Harmony Grove Village South

Appendix M-2

Hydromodification Screening Analysis

for the

Final Environmental Impact Report

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HYDROMODIFICATION SCREENING

FOR

HARMONY GROVE VILLAGE SOUTH

(PDS 2008-2700-15498 & PDS 2008-2140-5394-1)

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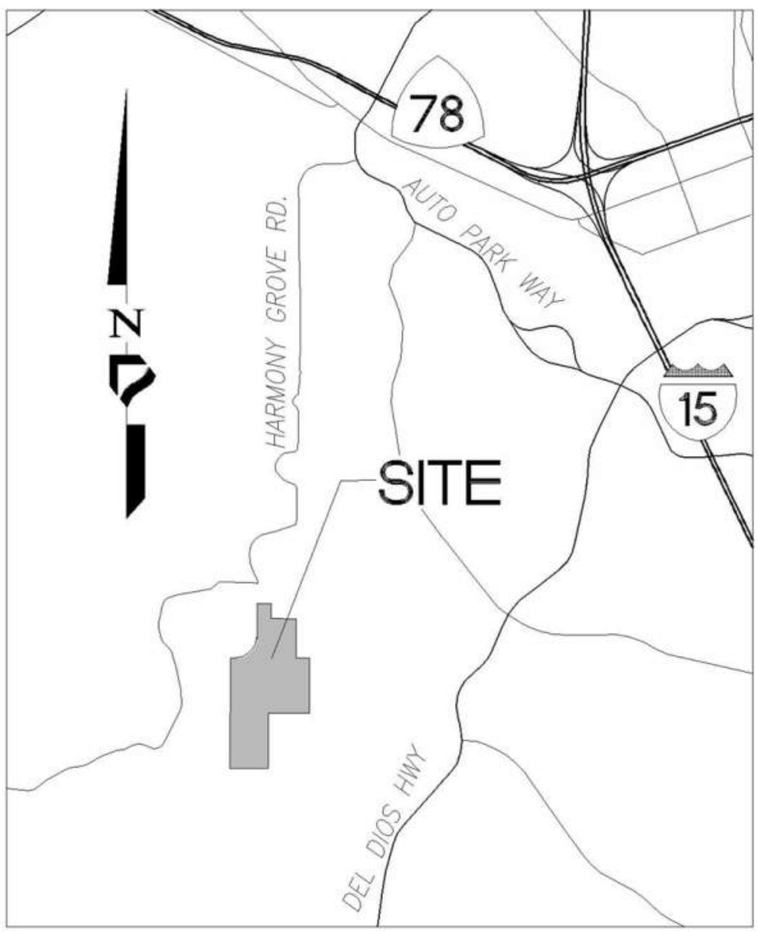
INTRODUCTION

The County of San Diego's March 2011, *Final Hydromodification Management Plan,* and January 8, 2011, *Standard Urban Stormwater Mitigation Plan* (SUSMP) outline low flow thresholds for hydromodification analyses. The thresholds are based on a percentage of the pre-project 2-year flow (Q_2), i.e., $0.1Q_2$ (low flow threshold and high susceptibility to erosion), $0.3Q_2$ (medium flow threshold and medium susceptibility to erosion), or $0.5Q_2$ (high flow threshold and low susceptibility to erosion). A flow threshold of $0.1Q_2$ represents a natural downstream receiving conveyance system with a high susceptibility to bed and/or bank erosion. This is the default value used for hydromodification analyses and will result in the most conservative (largest) on-site facility sizing. A flow threshold of $0.3Q_2$ or $0.5Q_2$ represents downstream receiving conveyance systems with a medium or low susceptibility to erosion, respectively. In order to qualify for a medium or low erosion susceptibility rating, a project must perform a channel screening analysis based on the March 2010, *Hydromodification Screening Tools: Field Manual for Assessing Channel Susceptibility,* developed by the Southern California Coastal Water Research Project (SCCWRP). The SCCWRP results are compared with the critical shear stress calculator results from the County of San Diego's Critical Flow Calculator spreadsheet to establish the appropriate erosion susceptibility threshold of low, medium, or high.



Vicinity Map

This report provides hydromodification screening analyses for the Harmony Grove Village South project being designed by Project Design Consultants. The Harmony Grove Village South (HGVS) project covers approximately 111 acres. The project proposes a maximum of 453 dwelling units and a commercial/civic area consisting of a clubhouse building that may accommodate such uses as food/beverage services, limited overnight accommodations, a gym, an event lawn, an equestrian hitching post, electric vehicle charging stations, and possibly a pool. HGVS also reserves space for wastewater treatment uses that may be needed in support of the project. The site is west of Interstate 15 and south of State Route 78. Specifically, the project is south of the intersection of Country Club Drive and Harmony Grove Road (see the Vicinity Map), and is bounded by Escondido Creek to the north, Country Club Drive to the west, and the Del Dios Highland Preserve to the South. The project is located to the south of the Harmony Grove Village development, currently under construction to the north of Escondido Creek by others.

Under existing conditions, the project development area consists of undeveloped land and is located within a larger tributary drainage basin that includes upstream properties in the upper hillsides of the valley. There are two main drainage areas for the project: the north drainage basin and the south drainage basin. The majority of the on-site project area is within the north drainage basin, which drains to the north towards Escondido Creek and includes upstream run-on as well as on-site storm flows. The south drainage basin is located in the southwestern corner of the site, and originates from the south (on- and off-site) and drains west to a defined drainage course along the western project boundary. This defined drainage course traverses the existing residential properties east and west of Cordrey Drive and ultimately flows into Escondido Creek downstream and west of the Country Club Drive crossing.

The SCCWRP screening tool requires both office and field work to establish the vertical and lateral susceptibility of a downstream receiving channel to erosion. The vertical and lateral assessments are performed independently of each other although the lateral results can be affected by the vertical rating. The project has two points of compliance (POC) for which screening can be performed. A POC is the location where the project's runoff enters a natural drainage course. One POC is at the project's storm drain outlets into Escondido Creek just downstream of Country Club Drive. These outlets convey runoff from the north drainage basin. At this POC, one storm drain outlets into the south side of the creek, while the other outlets into the north side of the creek. Since these two outlets are essentially at the same location along Escondido Creek, they are considered as a single POC. The second POC outlets into the defined drainage course serving the south drainage basin. The defined drainage course is a small unnamed natural drainage course near the southwest corner of the project. This drainage course flows over 1,000 feet in a westerly direction to Escondido Creek.

A screening analysis was performed to assess the low flow threshold for the two POC outlet locations, identified as POC 1 and POC 2, respectively (see the Study Area Exhibit in Appendix A). These POC's capture the majority of the project runoff containing residential development. The initial step in performing the SCCWRP screening analysis is to establish the domain of analysis and the study reaches within the domain. This is followed by office and field components of the screening tool along with the associated analyses and results. The following sections cover these procedures in sequence for POC 1 and 2.

DOMAIN OF ANALYSIS

SCCWRP defines an upstream and downstream domain of analysis, which establish the study limits. The County of San Diego's HMP specifies the downstream domain of analysis based on the SCCWRP criteria. The HMP indicates that the downstream domain is the first point where one of these is reached:

- at least one reach downstream of the first grade control point (or at second grade control)
- tidal backwater/lentic waterbody
- equal order tributary
- accumulation of 50 percent drainage area for stream systems or 100 percent drainage area for urban conveyance systems (storm drains, hardened channels, etc.)

The upstream limit is defined as:

- proceed upstream for 20 channel top widths or to the first grade control point, whichever comes first. Identify hard points that can check headward migration and evidence of active headcutting.

SCCWRP defines the maximum spatial unit, or reach (a reach is circa 20 channel widths), for assigning a susceptibility rating within the domain of analysis to be 200 meters (656 feet). If the domain of analysis is greater than 200 meters, the study area should be subdivided into smaller reaches of less than 200 meters for analysis. Most of the units in the HMP's SCCWRP analysis are metric. Metric units are used in this report only where given so in the HMP or Caltrans plans. Otherwise English units are used.

Downstream Domain of Analysis

The downstream domain of analysis for POC 1 and 2 have been determined by assessing and comparing the four bullet items above. The majority of the project's storm runoff (from the north drainage basin) will be conveyed by proposed drainage systems to outlets into Escondido Creek on the downstream side of Country Club Drive. These outlets correspond to POC 1. In addition, storm runoff from the project's south drainage basin discharges into an unnamed natural drainage course near the southwesterly corner of the site. This outlet corresponds to POC 2. Downstream domain of analysis locations are selected below both POC 1 and POC 2 as follows.

Per the first bullet item, the first grade control in Escondido Creek below POC 1 and 2 were located. The runoff from POC 1 outlets directly into Escondido Creek. The channel reach below POC 1 was walked and a concrete grade control was discovered approximately 696 feet downstream (see Figure 5 and the Study Area Exhibit in Appendix A). Natural grade controls were also observed in Escondido Creek created by objects such as fallen tree trunks. However, these were not considered since they can be dynamic. The unnamed natural drainage course below POC 2 was also walked and a rock-lined grade control was observed approximately 190 feet downstream (see Figure 10). Cordrey Drive crosses the unnamed natural drainage course approximately 33 feet below the rock-lined grade control. A culvert conveys flow under Cordrey Drive (see Figure 11). The culvert functions as a grade control.

The second bullet item is the tidal backwater or lentic (standing or still water such as ponds, pools, marshes, lakes, etc.) waterbody location. Runoff from POC 1 and POC 2 ultimately flows in Escondido Creek to San Elijo Lagoon, which is over 9 miles southwest of the site. Therefore, the tidal backwater or lentic waterbody will be much further downstream than the downstream domain of analysis established by the permanent grade control criteria for both POC 1 and POC 2.

The final two bullet items are related to a tributary drainage area. The drainage area tributary to POC 1 covers approximately 50 square miles per the Watershed Exhibit in Appendix A. The channel below POC 1 extends 696 feet to the closest grade control. Neither an equal order tributary (50 square miles) nor a 50 to 100 percent drainage area (25 to 50 square miles) occur between POC 1 and its closest downstream grade control. The drainage area tributary to POC 2 covers 14.13 acres per Project Design Consultants. The channel below POC 2 extends 190 feet to the closest grade control. An equal order tributary (13.3 acres) or a 50 to 100 percent drainage area (6.65 to 13.3 acres) will not occur between POC 2 and its closest downstream grade control.

Based on the above information, the downstream domain of analysis criteria for POC 1 is first met at the concrete grade control. This is the first point reached from the four bullet items. As stated in the first bullet item, the downstream domain of analysis should extend one reach below the grade control. As mentioned above, a reach is based on 20 channel widths, not to exceed 656 feet. The channel top width below the grade control is approximately 50 feet wide, and 20 times this width is 1,000 feet. This distance exceeds a reach, therefore, the downstream domain of analysis location was set at a reach or 656 feet downstream of the concrete grade control (see the Study Area Exhibit in Appendix A).

For POC 2, the downstream domain of analysis criteria is first met at the rock-lined grade control. For this POC, a second grade control occurs 33 feet below the rock-lined grade control, i.e., the second grade control is at the Cordrey Drive culvert. Therefore, the downstream domain of analysis location was set at the entrance to the Cordrey Drive culvert.

Upstream Domain of Analysis

POC 1 is just downstream of Country Club Drive. The Country Club Drive Arizona crossing is the first grade control point upstream of POC 1. Country Club Drive and its culverts will be replaced with a bridge as part of the project. However, the riprap grade control along Country Club Drive will remain. Since the grade control is immediately upstream of POC 1, the upstream domain of analysis location for POC 1 is at POC 1.

The proposed storm drain associated with POC 2 discharges laterally into the unnamed natural drainage course, so the drainage course extends upstream of the storm drain outlet. There are no grade controls in the vicinity upstream of POC 2, so the upstream domain of analysis location is based on 20 channel top widths. The channel top width is estimated at 4 feet from the project's 2-foot contour interval topographic mapping. Therefore, the upstream domain of analysis location is 20 times the channel top width or 80 feet upstream of POC 2.

Study Reaches within Domain of Analysis

The entire domain of analysis for POC 1 extends along Escondido Creek from POC 1 to one reach below the concrete grade control. This domain of analysis was subdivided into two reaches: Reach 1 and Reach 2 (see the Study Area Exhibit). Reach 1 extends 696 feet from POC 1 downstream to the concrete grade control. Reach 2 extends 656 feet from the concrete grade control to the downstream domain of analysis location. Reach 1 is slightly greater than the 656 foot (200 meters) maximum reach length specified by SCCWRP. Review of topographic mapping, aerial photographs, and field conditions reveals that the physical (channel geometry and longitudinal slope), vegetative, hydraulic, and soil conditions within Reach 1 are relatively uniform. Subdividing this reach into smaller subreaches of less than 656 feet will not yield varying conclusions within the reach. Although the screening tool was applied across the entire length of Reach 1, the results will be identical for shorter subreaches within Reach 1.

