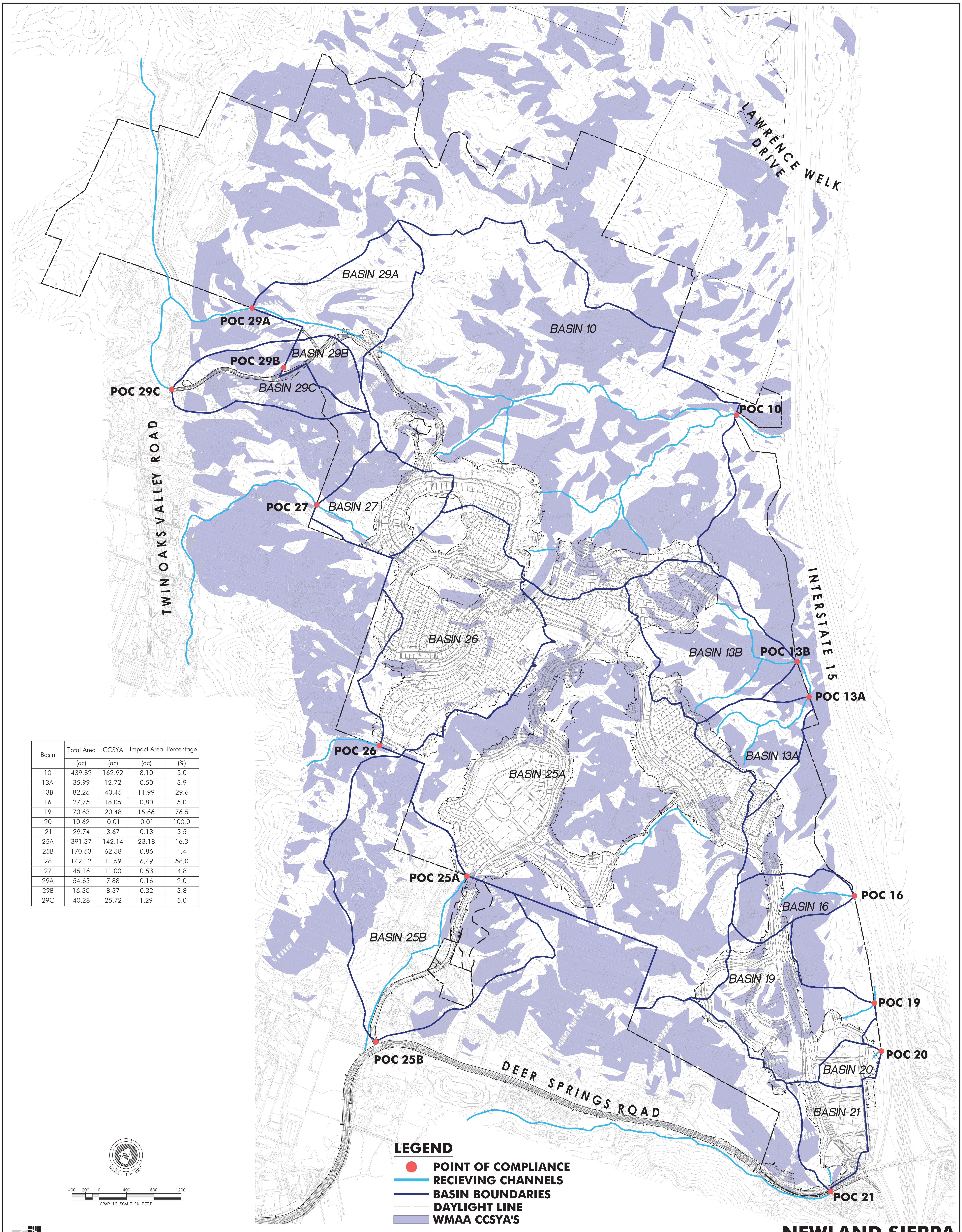

Basin	Total Area	CCSYA	Impact Area	Percentage
	(ac)	(ac)	(ac)	(%)
10	439.82	162.92	8.10	5.0
13A	35.99	12.72	0.50	3.9
13B	82.26	40.45	11.99	29.6
16	27.75	16.05	0.80	5.0
19	70.63	20.48	15.66	76.5
20	10.62	0.01	0.01	100.0
21	29.74	3.67	0.13	3.5
25A	391.37	142.14	23.18	16.3
25B	170.53	62.38	0.86	1.4
26	142.12	11.59	6.49	56.0
27	45.16	11.00	0.53	4.8
29A	54.63	7.88	0.16	2.0
29B	16.30	8.37	0.32	3.8
29C	40.28	25.72	1.29	5.0

LEGEND

● POINT OF COMPLIANCE
RECIEVING CHANNELS
BASIN BOUNDARIES
DAYLIGHT LINE
▨ WMAA CCSYA'S

FUSCOE
ENGINEERING
full circle thinking

Figure 1

NEWLAND SIERRA
CRITICAL COARSE SEDIMENT YIELD IMPACT EXHIBIT
JULY 2016

Appendix 1:

- Relevant Information from Appendix H
- Relevant Information from Regional WMAA CCSYA Quantitative Analysis

Appendix
H

Guidance for Investigating Potential Critical Coarse Sediment Yield Areas

February 26, 2016

H.3 Step 3: Bypass Onsite and Upstream CCSYAs

Another key element of preserving the stability of receiving waters is to maintain current bed sediment supply characteristics through effective bypass of onsite and upstream sediment sources. Upstream bed sediment sources may include overland flow from CCSYAs and/or concentrated channel flows. Applicants must ensure both onsite and upstream sources of bed sediment are effectively bypassed through their project. If onsite and/or upstream CCSYAs are not effectively bypassed per the criteria below, applicant must demonstrate no net impact to the receiving water per the guidance presented in Appendix H.4.

H.3.1 Bypass CCSYAs from Hillslopes

Both onsite and upstream hillslopes mapped as CCSYAs must be effectively bypassed through and/or around the proposed project site.

- Proposed hardened drainage systems (e.g. storm drains, drainage ditches) that convey the bed sediment from the hillslopes to the downstream waters of the state should maintain a peak velocity from the discrete 2-year, 24-hour runoff event greater than three feet per second.
    - When drainage ditches are proposed for bypass, this velocity may be achieved by designing to the minimum dimensions listed in the San Diego Regional Standard drawing D-75.
    - When an 18" concrete storm drain is proposed for bypass, this velocity may typically be achieved by maintaining a storm drain slope of ≥0.5%. In instances where 2 year, 24-hour peak flow rates associated with the storm drain are less than 1.1 cfs, applicants may refer to the table below for minimum slopes needed to maintain three feet per second. Applicants may interpolate the values from the table below, or may elect to perform more detailed cleansing velocity calculations presented in Appendix H.7.1.

2-Year, 24-Hour Peak Flow (cfs)	Minimum Slope for 18" Concrete Storm Drain
<0.25	n/a, this PCCSYA is considered de-minimis
0.25	2.0%
0.50	1.0%
1.10	0.5%

- Storm water runoff that contains the bed sediment from CCSYAs must not be routed through detention basins or other facilities with restricted outlets that will trap sediment. Bypass systems shall be designed as necessary so that the bed material is conveyed to the downstream receiving water. Structural BMPs (including most flow-thru BMPs) are likely to trap sediment.
- For scenarios where a BMP must be constructed to treat offsite drainage area and there are CCSYAs outside of the project footprint, it may be feasible to achieve mitigation by construction of an outlet structure that can convey the bed load to the downstream receiving water and clear water through a bypass structure to a BMP.
- Proposed crossings (culverts, driveways, etc.) should not impede the transport of upstream critical coarse sediment. Crossings should be designed to avoid headwater conditions that would result in the trapping/settling of sediment.

H.3.2 Bypass CCSYAs from Channels

Projects that effectively avoid and bypass CCSYAs mapped in Step 1 of this guidance are not required to take specific action to ensure bypass of channel flows. This guidance does not set forth channel bypass criteria for this scenario because it recognizes that existing regulator mechanisms (such as 401 certifications, site design requirements, etc) are generally sufficient to preserve the sediment transport functions of onsite channels.

However, projects that do not effectively avoid and bypass the CCSYAs mapped in Step 1, will be required to specifically account for bypass of channel flows as part of the demonstration of no net impact outlined in Appendix H.4.

H.3.3 De Minimis Upstream CCSYA

Applicants have an option to exclude de minimis upstream CCSYAs. De minimis upstream CCSYAs consist of coarse hillslope areas that are not significant contributors of bed sediment yield due to their small size, and are considered by the owner and County as not practicable to bypass to the downstream waters of the state. In limited scenarios where all of the criteria below are satisfied, de minimis upstream CCSYAs may be omitted from consideration.

- De minimis upstream CCSYA is not disturbed through the proposed project activities.
- De minimis upstream CCSYA is not part of an upstream drainage contributing more than 0.31 total acres to the project site.
- Multiple de minimis upstream CCSYAs cannot be adjacent to each other and hydraulically connected.
- The SWQMP must document the reason why each de minimis upstream CCSYA could not be bypassed to the downstream waters of the state.

The 0.31-acre (13,500 square feet) de minimis threshold was established using 0.25 cfs as the cut off peak flow for the 2-year, 24-hour event, rational method equation and the following assumptions:

- C = 0.225 (average runoff coefficient (C) for soil type A and B);
- Average 6-hour, 2-year storm depth = 1.5 inches;
- Time of concentration = 6 minutes; and
- 2-year peak intensity = 3.51 in/hr. (based on procedures from the County Hydrology Manual).

The strategies for sediment bypass do not mitigate for the reduction of CCSYA that have been replaced by development onsite but can only mitigate scenarios where development hinders movement of bed sediment through the project footprint. When preservation of existing channels and/or implementation of sediment bypass measures is not feasible and/or not implemented, the applicant must demonstrate no net impact to the receiving water via the guidance presented in Appendix H.4.

H.6.1 Site-Specific GLU Analysis

In order to perform a site-specific GLU analysis the applicant must first delineate the project boundary and any areas draining through the project boundary. The applicant must then determine appropriate slopes, geology, and land cover categories for this area as identified below.

There are four slope categories in the GLU analysis. Category numbers shown (1 to 4) were assigned for the purpose of GIS processing.

