survey of the gabion reach, we observed flow out of the culvert approximatly ten minutes after it began to rain. However, there was no flow on the surface of the channel until it emerged from beneath the last gabion. The water flowing out from beneath the gabion was not silty so it is unknown if this subsurface flow is causing erosion beneath the gabion. If our measurements and assumptions are correct, however, the observed cross section and flow conditions could promote erosion in these areas over the long term or perhaps during an extreme precipitation event.

Vegetation surveying

The success of the native plant revegetation was difficult to classify because we received only a preliminary plan. Chris Carmichael described the process through which the Botanical Gardens and the restoration designers achieved a balance between the restoration goals and the educational goals of the UC Botanical Garden. The Botanical Garden's objective for the Redwood Grove is to teach visitors about the vegetation native to California's redwood ecosystems. However, historically, the vegetation would have presumably resembled the riparian oak woodland ecosystem that surrounds Strawberry Creek on the other side of Centennial Drive. The creek was most likely not a redwood ecosystem as it is located outside the redwood range in California. For these reasons the planting plan went through numerous iterations to incorporate riparian plants (e.g. willows, dogwoods, sedges, rushes) with plants native to a redwood forest understory (e.g. sword ferns, azaleas, redwood sorrel). Some plants that were not listed in the plan were actually present in planting areas (Table 3-4). On the other hand, some plants that were listed in the plan were either not present in the planting area

or were present but in different numbers than were listed. Qualitatively, the plantings seemed to be successful, with the exception of many individuals of California azalea (Rhododendron occidentalis), which had fewer survivors over all and seemed to be in poor health (Tables 1-3). All observed California azaleas were more sparsely foliaged than would be expected and had spotting on the leaves, which denoted disease to us.

The success of the live pole plantings was similarly difficult to quantify because the planting plan we received showed the locations of live pole plantings but not the number planted (Fig. 20 and 22). We found the live pole plantings to have a low survival rate when comparing our counts of foliaged poles vs. bare poles (Table 4). The live pole plantings were more successful on the sunnier portion of the left bank downstream of the footbridge, but were not successful in the shade (Fig. 21). On the right bank, we counted three times as many dead or dormant pole plantings than alive and foliaged ones (Table 4; Fig. 21). As this vegetation is proposed to provide bank stabilization functions, the shade caused by the large redwoods adjacent to the right bank plantings demonstrate how the planting compromises in the planning process have created potentially unsustainable riparian vegetation which may put the bank stability at risk under future high flow events.

Photomonitoring

Although we were not able to obtain all of the photographs that corresponded with the photopoints, we can draw some conclusions based on the photos we were able to compare. The rock armoring / gabions do not appear to have eroded or moved during the first winter after installation (Fig. 20-24). The photographs show the greater extent of plant establishment on the left bank downstream of the foot bridge compared to that on the right bank (Figures 33-35). The annual grasses shown in many photographs were planted for soil stabilization in the first winter, are sterile, and will not reseed (Figures 26, 29, 32).

Hydrological analysis

Our hydrological analysis shows the very short lag time to peak flow in this small and steep watershed. It also demonstrates how development in the watershed has increased the percentage of percipitation that becomes runoff. Although we did not test water quality, the flow observed on October 23rd was silty and foamed as it spilled from the culvert indicating poor water quality. Future monitoring and restoration efforts could focus on increasing pervious surfaces and installing low impact designs upstream of the site, in order to reduce the flashiness of the stormwater flows to the site and to improve water quality before flows reach Strawberry Creek.

Conclusions / Recommendations

Restoration has been defined as the reestablishment of pre-disturbance ecosystem functions and related physical, chemical and biological characteristics (NRC, 1992), as the process of repairing damage caused by humans to the diversity and dynamics of indigenous ecosystems (Jordan et al, 1987), and as the return to an ecosystem that closely resembles unstressed surrounding areas (Gore, 1985). This specific project, however, was not based on the goal of restoring the site to pre-disturbance conditions. Prior to development in Strawberry Canyon, Winter Creek was presumably a small, ephemeral step-pool stream. Due to the highly urbanized nature of the Winter and Strawberry Creek watersheds, this definition of restoration may not be practical as it is impossible to recreate all historical conditions. However, according to the Society for Ecological Restoration (SER)'s 'International Primer on Ecological Restoration,' ecological restoration can also be defined as "the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed," frequently as the direct or indirect result of human activities (SER, 2004). The Winter Creek restoration plan can be categorized as a partial-restoration action that aims to restore only selected physical, chemical, or biological processes (Beechie et al, 2010). By this definition, this restoration has been successful in assisting the ecosystem in recovering from development-induced erosion. Although the extent of

armoring added to the channel is by no means historic, it has thus far been effective at reducing bank failure and downcutting (Palmer et al, 2005). The project goals were first and foremost to raise the channel bed and arrest erosion and bank failure. The project after the first year has been successful relative to these goals.

Although the primary objective of reducing erosion was achieved through this restoration project, many compromises were required to meet the contrasting goals of historical vegetation restoration and of teaching visitors to the Botanical Gardens about coastal redwood ecosystems. This project represented an interesting case where restoring historical ecosystems was perhaps not the highest priority at this site. This balance resulted in changes to the constructed design of a portion of the channel. For example, designed cuts were potentially not implemented potentially to maintain trees that were already present at the site and important to the gradens mission. It should be noted, however, that we performed the cross sections using a stadia rod and auto level and therefore it is possible that differences between our cross section data and the design plans is due to human error. If, in fact, the banks are steeper then designed there is a chance of erosion during dramatic precipitation events. However, the general success of the non-live pole planting will most likely help to stabalize these areas.

Compromises between restoration and education goals have impacted the success of the planting plan and potentially will also compromise the banks stability in the long run. Overall, the non-live pole plantings had good survivorship. In the instances where it was found that survivorship was poor as shown in Fig. 21, it would be of interest to note if the medium they are planted in, the water availability, or the elevations at which they were planted differs from the more successful plantings orwhether they were installed incorrectly or mishandled. These are some question we did not have time to investigate in more depth and might be of use in informing similar projects. However, it is evedent that the shading caused by the redwoods on the right bank has significantly hindered the survivorship of the live pole plantings. The purpose of these plantings is to provide bank stabilization therefore the right bank is now more susceptible to failure than the left bank where, unshaded, the live pole plantings have been very successful. This demonstrates how important it is to select restoration measures that are compatible with the surrounding environment. It is recommended that the project partners continue to monitor the project so that any problems that may arise from what we have observed can be identified and dealt with quickly to insure the stability of the banks.

Like many restorations projects, this project was affected by funding and permitting constraints (Beechie et. al. 2010). The construction designs went through much iteration to satisfy these constraints and additional changes occurred during construction to adapt the designs to the site conditions. Since we were not provided with complete documentation, including various planning document drafts and final construction designs, we are unable to draw definite conclusions on how the funding and permitting constraints impacted the final project construction. Jorgen Blomberg, Design Team Manager at PWA, mentioned that PWA did not perform post construction surveys and monitoring but did not explain the reasons for this. Funding for monitoring may have been limited which would have impeded the collection of post-assessment data. However, the project has only been finished for approximately one year. It is recommended that the project under go future monitoring efforts based on our post project appraisal which would include: regular repeat cross section and longitudinal profile surveys, annual photomonitoring at the same photopoints, and annual plant survivorship surveys. It is also reccomended that the partners replant the poor performing live-pole plantings with shade tolerant riparian vegatation. As mentioned above, future monitoring efforts could also include water quality. It is also reccomended that the partners replant the poor performing live-pole plantings with shade tolerant riparian vegatation. Finally, it is recommended that the project partners address upstream impact to the site by incorporating low impact design measures in the watershed in order to decrease the amount of impermeable surfaces upstream of the site.

References

Beechie, T. J. et al. 2010. Process-based Principles for Restoring River Ecosystems. BioScience: Vol. 60 No. 3. March 2010, p. 209

Bolton, Kate. 2010. Project Manager, UC Berkeley Capital Projects. Personal communication, October 18, 2010.

Blomberg, Jorgen. 2010. Design Team Director, ESA PWA. Personal communication, October 28, 2010.

California Data Exchange. 2010. 07 December 2010. California Department of Water Resources. 07 December 2010. http://cdec.water.ca.gov/histPlot/DataPlotter.jsp?staid=ONO&sensor_no=2&duration=H&start=01/01/2005+00:00&end=12/07/2010+17:28&geom=Large

Carmichael, Chris. 2010. Associate Director UC Berkeley Botanic Gardens. Personal Communication October 13, 2010.

Gore, J. A. 1985. Restoration of Rivers and Streams. Butterworth Publishers, Stoneham, MA.

Jordan, W.R. III, M.E. Gilpin, and J.D. Ober, Eds. 1987. Restoration Ecology: A Synthetic Approach to Ecological Research. Cambridge University Press, New York.

LBL. 2006. 2020 Long Range Development Plan. Accessed at: http://www.cp.berkeley.edu/LRDP_2020final.htm, November 6, 2010.

National Research Council (NRC). 1992. Restoration of Aquatic Ecosystems: Science, Technology, and Public Policy. Committee on Restoration of Aquatic Ecosystems: Science, Technology, and Public Policy.

Palmer, M. A. et al. 2005. Standards for ecologically successful river restoration. Journal of Applied Ecology. Volume 42, Issue 2, pages 208–217, April 2005

Regional Water Quality Control Board (RWQCB). 2006. Water Quality Certification for the Temporary Stabilization of a Failing Culvert on Winter Creek at the University of California at Berkeley Botanical Gardens in the City of Berkeley, Alameda County. January 31, 2006

Save Strawberry Canyon. 2010. Threats to Strawberry Canyon. Accessed at: http://savestrawberry-canyon.org/threats.html, November 6, 2010.

Society of Ecological Restoration. 2004. International Primer on Ecological Restoration Society for Ecological Restoration. International Science & Policy Working Group. Version 2, October, 2004.

United States Army Corps of Engineers (USACE). 2007. Regulatory Branch, SUBJECT: File Number 29866s. August 20, 2007.

Appendices

A. Restoration Designs
B. Revegetation Plan
C. Photomonitoring points and upstream/downstream reach cross section locations
D. Permit letters from USACE, CDFG, and RWQCB

Appendices

A. Restoration Designs
B. Revegetation Plan
C. Photomonitoring points and upstream/downstream reach cross section locations
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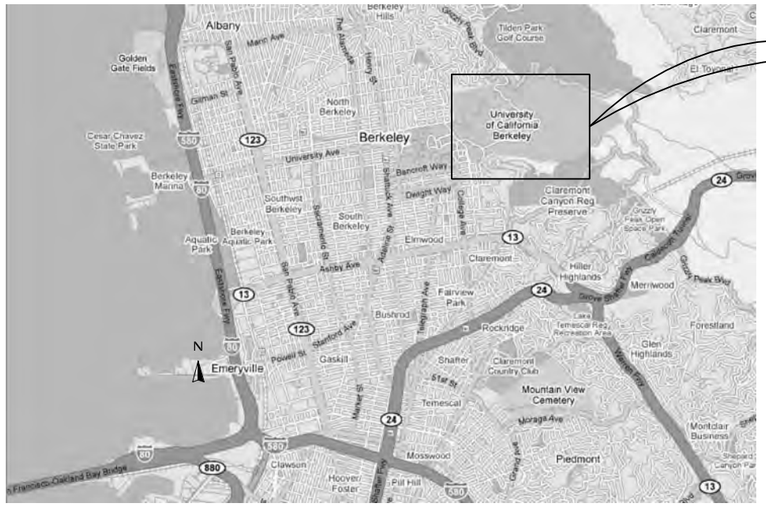
WINTER CREEK STABILIZATION & ENHANCEMENT PROJECT

UNIVERSITY OF CALIFORNIA, BERKELEY
UC BOTANICAL GARDENS
BERKELEY, CALIFORNIA



VICINITY MAP

LOCATION MAP

LEGEND

- (E) CONTOUR MAJOR (85)
- (E) CONTOUR MINOR
- PROPOSED CONTOUR MAJOR (90)
- PROPOSED CONTOUR MINOR
- GRADING LIMITS
- PROJECT LIMITS
- TOP OF BANK
- TOE OF BANK
- FILTER FABRIC
- IMPERMEABLE BARRIER
- ROPE
- UNWOVEN FABRIC
- WOVEN FABRIC
- ACCESS ROUTE
- COIR ROLL
- SACRETE WALL (E)
- SPOT ELEVATION (112.35)
- SLOPE INDICATOR
- BRUSHMAT
- (E) CONCRETE
- EXISTING GROUND
- EXCAVATION ONLY
- EXCAVATION & BACKFILL
- FILL
- STAGING AREA
- VEGETATED SOIL LIFTS (VSL)
- BENCHMARK (TEMPORARY)
- CONTROL POINT
- EXISTING TREE (PIP)
- EXISTING TREE (TO BE REMOVED)
- DETAIL (X) / SHEET DETAIL IS LOCATED (Y)

ABBREVIATIONS

CMP	CORRUGATED METAL PIPE
EOP	EDGE OF PATH
EL	ELEVATION
(E)	EXISTING
HDPE	HIGH DENSITY POLYETHYLENE
INV	INVERT
LB	POUND
MAX	MAXIMUM
MIN	MINIMUM
PIP	PROTECT IN PLACE
PLS	PURE LIVE SEED
RC	RELATIVE COMPACTION
RCP	REINFORCED CONCRETE PIPE
STA	STATION
SPECS	SPECIFICATIONS
TBD	TO BE DETERMINED
TOB	TOP OF BANK
TYP	TYPICAL
W/	WITH