The entire domain of analysis for Reach 2 extends along the unnamed drainage course from 140 feet upstream of POC 2 to the Cordrey Drive culvert. The domain of analysis was subdivided into two reaches: Reach 3 and Reach 4. Reach 3 extends 80 feet from the upstream domain of analysis location to POC 2. Reach 4 extends 223 feet from POC 2 to the downstream domain of analysis location at the Cordrey Drive culvert.

INITIAL DESKTOP ANALYSIS

After the domain of analysis is established, SCCWRP requires an "initial desktop analysis" that involves office work. The initial desktop analysis establishes the watershed area, mean annual precipitation, valley slope, and valley width. These terms are defined in Form 1, which is included in Appendix A. SCCWRP recommends the use of National Elevation Data (NED) to determine the watershed area, valley slope, and valley width. The NED data is similar to USGS quadrangle mapping, so USGS mapping can be used for watershed delineations. Two-foot contour interval topographic mapping is available for the site and adjacent areas, so this was used to more accurately assess the valley slopes and valley widths. A site investigation was performed that confirmed the mapping. The following discusses the initial desktop analyses and the corresponding topographic mapping used.

The watershed area for POC 1 was based on USGS mapping as well as FEMA's *Flood Insurance Study* (FIS). The FIS indicates that the watershed area tributary to Escondido Creek at Harmony Grove Road covers 48.3 square miles (see the FIS excerpt in Appendix A). In order to define the additional area tributary to Reach 1 and 2 below POC 1, USGS mapping was used, which is appropriate for delineating large drainage areas. The Watershed Exhibit in Appendix A delineates the two additional watershed areas below the POC. These were added to the 43.8 square miles to determine the watershed areas tributary to Reaches 1 and 2.

The watershed areas tributary to Reaches 3 and 4 associated with POC 2 were delineated from the USGS mapping as well as Project Design Consultant's proposed condition drainage area. The proposed condition drainage area was used in order to define the post-project conditions. The two watershed areas are included on the Watershed Exhibit.

The mean annual precipitation was obtained from the closest rain gage to the site with extensive historic data. This was the Western Regional Climate Center's Escondido gage (see Appendix A). The average rainfall measured at this gage for the period of record from 1893 to 1979 is 16.22 inches.

The valley slope of Reaches 1 to 4 were determined from the project's 2-foot contour interval topographic mapping. The valley slope is the longitudinal slope of the channel bed along the flow line, so it is determined by dividing the elevation difference within a reach by the flow path. The valley width is the average bottom width of the drainage course between valley slopes. The average valley widths were determined using the topographic mapping to estimate the interface between the bottom and side slopes of the drainage course. The drainage area, valley slope, and valley width within each study reach are summarized in Table 1.

Reach	Tributary Drainage Area, sq. mi.	Valley Slope, m/m	Valley Width, m
1	50.030	0.0027	30.48
2	52.842	0.0035	42.67
3	0.131	0.0412	1.22
4	0.139	0.0404	1.22

Table 1. Summary of Valley Slope and Valley Width

These values were input to a spreadsheet to calculate the simulated peak flow, screening index, and valley width index outlined in Form 1. The input data and results are tabulated in Appendix A. This completes the initial desktop analysis.

FIELD SCREENING

After the initial desktop analysis is complete, a field assessment must be performed. The field assessment is used to establish a natural channel's vertical and lateral susceptibility to erosion. SCCWRP states that although they are admittedly linked, vertical and lateral susceptibility are assessed separately for several reasons. First, vertical and lateral responses are primarily controlled by different types of resistance, which, when assessed separately, may improve ease of use and lead to increased repeatability compared to an integrated, cross-dimensional assessment. Second, the mechanistic differences between vertical and lateral responses point to different modeling tools and potentially different management strategies. Having separate screening ratings may better direct users and managers to the most appropriate tools for subsequent analyses.

The field screening tool uses combinations of decision trees and checklists. Decision trees are typically used when a question can be answered fairly definitively and/or quantitatively (e.g., d_{50} < 16 mm). Checklists are used where answers are relatively qualitative (e.g., the condition of a grade control). Low, medium, high, and very high ratings are applied separately to the vertical and lateral analyses. When the vertical and lateral analyses return divergent values, the most conservative value shall be selected as the flow threshold for the hydromodification analyses.

Vertical Stability

The purpose of the vertical stability decision tree (Figure 6-4 in the County of San Diego HMP) is to assess the state of the channel bed with a particular focus on the risk of incision (i.e., down cutting). The decision tree is included in Figure 16. The first step is to assess the channel bed resistance. There are three categories defined as follows:

1. Labile Bed – sand-dominated bed, little resistant substrate.

2. Transitional/Intermediate Bed – bed typically characterized by gravel/small cobble, Intermediate level of resistance of the substrate and uncertain potential for armoring.

3. Threshold Bed (Coarse/Armored Bed) – armored with large cobbles or larger bed material or highly-resistant bed substrate (i.e., bedrock).

Based on the channel photographs in the figures and site investigation, the bed material and resistance (associated with the dense, mature vegetation in some areas) is generally within the transitional/intermediate bed category. Some bed areas contain smaller grain sizes typically found in a labile bed. Although the Reach 1 to 4 channels contain small median grain sizes, the channels do not meet the criteria of containing loosely-packed material. The material is moderately-packed with dense vegetation binding the soil in many areas, which is a characteristic of an intermediate bed.

In addition to the material size and compaction, there are several factors that establish the erodibility of a channel such as the flow rate (i.e., size of the tributary area), grade controls, channel slope, vegetative cover, channel planform, etc. The Introduction of the SCCWRP *Hydromodification Screening Tools: Field Manual* identifies several of these factors. When multiple factors influence erodibility, it is appropriate to perform the more detailed SCCWRP analysis, which is to analyze a channel according to SCCWRP's transitional/intermediate bed procedure. This requires the most rigorous steps and will generate the appropriate results given the range of factors that define erodibility. The transitional/intermediate bed procedure takes into account that bed material may fall within the labile category (the bed material size is used in SCCWRP's Form 3 Figure 4), but other factors may trend towards a less erodible condition. Dr. Eric Stein from SCCWRP, who co-authored the *Hydromodification Screening Tools: Field Manual* in the *Final Hydromodification Management Plan* (HMP), indicated that it would be appropriate to analyze channels with multiple factors that impact erodibility using the transitional/intermediate bed procedure. Consequently, this procedure was used to produce more accurate results.

Transitional/intermediate beds cover a wide susceptibility/potential response range and need to be assessed in greater detail to develop a weight of evidence for the appropriate screening rating. The three primary risk factors used to assess vertical susceptibility for channels with transitional/intermediate bed materials are:

1. Armoring potential – three states (Checklist 1)

2. Grade control – three states (Checklist 2)

3. Proximity to regionally-calibrated incision/braiding threshold (Mobility Index Threshold – Probability Diagram)

These three risk factors are assessed using checklists and a diagram (see Appendix B), and the results of each are combined to provide a final vertical susceptibility rating for the intermediate/transitional bed-material group. Each checklist and diagram contains a Category A, B, or C rating. Category A is the most resistant to vertical changes while Category C is the most susceptible.

Checklist 1 determines armoring potential of the channel bed. The channel bed along Reach 1 through 4 are within Category B, which represents intermediate bed material within unknown armoring potential due to a surface veneer and dense vegetation. Figures 3 through 7 reveal that Reach 1 and 2 contain base flow, which makes the armoring potential in the center of the channel unknown. On the other hand, the channel area beyond the base flow and approaching the banks contains a uniform cover of grasses, weeds, bushes, and mature trees. The soil was probed and penetration was relatively difficult through the underlying layer. From a sediment transport standpoint, the Escondido Creek channel within Reach 1 and 2 has essentially reached a stable vertical profile due to upstream improvements. The first improvement is the concrete-lined channel a short distance upstream (constructed in the 1960s) within the majority of the city of Escondido. The second improvement is the Country Club Drive grade control immediately upstream of Reach 1 and 2. Both improvements significantly reduce sediment transport approaching Reach 1 and 2, maintain a relatively constant sediment inflow to the reaches, and have been in place for decades. As a result, vertical adjustments within Reach 1 and 2 have essentially reached a stable condition.

Reach 3 and 4 contain a moderate cover of grasses and weeds as well as scattered rock. The soil was probed at several locations throughout Reach 3 and 4, and penetration was difficult after a few inches below the surface veneer of soil and vegetation, which suggests that the underlying layer has a good armoring potential. Further evidence of a good armoring potential is that the Reach 3 and 4 drainage courses are undisturbed natural streams formed over geologic time without signs of vertical scour. Although the factors point to a good armoring potential, the resistance is unknown without additional testing. Consequently, Reach 3 and 4 are classified in Category B within Checklist 1.

Reach	S_v, feet/feet	$2/S_v$, feet	$4/S_v$, feet	Reach Length, feet	Category
1	0.0027	2,404	4,807	696	A
2	0.0035	1,871	3,743	656	A
3	0.0412	159	318	80	A
4	0.0404	163	325	223	B

Table 2. Checklist 2 Values based on Grade Control Spacing

Checklist 2 determines grade control characteristics of the channel bed. This is reliant on the spacing of the grade controls. The categories for Checklist 2 are related to a grade control spacing of $2/S_v$ and $4/S_v$, where S_v is the valley slope from Appendix A. The $2/S_v$ and $4/S_v$ results are in meters, so a factor is applied to convert to feet. A reach is in Category A if it has a spacing of less than $2/S_v$. A reach is in Category B if it has a spacing between $2/S_v$ and $4/S_v$. Finally, a reach is in Category C if it has a spacing greater than $4/S_v$. Table 2 summarizes the S_v, $2/S_v$ and $4/S_v$ values for Reaches 1 through 4 along with each reach length. Table 2 also identifies each reach's category.

The d_{50} value is the particle size in which 50 percent of the particles are smaller and 50 percent are larger. The pebble count results for each study reach are included in Appendix B and summarized in Table 3. The screening index values (INDEX) for the four reaches are tabulated on Form 1 in Appendix A and also included in Table 3. The Screening Index Threshold diagram (Checklist 3) in Appendix B provides 50% Risk values for various d_{50} values. These values are included in the last column of Table 3. If the INDEX value is less than the 50% Risk value, the reach has less than 50 percent probability of incising and falls within Category A. Table 2 shows that this is the case for all four study reaches.

Reach	D_{50}, mm	INDEX	50% Risk
1	11	0.0314	0.0378[1]
2	16	0.0413	0.0490
3	16	0.0358	0.0490
4	11	0.0359	0.0378

[1]The 50% Risk for 11 mm was interpolated from the 50% Risk for 8 mm and 16 mm from the Screening Index Threshold diagram in Appendix B.

Table 3. Summary of Pebble Count, Screening Index, Risk of Incision

Checklist 1 reflects the overall armoring potential of the channel bed based on the soil conditions at or near the ground surface. In some instances, large grain sizes (e.g., gravel or cobbles) are readily visible on the channel bed, which correspond to Category A. In other instances, sandy material susceptible to scour are visible, which correspond to Category C. As discussed above, the study reaches in this report have an unknown resistance, so Category B was selected for each reach. Checklist 3 is also based on soils in that it uses the d_{50}. However, this assesses the risk of incising or braiding based on the stream power related to d_{50}. SCCWRP indicates that Checklist 3 is modeled partially on analyses by Chang Consultants.

The overall vertical rating is determined from the above described Checklist 1, Checklist 2, and Mobility Index Threshold results. The scoring is based on the following values:

Category A = 3, Category B = 6, Category C = 9

The vertical rating score is based on these values and the equation:

$$\text{Vertical Rating} = [(\text{armoring} \times \text{grade control})^{1/2} \times \text{screening index score}]^{1/2}$$

Table 4 summarizes the Checklist 1, 2, and 3 values for each reach as well as their vertical rating. The results show the vertical rating for Reaches 1 through 4 is less than 4.5, so these reaches have a low threshold for vertical susceptibility.

Reach	Checklist 1	Checklist 2	Checklist 3	Vertical Rating
1	6	3	3	3.6
2	6	3	3	3.6
3	6	3	3	3.6
4	6	6	3	4.2

Table 4. Overall Vertical Rating

Lateral Stability

The purpose of the lateral decision tree (Figure 6-5 from County of San Diego HMP included in Figure 17) is to assess the state of the channel banks with a focus on the risk of widening. Channels can widen from either bank failure or through fluvial processes such as chute cutoffs, avulsions, and braiding. Widening through fluvial avulsions/active braiding is a relatively straightforward observation. If braiding is not already occurring, the next logical step is to assess the condition of the banks. Banks fail through a variety of mechanisms; however, one of the most important distinctions is whether they fail in mass (as many particles) or by fluvial detachment of individual particles. Although much research is dedicated to the combined effects of weakening, fluvial erosion, and mass failure, SCCWRP found it valuable to segregate bank types based on the inference of the dominant failure mechanism (as the management approach may vary based on the dominant failure mechanism). A decision tree (Form 4 in Appendix B) is used in conducting the lateral susceptibility assessment. Definitions and photographic examples are also provided below for terms used in the lateral susceptibility assessment.