- 0% to 10% (1)
- 10% to 20% (2)
- 20% to 40% (3)
- >40% (4)

There are seven geology categories in the GLU analysis:

- Coarse bedrock (CB)
- Coarse sedimentary impermeable (CSI)
- Coarse sedimentary permeable (CSP)
- Fine bedrock (FB)
- Fine sedimentary impermeable (FSI)
- Fine sedimentary permeable (FSP)
- Other (O)

There are six land cover categories in the GLU analysis:

- Agriculture/grass
- Forest
- Developed
- Scrub/shrub
- Other
- Unknown

Project site slopes shall be classified into the categories based on project-level topography. Project site geology may be determined from geologic maps (may be the same as regional-level information) or classified in the field by a qualified geologist. Table H.6-1 provides information to classify geologic map units into each geology category. Project site land cover shall be determined from

Map Unit	Map Name	Anticipated Grain size of Weathered Material	Bedrock or Sedimentary	Impermeable / Permeable	Geology Grouping
	Oceanside 30' x 60'				
Kgdf	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgh	San Diego 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgm	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgm1	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgm2	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgm3	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgm4	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgp	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgr	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgu	San Diego 30' x 60'	Coarse	Bedrock	Impermeable	CB
Khg	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Ki	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kis	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kjd	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
KJem	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
KJld	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kjv	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Klb	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Klh	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Klp	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Km	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kmg	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kmgp	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kmm	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kpa	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kpv	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kqbd	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kr	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Krm	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Krr	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kt	San Diego & Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Ktr	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kvc	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kwm	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kwp	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kwsr	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
m	Jennings; CA	Coarse	Bedrock	Impermeable	CB
Mzd	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Mzg	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Mzq	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Mzs	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
sch	Jennings; CA	Coarse	Bedrock	Impermeable	CB

Map Unit	Map Name	Anticipated Grain size of Weathered Material	Bedrock or Sedimentary	Impermeable / Permeable	Geology Grouping
Qoa2-6	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qoa5	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qoa6	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qoa7	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qoc	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop1	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qc	El Cajon 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qu	El Cajon 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qoa	San Diego, Oceanside & El Cajon 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop2-4	San Diego 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop3	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop4	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop6	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop7	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qya	San Diego, Oceanside & El Cajon 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qyc	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Mzu	San Diego & Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
gb	Jennings; CA	Fine	Bedrock	Impermeable	FB
JTRm	El Cajon 30' x 60'	Fine	Bedrock	Impermeable	FB
Kat	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Kc	El Cajon 30' x 60'	Fine	Bedrock	Impermeable	FB
Kgb	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
KJvs	El Cajon 30' x 60'	Fine	Bedrock	Impermeable	FB
Kmv	El Cajon 30' x 60'	Fine	Bedrock	Impermeable	FB
Ksp	El Cajon 30' x 60'	Fine	Bedrock	Impermeable	FB
Kvsp	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Kwmt	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Qv	Jennings; CA	Fine	Bedrock	Impermeable	FB
Tba	San Diego 30' x 60'	Fine	Bedrock	Impermeable	FB
Tda	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Tv	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Tvsr	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Kgdfg	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Ta	San Diego 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Tcs	Oceanside 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Td	San Diego &	Fine	Sedimentary	Impermeable	FSI

Map Unit	Map Name	Anticipated Grain size of Weathered Material	Bedrock or Sedimentary	Impermeable / Permeable	Geology Grouping
	Oceanside 30' x 60'				
Td+Tf	San Diego 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Qls	San Diego, Oceanside & El Cajon 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Tm	Oceanside 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Tf	San Diego, Oceanside & El Cajon 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Tfr	El Cajon 30' x 60'	Fine	Sedimentary	Impermeable	FSI
To	San Diego & El Cajon 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Qpe	San Diego & Oceanside 30' x 60'	Fine	Sedimentary	Permeable	FSP
Mexico	San Diego 30' x 60'	NA	NA	Permeable	Other
Kuo	San Diego 30' x 60'	NA (Offshore)	NA	Permeable	Other
Teo	San Diego & Oceanside 30' x 60'	NA (Offshore)	Sedimentary	Permeable	Other
Tmo	Oceanside 30' x 60'	NA (Offshore)	Sedimentary	Permeable	Other
Qmo	San Diego 30' x 60'	NA (Offshore)	Sedimentary	Permeable	Other
QTso	San Diego 30' x 60'	NA (Offshore)	Sedimentary	Permeable	Other
af	San Diego & Oceanside 30' x 60'	Variable, dependent on source material	Sedimentary		Other

TableH.6-2: Land Cover Grouping for SanGIS Ecology-Vegetation Data Set

Id	SanGIS Legend	SanGIS Grouping	Land Cover Grouping
1	42000 Valley and Foothill Grassland	Grasslands, Vernal Pools, Meadows, and Other Herb Communities	Agricultural/Grass
2	42100 Native Grassland		Agricultural/Grass
3	42110 Valley Needlegrass Grassland		Agricultural/Grass
4	42120 Valley Sacaton Grassland		Agricultural/Grass
5	42200 Non-Native Grassland	Grasslands, Vernal Pools, Meadows, and Other Herb Communities	Agricultural/Grass
6	42300 Wildflower Field		Agriculture/Grass
7	42400 Foothill/Mountain Perennial Grassland		Agriculture/Grass
8	42470 Transmontane Dropseed Grassland		Agriculture/Grass
9	45000 Meadow and Seep		Agriculture/Grass
10	45100 Montane Meadow		Agriculture/Grass
11	45110 Wet Montane Meadow		Agriculture/Grass
12	45120 Dry Montane Meadows		Agriculture/Grass
13	45300 Alkali Meadows and Seeps		Agriculture/Grass
14	45320 Alkali Seep		Agriculture/Grass
15	45400 Freshwater Seep		Agriculture/Grass
16	46000 Alkali Playa Community		Agriculture/Grass

Id	SanGIS Legend	SanGIS Grouping	Land Cover Grouping
17	46100 Badlands/Mudhill Forbs		Agriculture/Grass
18	Non-Native Grassland		Agriculture/Grass
19	18000 General Agriculture	Non-Native Vegetation, Developed Areas, or Unvegetated Habitat	Agriculture/Grass
20	18100 Orchards and Vineyards		Agriculture/Grass
21	18200 Intensive Agriculture		Agriculture/Grass
22	18200 Intensive Agriculture - Dairies, Nurseries, Chicken Ranches		Agriculture/Grass
23	18300 Extensive Agriculture - Field/Pasture, Row Crops		Agriculture/Grass
24	18310 Field/Pasture		Agriculture/Grass
25	18310 Pasture		Agriculture/Grass
26	18320 Row Crops		Agriculture/Grass
27	12000 Urban/Developed		Developed
28	12000 Urban/Develpped		Developed
29	81100 Mixed Evergreen Forest	Forest	Forest
30	81300 Oak Forest		Forest
31	81310 Coast Live Oak Forest		Forest
32	81320 Canyon Live Oak Forest		Forest
33	81340 Black Oak Forest		Forest
34	83140 Torrey Pine Forest		Forest
35	83230 Southern Interior Cypress Forest		Forest
36	84000 Lower Montane Coniferous Forest		Forest
37	84100 Coast Range, Klamath and Peninsular Coniferous Forest		Forest
38	84140 Coulter Pine Forest	Forest	Forest
39	84150 Bigcone Spruce (Bigcone Douglas Fir)-Canyon Oak Forest		Forest
40	84230 Sierran Mixed Coniferous Forest		Forest
41	84500 Mixed Oak/Coniferous/Bigcone/Coulter		Forest
42	85100 Jeffrey Pine Forest		Forest
43	11100 Eucalyptus Woodland	Non-Native Vegetation, Developed Areas, or Unvegetated Habitat	Forest
44	60000 RIPARIAN AND BOTTOMLAND HABITAT	Riparian and Bottomland Habitat	Forest
45	61000 Riparian Forests		Forest
46	61300 Southern Riparian Forest		Forest
47	61310 Southern Coast Live Oak Riparian Forest		Forest
48	61320 Southern Arroyo Willow Riparian Forest		Forest
49	61330 Southern Cottonwood-willow Riparian Forest		Forest
50	61510 White Alder Riparian Forest		Forest
51	61810 Sonoran Cottonwood-willow Riparian Forest		Forest

Id	SanGIS Legend	SanGIS Grouping	Land Cover Grouping
52	61820 Mesquite Bosque		Forest
53	62000 Riparian Woodlands		Forest
54	62200 Desert Dry Wash Woodland		Forest
55	62300 Desert Fan Palm Oasis Woodland		Forest
56	62400 Southern Sycamore-alder Riparian Woodland		Forest
57	70000 WOODLAND	Woodland	Forest
58	71000 Cismontane Woodland		Forest
59	71100 Oak Woodland		Forest
60	71120 Black Oak Woodland		Forest
61	71160 Coast Live Oak Woodland		Forest
62	71161 Open Coast Live Oak Woodland		Forest
63	71162 Dense Coast Live Oak Woodland		Forest
64	71162 Dense Coast Love Oak Woodland		Forest
65	71180 Engelmann Oak Woodland	Woodland	Forest
66	71181 Open Engelmann Oak Woodland		Forest
67	71182 Dense Engelmann Oak Woodland		Forest
68	72300 Peninsular Pinon and Juniper Woodlands		Forest
69	72310 Peninsular Pinon Woodland		Forest
70	72320 Peninsular Juniper Woodland and Scrub		Forest
71	75100 Elephant Tree Woodland		Forest
72	77000 Mixed Oak Woodland		Forest
73	78000 Undifferentiated Open Woodland		Forest
74	79000 Undifferentiated Dense Woodland		Forest
75	Engelmann Oak Woodland		Forest
76	52120 Southern Coastal Salt Marsh	Bog and Marsh	Other
77	52300 Alkali Marsh		Other
78	52310 Cismontane Alkali Marsh		Other
79	52400 Freshwater Marsh		Other
80	52410 Coastal and Valley Freshwater Marsh		Other
81	52420 Transmontane Freshwater Marsh		Other
82	52440 Emergent Wetland		Other
83	44000 Vernal Pool	Grasslands, Vernal Pools, Meadows, and Other Herb Communities	Other
84	44320 San Diego Mesa Vernal Pool		Other
85	44322 San Diego Mesa Claypan Vernal Pool (southern mesas)		Other
86	13100 Open Water	Non-Native Vegetation, Developed Areas, or Unvegetated Habitat	Other
87	13110 Marine		Other
88	13111 Subtidal		Other
89	13112 Intertidal		Other
90	13121 Deep Bay		Other
91	13122 Intermediate Bay		Other
92	13123 Shallow Bay		Other
93	13130 Estuarine		Other

Id	SanGIS Legend	SanGIS Grouping	Land Cover Grouping
94	13131 Subtidal		Other
95	13133 Brackishwater		Other
96	13140 Freshwater	Non-Native Vegetation, Developed Areas, or Unvegetated Habitat	Other
97	13200 Non-Vegetated Channel, Floodway, Lakeshore Fringe		Other
98	13300 Saltpan/Mudflats		Other
99	13400 Beach		Other
100	21230 Southern Foredunes	Dune Community	Scrub/Shrub
101	22100 Active Desert Dunes		Scrub/Shrub
102	22300 Stabilized and Partially-Stabilized Desert Sand Field		Scrub/Shrub
103	24000 Stabilized Alkaline Dunes		Scrub/Shrub
104	29000 ACACIA SCRUB		Scrub/Shrub
105	63000 Riparian Scrubs	Riparian and Bottomland Habitat	Scrub/Shrub
106	63300 Southern Riparian Scrub		Scrub/Shrub
107	63310 Mule Fat Scrub		Scrub/Shrub
108	63310 Mulefat Scrub		Scrub/Shrub
109	63320 Southern Willow Scrub		Scrub/Shrub
110	63321 Arundo donnax Dominant/Southern Willow Scrub		Scrub/Shrub
111	63330 Southern Riparian Scrub		Scrub/Shrub
112	63400 Great Valley Scrub		Scrub/Shrub
113	63410 Great Valley Willow Scrub		Scrub/Shrub
114	63800 Colorado Riparian Scrub		Scrub/Shrub
115	63810 Tamarisk Scrub		Scrub/Shrub
116	63820 Arrowweed Scrub		Scrub/Shrub
117	31200 Southern Coastal Bluff Scrub	Scrub and Chaparral	Scrub/Shrub
118	32000 Coastal Scrub		Scrub/Shrub
119	32400 Maritime Succulent Scrub		Scrub/Shrub
120	32500 Diegan Coastal Sage Scrub		Scrub/Shrub
121	32510 Coastal form		Scrub/Shrub
122	32520 Inland form (> 1,000 ft. elevation)		Scrub/Shrub
123	32700 Riversidian Sage Scrub		Scrub/Shrub
124	32710 Riversidian Upland Sage Scrub		Scrub/Shrub
125	32720 Alluvial Fan Scrub		Scrub/Shrub
126	33000 Sonoran Desert Scrub		Scrub/Shrub
127	33100 Sonoran Creosote Bush Scrub		Scrub/Shrub
128	33200 Sonoran Desert Mixed Scrub		Scrub/Shrub
129	33210 Sonoran Mixed Woody Scrub		Scrub/Shrub
130	33220 Sonoran Mixed Woody and Succulent Scrub	Scrub and Chaparral	Scrub/Shrub
131	33230 Sonoran Wash Scrub		Scrub/Shrub
132	33300 Colorado Desert Wash Scrub		Scrub/Shrub
133	33600 Encelia Scrub		Scrub/Shrub
134	34000 Mojavean Desert Scrub		Scrub/Shrub
135	34300 Blackbush Scrub		Scrub/Shrub