DRAWING LIST

GENERAL NOTES

1. RECONSTRUCTED CHANNEL SHHALL CONFORM TO EXISTING TOPOGRAPHY AS MUCH AS POSSIBLE.
2. GRADE CONTROL STRUCTURES SHALL BE FIELD LOCATED AND ADJUSTED AS NEEDED. SEE SPECIFICATIONS.
3. WHERE CHANNEL STABILIZATION PLAN AND PROFILE DIFFER, THE PROFILE GOVERNS. PLAN VIEW SHOWS THE TYPICAL EXTENT AND NATURE OF THE WORK. SEE GRADING SECTIONS AND DETAILS CLARIFICATION.
4. PROTECT ALL EXISTING TREES, EXCEPT THOSE SLATED FOR DEMOLITION, AND OTHER IMPORTANT VEGETATION WILL BE IDENTIFIED AND PROTECTED AS POSSIBLE IN CONSULTATION WITH UC BOTANICAL GARDEN STAFF.
5. SITE TOPOGRAPHIC SURVEY WAS PERFORMED IN FEBRUARY 2009 BY BASELINE ENVIRONMENTAL AND IS INTENDED FOR USE IN CHANNEL STABILIZATION DESIGN BY PHILIP WILLIAMS & ASSOCIATES AND THE UNIVERSITY.
6. ELEVATIONS SHOWN ARE BASED ON A TEMPORARY BENCH MARK (TBM) LOCATED AT THE SOUTHEAST CORNER OF THE CONCRETE UTILITY BOX ABOVE THE CMP OUTLET, ON THE EXISTING GRAVEL PATH. TMB SHOWN ON SHEET R8. ASSUMED ELEVATION=124.88, NORTHING=73.7, EASTING=0.6.
7. AN AUTOCAD LAYOUT PLAN AND THE UNDERLYING TOPOGRAPHIC SURVEY BASE MAP WILL BE FURNISHED PRIOR TO CONSTRUCTION FOR LOCATION OF ALL PROPOSED IMPROVEMENTS. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ESTABLISH HORIZONTAL AND VERTICAL CONTROL BASED ON THE SUPPLIED AUTOCAD FILES AND FEATURES SHOWN ON THE SURVEY, TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE. THE CONTRACTOR SHALL FIELD STAKE THE MAJOR IMPROVEMENTS, SHOWING BOTH HORIZONTAL AND VERTICAL LOCATION, FOR REVIEW AND APPROVAL BY OWNER'S REPRESENTATIVE PRIOR TO THE BEGINNING OF THE WORK.
8. NO SITE UTILITY WAS SURVEYED OR MAPPED. UNDERGROUND UTILITIES, IF EXISTING, HAVE NOT BEEN LOCATED OR IDENTIFIED IN THE SURVEY.

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SHEET TITLE: TITLE SHEET

WINTER CREEK STABILIZATION & ENHANCEMENT PROJECT
BUILDING OR PROJECT

PREPARED FOR:
UNIVERSITY OF CALIFORNIA
UC BOTANICAL GARDENS
BERKELEY, CALIFORNIA

APPROVED	
DESIGNED	JAB, SLS
DRAWN	SLS
INCHARGE	AEB
LOCATION	
SCALE	AS SHOWN
FILE NO.	1773.02
DATE	MAY 2009
SHEET	R0

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NOTES:

1. HARVESTED TREES SHALL BE CHIPPED AND USED ON SITE FOR EROSION CONTROL. SEE SHEET R11
2. SALVAGE AND REUSE ROCKS FROM (E) GEO GRID BASKETS AND GRAVEL BAGS. DISCARD GEOGRID AND BAG MATERIALS
3. INCORPORATE CONCRETE RUBBLE INTO SUBGRADE. CONCRETE SHALL NOT BE VISIBLE ON SURFACE OF CHANNEL.
4. FOOTBRIDGE SHALL BE REMOVED FROM FOOTINGS PRIOR TO CHANNEL CONSTRUCTION. PROTECT FOOTINGS IN PLACE. OWNER'S REPRESENTATIVE SHALL REVIEW CONDITION OF BRIDGE AND PROVIDE APPROVAL FOR TO REPLACEMENT.

(E) GEO-GRID AND GRAVEL BAGS REMOVE AND SALVAGE GRANULAR MATERIAL, TYP. (NOTE 2)

(E) CONCRETE RUBBLE, SALVAGE FOR SUBGRADE TYP. (NOTE 3)

(E) 30" CMP SALVAGE AND REUSE

PROJECT LIMITS, TYP.

GRADING LIMITS APPROX., TYP.

(E) TREE, PIP (TYP)

TREE TO BE REMOVED, TYP. OF 19 (NOTE 1)

POND

(E) FOOT BRIDGE TO BE REMOVED AND REPLACED (NOTE 4)

(E) LEVEL SPREADER AND RSP, PIP

CONSTRUCTION ACCESS, TYP

(E) PATH AND STAIRS TO BE RESTORED TO (E) CONDITION POST CONSTRUCTION

BOLLARD TO BE REMOVED, TYP.

(E) DRAIN PIPE TO BE REMOVED AND REPLACED W/ OUTLET AT CREEK INVERT

STAGING AREA

N

0 5 10 20

SCALE (FEET)

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PREPARED BY:

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SHEET TITLE

DEMOLITION AND ACCESS PLAN

WINTER CREEK STABILIZATION & ENHANCEMENT PROJECT

BUILDING OR PROJECT

PREPARED FOR:

UNIVERSITY OF CALIFORNIA
UC BOTANICAL GARDENS
BERKELEY, CALIFORNIA

APPROVED	
DESIGNED	JAB, SLS
DRAWN	SLS
INCHARGE	AEB
LOCATION	
SCALE	AS SHOWN
FILE NO.	1773.02
DATE	MAY 2009
SHEET	R1

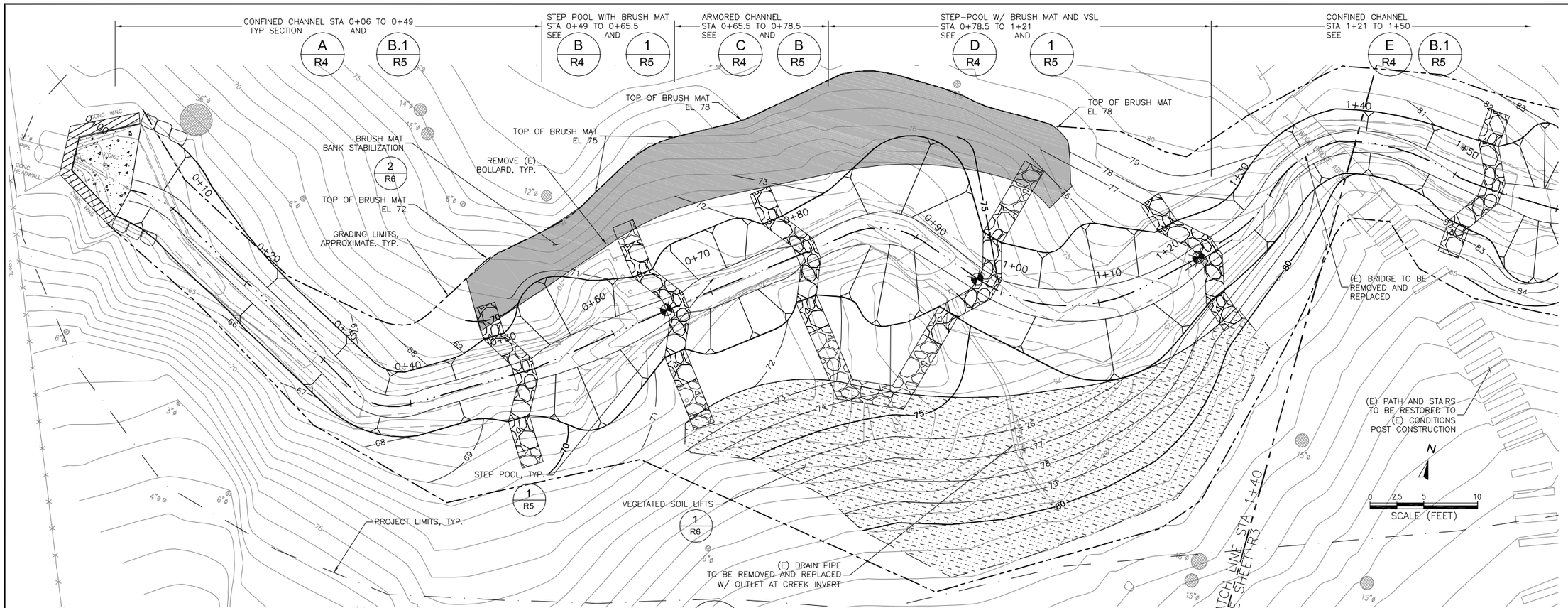
CONFINED CHANNEL STA 0+06 TO 0+49 TYP SECTION A R4 AND B.1 R5

STEP POOL WITH BRUSH MAT STA 0+49 TO 0+65.5 SEE B R4 AND 1 R5

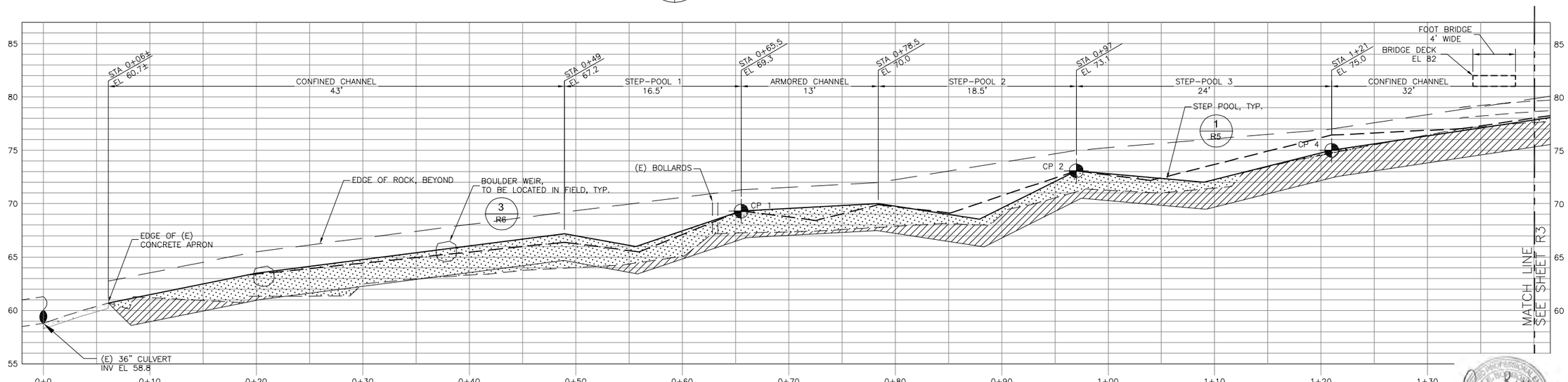
ARMORED CHANNEL STA 0+65.5 TO 0+78.5 SEE C R4 AND B R5

STEP-POOL W/ BRUSH MAT AND VSL STA 0+78.5 TO 1+21 SEE D R4 AND 1 R5

CONFINED CHANNEL STA 1+21 TO 1+50 SEE E R4 AND B.1 R5



1 - - DOWNSTREAM PLAN
STA 0+00 TO STA 1+40 SCALE: 1"=5'



A - - DOWNSTREAM PROFILE
STA 0+00 TO STA 1+40 SCALE: 1"=5'

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SHEET TITLE
DOWNSTREAM PLAN & PROFILE

WINTER CREEK STABILIZATION & ENHANCEMENT PROJECT
BUILDING OR PROJECT

PREPARED FOR:
UNIVERSITY OF CALIFORNIA
UC BOTANICAL GARDENS
BERKELEY, CALIFORNIA

APPROVED	
DESIGNED	JAB, SLS
DRAWN	SLS
INCHARGE	AEB
LOCATION	
SCALE	AS SHOWN
FILE NO.	1773.02
DATE	MAY 2009
SHEET	R2

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CONFINED CHANNEL STA 1+21 TO 1+53 SEE E R4 AND B.1 R5

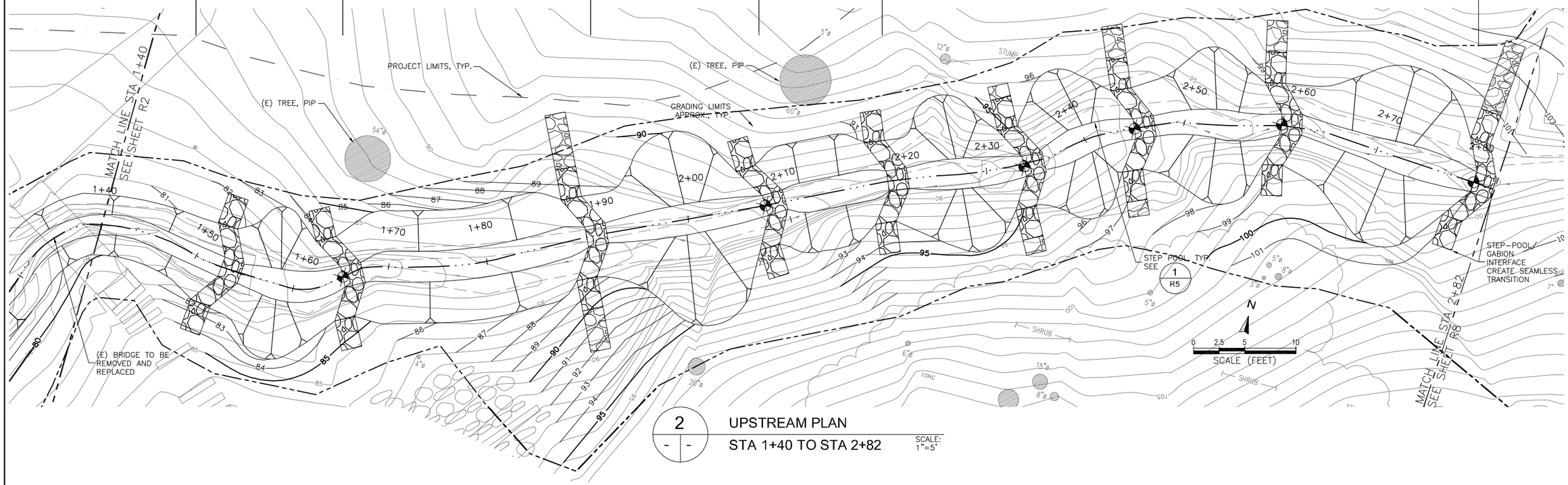
UPSTREAM STEP-POOL STA 1+53 TO STA 1+65 SEE F R4 AND 1 R5