The first step in the decision tree is to determine if lateral adjustments are occurring. The adjustments can take the form of extensive mass wasting (greater than 50 percent of the banks are exhibiting planar, slab, or rotational failures and/or scalloping, undermining, and/or tension cracks). The adjustments can also involve extensive fluvial erosion (significant and frequent bank cuts on over 50 percent of the banks). Neither extensive mass wasting nor extensive fluvial erosion was evident within Reaches 1 through 4 during a field investigation. The channel banks are intact in the photographs included in the figures, and some are armored with riprap.

The next step in the Form 4 decision tree is to assess the consolidation of the bank material. The banks were moderate to well-consolidated. This determination was made because the banks were difficult to penetrate with a probe. In addition, the banks showed limited evidence of crumbling and were composed of well-packed particles (see the figures).

Form 6 (see Appendix B) is used to assess the probability of mass wasting. Form 6 identifies a 10, 50, and 90 percent probability based on the bank angle and bank height. The site visit and topographic mapping reveal that the channel banks within all four reaches average 2:1 (26.6 degrees) or less. Form 6 shows that the probability of mass wasting and bank failure has less than 10 percent risk for a 26.6 degree bank angle or less regardless of the bank height.

The final two steps in the Form 4 decision tree are based on the braiding risk determined from the vertical rating as well as the Valley Width Index (VWI) calculated in Appendix A. If the vertical rating is high, the braiding risk is considered to be greater than 50 percent. Excessive braiding can lead to lateral bank failure. For Reaches 1 through 4 the vertical rating is low, so the braiding risk is less than 50 percent. Furthermore, a VWI greater than 2 represents channels unconfined by bedrock or hillslope and, hence, subject to lateral migration. The VWI calculation in the spreadsheet in Appendix A shows that the VWI for Reaches 1 through 4 are much less than 2.

From the above steps, the lateral susceptibility rating is low for all four reaches (red circles are included on the Form 4: Lateral Susceptibility Field Sheet decision tree in Appendix B showing the decision path).

CONCLUSION

The SCCWRP channel screening tools were used to assess the downstream channel susceptibility for the Harmony Grove Village South project. The project runoff will be collected by proposed on-site drainage facilities and outlet to two points of compliance. POC 1 serving the project's north drainage basin outlets into Escondido Creek and POC 2 serving the south drainage basin outlets into an unnamed natural drainage course. The downstream channel assessment for POC 1 and POC 2 indicate a low threshold for both for vertical and lateral susceptibilities.

The HMP requires that the POC 1 and POC 2 results be compared with the critical stress calculator results outlined in the County of San Diego HMP. The critical stress results are included in Appendix B for Reaches 1 through 4 using the spreadsheet provided by the County. The channel dimensions were estimated from the topographic mapping and site visit. Based on these values, the critical stress results returned a low threshold consistent with the SCCWRP channel screening results. Therefore, the SCCWRP analyses and critical stress calculator demonstrate that a low overall threshold is applicable to POC 1 and POC 2.

Figure 1. Country Club Drive (Grade Control) at Upper End of POC 1

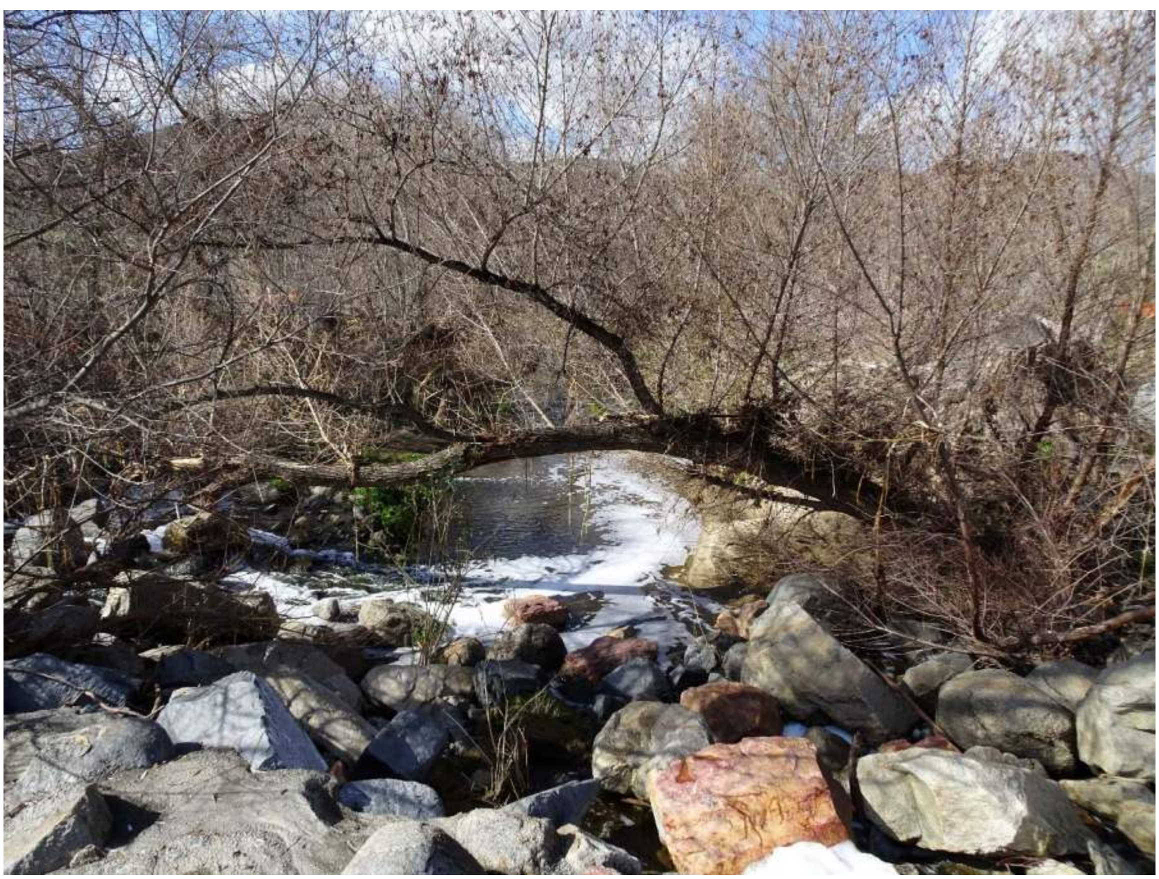


Figure 2. Looking Downstream at Reach 1 from Upper End at POC 1

Figure 3. Middle of Reach 1

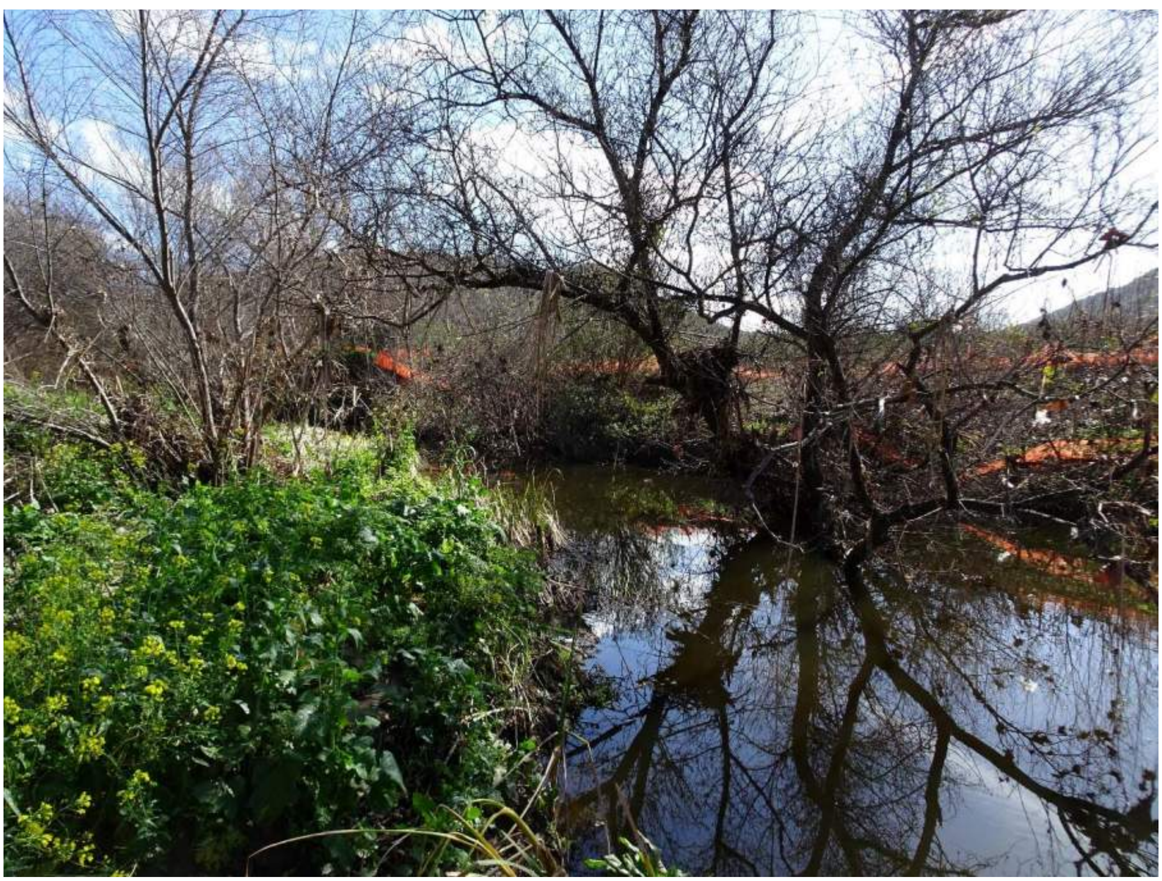


Figure 4. Looking Upstream at Reach 1 from Lower End

Figure 5. Concrete Grade Control between Reach 1 and Reach 2

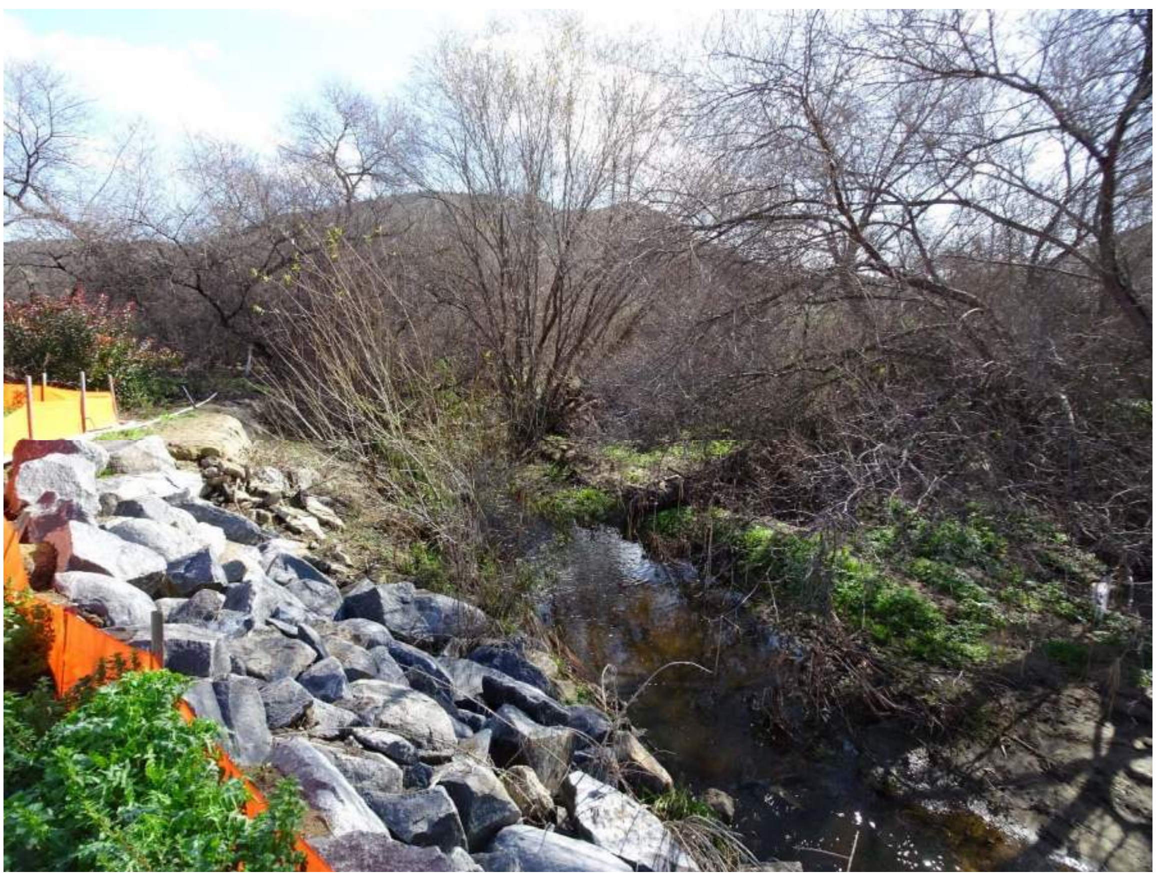


Figure 6. Upper End of Reach 2

Figure 7. Lower End of Reach 2

Figure 8. Looking Upstream towards Reach 3

Figure 9. Looking Downstream towards Reach 4

Figure 10. Rock-Lined Grade Control in Reach 4

Figure 11. Culvert (Grade Control) under Cordrey Drive at Downstream End of Reach 4