Id	SanGIS Legend	SanGIS Grouping	Land Cover Grouping
136	35000 Great Basin Scrub		Scrub/Shrub
137	35200 Sagebrush Scrub		Scrub/Shrub
138	35210 Big Sagebrush Scrub		Scrub/Shrub
139	35210 Sagebrush Scrub		Scrub/Shrub
140	36110 Desert Saltbush Scrub		Scrub/Shrub
141	36120 Desert Sink Scrub		Scrub/Shrub
142	37000 Chaparral		Scrub/Shrub
143	37120 Southern Mixed Chaparral		Scrub/Shrub
144	37120 Southern Mixed Chapparal		Scrub/Shrub
145	37121 Granitic Southern Mixed Chaparral		Scrub/Shrub
146	37121 Southern Mixed Chaparral		Scrub/Shrub
147	37122 Mafic Southern Mixed Chaparral		Scrub/Shrub
148	37130 Northern Mixed Chaparral		Scrub/Shrub
149	37131 Granitic Northern Mixed Chaparral		Scrub/Shrub
150	37132 Mafic Northern Mixed Chaparral		Scrub/Shrub
151	37200 Chamise Chaparral		Scrub/Shrub
152	37210 Granitic Chamise Chaparral		Scrub/Shrub
153	37220 Mafic Chamise Chaparral		Scrub/Shrub
154	37300 Red Shank Chaparral		Scrub/Shrub
155	37400 Semi-Desert Chaparral		Scrub/Shrub
156	37500 Montane Chaparral		Scrub/Shrub
157	37510 Mixed Montane Chaparral		Scrub/Shrub
158	37520 Montane Manzanita Chaparral		Scrub/Shrub
159	37530 Montane Ceanothus Chaparral		Scrub/Shrub
160	37540 Montane Scrub Oak Chaparral		Scrub/Shrub
161	37800 Upper Sonoran Ceanothus Chaparral		Scrub/Shrub
162	37830 Ceanothus crassifolius Chaparral		Scrub/Shrub
163	37900 Scrub Oak Chaparral		Scrub/Shrub
164	37A00 Interior Live Oak Chaparral		Scrub/Shrub
165	37C30 Southern Maritime Chaparral	Scrub and Chaparral	Scrub/Shrub
166	37G00 Coastal Sage-Chaparral Scrub		Scrub/Shrub
167	37K00 Flat-topped Buckwheat		Scrub/Shrub
168	39000 Upper Sonoran Subshrub Scrub		Scrub/Shrub
169	Diegan Coastal Sage Scrub		Scrub/Shrub
170	Granitic Northern Mixed Chaparral		Scrub/Shrub
171	Southern Mixed Chaparral		Scrub/Shrub
172	11000 Non-Native Vegetation	Non-Native Vegetation, Developed Areas, or Unvegetated Habitat	Unknown
173	11000 Non-Native VegetionVegetation		Unknown
174	11200 Disturbed Wetland		Unknown
175	11300 Disturbed Habitat		Unknown
176	13000 Unvegetated Habitat		Unknown
177	Disturbed Habitat		Unknown

Table H.6-3: Potential Critical Coarse Sediment Yield Areas

GLU	Geology	Land Cover	Slope (%)
CB-Agricultural/Grass-3	Coarse Bedrock	Agricultural/Grass	20% - 40%
CB-Agricultural/Grass-4	Coarse Bedrock	Agricultural/Grass	>40%
CB-Forest-2	Coarse Bedrock	Forest	10 – 20%
CB-Forest-3	Coarse Bedrock	Forest	20% - 40%
CB-Forest-4	Coarse Bedrock	Forest	>40%
CB-Scrub/Shrub-4	Coarse Bedrock	Scrub/Shrub	>40%
CB-Unknown-4	Coarse Bedrock	Unknown	>40%
CSI-Agricultural/Grass-2	Coarse Sedimentary Impermeable	Agricultural/Grass	10 – 20%
CSI-Agricultural/Grass-3	Coarse Sedimentary Impermeable	Agricultural/Grass	20% - 40%
CSI-Agricultural/Grass-4	Coarse Sedimentary Impermeable	Agricultural/Grass	>40%
CSP-Agricultural/Grass-4	Coarse Sedimentary Permeable	Agricultural/Grass	>40%
CSP-Forest-3	Coarse Sedimentary Permeable	Forest	20% - 40%
CSP-Forest-4	Coarse Sedimentary Permeable	Forest	>40%
CSP-Scrub/Shrub-4	Coarse Sedimentary Permeable	Scrub/Shrub	>40%

H.7 PCCSYAs: Refinement Options

If an applicant has identified onsite and/or upstream PCCSYAs and elects to perform additional optional analyses to refine the PCCSYA designation, the guidance presented below should be followed. Protection of critical coarse sediment yield areas is a necessary element of hydromodification management because coarse sediment supply is as much an issue for causing erosive conditions to receiving streams as are accelerated flows. However, not all downstream systems warrant preservation of coarse sediment supply nor all source areas need to be protected. The following guidance shall be used to refine PCCSYA designations:

- Depositional Analysis (Appendix H.7.1)
- Threshold Channel Analysis (Appendix H.7.2)
- Coarse Sediment Source Area Verification (Appendix H.7.3)

H.7.1 Depositional Analysis

Areas identified as PCCSYAs may be removed from consideration if it is demonstrated that these sources are deposited into existing systems prior to reaching the first downstream unlined water of the state. Systems resulting in deposition may include existing natural sinks, existing structural BMPs, existing hardened MS4 systems, or other existing similar features. Applicants electing to perform depositional analysis to refine PCCSYA mapping must meet the following criteria to qualify for exemption from CCSYA designation:

- The existing hardened MS4 system that is being analyzed should be upstream of the first downstream unlined waters of the state; and
- The peak velocity from the discrete 2-year, 24-hour runoff event for the existing hardened MS4 system that is being analyzed is less than three feet per second.

The three feet per second criteria is consistent with the recommended minimum velocity for storm and sanitary sewers in ASCE Manual of Engineering Practice No. 37 (ASCE, 1970).

In limited scenarios, applicant may have the option to establish site specific minimum self-cleansing velocity using Equation H.7-1 or other appropriate equations instead of using the default three feet per second criteria. This site specific analysis must be documented in the SWQMP and the County has the discretion to request additional analysis prior to approving a site specific minimum self-cleansing velocity. If an applicant chooses to establish a site specific minimum self-cleansing velocity for refinement, then the applicant must design any new bypass hardened conveyance systems proposed by the project to meet the site specific criteria.

Equation H.7-1: Minimum Self Cleansing Velocity

$$V = \frac{1.486}{n} R^{1/6} \left[B\left(s_g - 1\right)D_g\right]^{1/2}$$

Where:

V = minimum self-cleansing velocity (ft/sec)
R = hydraulic radius (ft)
n = Manning's roughness coefficient (unitless)
B = constant equal to 0.04 for clean granular particles (unitless)
s_g = specific gravity of sediment particle (unitless): **Use 2.65**
D_g = sediment particle diameter (inches): **Use 0.20 in**

H.7.2 Threshold Channel Analysis

A threshold channel is a stream channel in which channel boundary material has no significant movement during the design flow. If there is no movement of bed load in the stream channel, then it is not anticipated that reductions in sediment supply will be detrimental to stream stability because the channel bed consists of the parent material and not coarse sediment supplied from upstream. In such a situation, changes in sediment supply are not considered a geomorphic condition of concern. SCCWRP Technical Report 562 (2008) states the following in regards to sand vs. gravel bed behavior/threshold vs. live-bed contrasts:

> "Sand and gravel systems are quite varied in their transport of sediment and their sensitivity to sediment supply. On the former, sand-bed channels typically have live beds, which transport sediment continuously even at relatively low flows. Conversely, gravel/cobble-bed channels generally transport the bulk of their bed sediment load more episodically, requiring higher flow events for bed mobility (i.e., threshold behavior)."
>
> "Sand-bed streams without vertical control are much more sensitive to perturbations in flow and sediment regimes than coarse-grain (gravel/cobble) threshold channels. This has clear implications in their respective management regarding hydromodification (i.e., sand systems being relatively more susceptible than coarser systems). This also has direct implications for the issue of sediment trapping by storm water practices in watersheds draining to sand-bed streams, as well as general loss of sediment supply following the conversion from undeveloped sparsely-vegetated to developed well-vegetated via irrigation."

The following provides guidance for evaluating whether a stream channel is a threshold channel or not. This determination is important because while accounting for changes in bed sediment supply is appropriate for quantifying geomorphic impacts in non-threshold stream channels, it is not considered appropriate for threshold channels. The domain of analysis for this evaluation shall be the same as that used to evaluate susceptibility, per SCCWRP Technical Report 606, Field Manual for Assessing Channel Susceptibility (2010). This domain is defined by the following upstream and downstream boundaries:

- From the point of compliance proceed downstream until reaching one of the following:
    - At least one reach downstream of the first grade-control point (preferably second downstream grade control location);
    - Tidal backwater/lentic (still water) waterbody;
    - Equal order tributary (Strahler 1952);
    - A 2-fold increase in drainage area.

  OR demonstrate sufficient flow attenuation through existing hydrologic modeling.
- From the point of compliance proceed upstream for 20 channel top widths OR to the first grade control in good condition, whichever comes first.

Applicant must complete Worksheet H.7-1 to document selection of the domain of analysis. If the entire domain of analysis is classified as a threshold channel, then the PDP can be exempt from the MS4 Permit requirement for sediment supply. The following definitions from the Natural Resources Conservation Service's (NRCS) National Engineering Handbook Part 654 - Stream Restoration Design (2007) are helpful in understanding what a threshold channel is.

- **Alluvial Channel**: Streams and channels that have bed and banks formed of material transported by the stream. There is an exchange of material between the inflowing sediment load and the bed and banks of an alluvial channel (NRCS, 2007).
- **Threshold Channel**: A channel in which channel boundary material has no significant movement during the design flow (NRCS, 2007).

The key factor for determining whether a channel is a threshold channel is the composition of its bed material. Larger bed sediment consisting primarily of cobbles and boulders are typically immobile, unless the channel is a large river with sufficient discharge to regularly transport such grain sizes as bed load. As a rule-of-thumb, channels with bed material that can withstand a 10-year peak discharge without incipient motion are considered threshold channels and not live-bed alluvial channels. Threshold channel beds typically consist of cobbles, boulders, bedrock, or very dense vegetation (e.g., a thicket). Threshold channels also includes channels that have existing grade control structures that protect the stream channels from hydromodification impacts.

For a project to be exempt from coarse sediment supply requirements, the applicant must submit the following for approval by the County:

- Photographic documentation and grain size analysis used to determine the d_{50} of the bed material; and

- Calculations that show that the receiving water of concern meets the specific stream power criteria defined below or a finding from a geomorphologist that the stream channel has existing grade control structures that protect the stream channel from hydromodification impacts.

Specific Stream Power

Specific (i.e., unit) stream power is the rate at which the energy of flowing water is expended on the bed and banks of a channel (refer to Equation H.7-2). SCCWRP studies have found that locating channels on a plot of Specific Stream Power at Q_{10} (as calculated by the Hawley et al. method optimized for Southern California watersheds – Figure H.7-2) versus median channel grain size is a good predictor of channel stability. The Q_{10} equation from SCCWRP TR 606 is presented as Equation H.7-3.