ARMOR CHANNEL STA 1+65 TO STA 1+90 SEE G R4 AND B R5

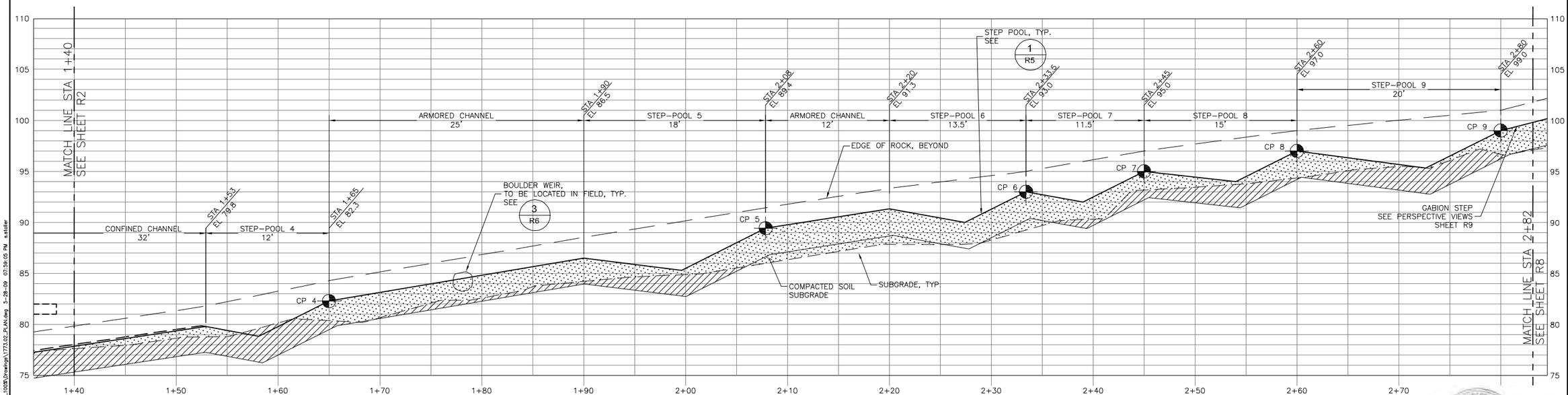
UPSTREAM STEP-POOLS STA 1+90 TO STA 2+08 SEE F R4 AND 1 R5

ARMOR CHANNEL STA 2+08 TO STA 2+20 SEE G R4 AND B R5

UPSTREAM STEP-POOLS STA 2+20 TO STA 2+80 SEE F R4 AND 1 R5



2 - - UPSTREAM PLAN
STA 1+40 TO STA 2+82 SCALE: 1"=5'



B - - UPSTREAM PROFILE
STA 1+40 TO STA 2+82 SCALE: 1"=5'

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UPSTREAM PLAN & PROFILE

WINTER CREEK STABILIZATION & ENHANCEMENT PROJECT

BUILDING OR PROJECT

SHEET TITLE

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BERKELEY, CALIFORNIA

APPROVED

DESIGNED JAB, SLS
DRAWN SLS
INCHARGE AEB
LOCATION
SCALE AS SHOWN
FILE NO. 1773.02
DATE MAY 2009
SHEET

R3

RECOMMENDED FOR APPROVAL C 053410 Exp. 6/30/09 CIVIL STATE OF CALIFORNIA

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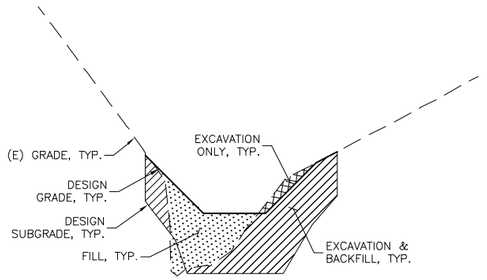
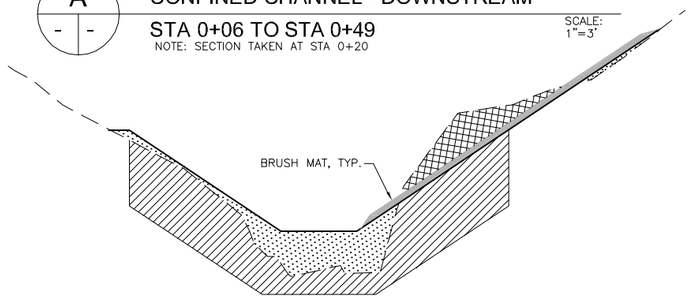
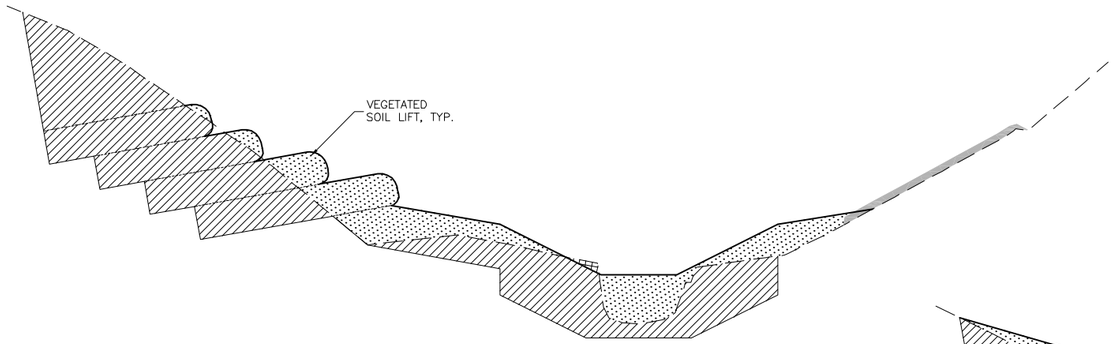


A — CONFINED CHANNEL - DOWNSTREAM
STA 0+06 TO STA 0+49
NOTE: SECTION TAKEN AT STA 0+20
SCALE: 1"=3'

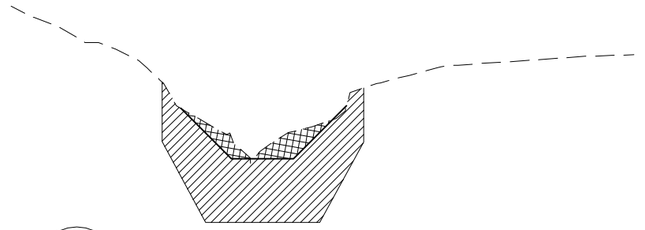


B — STEP-POOL W/ BRUSH MAT
STA 0+49 TO STA 0+66
NOTE: SECTION TAKEN AT STA 0+55
SCALE: 1"=3'

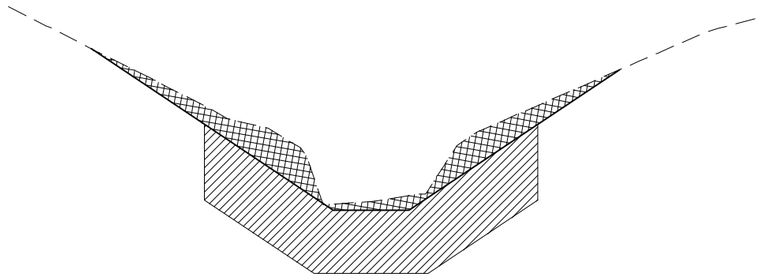


C — ARMORED CHANNEL - DOWNSTREAM
STA 0+66 TO STA 0+79
NOTE: SECTION TAKEN AT STA 0+70
SCALE: 1"=3'

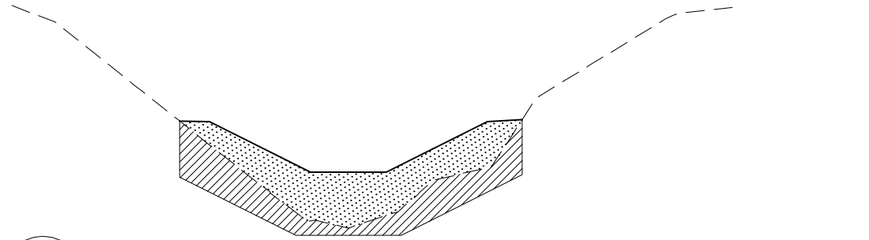
HATCH KEY
- EXCAVATION ONLY
- EXCAVATION & BACKFILL
- FILL



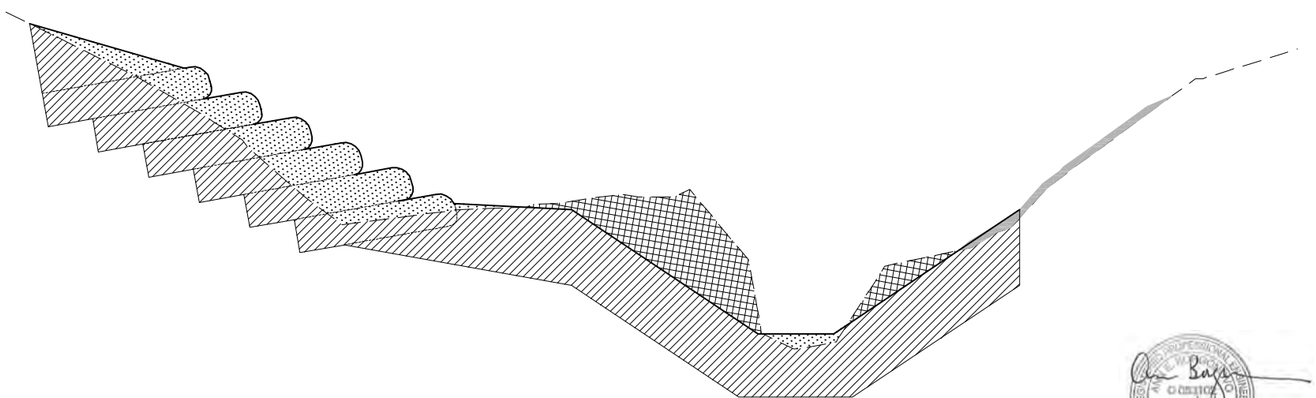
E — CONFINED CHANNEL - UPSTREAM
STA 1+21 TO STA 1+50
NOTE: SECTION TAKEN AT STA 1+30
SCALE: 1"=3'



F — STEP-POOL - UPSTREAM
STA 1+50 TO 1+65, STA 1+90 TO 2+08, & STA 2+20 TO 2+80
NOTE: SECTION TAKEN AT STA 1+60
SCALE: 1"=3'



G — ARMORED CHANNEL - UPSTREAM
STA 1+65 TO 1+90 & STA 2+08 TO 2+20
NOTE: SECTION TAKEN AT STA 1+80
SCALE: 1"=3'



D — STEP-POOL W/ BRUSH MAT & VSL
STA 0+79 TO STA 1+21
NOTE: SECTION TAKEN AT STA 0+88
SCALE: 1"=3'

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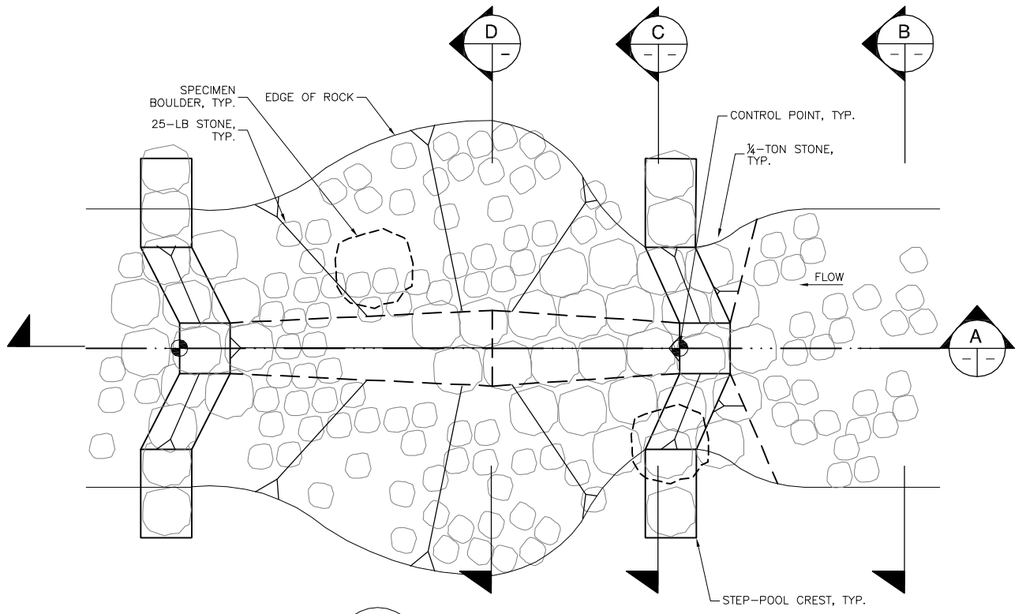
SHEET TITLE: TYPICAL CHANNEL GRADING SECTIONS