Figure 12. Gravelometer along Reach 1

Figure 13. Gravelometer along Reach 2

Figure 14. Gravelometer along Reach 3

Figure 15. Gravelometer along Reach 4

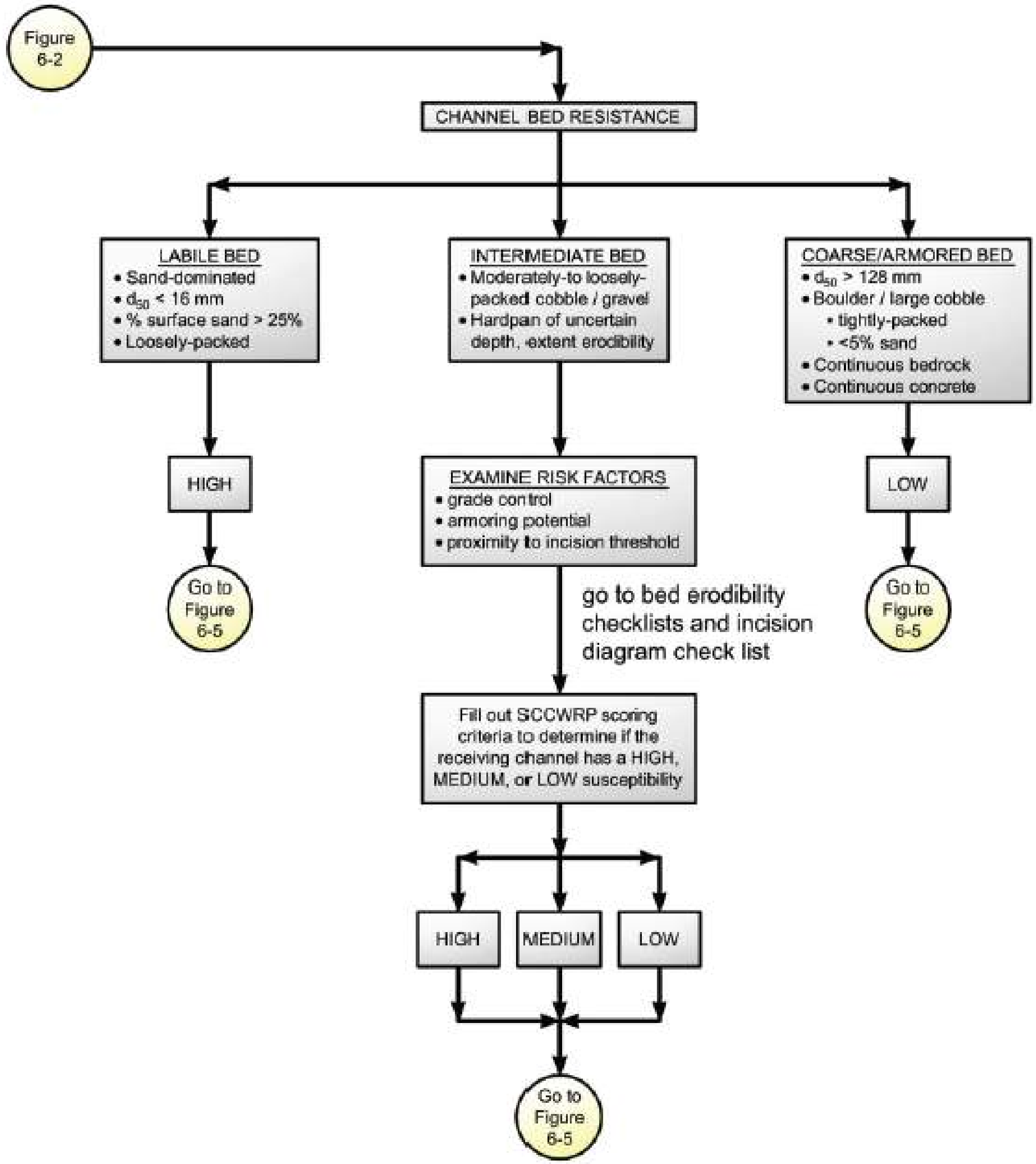


Figure 6-4. SCCWRP Vertical Susceptibility

Figure 16. SCCWRP Vertical Channel Susceptibility Matrix

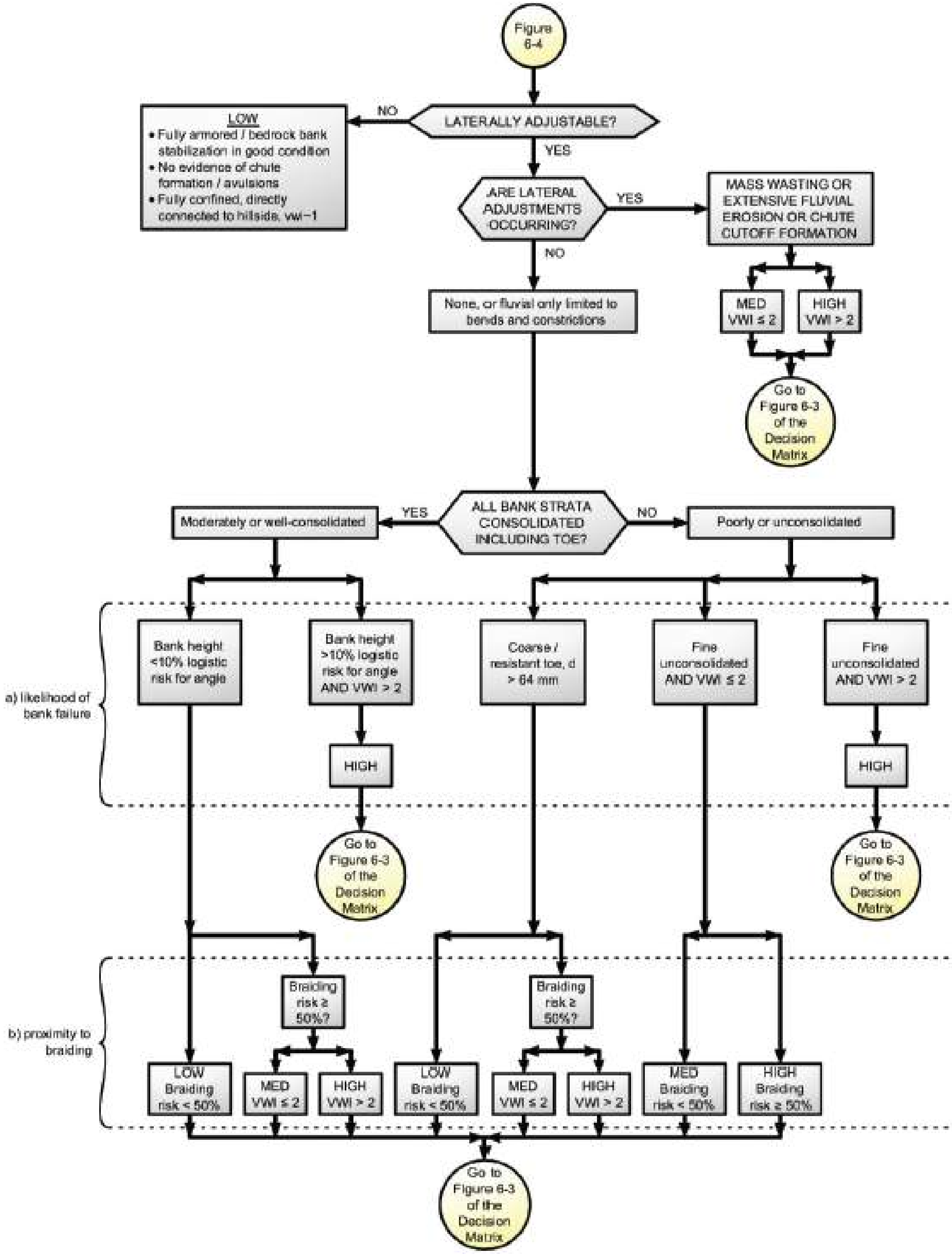


Figure 6-5. Lateral Channel Susceptibility

Figure 17. SCCWRP Lateral Channel Susceptibility Matrix

APPENDIX A

SCCWRP INITIAL DESKTOP ANALYSIS

FORM 1: INITIAL DESKTOP ANALYSIS

Complete all shaded sections.

IF required at multiple locations, circle one of the following site types:

Applicant Site / **Upstream Extent** / **Downstream Extent**

Location: Latitude: 33.0991 Longitude: -117.1306

Description (river name, crossing streets, etc.): Escondido Creek and Country Club Drive

GIS Parameters: The International System of Units (SI) is used throughout the assessment as the field standard and for consistency with the broader scientific community. However, as the singular exception, US Customary units are used for contributing drainage area (A) and mean annual precipitation (P) to apply regional flow equations after the USGS. See SCCWRP Technical Report 607 for example measurements and "Screening Tool Data Entry.xls" for automated calculations.

Form 1 Table 1. Initial desktop analysis in GIS.

	Symbol	Variable	Description and Source	Value
Watershed properties (English units)	A	Area (mi^2)	Contributing drainage area to screening location via published Hydrologic Unit Codes (HUCs) and/or ≤ 30 m National Elevation Data (NED), USGS seamless server	See attached Form 1 table on next page for calculated values for each reach.
	P	Mean annual precipitation (in)	Area-weighted annual precipitation via USGS delineated polygons using records from 1900 to 1960 (which was more significant in hydrologic models than polygons delineated from shorter record lengths)	
Site properties (SI units)	S_v	Valley slope (m/m)	Valley slope at site via NED, measured over a relatively homogenous valley segment as dictated by hillslope configuration, tributary confluences, etc., over a distance of up to ~500 m or 10% of the main-channel length from site to drainage divide	
	W_v	Valley width (m)	Valley bottom width at site between natural valley walls as dictated by clear breaks in hillslope on NED raster, irrespective of potential armoring from floodplain encroachment, levees, etc. (imprecise measurements have negligible effect on rating in wide valleys where VWI is >> 2, as defined in lateral decision tree)	

Form 1 Tabl e 2. Simplif ied peak flo w, screening index, and valley width index. Values for this table should be calculated in the sequence shown in this table, using values from Form 1 Table 1.