Equation H.7-2: Calculation of Specific Stream Power

$$Specific\ Stream\ Power = \frac{Total\ Stream\ Power}{Channel\ Width} = \frac{\gamma QS}{w}$$

Where:

γ: Specific Weight of Water (9810 N/m^3)
Q: Flow Rate (dominant discharge in many cases, m^3/sec)
S: Slope of Channel
w: Channel Width (meters)

Equation H.7-3: Calculation of Q_{10} using the Hawley et al. method

$$Q_{10cfs} = 18.2 * A^{0.87} * P^{0.77}$$

Where:

Q_{10cfs}: 10 year Flow Rate in cubic feet per second
A: Drainage Area in sq. miles
P: Mean Annual Precipitation in inches

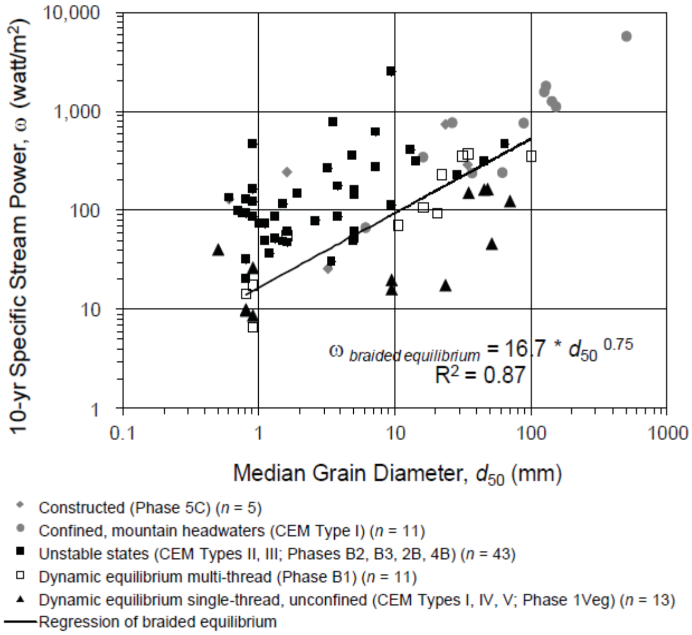

Figure H.7-1: Threshold of stream instability based on specific stream power and channel sediment diameter

Since the SCCWRP TR 606 Q_{10} (Equation H.7-3) does not explicitly consider watershed imperviousness, adjustment factors (AF) shown in Figure H.7-2 were developed using the following Equation H.7-4 for Q_{10} from SCCWRP TR 654 to account for imperviousness while estimating Q_{10}.

Equation H.7-4: Calculation of Q_{10} using equation from SCCWRP TR 654

$$Q_{10} = e^{3.61} * A^{0.865} * DD^{0.804} * P_{224}^{0.778} * IMP^{0.096}$$

Where:

Q_{10}: 10 year Flow Rate
A: Drainage Area in sq. miles
DD: Drainage Density
P_{224}: 2-Year 24-Hour Precipitation in inches
IMP: Watershed Imperviousness

Adjustment factors were developed as part of this methodology by changing the watershed imperviousness in Equation H.7-4 and keeping the remaining terms constant. Adjustment factor for imperviousness of 3.6% was set to 1; since it is the mean imperviousness of the dataset used to develop the stability curve in Figure H.7-1. Updated Q_{10} equation with adjustment factor is presented as Equation H.7-5 below:

Equation H.7-5: Calculation of Q_{10} with Adjustment Factor for Watershed Imperviousness

$$Q_{10cfs} = AF * 18.2 * A^{0.87} * P^{0.77}$$

Where:

Q_{10cfs}: 10 year Flow Rate in cubic feet per second
AF: Adjustment Factor
A: Drainage Area in sq. miles
P: Mean Annual Precipitation in inches

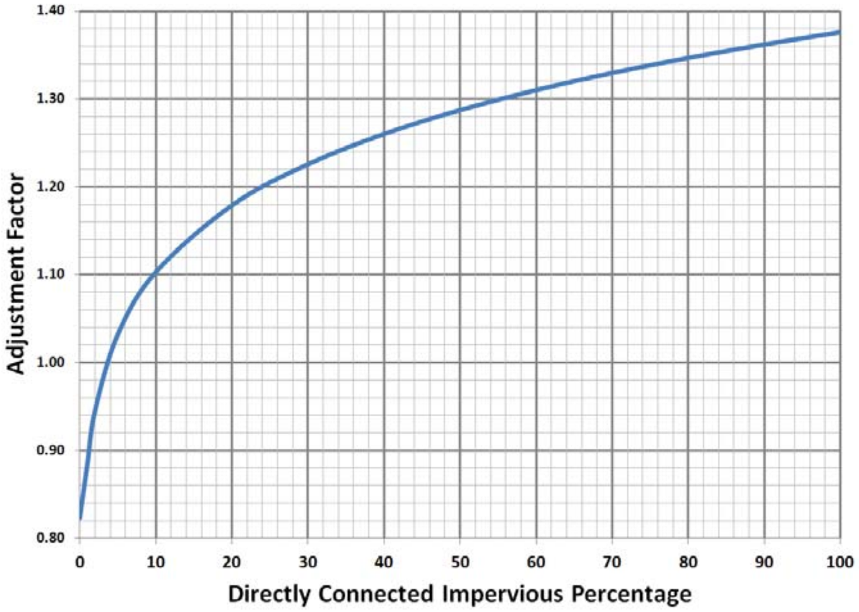

Figure H.7-2: Adjustment factor to account for imperviousness while estimating Q_{10}

Steps for evaluating the specific stream power criteria are presented below:

- **Step 1**: Calculate the specific stream power for the receiving water. Use Equation H.7-2, H.7-5 and Figure H.7-2. Directly connected imperviousness shall be estimated using guidance provided in the Water Quality Equivalency guidance document.
- **Step 2**: Determine the d_{50} of representative cross section within the domain of analysis.
- **Step 3**: Use results from Step 1 and Step 2; and Figure H.7-1 to determine if the receiving water meets the specific stream power criteria. Receiving water shall be considered meeting the specific stream power criteria when the point plotted based on results from Step 1 and Step 2 is below the solid line in Figure H.7-1.

H.7.3 Coarse Sediment Source Area Verification

When it has been determined that PCCSYAs are present, and it has been determined that downstream systems require protection, additional analysis may be performed that may refine the extents of actual CCSYAs to be protected onsite. The following analysis shall be performed to determine if the mapped PCCSYAs are a significant source of bed sediment supply to the receiving water, based on the coarse sediment proportion of the soil onsite

- Obtain a grain size distribution per ASTM D422 for the project's PCCSYA that is being evaluated.
- Identify whether the source material is a coarse grained or fine grained soil. Coarse grained is defined as over 50% by weight coarse than no. 200 sieve (i.e., $d_{50} > 0.074$ mm).
- By performing this analysis, the applicant can exclude PCCSYAs that are determined to be fine grained (i.e., $d_{50} < 0.074$ mm). Fine grained soils are not considered significant sources of bed sediment supply.
- Applicant shall include the following information in the SWQMP when this refinement option is performed:
    - Map with locations on where the grain size distribution analysis was performed;
    - Photographic documentation; and
    - Grain size distribution.
- Additional grain size distribution analysis may be requested at specific locations by the County prior to approval of this refinement.

Areas that are not expected to be a significant source of bed sediment supply (i.e. fine grained soils) to the receiving stream do not require protection and are not considered CCSYAs.

If it is determined that the PCCSYAs are producing sediment that is critical to receiving streams, or if the optional additional analysis presented above has not been performed, the project must provide management measures for protection of critical coarse sediment yield (refer to Appendix H.2, H.3 and H.4).

H.8 Calculation Methodology for Ep and Sp

One method for quantifying hydromodification impacts to stream channels, which takes into account changes in the four factors in Lane's relationship (i.e., hydrology, channel geometry, bed and bank material, and sediment supply), is to compare long-term changes in sediment transport capacity, or in-stream work, to bed sediment supply. For the purposes of demonstrating no net impact within the MS4-permitted region of the County of San Diego, Erosion Potential (Ep) is defined as the ratio of post-project/pre-development (natural) long-term transport capacity or work. To calculate Ep, the hydrology, channel geometry, and bed/bank material factors mentioned above need to be characterized for both land use scenarios. Sediment Supply Potential (Sp) is defined as the ratio of post-project/pre-project (existing) long-term bed sediment supply. While evaluating changes in discharge and sediment supply is done primarily as a desktop analysis, geomorphic field assessment is often necessary to characterize channel geometry and bed/bank material, and to ground truth assumptions for the desktop analyses. This appendix provides methodologies for the following:

- Calculation of Ep, and
- Calculation of Sp.

H.8.1 Calculation of Ep

Erosion Potential (Ep) is defined as the ratio of post-project/pre-development (natural) long-term transport capacity or work. To calculate Ep, the hydrology, channel geometry, and bed/bank material factors mentioned above need to be characterized for both land use scenarios. Traditionally, Ep is calculated based on a watershed-scale analysis (using future built out conditions) of the area tributary to a given receiving channel of concern at the point of compliance. However, watershed-scale continuous hydrologic modeling might not be feasible for small projects, with this understanding specific simplification steps for project-scale modeling are provided in this appendix. The applicant shall perform Ep calculations using one of the following methods, as applicable:

- **<u>Simplified Ep Method</u>**: Applicable when the default low flow threshold of $0.1Q_2$ is used and no changes to the receiving water are proposed. Refer to Appendix H.8.1.1.
- **<u>Standard Ep Method</u>**: Applicable for all scenarios. Refer to Appendix H.8.1.2.

H.8.1.1 Simplified Ep Method

The simplified method is based on the relationships developed by Parra (2016) between the flow duration curve in the pre-development and post-project conditions and the standard simplified work equation. These relationships were developed using standard hydraulic equations and approximations that are applicable for channels of any lateral slope and the following geometrical cross sections: (a) wide rectangular sections; (b) relatively wide parabolic sections, and (c) triangular sections. The simplified Ep method is only applicable when the default low flow threshold of $0.1Q_2$ has been selected by the applicant for flow duration control and no changes to the receiving water geometry are proposed. Applicants shall follow Steps 1 through 3 to calculate Ep using the simplified methodology:

1. Perform continuous hydrologic simulation for the pre-development and post-project condition following guidelines in Appendix G. Generate flow bins and flow duration tables for the range of flows from $0.1Q_2$ to Q_{10}.
2. Calculate the total work in the pre-development and the post-project condition using Equation H.8.1

$$W_t = \sum_{j=1}^{n} \Delta t_j . \left(Q^{3m/2} - (0.1Q_2)^{3m/2}\right)^{1.5} Q^m$$

Equation H.8.1

Where:

W_t = Total Work [dimensionless]

Δt_j = Duration per flow bin

Q = Flow Rates estimated in STEP 1 [cfs] for a typical bin “j”. Usually, in Flow Duration Curve (FDC) analyses, the number of bins is 100, so j = 1 to n (with n= 100). However, the number of bins can be as small as 20 (n = 20).

Q_2 = Pre-development 2-year peak flow [cfs]

m = exponent based on the function of the receiving channels geometry.

- For narrow creek where the top width is 7 times or less the corresponding depth, m = 1/4.
- For intermediate creeks, where the top width is more than 7 times but less than 25 times the depth, m = 4/13.
- For wide creeks, where the top width is more than 25 times the depth, m = 2/5.

3. Ep is calculated by dividing the total work of the post-project condition by that of the pre-development (natural) condition. Ep is expressed as:

$E_p = W_{t,post} / W_{t,pre}$ Equation H.8.2

Where:

E_p = Erosion Potential [unitless]

$W_{t,post}$ = Total Work associated with the post-project condition [unitless]

$W_{t,pre}$ = Total Work associated with the pre-development condition [unitless]

H.8.1.2 Standard Ep Method

While using the standard method, Ep calculation must be performed using the receiving water information from the point of compliance. Suggested steps for performing an Ep analysis are shown in the Figure H.8-1 below. This appendix describes each analysis step shown in Figure H.8-1, including the inputs and outputs of each step.