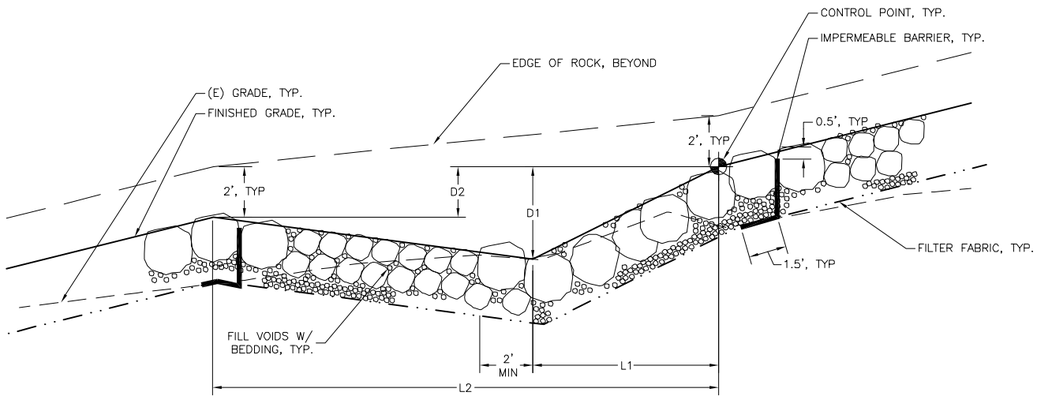
WINTER CREEK STABILIZATION & ENHANCEMENT PROJECT
BUILDING OR PROJECT

PREPARED FOR:
UNIVERSITY OF CALIFORNIA
UC BOTANICAL GARDENS
BERKELEY, CALIFORNIA

APPROVED	
DESIGNED	JAB, SLS
DRAWN	SLS
INCHARGE	AEB
LOCATION	
SCALE	AS SHOWN
FILE NO.	1773.02
DATE	MAY 2009
SHEET	R4



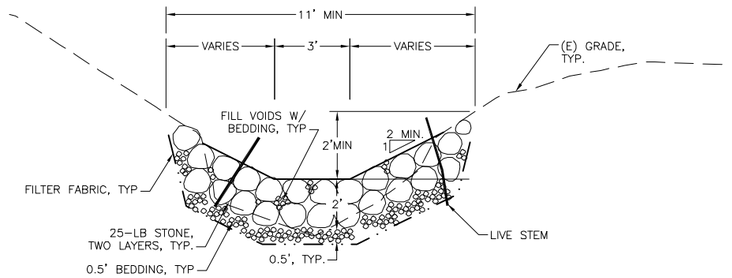
1 R1 R2 R5 — STEP-POOL TYPICAL PLAN — SCALE: 1"=3'



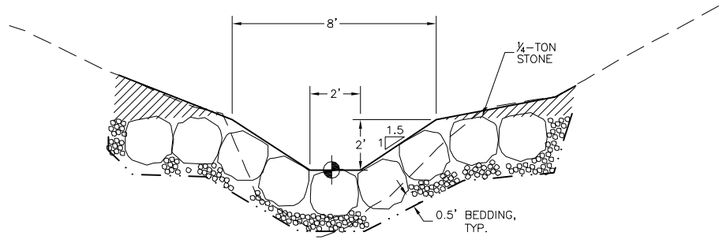
A - - STEP-POOL TYPICAL PROFILE — SCALE: 1"=3'

STEP-POOL SCHEDULE

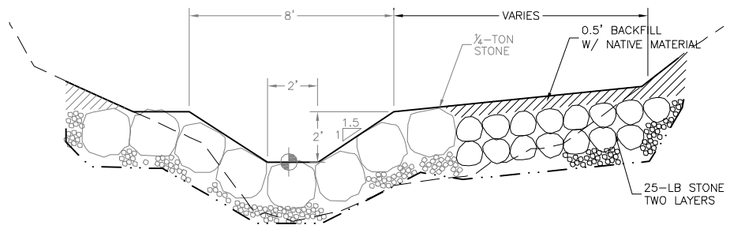
STEP-POOL	CP STA	CP ELEV	NORTHING	EASTING	L1	L2	D1	D2	W
1	0+65.5	69.3	-23.5	-259.4	9.9	16.6	3.3	2.1	15.2
2	0+97	73.1	-13.1	-232.3	9.1	18.6	4.5	3.1	18
3	1+21	75.0	-5.8	-213.0	12	24.0	3.0	1.9	15
4	1+65	82.2	9.8	-177.7	6.9	12.1	3.5	2.5	15.1
5	2+08	89.4	27.4	-139.8	8.3	17.9	4.1	2.9	17.3
6	2+33.5	93.0	37.8	-116.4	6.0	13.4	3.0	1.7	15.8
7	2+45	95.0	44.2	-107.0	6.0	11.6	3.0	2.0	14.9
8	2+60	97.0	48.4	-93.2	6.0	15.0	3.0	2.0	15.6
9	2+80	99.0	47.9	-73.7	7.3	20.0	3.7	2.0	17.8



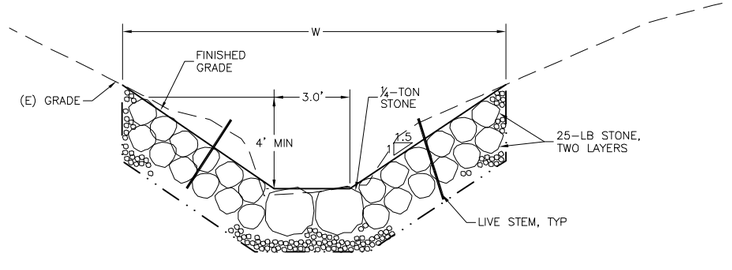
B R2,R3,R6 R5 — CHANNEL ARMOR TYPICAL SECTION — SCALE: 1"=3'



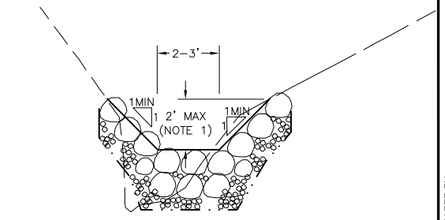
C - R5 — CREST TYPICAL SECTION — SCALE: 1"=3'



C.1 - R5 — CREST W/ TERRACE CUTOFF TYPICAL SECTION (NOTE 2) — SCALE: 1"=3'



D - R5 — POOL TYPICAL SECTION — SCALE: 1"=3'



B.1 R2,R3 R5 — CONFINED CHANNEL TYPICAL SECTION — SCALE: 1"=3'

NOTES:

1. PLACEMENT AND HEIGHT OF ARMOR STONE TO BE DETERMINED. BASED ON SITE SPECIFIC CONDITIONS.
2. CREST CUTOFF SECTION C.1 CAN APPLY ON THE LEFT OR RIGHT BANK AND WILL BE USED AT STATIONS: 0+65.5, 0+78.5, 0+97, AND 2+80.

ROCK SCHEDULE

LOCATION	ROCK TYPE
CHANNEL	25-LB: CALTRANS BACKING CLASS NO.2
STEP-POOL: CREST	1/4 -TON
STEP-POOL: RAMP	1/4 -TON
STEP-POOL: POOL	25-LB: CALTRANS BACKING CLASS NO.2
BOULDER WEIR	1/4 -TON

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SHEET TITLE
TYPICAL CHANNEL AND STEP POOL DETAILS

WINTER CREEK STABILIZATION & ENHANCEMENT PROJECT
BUILDING ON PROJECT

PREPARED FOR:
UNIVERSITY OF CALIFORNIA
UC BOTANICAL GARDENS
BERKELEY, CALIFORNIA

APPROVED
DESIGNED JAB, SLS
DRAWN SLS
INCHARGE AEB
LOCATION
SCALE AS SHOWN
FILE NO. 1773.02
DATE MAY 2009
SHEET
R5

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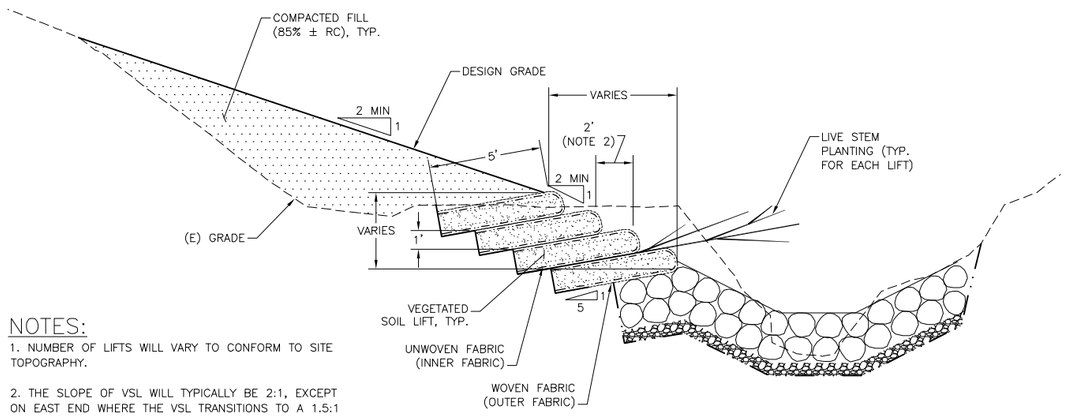
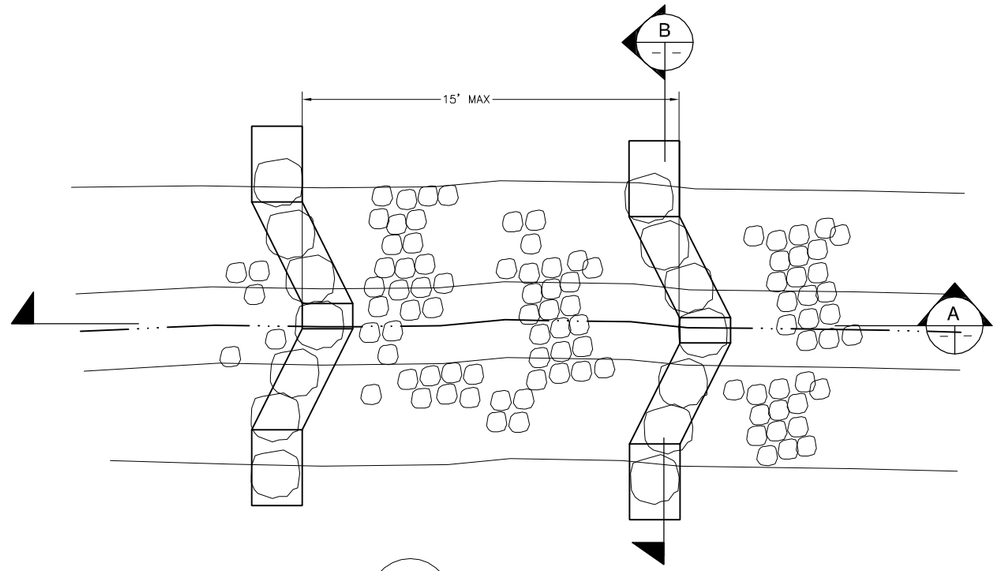


NOTES:

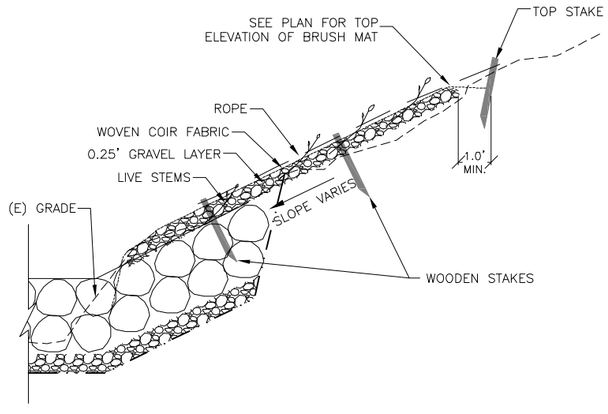
1. NUMBER OF LIFTS WILL VARY TO CONFORM TO SITE TOPOGRAPHY.

2. THE SLOPE OF VSL WILL TYPICALLY BE 2:1, EXCEPT ON EAST END WHERE THE VSL TRANSITIONS TO A 1.5:1 SLOPE. THE HORIZONTAL DIMENSION WILL DECREASE IN THE TRANSITION.

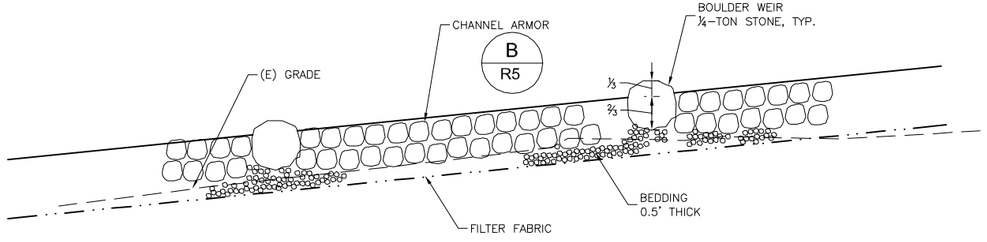
1 / R1 R6 — BIOTECHNICAL STABILIZATION: VEGETATED SOIL LIFT (VSL) TYPICAL SECTION — SCALE: NTS



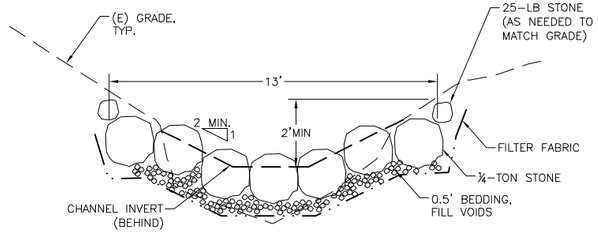
3 / R1, R2 R6 — BOULDER WEIR PLAN — SCALE: 1"=3'



2 / R1 R6 — BIOTECHNICAL STABILIZATION: BRUSH MAT TYPICAL SECTION — SCALE: NTS



A / - - — BOULDER WEIR PROFILE — SCALE: 1"=3'



B / - - — BOULDER WEIR SECTION — SCALE: 1"=3'

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SHEET TITLE: BANK STABILIZATION & BOULDER WEIR DETAILS

WINTER CREEK STABILIZATION & ENHANCEMENT PROJECT

BUILDING OR PROJECT

PREPARED FOR:
UNIVERSITY OF CALIFORNIA
UC BOTANICAL GARDENS
BERKELEY, CALIFORNIA

APPROVED	
DESIGNED	JAB, SLS
DRAWN	SLS
INCHARGE	AEB
LOCATION	
SCALE	AS SHOWN
FILE NO.	1773.02
DATE	MAY 2009
SHEET	R6

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PLANTING NOTES

1. PLANTING AND SEEDING SCHEDULES ARE PROVISIONAL FOR SUGGESTED POTENTIAL PLANT SPECIES. PLANT AND SEEDING LISTS, INCLUDING PROVENANCE, WILL BE REVISED AND APPROVED BY UCB BOTANICAL GARDEN STAFF BASED ON SPECIES OCCURING IN NATIVE COASTAL REDWOOD FOREST AND EAST BAY RIPARIAN PLANT COMMUNITIES.