Symbol	Dependent Variable	Equation	Required Units	Value
Q_{10cfs}	10-yr peak flow (ft^3/s)	$Q_{10cfs} = 18.2 * A^{0.87} * P^{0.77}$	A (mi^2) P (in)	See attached Form 1 table on next page for calculated values for each reach.
Q_{10}	10-yr peak flow (m^3/s)	$Q_{10} = 0.0283 * Q_{10cfs}$	Q_{10cfs} (ft^3/s)	
INDEX	10-yr screening index ($m^{1.5}/s^{0.5}$)	$INDEX = S_v * Q_{10}^{0.5}$	Sv (m/m) Q_{10} (m^3/s)	
W_{ref}	Reference width (m)	$W_{ref} = 6.99 * Q_{10}^{0.438}$	Q_{10} (m^3/s)	
VWI	Valley width index (m/m)	$VWI = W_v/W_{ref}$	W_v (m) W_{ref} (m)	

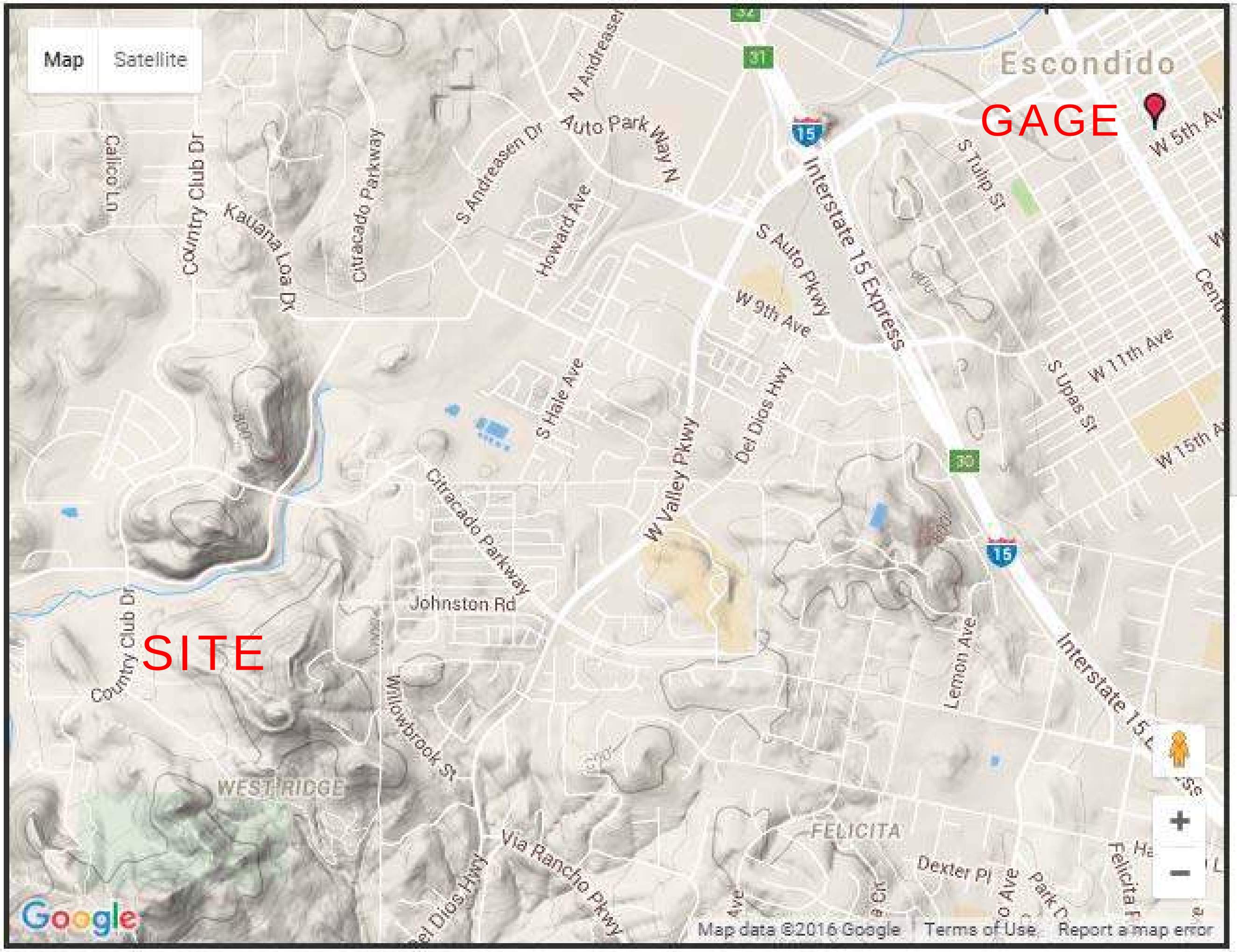
(Sheet 1 of 1)

SCCWRP FORM 1 ANALYSES

Reach	Area A, sq. mi.	Mean Annual Precip. P, inches	Valley Slope Sv, m/m	Valley Width Wv, m	10-Year Flow Q10cfs, cfs	10-Year Flow Q10, cms
1	50.030	16.22	0.0027	30.48	4,679	132.41
2	52.842	16.22	0.0035	42.67	4,907	138.86
3	0.131	16.22	0.0412	1.22	27	0.75
4	0.139	16.22	0.0404	1.22	28	0.79

Reach	10-Year Screening Index INDEX	Reference Width Wref, m	Valley Width Index VWI, m/m
1	0.0314	59.41	0.51
2	0.0413	60.66	0.70
3	0.0358	6.17	0.20
4	0.0359	6.31	0.19

US COOP Station Map



RAIN GAGE AND SITE LOCATION

ESCONDIDO, CALIFORNIA (042862)

Period of Record Monthly Climate Summary

Period of Record : 12/01/1893 to 03/31/1979

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	64.9	66.3	68.8	72.2	76.1	82.0	88.2	88.2	85.7	79.0	72.9	66.5	75.9
Average Min. Temperature (F)	37.1	39.7	42.4	46.0	50.5	54.0	58.0	58.6	55.1	48.7	41.2	37.4	47.4
Average Total Precipitation (in.)	3.24	3.11	2.68	1.32	0.47	0.09	0.03	0.13	0.23	0.70	1.54	2.67	16.22
Average Total SnowFall (in.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average Snow Depth (in.)						No	Data						

Percent of possible observations for period of record.
Max. Temp.: 99.7% Min. Temp.: 99.7% Precipitation: 99.7% Snowfall: 63.6% Snow Depth: 63.5%
Check Station Metadata or Metadata graphics for more detail about data completeness.

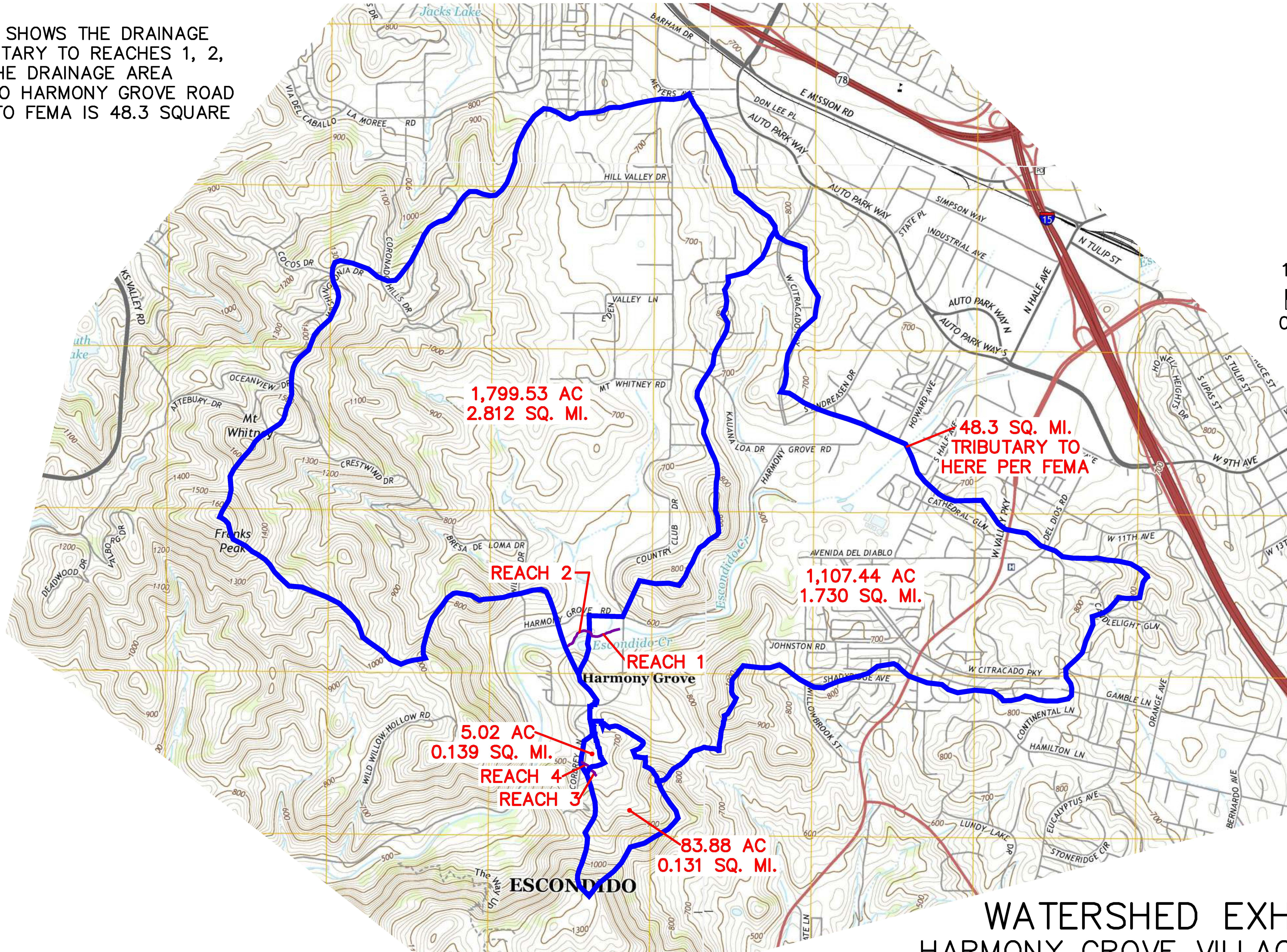
Western Regional Climate Center, wrcc@dri.edu

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
At Apex of Alluvial Fan	1.9	450	1,150	1,700	2,650
Encanto Branch					
Above Confluence with South Las Chollas Creek	6.0	1,200	2,700	3,500	6,600
Above Confluence with Radio Drive Tributary	4.8	1,100	2,600	3,400	6,500
At 64th Street	4.2	950	2,300	3,000	6,100
Above Confluence with Jamacha Branch	2.4	640	1,400	1,700	3,200
Escondido Creek					
At Interstate Highway 5	77.7	3,400	15,500	22,000	41,000
Upstream of Lake Val Sereno	68.0	3,200	14,500	21,000	38,400
Upstream of Elfin Forest Lake	55.7	2,800	13,000	19,000	35,000
At Harmony Grove Road	48.3	2,600	12,000	18,000	32,000
Approximately 11,200 feet Upstream of Wohlford Dam	2.2	--	--	2,700	--
Eucalyptus Hills East Branch					
At Riverside Drive	1.5	--	--	860	--
Eucalyptus Hills West Branch					

EXCERPT FROM FEMA "FLOOD INSURANCE STUDY"
(SEE WATERSHED EXHIBIT FOR ADDITIONAL DRAINAGE AREAS DOWNSTREAM OF HARMONY GROVE ROAD)

NOTE:
THIS EXHIBIT SHOWS THE DRAINAGE AREAS TRIBUTARY TO REACHES 1, 2, 3, AND 4. THE DRAINAGE AREA TRIBUTARY TO HARMONY GROVE ROAD ACCORDING TO FEMA IS 48.3 SQUARE MILES.

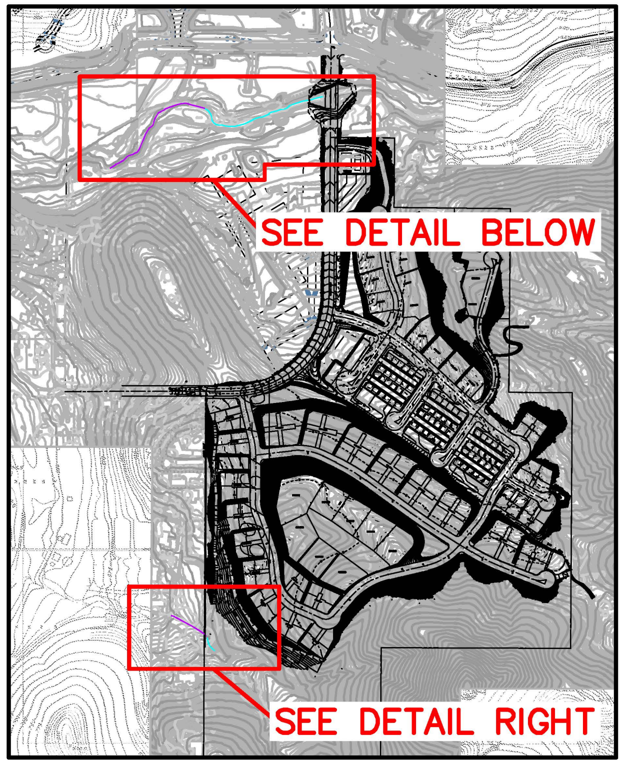


1" = 2,000'