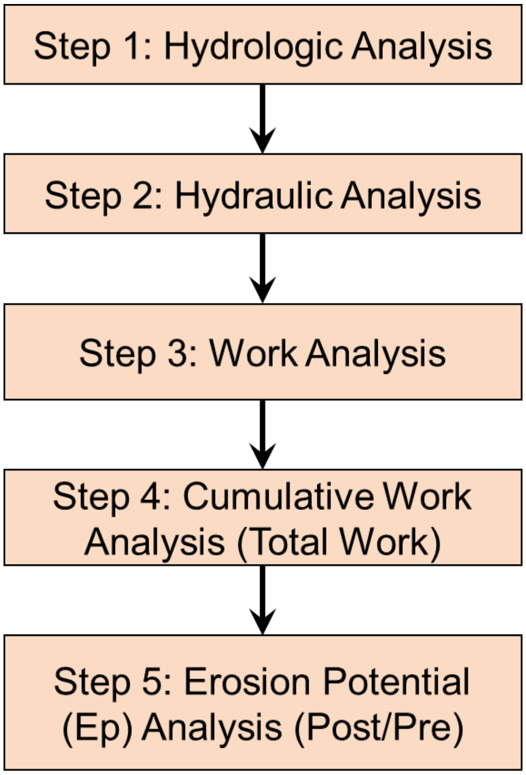

Figure H.8-1 Erosion Potential Flow Chart

STEP 1: CONTINUOUS HYDROLOGIC ANALYSIS

Hydrologic models are applied to simulate the hydrologic response of the watershed under pre-development and post-project conditions for a continuous period of record. Modeling software appropriate for this type of simulation includes USEPA's Storm Water Management Model (SWMM), Hydrological Simulation Program – Fortran (HSPF) developed by the USGS and USEPA, USACE's Hydrologic Modeling System (HEC-HMS), and the San Diego Hydrology Model (SDHM) developed by Clear Creek Solutions, Inc. SDHM uses an HSPF computational engine, long-term precipitation data, and is a visually-oriented interactive tool for automated modeling and facility sizing.

Input parameters for these continuous simulations are hourly precipitation data for a long-term (>30 years) record, sub-catchment delineation, impervious cover, soil type, vegetative cover, terrain steepness, lag time or flow path length, and monthly evapotranspiration rate. The primary output is a simulated discharge record associated with the receiving channel of concern. Flow routing through drainage conveyances is necessary for continuous hydrologic analysis at the watershed scale. Appendix G provides guidance for developing continuous simulation models.

Traditionally, a hydrograph (Figure H.8-2) is the primary means for graphically comparing discharge records; however, a hydrograph is not ideal because long-term flow records span several decades.

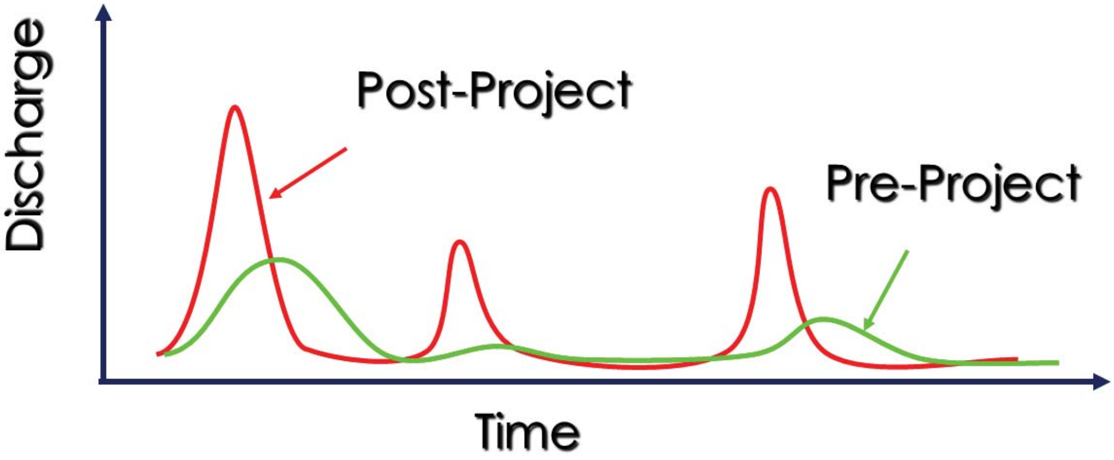

Figure H.8-2 Example Hydrograph Comparison

Instead, a more effective means for comparing long-term continuous discharge records is to create a flow histogram, which differentiates the simulated flowrates into distinct "flow bins" so that the duration of flow for each bin can be tabulated. One method for establishing the distribution of flow bins is to increment the flow bins according to increments of flow stage using a hydraulic analysis, such as the normal depth equation. In this way, the hydraulic analysis step (Step 2) can be considered an input to the continuous hydrologic analysis step. While there is no established rule of thumb for how many flow bins are necessary, it is suggested that no less than 20 be used for an Ep analysis. An example of a flow histogram is provided on Figure H.8-3.

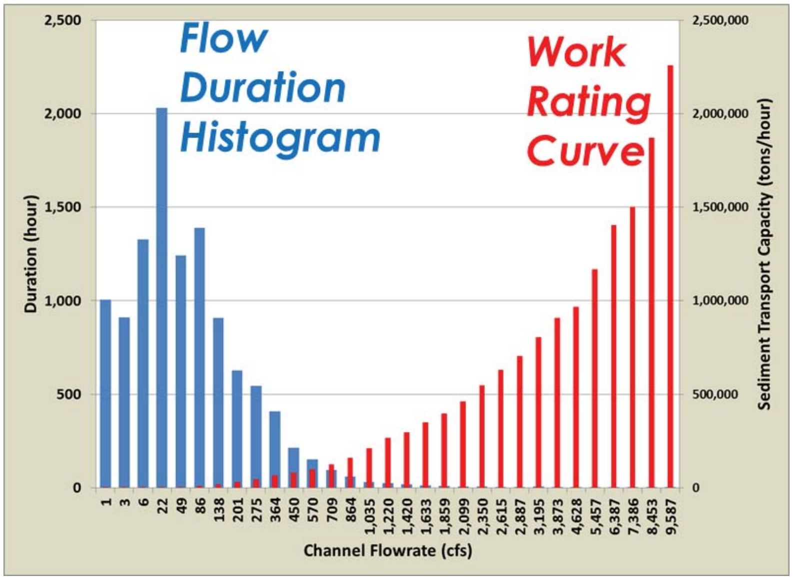

Figure H.8-3 Example Flow Duration Histogram

Flow duration curves are another commonly used method for graphically interpreting long-term flow records. A flow duration curve is simply a plot of flowrate (y-axis) versus the cumulative duration, or percentage of time, that a flowrate is equaled or exceeded in the simulation record (x-axis). Figure H.8-4 provides an example flow duration curve comparison.

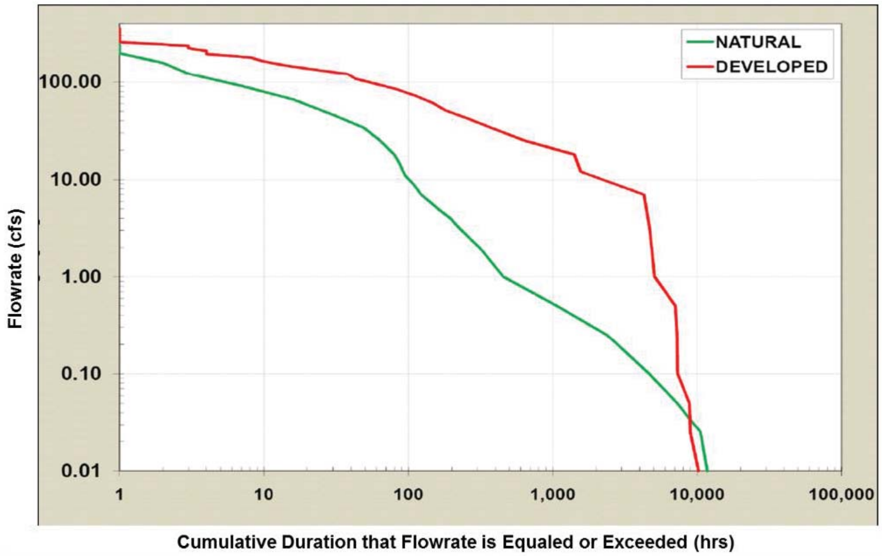

Figure H.8-4 Example Flow Duration Curve

Scaling Factor for Project-Scale Modeling

Project-scale flow rates derived from continuous hydrologic simulation can be scaled using the ratio of the pre-development 2-year peak discharge for the watershed and project catchment (i.e., Q_2 watershed / Q_2 project catchment) so that hydraulic and effective work calculations can be

STEP 2: HYDRAULIC ANALYSIS

Hydraulic parameters, such as stage, effective shear stress, and flow velocity, are computed for each designated flow bin using channel geometry and roughness data. Hydraulic calculations can be as simple as using the normal flow equation and obtaining results for the central channel or as complicated as using hydraulic models which account for backwater effects, such as HEC-RAS.

Using the formula for unit tractive force (Chow 1959), effective shear stress is expressed using equation H.8.4

$$\tau = \gamma RS \qquad \text{Equation H.8.4}$$

Where:

τ = Effective Shear Stress [lb/ft^2]

γ = Unit Weight of Water [62.4 lb/ft^3]

R= Hydraulic Radius [ft]

S = Energy Gradient Assumed Equal to Longitudinal Slope [ft/ft].

Normal depth can be estimated using Manning's equation (Equation H.8.5). Several sources provide lists of roughness coefficients for use in hydraulic analysis (Chow, 1959).

$$Q = \frac{1.49AR^{0.67}S^{0.5}}{n} \; or \; V = \frac{1.49R^{0.67}S^{0.5}}{n} \qquad \text{Equation H.8.5}$$

Where

Q = Peak Flowrate [cfs]

V = Average Flow Velocity [ft/s]

A = Cross-Section Flow Area [ft^2]

R = Hydraulic Radius [ft] = A/P

P = Wetted Perimeter [ft]

S = Energy Gradient Assumed Equal to Longitudinal Slope [ft/ft]

n = Manning Roughness [unit less]

Channel geometry inputs should be characterized by surveying cross-sections and longitudinal profiles of the active channel at strategic locations. Methods of collecting topographic survey data can range from traditional survey techniques (auto level, cloth tape, and survey rod), to conducting a detailed ground-based LiDAR survey.

STEP 3: WORK ANALYSIS

Hydraulic results for each flow bin along with the critical bed/bank material strength parameters are input into a work or sediment transport function in order to produce a work or transport rating curve. An example of such a rating curve is provided on Figure H.8-3. The work equations can range from simplistic indices, material-specific sediment transport equations, or more complex functions based on site-calibrated sediment transport rating curves.

- **Simplistic indices:** An acceptable equation for effective work, as stated in the Los Angeles Regional MS4 Permit (LARWQCB, 2012) is expressed using equation H.8.6:

  $$W = (\tau - \tau_c)^{1.5} V \qquad \text{Equation H.8.6}$$

  Where:

  W = Work [dimensionless];
  τ = Effective Shear Stress [lb/ft^2];
  τ_c = Critical Shear Stress [lb/ft^2];
  V = Mid-Channel Flow Velocity [ft/s]

- **Material-specific sediment transport equations**: Material specific sediment transport equations are allowed to estimate the sediment transport capacity in the post-project and pre-development condition.

- **Site-calibrated sediment transport curves**: Applicants may have an option to use site-calibrated sediment transport curves. In the future these may be available based on monitoring efforts being performed to support the County of San Diego's Hydromodification Management Plan.

The critical shear stress to be used in equation H.8.6 must be estimated using one of the following:

- Shear stress corresponding to the critical flow rate or low flow threshold (Qc). Qc is the flowrate that results in incipient motion of bed or bank material, whichever is least resistant. Qc is expressed as a fraction of the pre-development 2-year peak flow. The allowable low flow threshold Qc can be estimated as 10%, 30%, or 50% of the pre-development 2-year peak flow ($0.1Q_2$, $0.3Q_2$, or $0.5Q_2$) depending on the receiving stream susceptibility to erosion, per SCCWRP Technical Report 606, Field Manual for Assessing Channel Susceptibility (SCCWRP, 2010). If a channel susceptibility assessment is not performed, then the conservative default is a Qc equal to $0.1Q_2$.