2. ALL DISTURBED AREAS WILL BE PLANTED AND/OR HYDRO–SEEDED FOR EROSION CONTROL AND REVEGETATION.

3. NATIVE TREES THAT ARE REMOVED WILL BE REPLACED AT A 3:1 RATIO (MINIMUM).

PLANT SCHEDULE

	BOTANICAL NAME	COMMON NAME	MIN. SPACING	SIZE	QUANTITY
PERENNIALS	*ADIANTUM JORDANII*	**CALIFORNIA MAIDENHAIR FERN**	4' O.C.	1 GALLON	24
	ASARUM CAUDATUM	**WILD GINGER**	18" O.C.	1 GALLON	50
	CAREX NUDATA	**TORRENT SEDGE**	2' O.C.	1 GALLON	100
	EQUISETUM ARVENSE	**HORSETAIL**	12" O.C.	1 GALLON	60
	HEUCHERA MICRANTHA	**ALUM ROOT**	6' O.C.	1 GALLON	24
	IRIS DOUGLASIANA	**DOUGLAS IRIS**	18" O.C.	1 GALLON	100
	JUNCUS PATENS	**COMMON RUSH**	2' O.C.	1 GALLON	40
	LONICERA HISPUDULA	**CALIFORNIA HONEYSUCKLE**	7' O.C.	1 GALLON	12
	LONICERA INVOLUCRATA	**BLACK TWINBERRY**	6' O.C.	5 GALLON	8
	OXALIS OCCIDENTALIS	**REDWOOD SORREL**	1' O.C.	1 GALLON	200
	POLYSTITCHUM MUNITUM	**WESTERN SWORDFERN**	4' O.C.	1 GALLON	80
	WOODWARDIA FIMBRIATA	**GIANT CHAIN FERN**	4' O.C.	1 GALLON	20
SHRUBS	*CERCIS OCCIDENTALIS*	**WESTERN REDBUD**	6' O.C.	5 GALLON	18
	CORNUS RUBRA	**RED -STEMMED DOGWOOD**	4' O.C.	1 GALLON	40
	HETEROMELES ARBUTIFOLIA	**TOYON**	8' O.C.	5 GALLON	4
	RIBES SANGUINEUM	**FLOWERING CURRANT**	5' O.C.	1 GALLON	38
	ROSA CALIFORNICA	**CALIFORNIA ROSE**	8' O.C.	1 GALLON	33
	RUBUS SPP.	**CALIFORNIA BLACKBERRY**	6' O.C.	1 GALLON	108
	SYMPHORICARPOS ALBUS	**CALIFORNIA SNOWBERRY**	6' O.C.	5 GALLON	20
TREES	*ACER MACROPHYLUM*	**BIG-LEAF MAPLE**	--	5 GALLON	12
	AESCULUS CALIFORNICA	**CALIFORNIA BUCKEYE**	--	15 GALLON	9
	ALNUS RHOMBIFOLIA	**WHITE ALDER**	--	15 GALLON	6
	LAURUS CALIFORNICA	**CALIFORNIA BAY**	--	5 GALLON	8
	SEQUOIA SEMPERVIRINS	**COAST REDWOOD**	--	15 GALLON	12
	QUERCUS ARGIFOLIA	**COAST LIVE OAK**	--	15 GALLON	8
BIOTECH	*SALIX LASIOLEPIS*	**ARROYO WILLOW**	--	CUTTING	TBD
	SALIX LAEVIGATA	**RED WILLOW**	--	CUTTING	TBD
	CORNUS RUBRA	**RED -STEMMED DOGWOOD**	--	CUTTING	TBD
	SYMPHORICARPOS ALBUS	**CALIFORNIA SNOWBERRY**	--	CUTTING	TBD

SEED MIX SCHEDULE

MIX	SEED AND OTHER COMPONENTS	FUNCTION/TYPE	QUANTITY/ACRE – PLS (LBS)
1	**BLUE WILD RYE** *(ELYMUS GLAUCUS)*	PERENNIAL	10 (7.5)
1	**CALIFORNIA BROME** *(BROMUS CARINATUS) NATIVE VARIETY*	PERENNIAL	10 (7.5)
1	**FAREWELL-TO-SPRING** (*CLARKIA ELEGANS*)	PERENNIAL	3 (2.25)
1	**CALIFORNIA POPPY** *(ESCHSCHOLZIA CALIFORNICA)*	ANNUAL	3 (2.25)
1	**RED FESCUE MOLATE** (*FESTUCA RUBRA*)	NATIVE GRASS	3(2.25)
	TOTAL		**29.0** (21.75)
1	MULCH	EROSION CONTROL	2000
1	FERTILIZER	PLANT ESTABLISHMENT	200
1	TACKIFIER	EROSION CONTROL	100

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SHEET TITLE
PLANTING SCHEDULE

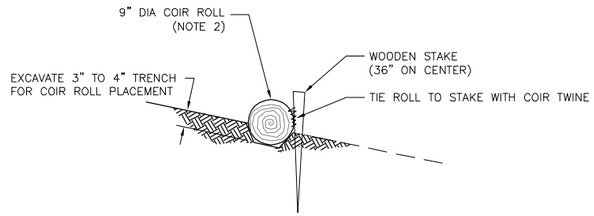
WINTER CREEK STABILIZATION & ENHANCEMENT PROJECT
BUILDING OR PROJECT

PREPARED FOR:
UNIVERSITY OF CALIFORNIA
UC BOTANICAL GARDENS
BERKELEY, CALIFORNIA

APPROVED	
DESIGNED	JAB, SLS
DRAWN	SLS
INCHARGE	AEB
LOCATION	
SCALE	AS SHOWN
FILE NO.	1773.02
DATE	MAY 2009
SHEET	R7

NOTES:

1. AT A MINIMUM, COIR WATTLES TO BE PLACED AS SHOWN.
2. CONTOUR SPACING BETWEEN WATTLES SHALL NOT BE GREATER THAN 10FT CENTER TO CENTER.
3. ALL DISTURBED AREAS TO BE HYDROSEEDED AND/OR PLANTED. CONTRACTOR TO SUBMIT HYDROSEEDING AND PLANTING PLAN TO BOTANICAL GARDEN STAFF FOR APPROVAL.
4. PLACE COIR WATTLES AND /OR BIODEGRADABLE EROSION CONTROL FABRIC AS NEEDED ON ALL DISTURBED AREAS. SEE SPECIFICATIONS.
5. BRUSH MAT AND VEGETATED SOIL LIFTS ARE INTEGRAL TO LONG-TERM EROSION CONTROL STRATEGY.



A COIR WATTLE DETAIL

SCALE: NTS

COIR WATTLE, TYP.
(NOTES 1-4)
A

BRUSH MAT
(NOTE 5)

VEGETATED SOIL LIFTS
(NOTE 5)

COIR WATTLE

STAGING AREA

SCALE (FEET) 0 5 10 20

N

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SHEET TITLE
EROSION CONTROL PLAN

WINTER CREEK STABILIZATION & ENHANCEMENT PROJECT
BUILDING OR PROJECT

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BERKELEY, CALIFORNIA

APPROVED	
DESIGNED	JAB, SLS
DRAWN	SLS
INCHARGE	AEB
LOCATION	
SCALE	AS SHOWN
FILE NO.	1773.02
DATE	MAY 2009
SHEET	R11

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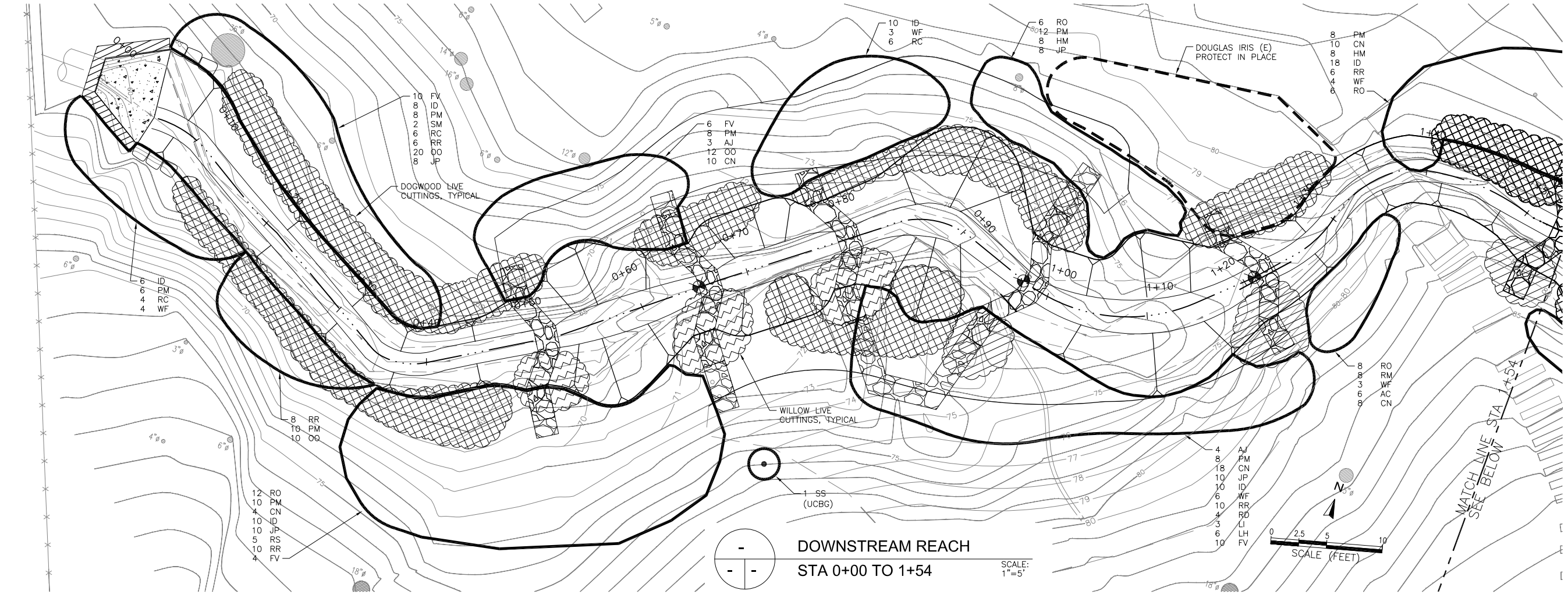
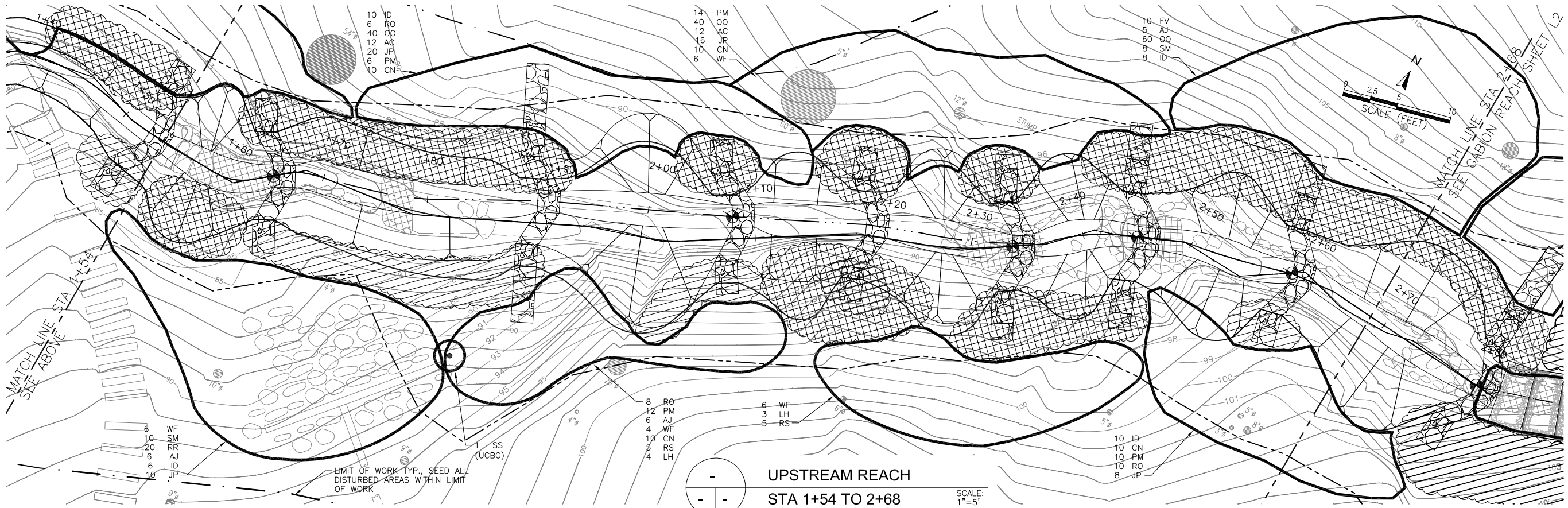