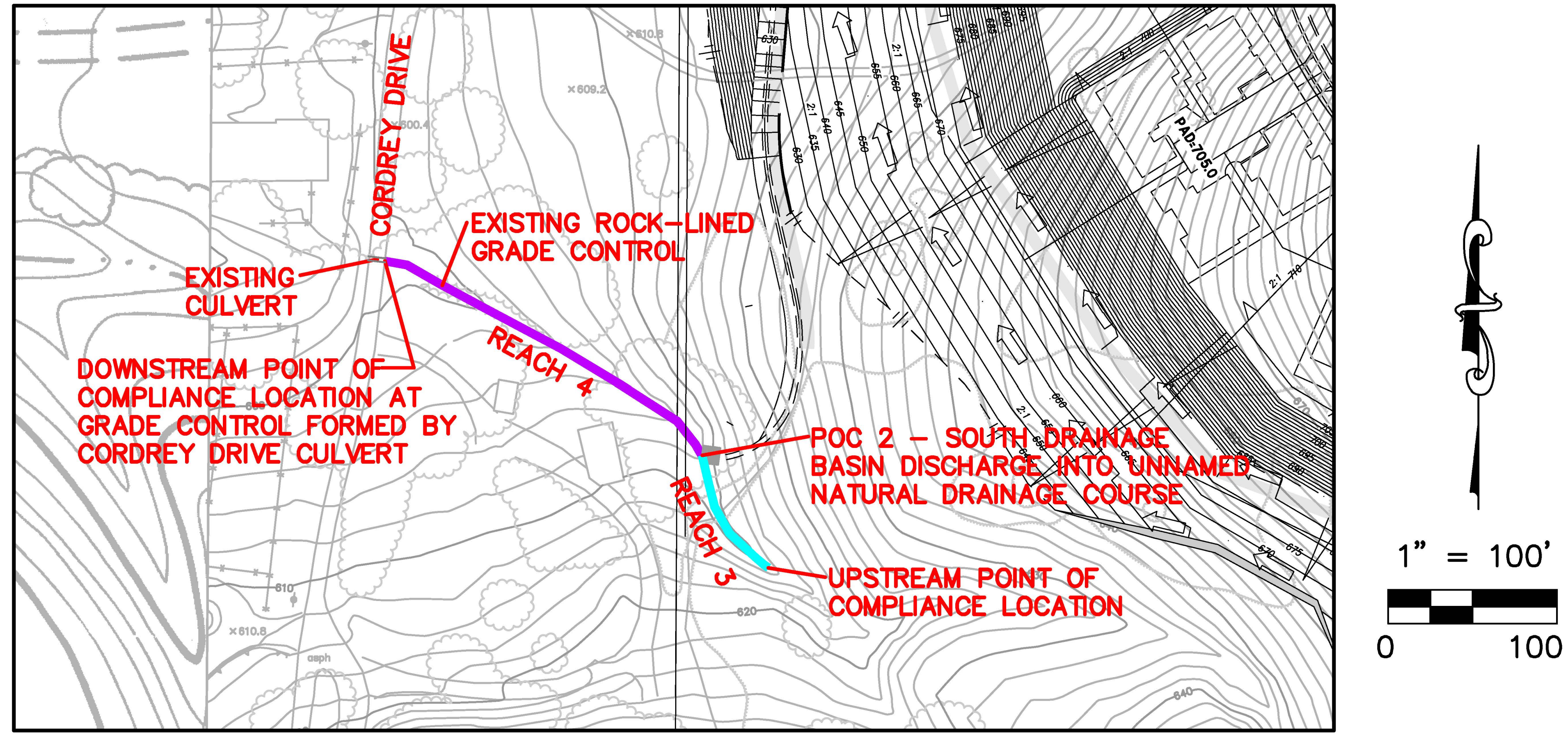
0 2,000

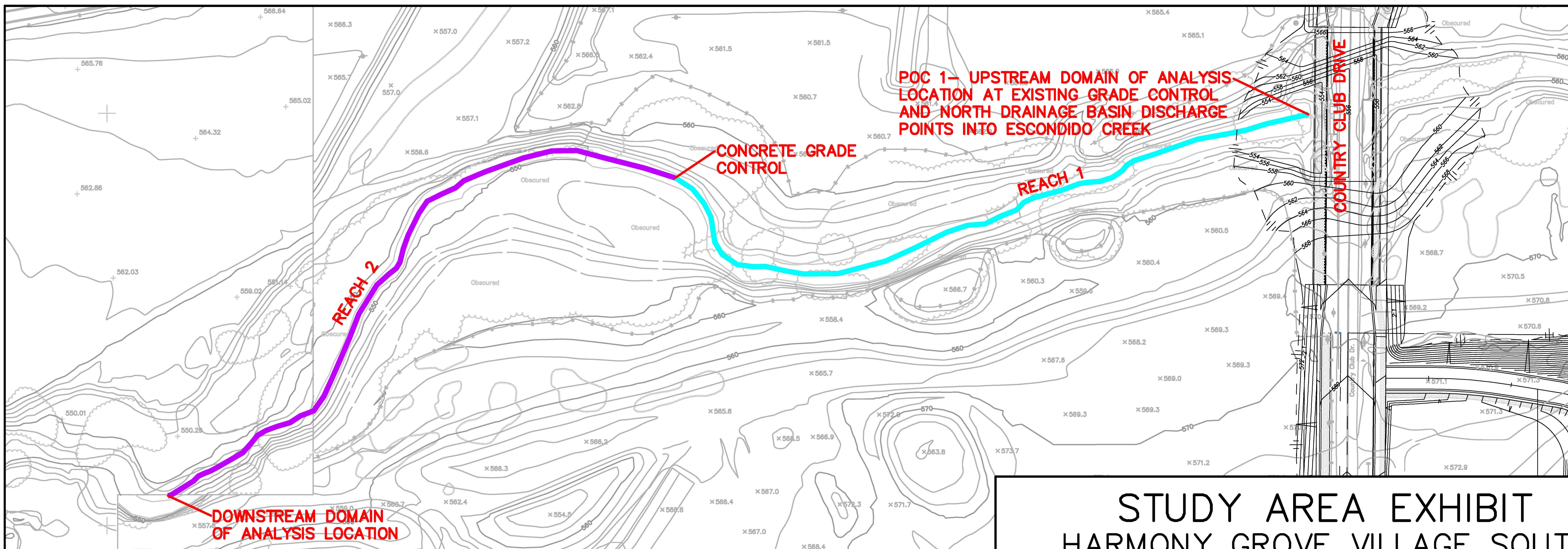
WATERSHED EXHIBIT

HARMONY GROVE VILLAGE SOUTH



KEY MAP – 1"=1,000'





STUDY AREA EXHIBIT
HARMONY GROVE VILLAGE SOUTH

APPENDIX B

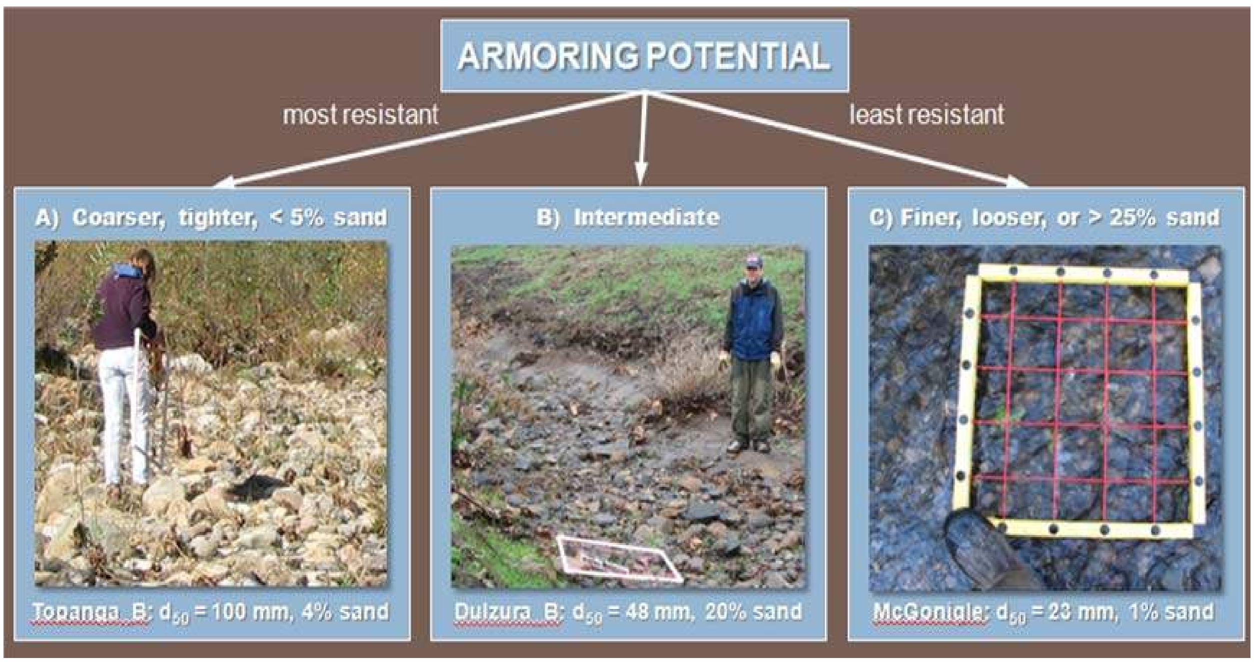
SCCWRP FIELD SCREENING DATA

Form 3 Support Materials

Form 3 Checklists 1 and 2, along with information recording in Form 3 Table 1, are intended to support the decisions pathways illustrated in Form 3 Overall Vertical Rating for Intermediate/Transitional Bed.

Form 3 Checklist 1: Armoring Potential

□	A	A mix of coarse gravels and cobbles that are tightly packed with <5% surface material of diameter <2 mm
X	B	Intermediate to A and C or hardpan of unknown resistance, spatial extent (longitudinal and depth), or unknown armoring potential due to surface veneer covering gravel or coarser layer encountered with probe
□	C	Gravels/cobbles that are loosely packed or >25% surface material of diameter <2 mm



Form 3 Figure 2. Armoring potential photographic supplement for assessing intermediate beds (16 < d_{50} < 128 mm) to be used i**n conjunction with Form 3 Checklist 1.**

(Sheet 2 of 4)

RESULT FOR ALL STUDY REACHES

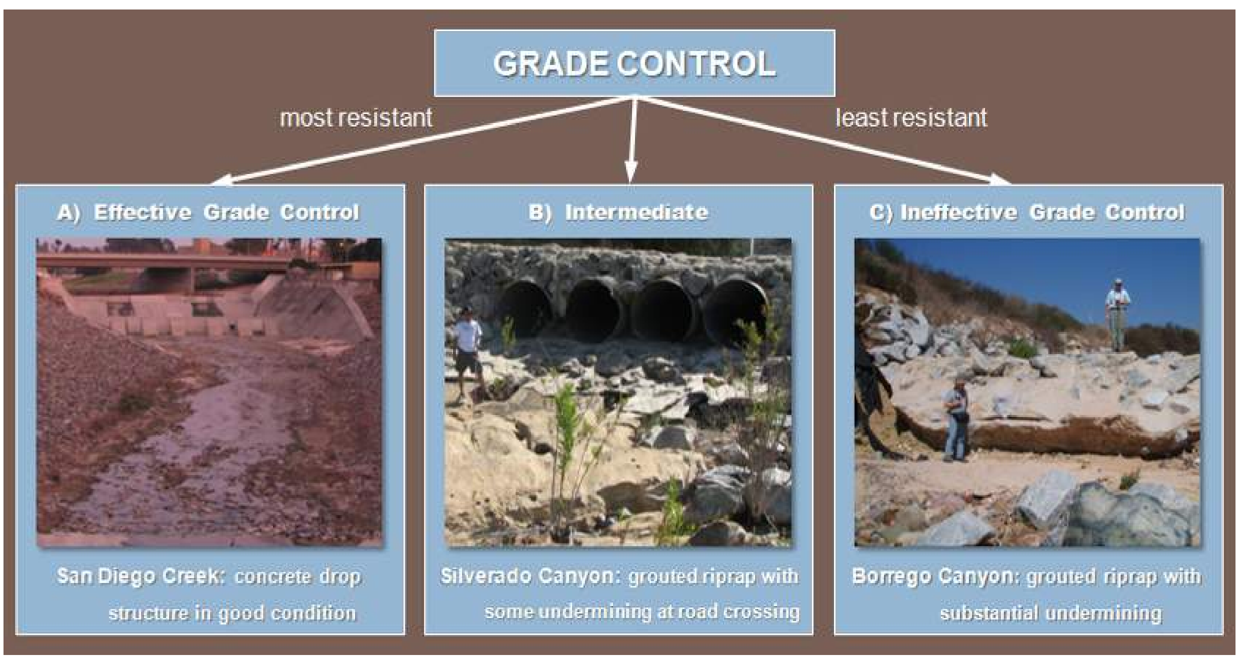
Form 3 Checklist 2: Grade Control

X A Grade control is present with spacing <50 m or $2/S_v$ m

- No evidence of failure/ineffectiveness, e.g., no headcutting (>30 cm), no active mass wasting (analyst cannot say grade control sufficient if mass-wasting checklist indicates presence of bank failure), no exposed bridge pilings, no culverts/structures undermined
- Hard points in serviceable condition at decadal time scale, e.g., no apparent undermining, flanking, failing grout
- If geologic grade control, rock should be resistant igneous and/or metamorphic; For sedimentary/hardpan to be classified as 'grade control', it should be of demonstrable strength as indicated by field testing such as hammer test/borings and/or inspected by appropriate stakeholder