- Bed and bank material can also be characterized through a geomorphic field assessment. For each stream location analyzed, a measure of critical shear stress can be obtained for the weakest bed or bank material prevalent in the channel. For non-cohesive material, a Wolman pebble count or sieve analysis can be used to obtain a grain size distribution, which can be converted to a critical shear stress using empirical relationships or published reference tables.

For cohesive material, an in-situ jet test or reference tables are used. For banks reinforced with vegetation, reference tables are generally used. Appropriate references for critical shear stress values are provided in ASCE No.77 (1992) and Fischenich (2001). To account for the effects of vegetation density and channel irregularities, the applied shear stress can be partitioned into channel form and bed/bank roughness components. SCCWRP Technical Report 667 also has guidance for estimating critical shear stress.

STEP 4: CUMULATIVE WORK ANALYSIS

Cumulative work is a measure of the long-term total work or sediment transport capacity performed at a creek location. It incorporates the distribution of both discharge magnitude and duration for the flow rates simulated. The cumulative work analysis must be performed up to the maximum geomorphically significant flow of Q_{10}. To calculate cumulative work, first multiply the work (from STEP 3) and duration associated with each flow bin (from STEP 1). Then, the total work is obtained by summing the cumulative for all flow binds (Q_c to Q_{10}). This analysis can be expressed as:

$$W_t = \sum_{i=1}^{n} W_i \, \Delta t_i \quad \text{Equation H.8.7}$$

Where:

W_t = Total Work [dimensionless]

W_i = Work per flow bin [dimensionless]

Δt = Duration per flow bin [hours]

n = number of flow bins

The distribution of cumulative work, also referred to as a work curve (or work histogram), is helpful in understanding which flow rates are performing the most work on the channel of interest. An example work curve is provided in Figure H.8-5.

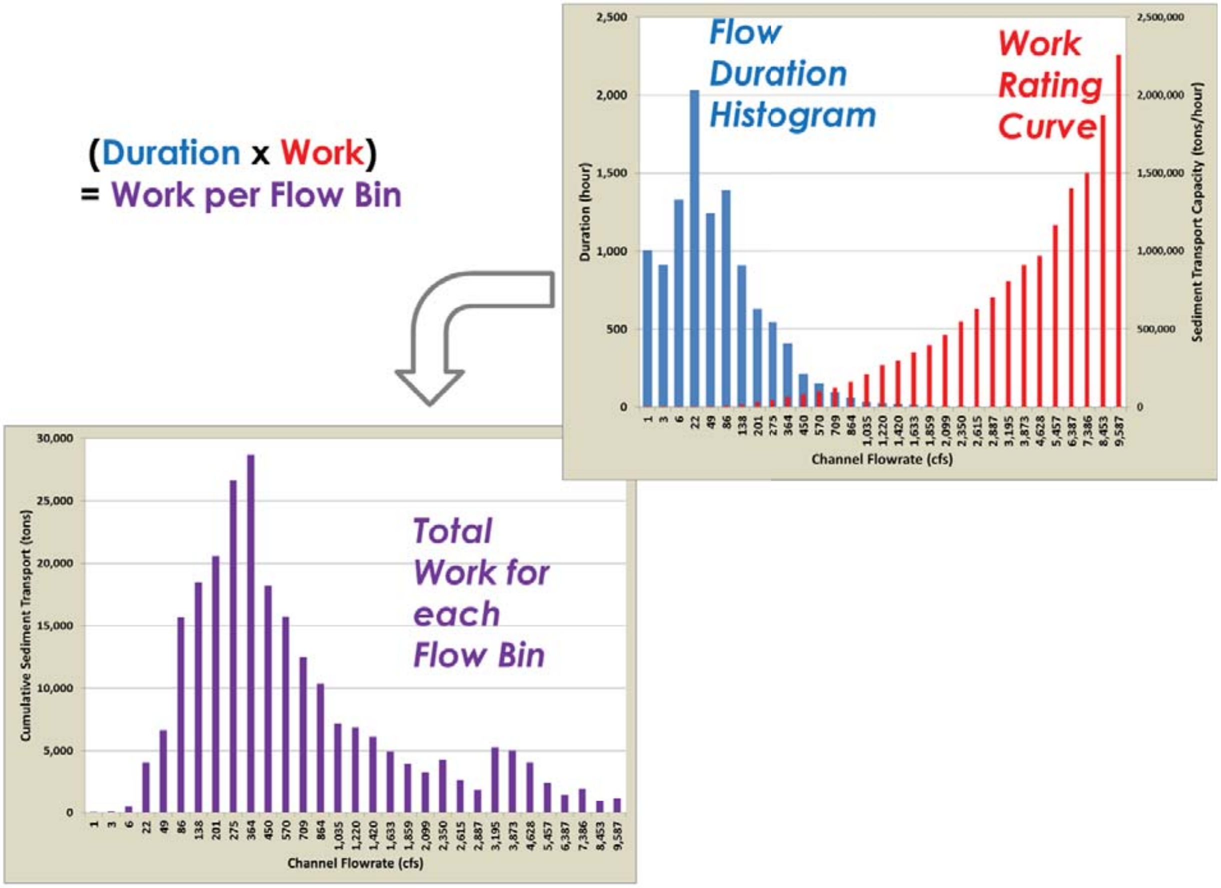

Figure H.8-5 Example Work Curve

STEP 5: EROSION POTENTIAL ANALYSIS

Ep is calculated by simply dividing the total work of the post-project condition by that of the pre-development (natural) condition. Ep is expressed as:

$$E_p = W_{t,post} / W_{t,pre} \qquad \text{Equation H.8.8}$$

Where:

E_p = Erosion Potential [unitless]

$W_{t,post}$ = Total Work associated with the post-project condition [unitless]

$W_{t,pre}$ = Total Work associated with the pre-development condition [unitless]

As applicable, the applicant must use Worksheet H.8.1-1 and H.8.1-2 to document the Ep calculations for each point of compliance.

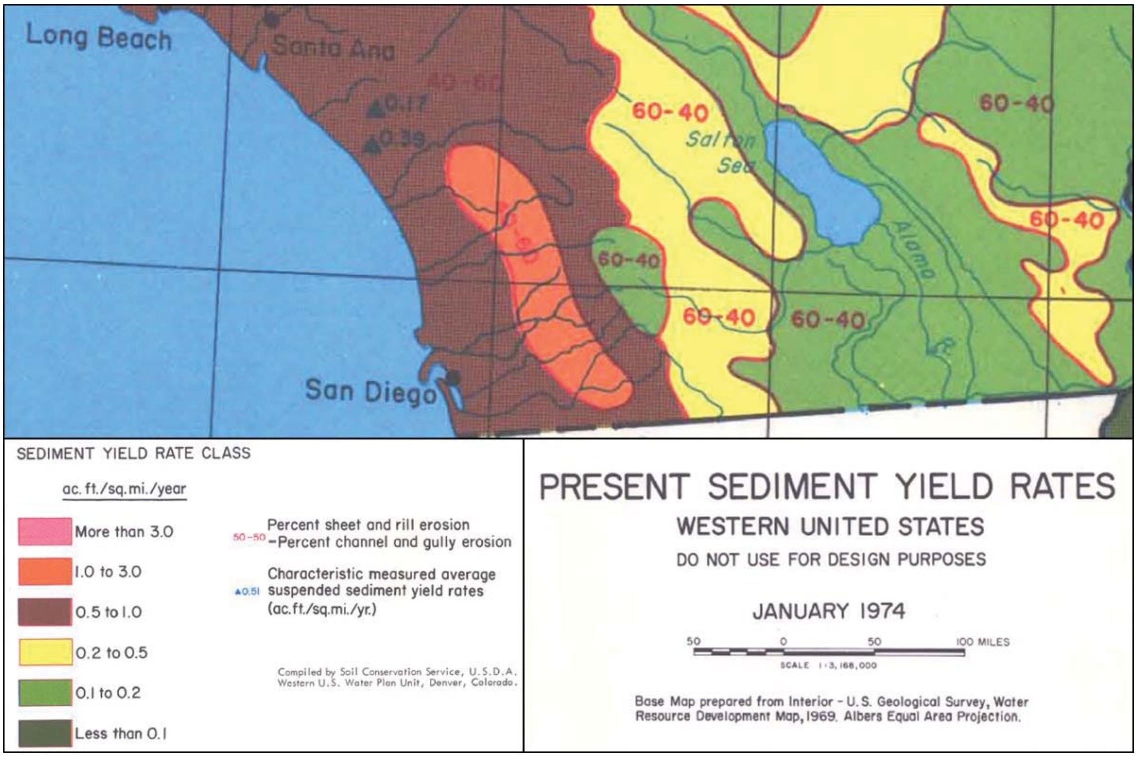

Figure H.8-6 Regional Sediment Yield Map

According to a regional sediment yield map of the Western US (USDA, 1974), hillslope processes (sheet and rill erosion) account for approximately 40% of the sediment yield in the San Diego County region, while channel processes (in-stream and gully erosion) account for approximately 60% of the sediment yield. Figure H.8-7 shows the different erosion processes. Provision E.3.a.(3)(a) of the MS4 Permit requires, "maintenance or restoration of natural storage reservoirs and drainage corridors (including topographic depressions, areas of permeable soils, natural swales, and ephemeral and intermittent streams)", effectively making maintenance or restoration of channels and gullies within a project site a site design requirement.

H.8.2 Calculation of Sp

While there are many categories of erosion processes (e.g., landslides, debris flows, gullies, tree throw, animal burrows, sheetwash erosion, wind erosion, dry ravel, bank erosion), in this evaluation processes will be simplified to sediment production from hillslopes and channels. Under ideal circumstances, the total bed sediment supply rate (tons/year) would be calculated for both the post-project built-out condition and pre-project condition using a watershed-scale Geomorphic Landscape Unit (GLU) and Geomorphic Channel Unit (GCU) approach which:

(1) identifies different sources of sediment supply based on categories of terrain slope, geology, land cover, and stream order;
(2) estimates the base erosion rate of those sources (GLUs and GCUs);
(3) approximates the sediment delivery ratio (SDR) to the receiving channel;
(4) evaluates the coarse bed-load fraction of the sources; and
(5) integrates these considerations into a bed-load yield rate for both the existing condition and proposed built-out condition.

However, calculation of sediment yield rates for each GLU (tons/mi^2-yr) and GCU (tons/mi-yr) using the available science is inherently inexact and requires extensive field calibration. Additionally, performing the geospatial calculations necessary for such a comprehensive GLU and GCU analysis may not be straightforward for some project applicants. Since the objective is to determine the fraction of reduction in bed sediment supply in the post-project condition compared to the pre-project condition, but not to determine the bed sediment yield in physical units (tons/year/acre, for example) the following simplifications are allowed. These simplifications take into consideration the regional sediment yield map shown in Figure H.8.6.