DOWNSTREAM REACH
STA 0+00 TO 1+54

SCALE: 1"=5'



UPSTREAM REACH
STA 1+54 TO 2+68

SCALE: 1"=5'

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SHEET TITLE
REVEGETATION PLAN
PLANTING PLAN

WINTER CREEK STABILIZATION &
ENHANCEMENT PROJECT
BUILDING GR PROJECT

PREPARED FOR:
UNIVERSITY OF CALIFORNIA
UC BOTANICAL GARDENS
BERKELEY, CALIFORNIA

APPROVED	
DESIGNED	JAB
DRAWN	BDT
INCHARGE	AEB
LOCATION	
SCALE	AS SHOWN
FILE NO.	1773.02
DATE	SEPTEMBER, 2009
SHEET	L1

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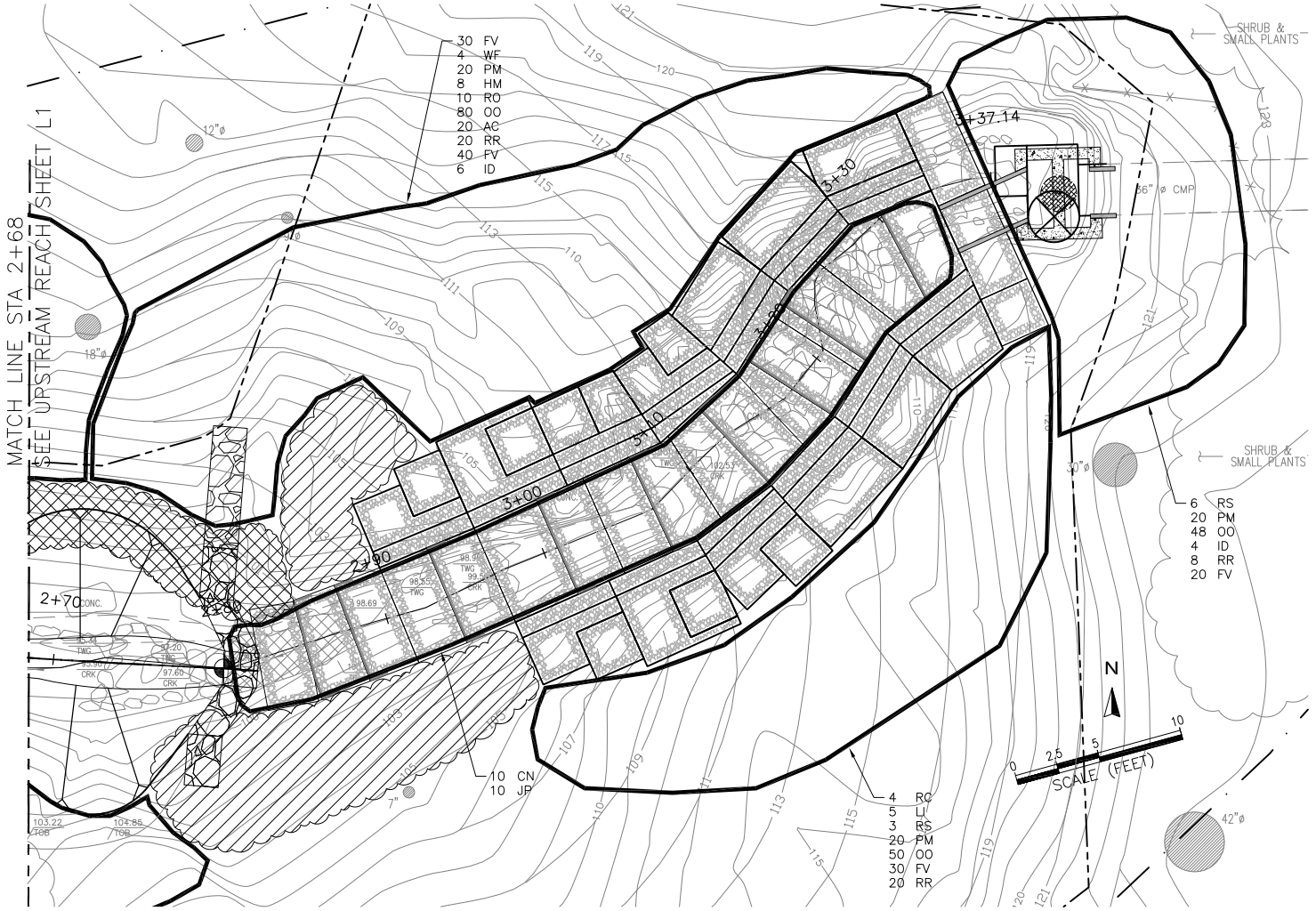
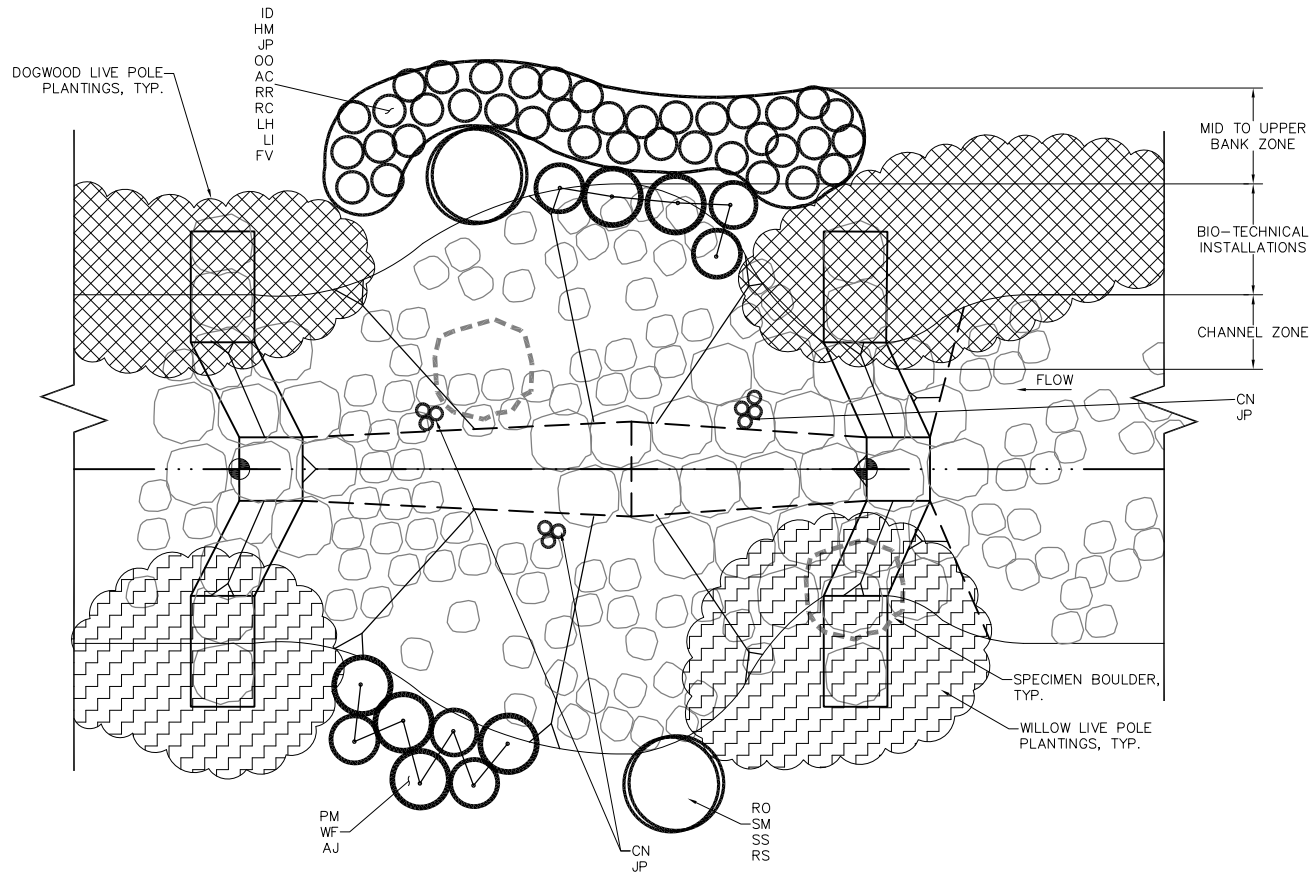




- / - GABION REACH
STA 2+82 TO 3+31
SCALE: 1"=5'

- / - TYPICAL PLAN
LAYOUT DETAIL
SCALE: 1"=3'

PLANT SCHEDULE

SYMBOL	QUANTITY	BOTANICAL NAME	COMMON NAME	SPACING	SIZE
AJ	24	*ADIANTUM JORDANII*	CALIFORNIA MAIDENHAIR FERN	4' O.C.	1 GALLON
AC	50	*ASARUM CAUDATUM*	WILD GINGER	18" O.C.	1 GALLON
CN	100	*CAREZ NUDATA*	TORRENT SEDGE	2' O.C.	1 GALLON
FV	100	*FRAGARIA VESCA**	WOODLAND STRAWBERRY	3' O.C.	1 GALLON
HM	24	*HEUCHERA MICRANTHA*	ALUM ROOT	6' O.C.	1 GALLON
ID	100	*IRIS DOUGLASIANA*	DOUGLAS IRIS	2' O.C.	1 GALLON
JP	100	*JUNCUS PATENS*	COMMON RUSH	2' O.C.	1 GALLON
LH	12	*LONICERA HISPUDULA*	CALIFORNIA HONEYSUCKLE	7' O.C.	1 GALLON
LI	8	*LONICERA INVOLUCRATA*	BLACK TWINBERRY	6' O.C.	5 GALLON
OO	360	*OXALIS OCCIDENTALIS*	REDWOOD SORREL	2' O.C.	1 GALLON
PM	180	*POLYSTITCHUM MUNITUM*	WESTERN SWORDFERN	4' O.C.	1 GALLON
RO	70	*RHODODENDRON OCCIDENTALIS***	CALIFORNIA AZALEA	5' O.C.	VARIES
RS	24	*RIBES SANGUINEUM*	FLOWERING CURRANT	5' O.C.	5 GALLON
RC	28	*ROSA CALIFORNICA*	CALIFORNIA ROSE	8' O.C.	1 GALLON
RR	108	*RUBUS SP.*	CALIFORNIA BLACKBERRY	6' O.C.	1 GALLON
SM	20	*SYMPHORICARPOS MOLLIS*	CALIFORNIA SNOWBERRY	6' O.C.	5 GALLON
SS	2	*SEQUOIA SEMPERVIRINS**	COAST REDWOOD	--	N/A
WF	40	*WOODWARDIA FIMBRIATA*	GIANT CHAIN FERN	4' O.C.	1 GALLON

* SUBSTITUTE WITH *FRAGARIA VESCA VAR. BRACTEATA* WHICHEVER IS MOST CONSISTENT WITH DESIRED NORTHCOAST ORIGIN.

** SUPPLIED BY UNIVERSITY OF CALIFORNIA BOTANTICAL GARDEN FOR INSTALLATION BY CONTRACTOR. SIZES WILL VARY BETWEEN 7-INCH AND 9-INCH POTS.

NOTES:

1. CONTRACTOR IS RESPONSIBLE FOR PROVISION OF SPECIES AND QUANTITIES SPECIFIED. SUBSTITUTIONS ARE ALLOWABLE IF APPROVED BY PWA AND THE UC BOTANICAL GARDEN. EMPHASIS ON PLANT MATERIAL WITH VERIFIABLE GENETIC ORIGIN FROM NORTHCOAST CALIFORNIA REGIONS.
2. PLANTING LAYOUT PLAN IS DIAGRAMATIC INTENDED TO GUIDE INSTALLATION OF REVEGETATION PLAN. ACTUAL LOCATIONS AND QUANTITIES OF PLANTS AT SPECIFIC LOCATIONS MAY VARY DUE TO CONDITIONS ESTABLISHED IN THE FIELD. CONTRACTOR SHALL PROVIDE LAYOUT OF PLAN USING FLAGS AND PINS OR OTHER APPROPRIATE MEASURES FOR REVIEW BY PWA AND UC BOTANTICAL GARDEN STAFF. PLANT LOCATIONS MAY BE ADJUSTED IN THE FIELD BY PWA AND/OR BOTANTICAL GARDEN STAFF.
3. TYPICAL PLANTING LAYOUT IS INTENDED TO GUIDE INSTALLATION OF PLANTS BY ZONE RELATIVE TO THE CREEK CHANNEL. PLANTING ZONES ARE TYPICAL OR CONSISTENT ON BOTH SIDES OF THE CHANNEL.
4. ALL PLANT MATERIAL SHALL BE INSTALLED PER THE STANDARD OF PRACTICE INCLUDING PROVISION OF ADEQUATELY SIZED AND PREPARED PLANTING HOLES, USE OF SUITABLE PLANTING AND BACKFILL MATERIAL (NATIVE SOILS) AND PROPER PLACEMENT OF THE PLANT RELATIVE TO EXISTING GRADE.
5. CONTRACTOR IS RESPONSIBLE FOR DESIGN AND INSTALLATION OF AN IRRIGATION SYSTEM BASED ON THE PLANTING PLAN PER THE PROJECT SPECIFICATIONS. CONTRACTOR SHALL REFER TO PROJECT SPECIFICATIONS FOR SPECIFIC REQUIREMENTS FOR THE IRRIGATION SYSTEM. IN ADDITION CONTRACTOR SHALL COORDINATE WITH UC AND UC BOTANICAL GARDEN STAFF FOR DESIGN AND INSTALLATION OF IRRIGATION SYSTEM.