☒ B Intermediate to A and C – artificial or geologic grade control present but spaced 2/Sv m to 4/Sv m or potential evidence of failure or hardpan of uncertain resistance

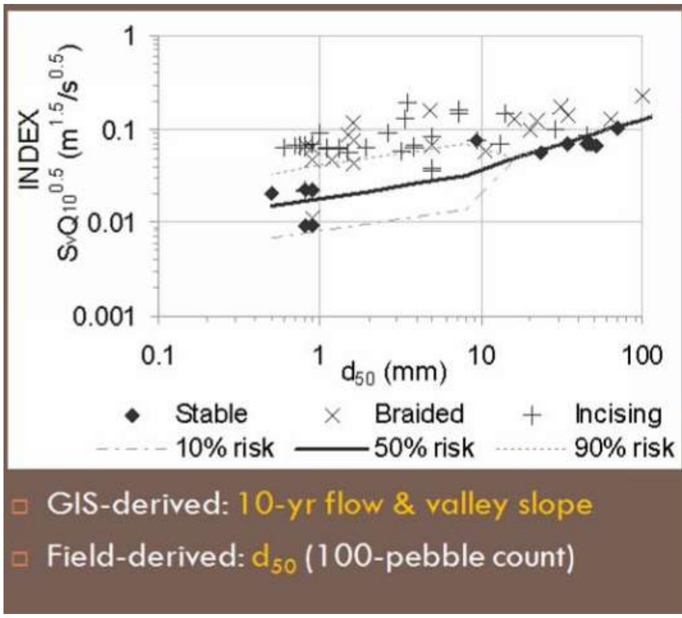
☐ C Grade control absent, spaced >100 m or $>4/S_v$ m, or clear evidence of ineffectiveness



Form 3 Figure 3. Grade-control (condition) photographic supplement for assessing intermediate beds ($16 < d_{50} < 128$ mm) to be used in conjunction with Form 3 Checklist 2.

Regionally-Calibrated Screening Index Threshold for Incising/Braiding

For transitional bed channels (d_{50} between 16 and 128 mm) or labile beds (channel not incised past critical bank height), use Form 3 Figure 3 to determine Screening Index Score and complete Form 3 Table 1.



Model Type	d_{50} (mm)	50% Risk $S_vQ_{10}^{0.5}$ ($m^{1.5}/s^{0.5}$)
Logistic Regression $d_{50} \geq 16$ mm	128	0.145
	96	0.125
	80	0.114
	64	0.101
	48	0.087
	32	0.070
	16	0.049
Logistic Reg. $d_{50} < 16$ mm	8	0.031
	4	0.026
	2	0.022
	1	0.018
	0.5	0.015

11mm = 0.0378

Form 3 Figure 4. Probability of incising/braiding based on logistic regression of Screening Index and d_{50} to be used in conjunction with Form 3 Table 1.

Form 3 Table 1. Values for Screening Index Threshold (probability of incising/braiding) to be used in conjunction with Form 3 Figure 4 (above) to complete Form 3 Overall Vertical Rating for Intermediate/Transitional Bed (below).. Screening Index Score: A = <50% probability of incision for current Q_{10}, valley slope, and d_{50}; B = Hardpan/d_{50} indeterminate; and C = $\geq$50% probability of incising/braiding for current Q_{10}, valley slope, and d_{50}.

d_{50} (mm) *From Form 2*	**S_v*$Q_{10}^{0.5}$ ($m^{1.5}/s^{0.5}$)** *From Form 1*	**S_v*$Q_{10}^{0.5}$ ($m^{1.5}/s^{0.5}$)** *50% risk of incising/braiding from table in Form 3 Figure 3 above*	**Screening Index Score (A, B, C)**

Overall Vertical Rating for Intermediate/Transitional Bed

Calculate the overall Vertical Rating for Transitional Bed channels using the formula below. Numeric values for responses to Form 3 Checklists and Table 1 as follows: A = 3, B = 6, C = 9.

$$Vertical\ Rating = \sqrt{\{(\sqrt{armoring * grade\ control}) * screening\ index\ score\}}$$

Vertical Susceptibility based on Vertical Rating: <4.5 = LOW; 4.5 to 7 = MEDIUM; and >7 = HIGH.

(Sheet 4 of 4)

RESULT FOR ALL STUDY REACHES

PEBBLE COUNT

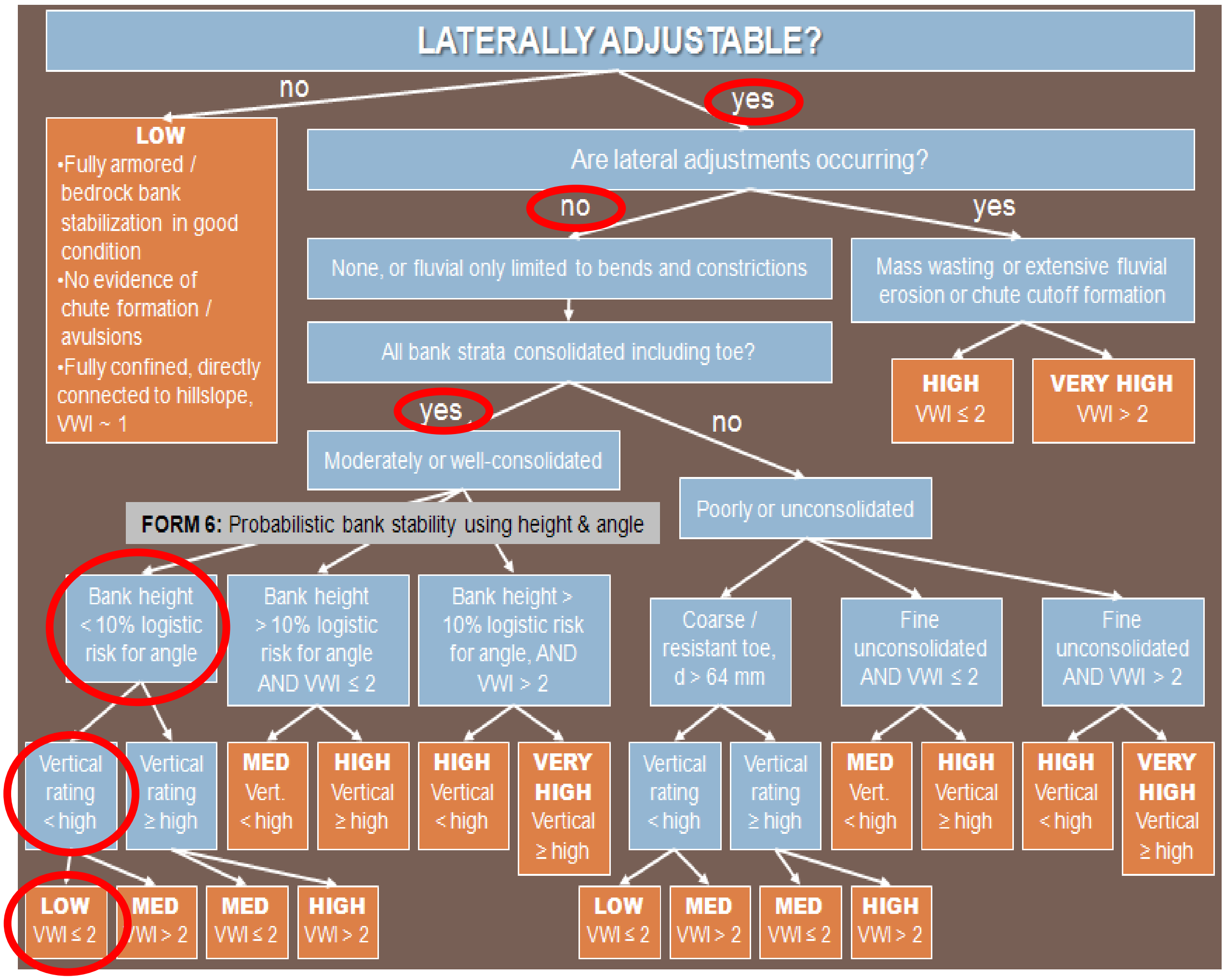
#	Reach 1 Diameter, mm	Reach 2 Diameter, mm	Reach 3 Diameter, mm	Reach 4 Diameter, mm
1	2	2	2	2
2	2.8	2	2	2
3	2.8	2	2.8	2.8
4	2.8	2.8	2.8	2.8
5	2.8	2.8	2.8	2.8
6	2.8	2.8	2.8	2.8
7	4	2.8	4	4
8	4	2.8	4	4
9	4	4	4	4
10	4	4	4	4
11	4	4	4	4
12	4	4	4	5.6
13	4	4	5.6	5.6
14	5.6	4	5.6	5.6
15	5.6	5.6	5.6	5.6
16	5.6	5.6	5.6	5.6
17	5.6	5.6	5.6	5.6
18	5.6	5.6	5.6	5.6
19	5.6	5.6	5.6	5.6
20	5.6	5.6	5.6	5.6
21	5.6	5.6	5.6	5.6
22	5.6	5.6	8	5.6
23	5.6	5.6	8	5.6
24	8	8	8	5.6
25	8	8	8	8
26	8	8	8	8
27	8	8	8	8
28	8	8	8	8
29	8	8	8	8
30	8	8	8	8
31	8	8	8	8
32	8	8	8	8
33	8	8	8	8
34	8	8	8	8
35	8	8	8	8
36	8	8	11	8
37	8	8	11	8
38	8	11	11	11
39	8	11	11	11
40	8	11	11	11
41	8	11	11	11
42	8	11	11	11
43	8	11	11	11

#	Reach 1 Diameter, mm	Reach 2 Diameter, mm	Reach 3 Diameter, mm	Reach 4 Diameter, mm	
44	8	11	11	11	
45	11	11	11	11	
46	11	11	11	11	
47	11	11	11	11	
48	11	16	11	11	
49	11	16	11	11	
50	11	16	16	11	D50
51	11	16	16	11	
52	11	16	16	11	
53	11	16	16	11	
54	11	16	16	11	
55	11	16	16	11	
56	11	16	16	11	
57	11	16	16	11	
58	11	16	16	11	
59	11	16	16	16	
60	11	16	16	16	
61	11	16	16	16	
62	11	16	16	16	
63	11	16	16	16	
64	11	16	16	16	
65	11	16	16	16	
66	11	16	16	16	
67	16	16	16	16	
68	16	16	16	16	
69	16	16	16	16	
70	16	16	16	16	
71	16	16	16	16	
72	16	16	16	16	
73	16	16	16	16	
74	16	16	16	16	
75	16	16	16	16	
76	16	16	16	16	
77	16	16	16	16	
78	16	16	16	16	
79	16	16	22.6	16	
80	16	22.6	22.6	16	
81	16	22.6	22.6	16	
82	16	22.6	22.6	22.6	
83	16	22.6	22.6	22.6	
84	16	22.6	22.6	22.6	
85	16	22.6	22.6	22.6	
86	16	22.6	22.6	22.6	
87	16	22.6	22.6	22.6	
88	16	22.6	22.6	22.6	

#	Reach 1 Diameter, mm	Reach 2 Diameter, mm	Reach 3 Diameter, mm	Reach 4 Diameter, mm
89	16	22.6	22.6	22.6
90	16	22.6	22.6	22.6
91	22.6	32	22.6	22.6
92	22.6	32	32	22.6
93	22.6	32	32	22.6
94	22.6	32	32	32
95	32	32	45	32
96	32	45	45	32
97	45	45	45	32
98	45	64	45	45
99	64	64	64	45
100	64	64	64	64

FORM 4: LATERAL SUSCEPTIBILTY FIELD SHEET

Circle appropriate nodes/pathway for proposed site
OR use sequence of questions provided in Form 5.