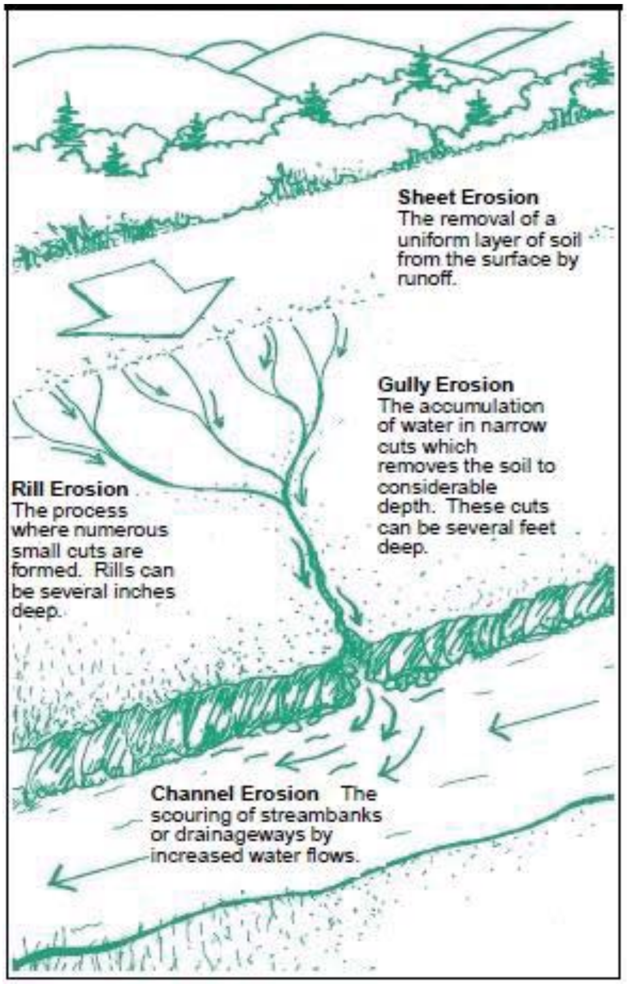

Figure H.8-7 Different Erosion Processes that Contribute Sediment

Source: http://www.fairfaxcounty.gov/nvswcd/youyourland/soil.htm

Sediment yield from hillslope processes (sheet and rill erosion) can be estimated using the Revised Universal Soil Loss Equation (RUSLE) and a sediment delivery ratio. For channel processes, the best available regional datasets are the USGS National Hydrography Dataset (NHD) and the NHDPlus dataset from USEPA and USGS (http://www.horizon-systems.com/nhdplus/). Both these datasets may not include the lowest order channels or gullies in the stream network, which can contribute a considerable amount of sediment produced from channel processes. Since the lower order channels and gullies originate and are mostly on the hillslopes, it is assumed for the Sp analysis that the sediment yield from lower order channels and gullies is proportional to the sediment yield from hill slopes. Based on feedback received during the TAC meetings (Appendix H.5.1) the following distribution is proposed for the calculation of Sp:

- 70% of bed sediment yield ratio from RUSLE analysis (assumed to account for sediment yield from hillslope processes (sheet and rill erosion) and channels and gullies not part of the NHDPlus dataset); and

- 30% of bed sediment yield ratio from channels in the NHDPlus dataset.

Note:

- If an applicant elects to map the waters of the state, the Sp distribution shall be revised to
  - 40% of bed sediment yield ratio from RUSLE analysis;
  - 30% of bed sediment yield ratio from waters of the state that are not part of NHDPlus dataset; and
  - 30% of bed sediment yield ratio from channels in the NHDPlus dataset.

SCALE OF ANALYSIS

The project applicant shall perform the Sp analysis at point (or points) where runoff leaves the project site[25]. The steps for performing an Sp analysis are shown in Figure H.8-8 and described below.

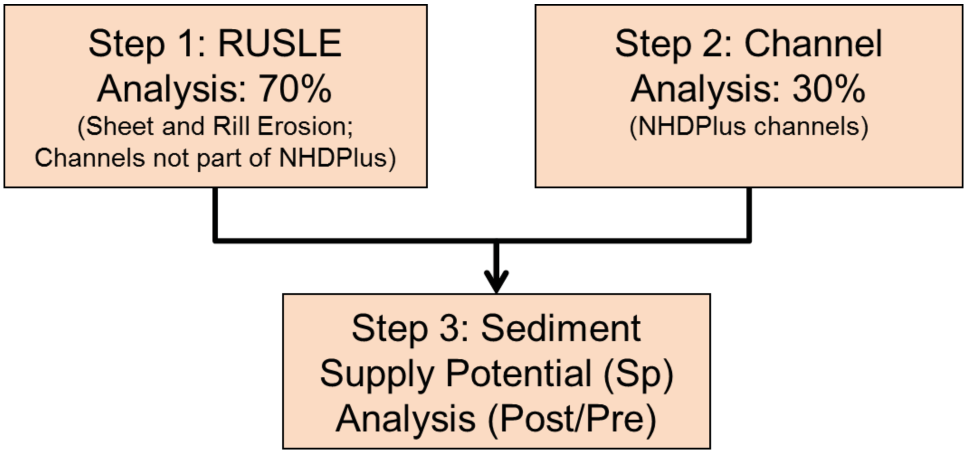

Figure H.8-8 Sediment Supply Potential Flow Chart

STEP 1: RUSLE ANALYSIS

RUSLE analysis is assumed to account for sediment yield from hillslope processes (sheet and rill erosion) and channels and gullies not part of the NHDPlus dataset. The change in bed sediment yield in the post-project condition compared to the pre-project condition using the RUSLE analysis must be estimated using equation H.8.9. This equation is a modified form of the standard RUSLE equation. Only hillslopes that are anticipated to generate coarse sediment must be used in this

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[25] In limited scenarios, the County has the discretion allow for a watershed-scale Sp analysis to be performed at the point of compliance it the future built-out conditions of the watershed are used in the analysis.

analysis. Since Sp is a dimensionless index the terms that are relatively constant in the pre and post project condition, such as rainfall factor, have been removed.

$$SY_{RUSLE} = \frac{Post\!-\!Project \sum\{A \times K \times LS \times C \times P\}}{Pre\!-\!Project \sum\{A \times K \times LS \times C\}} \qquad \text{Equation H.8.9}$$

Where:

A = Hillslope Area (acres)

K = Soil erodibility factor, this value can be obtained from regional K factor map from SWRCB or web soil survey or site-specific grain size analysis

LS = Slope length and steepness factor, this value can be obtained from the regional LS factor map from SWRCB or site-specific determination using look up tables based on slope and horizontal slope length from USDA Agriculture Handbook Number 703 (Renard et al., 1997) or other relevant sources

C= Cover management factor, use regional C factor map from USEPA or site-specific information; this is the reciprocal of the amount of surface cover on soil, whether it be vegetation, temporary mulch or other material. It is roughly the percentage of exposed soil, i.e., 95 percent cover yields a "C" value of 0.05. Use C=0 for areas where management actions are implemented (e.g. impervious areas)

P = Practice factor, only included in post-project condition. This term is added to account for sediment yield from engineered slopes. Practice factor of 0.25 shall be used for fill slopes and a practice factor of 0.50 shall be used for cut slopes. Use a practice factor of 1 for undisturbed areas.

The applicant may be allowed to receive credit for bed sediment yield from engineered slopes on the project perimeter directly discharging to conveyance systems if <u>all</u> of the following criteria are met:

- The engineered slopes consist of coarse bed material. This is confirmed by performing grain size distribution per ASTM D422 for the engineered slope and verifying that the d_{50} is greater than no. 200 sieve (0.074 mm).
- Cover factor in the post project condition shall not be greater than the cover factor used in the pre project condition for the same area.
- A maximum practice factor of 0.25 may applied to proposed fill slopes. A maximum practice factor of 0.50 may be applied to proposed cut slopes.
- A statement from the geotechnical engineer is included in the SWQMP certifying that the engineered slope will be stable even after accounting for bed sediment generation and the anticipated soil loss during the planned lifetime of the engineered slope is acceptable.

Additional analysis and/or documentation may be requested by the County prior to approval of the credit for bed sediment yield from engineered slopes.

performed at the point of compliance with a larger tributary watershed. This scaling translates the runoff from the project catchment to its contribution to erosivity in the down gradient receiving channel, without the need for a complex watershed-scale continuous hydrologic model.

Applicant can estimate the scaling factor using Equation H.8.3. The scaling factor equation was developed using the 2-year peak flow rate empirical equation from Hawley and Bledsoe (2011) and removing the terms (average annual precipitation and imperviousness (pre-development condition as required by the MS4 Permit) that are constant.

$$Scaling\ Factor = \left(\frac{A_{watershed}}{A_{project}}\right)^{0.667} \qquad \text{Equation H.8.3}$$

Where:

$A_{watershed}$ = total watershed drainage area at the point of compliance(mi^2)

$A_{project}$ = total project drainage area (mi^2)

STEP 2: CHANNEL ANALYSIS

If an NHDPlus mapped channel exists within the project property boundary, applicants must consider the sediment production from this existing channel system. The change is bed sediment yield in the post-project condition compared to the pre-project condition from channels in the NHDPlus dataset must be estimated using equation H.8.10 (SY_{NHD}). This equation is based on screening-level GIS calculations of stream length that will be contributing sediment in the post-project condition in the watershed tributary to the point of compliance.

$$SY_{NHD} = \frac{L_{post}}{L_{pre}} \qquad \text{Equation H.8.10}$$

Where:

L_{post} = Length of NHDplus streams in the watershed contributing to bed sediment supply in the post-project condition [miles]

L_{pre} = Length of NHDplus streams in the watershed contributing to bed sediment supply in the pre-project existing condition [miles]

STEP 3: SEDIMENT SUPPLY POTENTIAL ANALYSIS

Sediment Supply Potential (Sp) is defined as the ratio of post-project/pre-project (existing) long-term bed sediment supply. Sp must be calculated using equation H.8.11 presented below:

$$S_p = 0.7 \times SY_{RUSLE} + 0.3 \times SY_{NHD} \qquad \text{Equation H.8.11}$$

Where:

S_p = Sediment Supply Potential [unitless]

SY_{RUSLE} = Change in bed sediment yield from hillslopes and lower order channels and gullies not part of NHDPlus dataset [unitless]

SY_{NHD} = Change in bed sediment yield from channels in NHDPlus dataset [unitless]

When estimating Sp the following additional conditions apply:

- Projects that do not have onsite NHDPlus channels shall omit consideration of SY_{NHD} and weighting factors depicted in Equation H.8.11. This simply results in Sp = $SY_{RUSLE.}$
- It must be assumed that the sediment yield from an area that drains to a structural BMP is zero. Consideration of sediment yield from an area draining to the structural BMP may be allowed if sediment bypass measures are implemented upstream of the structural BMP. However, additional analysis may be requested by the County to substantiate the sediment yield estimates proposed by the applicant from implementing sediment bypass measures.
- For scenarios where an upstream coarse sediment yield area drains through the project footprint and the project footprint cuts off conveyance of bed sediment generated upstream

of the project footprint to the point of compliance, (e.g., via debris basins) the contribution from the upstream area shall be assumed to be zero.

As applicable, the applicant must use Worksheet H.8.2-1 to document the Sp calculations for each point of compliance.

A.4.2 Quantitative Analysis

Soil loss estimates for each Geomorphic Landscape Unit were estimated using the Revised Universal Soil Loss Equation (RUSLE; Renard et al. 1997) listed below:

$$A = R \times K \times LS \times C \times P$$

Where

A = estimated average soil loss in tons/acre/year

R = rainfall-runoff erosivity factor

K = soil erodibility factor

LS = slope length and steepness factor

C = cover-management factor

P = support practice factor; assumed 1 for this analysis

Regional datasets used to estimate the inputs required to estimate the soil loss from each GLU are listed in table below:

Dataset	Source	Download year	Description
RUSLE – R Factor	SWRCB	2014	Regional R factor map was downloaded from ftp://swrcb2a.waterboards.ca.gov/pub/swrcb/dwq/cgp/Risk/RUSLE/RUSLE_R_Factor/
RUSLE – K Factor	SWRCB	2014	Regional K factor map was downloaded from ftp://swrcb2a.waterboards.ca.gov/pub/swrcb/dwq/cgp/Risk/RUSLE/RUSLE_K_Factor/
RUSLE – LS Factor	SWRCB	2014	Regional LS factor map was downloaded from ftp://swrcb2a.waterboards.ca.gov/pub/swrcb/dwq/cgp/Risk/RUSLE/RUSLE_LS_Factor/
RUSLE – C Factor	USEPA	2014	Regional C factor map was downloaded from http://www.epa.gov/esd/land-sci/emap_west_browser/pages/wemap_mm_sl_rusle_c_qt.htm#mapnav

GIS analysis was used to calculate the area weighted estimate of R, K, LS and C factors using the regional datasets listed in the table above. For the developed land cover the C factor was then adjusted to 0 from the regional estimate to account for management actions implemented on developed sites (e.g. impervious surfaces). Soil loss estimates ranged from 0 to 15.2 tons/acre/year.