PREPARED BY:
PWA
PHILIP WILLIAMS & ASSOCIATES, LTD.
ENVIRONMENTAL HYDROLOGY
550 KEARNY STREET, SUITE 900
SAN FRANCISCO, CALIFORNIA 94108
PHONE (415) 262-2300 FAX (415) 262-2303

SHEET TITLE
REVEGETATION PLAN
PLANTING PLAN

WINTER CREEK STABILIZATION & ENHANCEMENT PROJECT

BUILDING OR PROJECT

PREPARED FOR:
UNIVERSITY OF CALIFORNIA
UC BOTANICAL GARDENS
BERKELEY, CALIFORNIA

APPROVED	
DESIGNED	JAB
DRAWN	BDT,SLS
INCHARGE	AEB
LOCATION	
SCALE	AS SHOWN
FILE NO.	1773.02
DATE	SEPTEMBER 2009
SHEET	P2

XS1

XS 2

PP5

PP11a

PP12

NOTE:
1. ALL CROSS SECTIONS TO BE MEASURED AND REPRESENTED LOOKING DOWNSTREAM (TYP).

N

0 2.5 5 10
SCALE - (FEET)

MATCH LINE STA 1+40
SEE SHEET M2

PREPARED BY:

PWA
PHILIP WILLIAMS & ASSOCIATES, LTD.
ENVIRONMENTAL HYDROLOGY
SAN FRANCISCO, CALIFORNIA 94105
PHONE (415) 262-2300 FAX (415) 262-2303

SHEET TITLE
DOWNSTREAM
PLAN & PROFILE

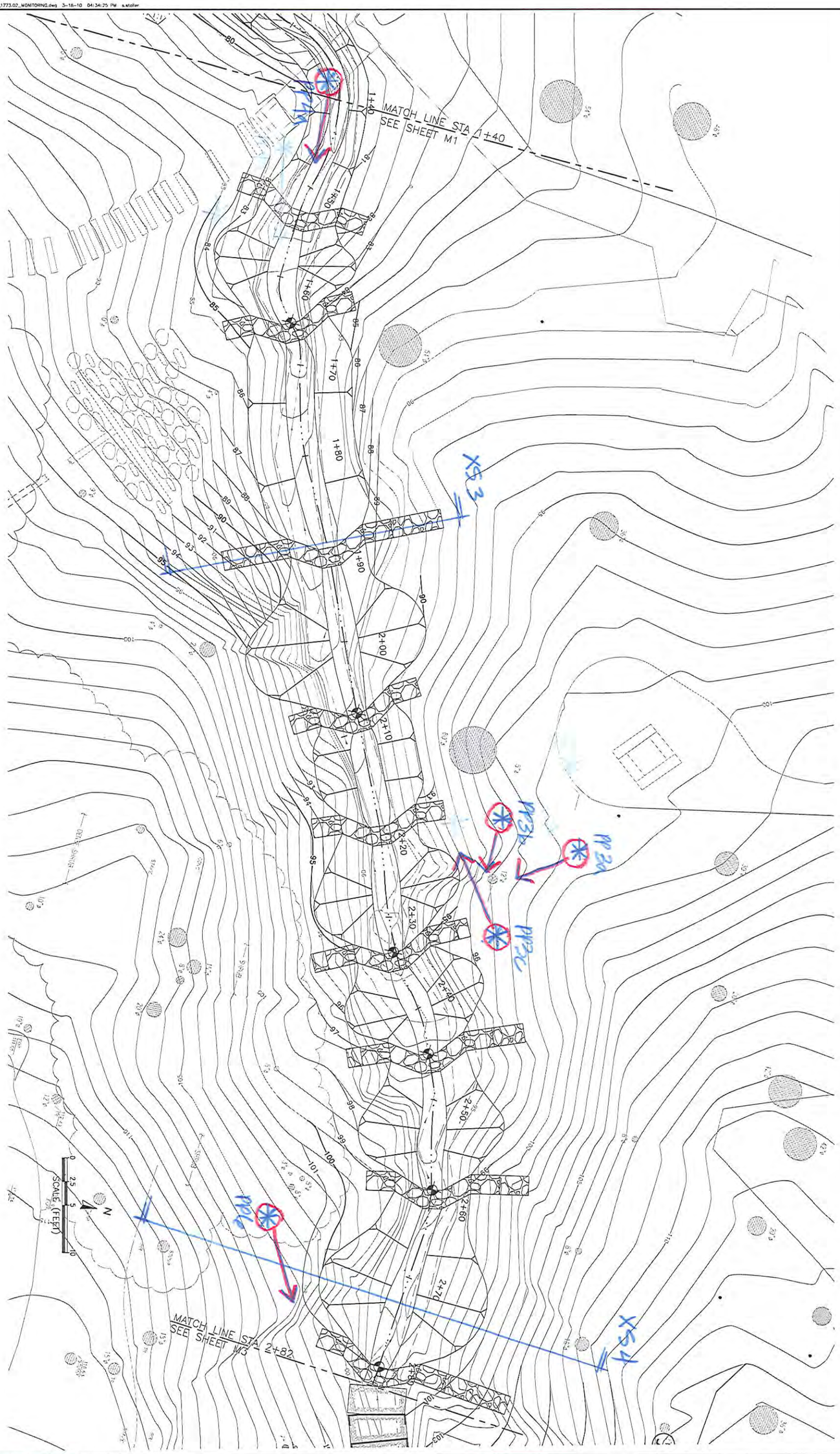
BUILDING OR PROJECT
WINTER CREEK STABILIZATION &
ENHANCEMENT PROJECT

PREPARED FOR:
UNIVERSITY OF CALIFORNIA
UC BOTANICAL GARDENS
BERKELEY, CALIFORNIA

APPROVED	
DESIGNED	JAB, SLS
DRAWN	SLS
INCHARGE	AEB
LOCATION	
SCALE	AS SHOWN
FILE NO.	1773.02
DATE	MAY 2009
SHEET	M1

D:\Projects\1773.02_Winter_Creek_100S\Drawings\1773.02_MONITORING.dwg 3-18-10 04:26:28 PM eastdor

PRELIMINARY SUGGESTED PHOTOPOINT AND CROSS-SECTION LOCATIONS
WINTER CREEK MONITORING PROGRAM, 1 OF 3 PWA 3/10



PRELIMINARY SUGGESTED PHOTOPOINT AND CROSS-SECTION LOCATIONS
WINTER CREEK MONITORING PROGRAM, 2 OF 3
PWA 3/10

M2

DATE	
SHEET	
FILE NO.	1773.02
SCALE	AS SHOWN
LOCATION	
DRAWN	AEB
CHECKED	SJS
DESIGNED	MB, SJS
APPROVED	

PREPARED FOR:

UNIVERSITY OF CALIFORNIA
UC BOTANICAL GARDENS
BERKELEY, CALIFORNIA

SHEET TITLE

UPSTREAM
PLAN & PROFILE

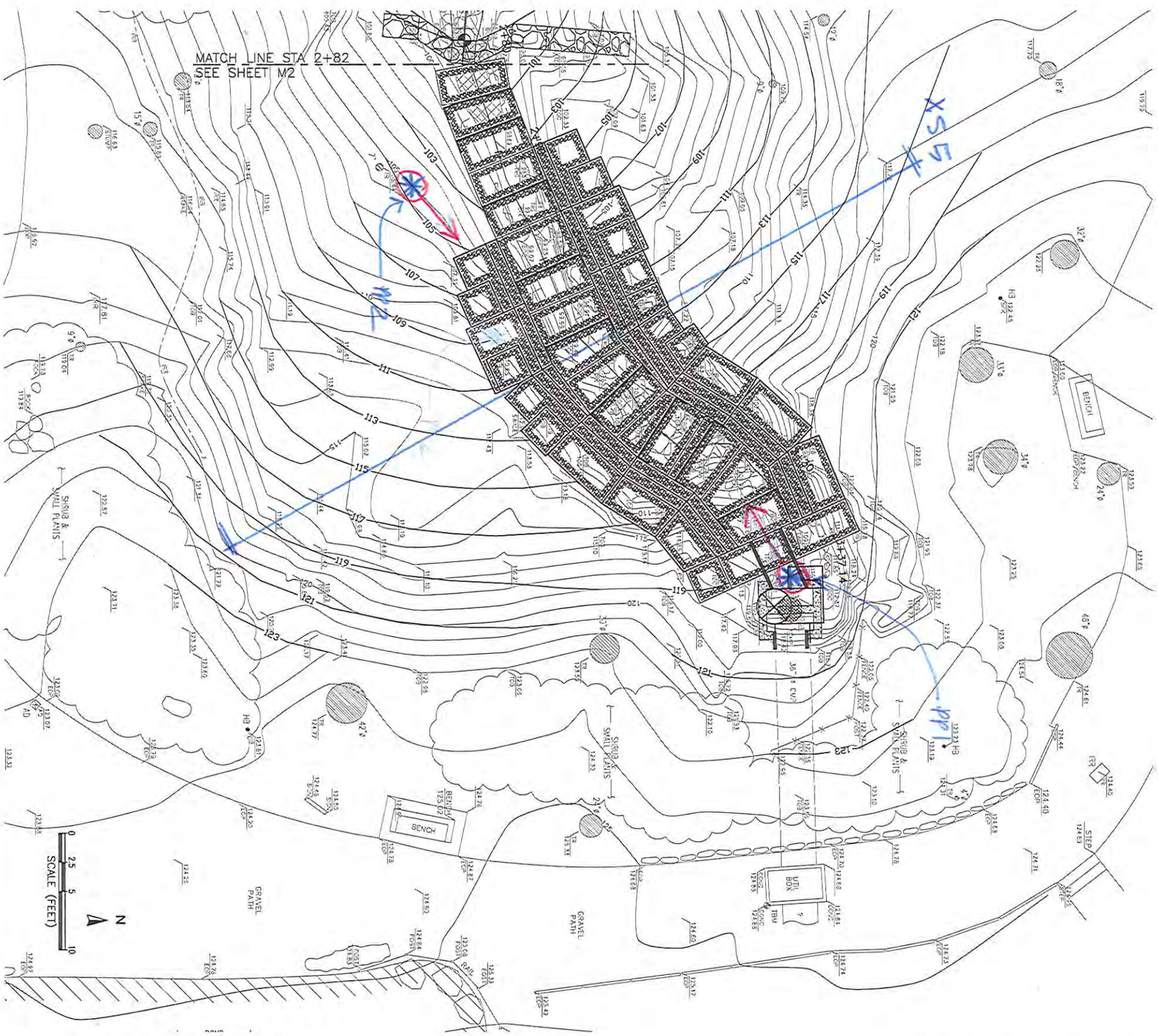
WINTER CREEK STABILIZATION &
ENHANCEMENT PROJECT

BUILDING OR PROJECT

PREPARED BY:

PWA
PHILIP WILLIAMS & ASSOCIATES, LTD.
ENVIRONMENTAL HYDROLOGY
550 KEARNY STREET, SUITE 900
SAN FRANCISCO, CALIFORNIA 94108
PHONE (415) 262-2300 FAX (415) 262-2303

PRELIMINARY SUGGESTED PHOTOPOINT AND CROSS-SECTION LOCATIONS
WINTER CREEK MONITORING PROGRAM, 3 OF 3
PWA 3/10



M3	DATE	MAY 2009	DESIGNED	JAB, SLS							
	SHEET		DRAWN	SLS							
	FILE NO.	1773.02	INCHARGE	AEB							
	SCALE	AS SHOWN	LOCATION								

PREPARED FOR:
UNIVERSITY OF CALIFORNIA
UC BOTANICAL GARDENS
BERKELEY, CALIFORNIA

SHEET TITLE
UPSTREAM REACH
MONITORING PLAN & ~~PROFILE~~

WINTER CREEK STABILIZATION & ENHANCEMENT PROJECT
BUILDING OR PROJECT

PREPARED BY:
PWA
PHILIP WILLIAMS & ASSOCIATES, LTD.
ENVIRONMENTAL HYDROLOGY
550 KEARNY STREET, SUITE 800
SAN FRANCISCO, CALIFORNIA 94108
PHONE (415) 262-2300 FAX (415) 262-2303

STATE OF CALIFORNIA THE RESOURCES AGENCY ARNOLD SCHWARZENEGGER, GOVERNOR
DEPARTMENT OF FISH AND GAME
BAY DELTA REGION
(707) 944-5520
Mailing address:
POST OFFICE BOX 47
YOUNTVILLE CALIFORNIA 94599
Street address:
7329 SILVERADO TRAIL
NAPA CALIFORNIA 94558

August 7, 2007

Notification Number: 1600-2006-0177-3

Ron Coley / University of California, Berkeley
125 University Hall
Berkeley, CA 94720-1100

1602 LAKE AND STREAMBED ALTERATION AGREEMENT

This agreement is issued by the Department of Fish and Game pursuant to Division 2, Chapter 6 of the California Fish and Game Code:

WHEREAS, the applicant Ron Coley / University of California, Berkeley, hereafter called the Operator, submitted a signed NOTIFICATION proposing to substantially divert or obstruct the natural flow of, or substantially change the bed, channel, or bank of, or use material from the streambed or lake of the following water: Winter Creek, located in Mather Memorial Redwood Grove at the UC Botanical Gardens, in the County of Alameda, State of California; and

WHEREAS, the Department has determined that such operations may substantially adversely affect existing fish and wildlife resources including water quality, hydrology, aquatic or terrestrial plant or animal species; and

WHEREAS, the project has undergone the appropriate review under the California Environmental Quality Act; and

WHEREAS, the Operator shall undertake the project as proposed in the signed PROJECT DESCRIPTION and PROJECT CONDITIONS (attached). If the Operator changes the project from that described in the PROJECT DESCRIPTION and does not include the PROJECT CONDITIONS, this agreement is no longer valid; and

WHEREAS, the agreement shall expire on December 31, 2009; with the work to occur between June 15 and October 15; and

WHEREAS, nothing in this agreement authorizes the Operator to trespass on any land or property, nor does it relieve the Operator of the responsibility for compliance with applicable Federal, State, or local laws or ordinances. Placement, or removal, of any material below the level of ordinary high water may come under the jurisdiction of the U. S. Army Corps of Engineers pursuant to Section 404 of the Clean Water Act;

THEREFORE, the Operator may proceed with the project as described in the PROJECT DESCRIPTION and PROJECT CONDITIONS. A copy of this agreement, with attached PROJECT DESCRIPTION and PROJECT CONDITIONS, shall be provided to contractors and subcontractors and shall be in their possession at the work site.