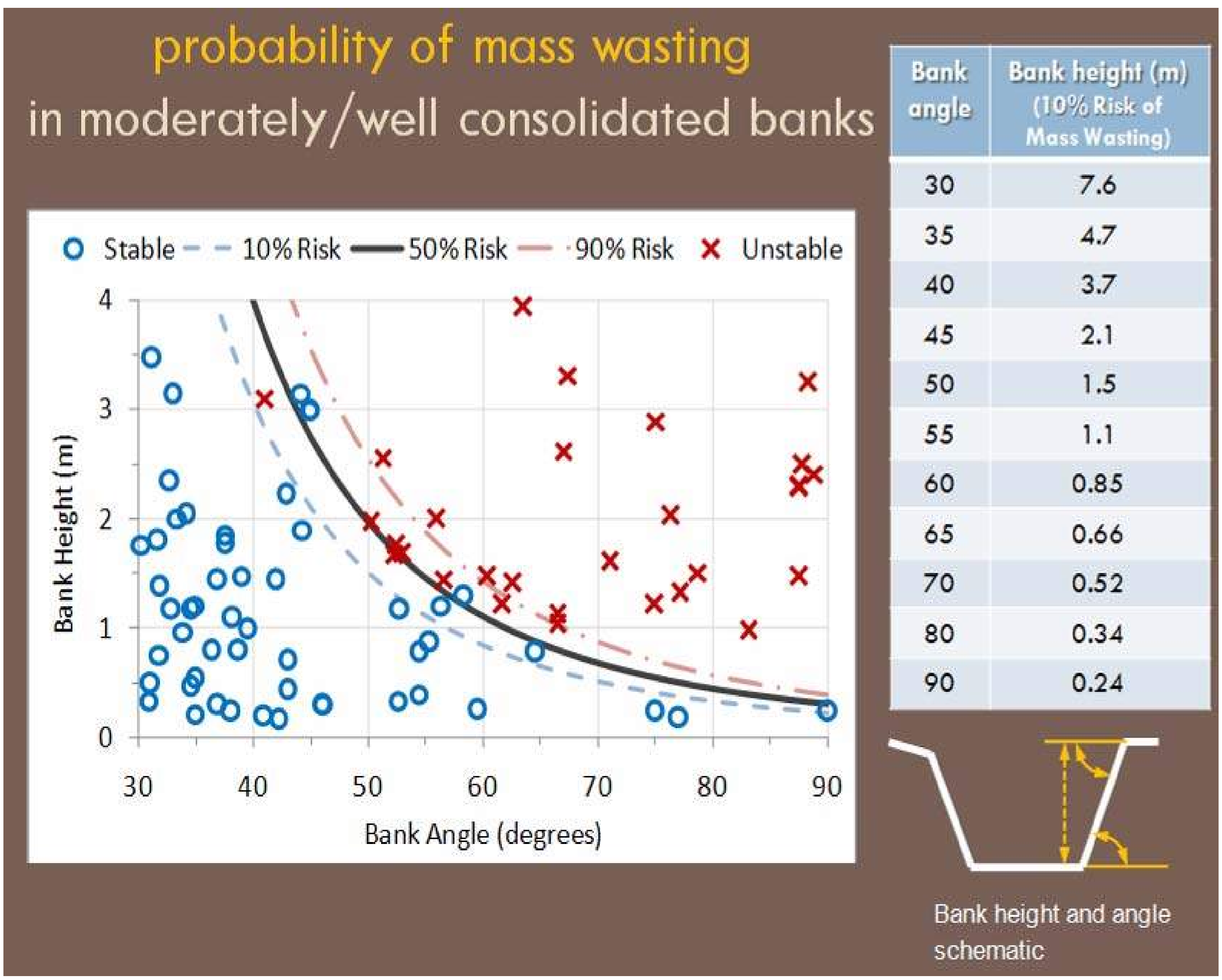
(Sheet 1 of 1)

RESULT FOR ALL STUDY REACHES

FORM 6: PROBABILITY OF MASS WASTING BANK FAILURE

If mass wasting is not currently extensive and the banks are moderately- to well-consolidated, measure bank height and angle at several locations (i.e., at least three locations that capture the range of conditions present in the study reach) to estimate representative values for the reach. Use Form 6 Figure 1 below to determine if risk of bank failure is >10% and complete Form 6 Table 1. Support your results with photographs that include a protractor/rod/tape/person for scale.

	Bank Angle (degrees) *(from Field)*	**Bank Height (m)** *(from Field)*	**Corresponding Bank Height for 10% Risk of Mass Wasting (m)** *(from Form 6 Figure 1 below)*	**Bank Failure Risk** *(<10% Risk)* *(>10% Risk)*
Left Bank	<2:1 (26.6 deg)	varies	---	<10%
Right Bank	<2:1 (26.6 deg)	varies	---	<10%



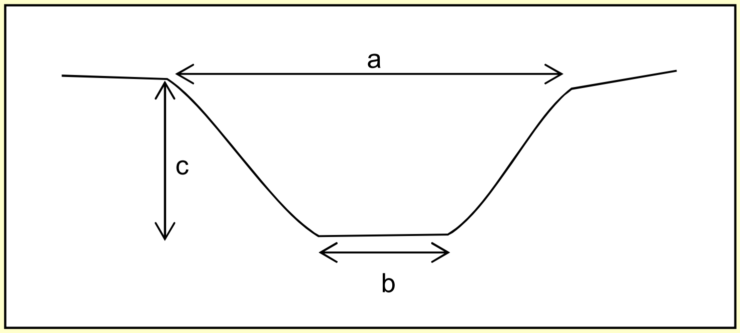
Form 6 Figure 1. Probability Mass Wasting diagram, Bank Angle:Height/% Risk table, and Band Height:Angle schematic.

(Sheet 1 of 1)

Critical Flow Calculator

Reach 1

enter all values in green cells
and drop down boxes



Inputs

a) Receiving channel width at top of bank (ft) - see figure on right	70.0
b) Channel width at bed (ft)	20.0
c) Bank height at top of bank (ft)	6.0
Channel gradient (ft/ft)	0.0027
Receiving channel roughness	Light brush and trees, leaves not present n=0.06

Channel materials (use weakest of bed or banks). If materials are varied use weakest material covering more than 20% of channel.

- unconsolidated sandy loam 0.035 lb/sq ft
- alluvial silt (non coloidal) 0.045 lb/sq ft
- medium gravel 0.12 lb/sq ft
- alluvial silt/clay 0.26 lb/sq ft
- 2.5 inch cobble 1.1 lb/sq ft
- enter own d50 (variable)
- vegetation (bed and banks) 0.6 lb/sq ft

Select method of calculating Q2

- Input own Q2
- Calculate Q2 using USGS regression

Receiving water watershed annual precip (inches)	16.22	Receiving water watershed area at PoC (sq mi)	50.0300
Project watershed annual precipitation (inches)	16.22	Project watershed area draining to PoC (sq mi)	50.0300

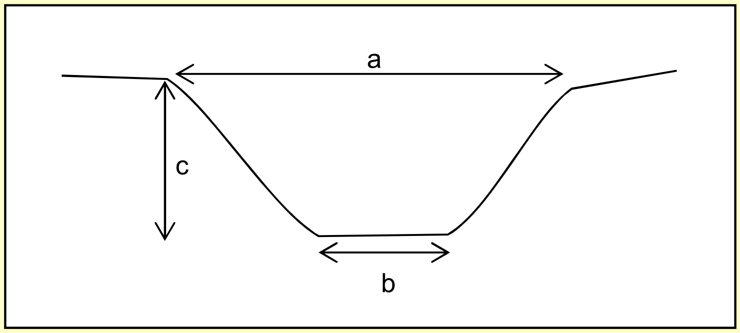
Outputs - Flow control range

Receiving water Q2	213.7	**Point of Compliance low flow rate (cfs)**	**106.9**
Project site Q2	213.7	**Low flow class**	**0.5Q2**
		Channel vulnerability	**Low**

Critical Flow Calculator

Reach 2

enter all values in green cells
and drop down boxes



Inputs

a) Receiving channel width at top of bank (ft) - see figure on right	60.0
b) Channel width at bed (ft)	16.0
c) Bank height at top of bank (ft)	5.0
Channel gradient (ft/ft)	0.0035
Receiving channel roughness	Light brush and trees, leaves not present n=0.06

Channel materials (use weakest of bed or banks). If materials are varied use weakest material covering more than 20% of channel.

- unconsolidated sandy loam 0.035 lb/sq ft
- alluvial silt (non coloidal) 0.045 lb/sq ft
- medium gravel 0.12 lb/sq ft
- alluvial silt/clay 0.26 lb/sq ft
- 2.5 inch cobble 1.1 lb/sq ft
- enter own d50 (variable)
- vegetation (bed and banks) 0.6 lb/sq ft

Select method of calculating Q2

- Input own Q2
- Calculate Q2 using USGS regression

Receiving water watershed annual precip (inches)	16.22	Receiving water watershed area at PoC (sq mi)	52.8420
Project watershed annual precipitation (inches)	16.22	Project watershed area draining to PoC (sq mi)	52.8420

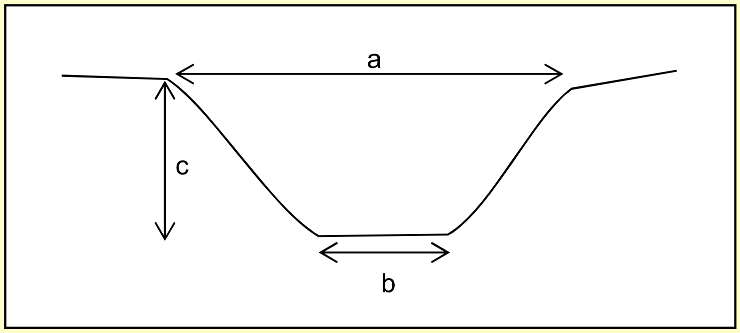
Outputs - Flow control range

Receiving water Q2	222.3	**Point of Compliance low flow rate (cfs)**	**66.7**
Project site Q2	222.3	**Low flow class**	**0.3Q2**
		Channel vulnerability	**Low**

Critical Flow Calculator

Reach 3

enter all values in green cells
and drop down boxes



Inputs

a) Receiving channel width at top of bank (ft) - see figure on right	28.0
b) Channel width at bed (ft)	4.0
c) Bank height at top of bank (ft)	2.0
Channel gradient (ft/ft)	0.0412
Receiving channel roughness	Light brush and trees, leaves not present n=0.06

Channel materials (use weakest of bed or banks). If materials are varied use weakest material covering more than 20% of channel.

- unconsolidated sandy loam 0.035 lb/sq ft
- alluvial silt (non coloidal) 0.045 lb/sq ft
- medium gravel 0.12 lb/sq ft
- alluvial silt/clay 0.26 lb/sq ft
- 2.5 inch cobble 1.1 lb/sq ft
- enter own d50 (variable)
- vegetation (bed and banks) 0.6 lb/sq ft

Select method of calculating Q2

- Input own Q2
- Calculate Q2 using USGS regression

Receiving water watershed annual precip (inches)	16.22	Receiving water watershed area at PoC (sq mi)	0.1311
Project watershed annual precipitation (inches)	16.22	Project watershed area draining to PoC (sq mi)	0.1311

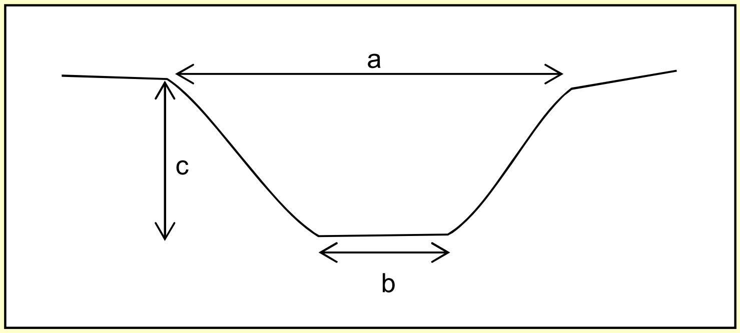
Outputs - Flow control range

Receiving water Q2	3.0	**Point of Compliance low flow rate (cfs)**	**1.5**
Project site Q2	3.0	**Low flow class**	**0.5Q2**
		Channel vulnerability	**Low**

Critical Flow Calculator

Reach 4

enter all values in green cells
and drop down boxes



Inputs

a) Receiving channel width at top of bank (ft) - see figure on right	20.0
b) Channel width at bed (ft)	4.0
c) Bank height at top of bank (ft)	2.0
Channel gradient (ft/ft)	0.0404
Receiving channel roughness	Light brush and trees, leaves not present n=0.06

Channel materials (use weakest of bed or banks). If materials are varied use weakest material covering more than 20% of channel.

- unconsolidated sandy loam 0.035 lb/sq ft
- alluvial silt (non coloidal) 0.045 lb/sq ft
- medium gravel 0.12 lb/sq ft
- alluvial silt/clay 0.26 lb/sq ft
- 2.5 inch cobble 1.1 lb/sq ft
- enter own d50 (variable)
- vegetation (bed and banks) 0.6 lb/sq ft

Select method of calculating Q2

- Input own Q2
- Calculate Q2 using USGS regression

Receiving water watershed annual precip (inches)	16.22	Receiving water watershed area at PoC (sq mi)	0.1389
Project watershed annual precipitation (inches)	16.22	Project watershed area draining to PoC (sq mi)	0.1389

Outputs - Flow control range

Receiving water Q2	3.1	**Point of Compliance low flow rate (cfs)**	**1.5**
Project site Q2	3.1	**Low flow class**	**0.5Q2**
		Channel vulnerability	**Low**