Failure to comply with all conditions of this agreement may result in legal action.

This agreement is approved by:

Charles Armor
Regional Manager
Bay Delta Region

cc: Warden Bowers
Lieutenant Christensen

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, U.S. ARMY CORPS OF ENGINEERS
1455 MARKET STREET
SAN FRANCISCO, CALIFORNIA 94103-1398

AUG 17 2007

Regulatory Branch

SUBJECT: File Number 29866S

Mr. Mark Freiberg
University of California, Berkeley
Office of Environment, Health and Safety
University Hall, 3rd Floor
Berkeley, California 94720-1150

Dear Mr. Freiberg:

This letter is written in response to your July 9, 2007 request for a two year extension of your May 4, 2006 Department of the Army authorization to implement a permanent solution to the severe erosion that has been observed on a portion of Winter Creek, located inside Mather Memorial Redwood Grove, at the UC Berkeley Botanical Gardens, 200 Centennial Dr., #5045, in the City of Berkeley, Alameda County, California 94720-5045. This project will raise the stream bed 2 to 3 feet, and create a series of step pool and riffle sequences using rock grade control structures to stabilize and reconstruct the 'naturalized' creek bed. The unstable creek banks will be regraded and biotechnical stabilization measures, such as vegetated soil lifts and brush mats in combination with specific native planting and seeding plans, will be utilized to stabilize and revegetate the banks. The culvert at the top of the project will be extended and an outfall dissipation basin will be created to absorb some of the energy flowing out of the culvert. In total, the project will impact approximately 170 linear feet of channel bed and 2,100 square feet of channel and bank areas.

Based on a review of the information you submitted and an inspection of the project site conducted by Corps personnel on April 28, 2006, your project qualifies for authorization under Department of the Army Nationwide Permit (NWP) 27 for Stream and Wetland Restoration Activities and NWP 33 for Temporary Construction, Access and Dewatering, (67 Fed. Reg. 2020, January 15, 2002), pursuant to Section 404 of the Clean Water Act (33 U.S.C. Section 1344). See Enclosure 1. All work shall be completed in accordance with submitted drawings titled "Winter Creek Stabilization & Enhancement Project, University of California, Berkeley UC Botanical Gardens; Conceptual Plan –Reach 1 and Reach 2 (both dated 3-1-06), Profile (dated 2-22-06), and Details (dated 2-22-06)".

The project must be in compliance with the General Conditions cited in Enclosure 2 for this Nationwide Permit authorization to remain valid. Non-compliance with any condition could result in the suspension, modification or revocation of the authorization for your project, thereby requiring you to obtain an Individual Permit from the Corps. This Nationwide Permit authorization does not obviate the need to obtain other State or local approvals required by law.

This authorization will remain valid for two years from the date of this letter unless the Nationwide Permit is modified, suspended or revoked. If you have commenced work or are under contract to commence work prior to the suspension, or revocation of the Nationwide Permit and the project would not comply with the resulting Nationwide Permit authorization, you have twelve (12) months from that date to complete the project under the present terms and conditions of the Nationwide Permit. Upon completion of the project and all associated mitigation requirements, you shall sign and return the Certification of Compliance, Enclosure 3, verifying that you have complied with the terms and conditions of the permit.

This office has not received a copy of your Section 401 water quality certification from the San Francisco Bay Regional Water Quality Control Board (RWQCB). If you have received a water quality certification, please submit a copy of the certification to the Corps prior to the commencement of work.

To ensure compliance with this Nationwide Permit authorization, the following special conditions shall be implemented:

1. **Vegetative clearing shall be minimized to the maximum extent practicable.**

2. **Erosion control measures on the banks shall be designed to withstand a significant first year storm event in effort to minimize potential sediment loss prior to full vegetative development.**

Should you have any questions regarding this matter, please contact Mark D'Avignon of our Regulatory Branch at 415-503-6773 or Mark.R.D'Avignon@usace.army.mil. Please address all correspondence to the Regulatory Branch and refer to the File Number at the head of this letter. If you would like to provide comments on our permit review process, please complete the Customer Survey Form available through the Forms and Contacts Block on our website: www.spn.usace.army.mil/regulatory.

Sincerely,

Molly Martindale for

Mark D'Avignon
Chief, South Section
Regulatory Branch

Enclosures

Copy furnished (w/o enclosures):

CA DFG, Yountville, CA (attn: Marcia Grefsrud)
CA RWQCB, Oakland, CA (attn: Brian Wines)

California Regional Water Quality Control Board
San Francisco Bay Region

Alan C. Lloyd, Ph.D.
Agency Secretary

1515 Clay Street, Suite 1400, Oakland, California 94612
(510) 622-2300 • Fax (510) 622-2460
http://www.waterboards.ca.gov/sanfranciscobay

Arnold Schwarzenegger
Governor

Date: JAN 3 1 2006
File No: 2198.11 (bkw)
Site No: 02-01-C0860
ACOE File No: 29866S

Mr. Steve Lustig
Acting Vice Chancellor
University of California, Berkeley
200 California Hall
Berkeley, CA 94720-1500

Subject: Water Quality Certification for the Temporary Stabilization of a Failing Culvert on Winter Creek at the University of California at Berkeley Botanical Gardens in the City of Berkeley, Alameda County

Dear Mr. Lustig:

We have reviewed the application materials submitted to the San Francisco Bay Regional Water Quality Control Board (Water Board) by the University of California, Berkeley (the Applicant) and hereby issue after-the-fact water quality certification for the Applicant's project to stabilize a failing culvert on Winter Creek at the University of California at Berkeley (UCB) Botanical Gardens in the City of Berkeley, Alameda County (Project). The Applicant received authorization for the Project from the United States Army Corps of Engineers (ACOE) under Clean Water Act (CWA) Section 404 Nationwide Permit (NWP) No. 18 (*Minor Discharges*) (ACOE File No. 29866S). You have applied to the Water Board for Clean Water Act Section 401 water quality certification that the Project will not violate State water quality standards.

Project Description: The following Project description was derived from application materials received on September 23, 2005, as well as e-mail communications from the Applicant in August and December of 2005. The Project goal was to prevent ongoing erosion of the bed and bank of Winter Creek, which has been caused by erosion at the outlet of a culvert under the entry road to the Mather Redwood Grove in the UCB Botanical Garden. Winter Creek is a tributary to Strawberry Creek. In recent years, run-off flows have created a scour pond at the outlet of the culvert, resulting in a 12-foot drop in grade along the channel invert. During the 2004 –2005 wet season, the walls of the scour pool collapsed, and adjacent banks began slumping into the pool. Continued erosion of the channel was likely to undermine the outlet of the culvert, several large redwoods along creek bank, and the sole access road to the Mather Redwood Grove. In addition to the threat to trees and infrastructure, continued erosion would have contributed excess sediment to the Strawberry Creek watershed.

Because erosion was likely to continue during the 2005 – 2006 wet season, on September 30, 2005, Water Board staff provided the Applicant with an e-mail in which the Applicant was allowed to install temporary erosion control measures before receiving CWA section 401 water quality certification. The approval for the temporary erosion control work was made with the Applicant's understanding that the Applicant was to apply for certification for a permanent fix prior to the 2007 – 2008 wet season.

Material staging and installation of the temporary stabilization project took place between October 26 and November 4, 2005. A temporary water diversion system was installed to direct creek flows around the area of work. The structures were installed using hand labor.

The temporary stabilization project consists of several interim erosion control measures: a temporary extension of the existing culvert; installing an energy dissipation basin at the outlet of the extended culvert outfall; and the installation of seven stabilization structures in the creek channel. The structures were installed within a 350-foot long reach of the creek, extending from the failing culvert outlet at the upstream limit of the Project reach, to a culvert inlet at Centennial Drive.

The culvert extension bypasses creek flows through the vulnerable scour and headcut section at the upstream limit of the Project site. The culvert extension consists of two sections of 30-inch diameter corrugated metal pipe. A 30-inch diameter T-Connection with a clean-out access hatch was attached to the existing culvert using pipe coupling. A 30-inch diameter 90 degree-pipe fitting was then placed at the bottom end of the T-Connection pipe and positioned on a gravel bag foundation on the channel bed. Gravel bags were also used to construct an energy dissipation structure at the outlet of the culvert extension.

Grade stabilization structures were constructed using a combination of Tensar Geogrid™ baskets filled with 3-inch minus washed drain rock and gravel bags filled with 1-inch minus washed drain rock. The structures were installed to protect and stabilize the channel at the locations of the most severe and active headcuts.

Impacts: The seven structures and the dissipation basin impacted a total of 145.5 linear feet of channel bed and 1,936 square feet (0.04 acres) of channel and bank area. About 24.6 cubic yards (cy) of rock were used in the stabilization structures; the Tensar Geogrid™ baskets contained 9 cy of 3-inch rock and the gravel bags contained 15.6 cy of 1-inch rock.

Mitigation: A final stabilization project will be submitted for review by the resource agencies and the approved project will be implemented prior to October 2007. To stabilize the project site, 1,936 square feet of biodegradable coir erosion fabric was placed on creek banks that were disturbed by installation activities and/or were exposed and vulnerable to surface erosion.

CEQA Compliance: On July 14, 2005, the University of California determined that the Project was categorically exempt from the requirements of the California Environmental Quality Act (CEQA), as a Class 33 Small Habitat Restoration Project.

Certification and General Waste Discharge Requirements: I hereby issue an order certifying that any discharge from the referenced Project will comply with the applicable provisions of sections 301 (Effluent Limitations), 302 (Water Quality Related Effluent Limitations), 303 (Water Quality Standards and Implementation Plans), 306 (National Standards of Performance), and 307 (Toxic and Pretreatment Effluent Standards) of the Clean Water Act, and with other applicable requirements of State law. This discharge is also regulated under State Water Resources Control Board Order No. 2003 - 0017 - DWQ, "General Waste Discharge Requirements for Dredge and Fill Discharges That Have Received State Water Quality Certification" which requires compliance with all conditions of this Water Quality Certification. The following conditions are associated with this certification:

1. No debris, rubbish, creosote-treated wood, soil, silt, sand, cement, concrete, or washings thereof, or other construction related materials or wastes, oil or petroleum products or other organic or earthen material shall be allowed to enter into, or be placed where it may be washed by rainfall or runoff into Winter Creek. Any of these materials placed within or where they may enter Winter Creek by the Applicant or any party working under contract, or with the permission of the Applicant shall be removed immediately. When operations are completed, any excess material shall be removed from the work area and any areas adjacent to the work area where such material may be washed into Winter Creek. During construction, the contractor shall not dump any litter

or construction debris within the riparian/stream zone. All such debris and waste shall be picked up daily and properly disposed of at an appropriate site;

2. No equipment shall be operated in areas of flowing or standing water; no fueling, cleaning, or maintenance of vehicles or equipment shall take place within any areas where an accidental discharge to Winter Creek may occur; construction materials and heavy equipment must be stored outside of the creek channel;
3. The Applicant shall submit a long-term stabilization plan for Winter Creek to the Executive Officer of the Water Board for review and approval by March 31, 2006. The Applicant shall apply for Water Quality Certification for implementation of the long-term stabilization plan, and the approved plan shall be implemented prior to October 1, 2007;
4. This certification action is subject to modification or revocation upon administrative or judicial review, including review and amendment pursuant to Section 13330 of the California Water Code (CWC) and Section 3867 of Title 23 of the California Code of Regulations (23 CCR);
5. This certification action is not intended and shall not be construed to apply to any discharge from any activity involving a hydroelectric facility requiring a Federal Energy Regulatory Commission (FERC) license or an amendment to a FERC license unless the pertinent certification application was filed pursuant to 23 CCR Subsection 3855(b) and that application specifically identified that a FERC license or amendment to a FERC license for a hydroelectric facility was being sought; and,
6. Certification is conditioned upon total payment of the full fee required in State regulations (23 CCR Section 3833). Payment in full was received on September 23, 2005.

Please be aware that any violation of water quality certification conditions is a violation of State law and subject to administrative civil liability pursuant to California Water Code (CWC) Section 13350. Failure to respond, inadequate response, late response, or failure to meet any condition of a certification may subject the Applicant to civil liability imposed by the Water Board to a maximum of $5,000 per day of violation or $10 for each gallon of waste discharged in violation of this action. Any request for a report made as a condition to this action (e.g., Condition 3) is a formal request pursuant to CWC Section 13267, and failure or refusal to provide, or falsification of such requested report is subject to civil liability as described in CWC Section 13268. We anticipate no further action on this request. However, should new information come to our attention that indicates a water quality problem with this Project, the Water Board may issue Waste Discharge Requirements.

Please contact Brian Wines of my staff at (510) 622-5680 or bwines@waterboards.ca.gov if you have any questions. All future correspondence regarding this Project should reference the Site Number indicated at the top of this letter.

Sincerely,

Bruce H. Wolfe
Executive Officer

cc: Office of Environment, Health & Safety, ATTN: Steve Maranzana, 317 University Hall, Berkeley, CA 94720-1150
SWRCB-DWQ, Oscar Balaguer
USACE, San Francisco District, Attn: Regulatory Branch, 333 Market Street, San Francisco, CA 94105 –2197 (File Number 29866S)
CDFG, Central Coast Region, Attn: Robert Floerke, Regional Manager, P.O. Box 47, Yountville CA 94599 (Notification Number 1600-2005-0639-3)
U.S. EPA, Tim Vendlinski, WTR-8.