For evaluating the degree of relative risk to a stream solely arising from changes in sediment and/or water delivery SCCWRP Technical Report 605, 2010 states:

> *“The challenge in implementing this step is that presently we have insufficient basis to defensibly identify either low-risk or high-risk conditions using these metrics. For example, channels that are close to a threshold for geomorphic change may display significant morphological changes under nothing more than natural year-to-year variability in flow or sediment load.*

- *Acknowledging this caveat, we nonetheless anticipate that changes of less than 10% in either driver are unlikely to instigate, on their own, significant channel changes. This value is a conservative estimate of the year-to-year variability in either discharge or sediment flux that can be accommodated by a channel system in a state of dynamic equilibrium. It does not "guarantee," however, that channel change may not occur—either in response to yet modest alterations in water or sediment delivery, or because of other urbanization impacts (e.g., point discharge of runoff or the trapping of the upstream sediment flux; see Booth 1990) that are not represented with this analysis.*
- *In contrast, recognizing a condition of undisputed "high risk" must await broader collection of regionally relevant data. We note that >60% reductions in predicted sediment production have resulted in both minimal (McGonigle) and dramatic (Agua Hedionda) channel changes, indicating that "more data" may never provide absolute guidance. At present, we suggest using predicted watershed changes of 50% or more in either runoff (as indexed by change in impervious area) or sediment production as provisional criteria for requiring a more detailed evaluation of both the drivers and the resisting factors for channel change, regardless of other screening-level assessments. Clearly, however, only more experience with the application of such "thresholds," and the actual channel conditions that accompany them, will provide a defensible basis for setting numeric standards."*

The following criterion was developed using the suggestions listed above and then used to assign relative sediment production rating to each GLU:

- Low: Soil Loss < 5.6 tons/acre/year [GLUs that have a soil loss of 0 to 5.6 tons/acre/year produces around 10% of the total coarse sediment soil loss from the study area]
- Medium: 5.6 tons/acre/year < Soil Loss < 8.4 tons/acre/year
- High: > 8.4 tons/acre/year [GLUs that have a soil loss greater than 8.4 tons/acre/year produces around 42% of the total coarse sediment soil loss from the study area]

Results from the quantitative analysis are summarized in Table A.4.2.

Table A.4.2 Relative Sediment Production for different Geomorphic Landscape Units

Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
CB-Agricultural/Grass-1	52883	0.20	4.67	0.14	50	6.5	Medium	No
CB-Agricultural/Grass-2	40633	0.21	5.19	0.14	56	8.3	Medium	No
CB-Agricultural/Grass-3	32617	0.22	6.04	0.14	57	10.6	High	Yes
CB-Agricultural/Grass-4	11066	0.23	7.38	0.14	57	13.5	High	Yes
CB-Developed-1	39746	0.22	3.77	0	49	0	Low	No
CB-Developed-2	32614	0.22	4.28	0	50	0	Low	No
CB-Developed-3	15841	0.22	4.86	0	49	0	Low	No
CB-Developed-4	1805	0.22	5.63	0	48	0	Low	No
CB-Forest-1	32231	0.20	6.38	0.14	39	6.8	Medium	No
CB-Forest-2	38507	0.20	7.20	0.13	45	8.8	High	Yes
CB-Forest-3	55303	0.20	8.14	0.13	48	10.6	High	Yes
CB-Forest-4	38217	0.20	9.95	0.14	50	13.6	High	Yes
CB-Other-1	1036	0.20	5.52	0.13	45	6.5	Medium	No
CB-Other-2	317	0.20	6.46	0.13	45	7.9	Medium	No
CB-Other-3	296	0.20	6.96	0.14	43	8.3	Medium	No
CB-Other-4	111	0.21	6.84	0.14	41	8.2	Medium	No
CB-Scrub/Shrub-1	88135	0.20	5.66	0.14	33	5.3	Low	No
CB-Scrub/Shrub-2	143694	0.20	6.51	0.14	37	6.8	Medium	No
CB-Scrub/Shrub-3	246703	0.21	7.33	0.14	41	8.4	Medium	No
CB-Scrub/Shrub-4	191150	0.21	8.28	0.14	42	9.8	High	Yes
CB-Unknown-1	1727	0.21	5.32	0.13	44	6.3	Medium	No
CB-Unknown-2	1935	0.21	5.95	0.13	44	7.1	Medium	No

Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
CB-Unknown-3	1539	0.22	6.21	0.13	44	7.7	Medium	No
CB-Unknown-4	278	0.22	6.61	0.13	44	8.4	High	Yes
CSI-Agricultural/Grass-1	14609	0.34	2.72	0.14	39	4.8	Low	No
CSI-Agricultural/Grass-2	9059	0.37	3.61	0.14	47	8.7	High	Yes
CSI-Agricultural/Grass-3	10096	0.38	3.99	0.14	47	9.8	High	Yes
CSI-Agricultural/Grass-4	2498	0.37	4.33	0.14	47	10.5	High	Yes
CSI-Developed-1	82371	0.28	2.51	0	39	0	Low	No
CSI-Developed-2	22570	0.30	2.66	0	41	0	Low	No
CSI-Developed-3	13675	0.30	2.89	0	40	0	Low	No
CSI-Developed-4	3064	0.27	3.20	0	39	0	Low	No
CSI-Forest-1	449	0.27	4.26	0.13	43	6.6	Medium	No
CSI-Forest-2	611	0.25	5.11	0.13	44	7.5	Medium	No
CSI-Forest-3	716	0.29	4.43	0.13	44	7.4	Medium	No
CSI-Forest-4	348	0.30	4.49	0.13	43	7.6	Medium	No
CSI-Other-1	319	0.31	2.50	0.13	32	3.2	Low	No
CSI-Other-2	83	0.27	3.01	0.13	39	4.3	Low	No
CSI-Other-3	45	0.28	3.03	0.13	39	4.5	Low	No
CSI-Other-4	13	0.24	4.01	0.14	39	5.2	Low	No
CSI-Scrub/Shrub-1	9051	0.26	3.53	0.13	39	4.7	Low	No
CSI-Scrub/Shrub-2	10802	0.27	4.36	0.13	41	6.3	Medium	No
CSI-Scrub/Shrub-3	28220	0.26	4.82	0.13	41	6.7	Medium	No
CSI-Scrub/Shrub-4	20510	0.26	5.52	0.13	41	7.8	Medium	No
CSI-Unknown-1	5292	0.28	2.38	0.13	36	3.1	Low	No

Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
CSI-Unknown-2	2074	0.29	2.98	0.13	40	4.5	Low	No
CSI-Unknown-3	2171	0.27	3.04	0.13	39	4.2	Low	No
CSI-Unknown-4	676	0.26	3.04	0.13	38	3.8	Low	No
CSP-Agricultural/Grass-1	59327	0.22	3.01	0.14	44	4.0	Low	No
CSP-Agricultural/Grass-2	8426	0.23	3.81	0.14	42	5.2	Low	No
CSP-Agricultural/Grass-3	2377	0.24	4.05	0.14	41	5.6	Low	No
CSP-Agricultural/Grass-4	291	0.22	6.28	0.14	52	10.1	High	Yes
CSP-Developed-1	85283	0.27	2.10	0	42	0	Low	No
CSP-Developed-2	7513	0.26	2.77	0	42	0	Low	No
CSP-Developed-3	2317	0.27	2.70	0	40	0	Low	No
CSP-Developed-4	272	0.27	2.76	0	38	0	Low	No
CSP-Forest-1	14738	0.22	4.52	0.14	44	6.0	Medium	No
CSP-Forest-2	3737	0.22	5.99	0.14	45	8.2	Medium	No
CSP-Forest-3	1858	0.21	6.42	0.14	45	8.5	High	Yes
CSP-Forest-4	484	0.21	7.62	0.14	48	10.2	High	Yes
CSP-Other-1	7404	0.23	2.61	0.14	39	3.2	Low	No
CSP-Other-2	343	0.24	3.68	0.13	40	4.8	Low	No
CSP-Other-3	126	0.24	3.76	0.13	40	4.9	Low	No
CSP-Other-4	17	0.24	4.19	0.13	39	5.3	Low	No
CSP-Scrub/Shrub-1	22583	0.23	3.75	0.14	41	4.8	Low	No
CSP-Scrub/Shrub-2	8938	0.24	5.63	0.14	40	7.1	Medium	No
CSP-Scrub/Shrub-3	7186	0.23	6.15	0.13	39	7.5	Medium	No
CSP-Scrub/Shrub-4	2609	0.22	7.16	0.14	43	9.3	High	Yes

Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
CSP-Unknown-1	6186	0.25	2.63	0.13	40	3.4	Low	No
CSP-Unknown-2	744	0.27	3.49	0.13	39	4.8	Low	No
CSP-Unknown-3	350	0.28	3.32	0.13	38	4.5	Low	No
CSP-Unknown-4	78	0.28	3.26	0.13	40	4.5	Low	No
FB-Agricultural/Grass-1	6103	0.25	5.49	0.14	49	9.2	High	No
FB-Agricultural/Grass-2	7205	0.25	5.87	0.14	51	10.1	High	No
FB-Agricultural/Grass-3	6730	0.24	6.43	0.14	53	11.3	High	No
FB-Agricultural/Grass-4	2586	0.22	8.62	0.14	57	15.2	High	No
FB-Developed-1	10116	0.28	3.94	0	46	0	Low	No
FB-Developed-2	9075	0.28	4.41	0	45	0	Low	No
FB-Developed-3	5499	0.27	4.72	0	44	0	Low	No
FB-Developed-4	785	0.27	5.08	0	43	0	Low	No
FB-Forest-1	3780	0.21	7.24	0.13	39	8.0	Medium	No
FB-Forest-2	7059	0.21	7.53	0.13	43	8.8	High	No
FB-Forest-3	13753	0.22	8.02	0.13	43	9.7	High	No
FB-Forest-4	8899	0.26	9.63	0.13	35	11.5	High	No
FB-Other-1	172	0.26	5.72	0.13	44	8.6	High	No
FB-Other-2	75	0.26	5.97	0.13	38	7.7	Medium	No
FB-Other-3	76	0.28	6.27	0.13	34	7.6	Medium	No
FB-Other-4	36	0.31	6.70	0.13	33	8.6	High	No
FB-Scrub/Shrub-1	10297	0.24	6.94	0.14	36	8.3	Medium	No
FB-Scrub/Shrub-2	25150	0.25	7.24	0.14	38	9.0	High	No
FB-Scrub/Shrub-3	70895	0.25	7.89	0.13	38	10.0	High	No

Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
FB-Scrub/Shrub-4	70679	0.26	9.05	0.14	39	12.1	High	No
FB-Unknown-1	654	0.30	5.33	0.13	37	7.6	Medium	No
FB-Unknown-2	829	0.29	5.26	0.13	40	7.9	Medium	No
FB-Unknown-3	1062	0.29	5.54	0.13	39	8.2	Medium	No
FB-Unknown-4	299	0.28	6.02	0.13	38	8.4	High	No
FSI-Agricultural/Grass-1	8462	0.32	3.91	0.13	24	3.9	Low	No
FSI-Agricultural/Grass-2	4979	0.33	4.29	0.13	31	5.7	Medium	No
FSI-Agricultural/Grass-3	4808	0.34	4.26	0.13	34	6.3	Medium	No
FSI-Agricultural/Grass-4	1055	0.35	4.11	0.13	36	6.7	Medium	No
FSI-Developed-1	9953	0.29	3.09	0	34	0	Low	No
FSI-Developed-2	4972	0.31	3.22	0	37	0	Low	No
FSI-Developed-3	3350	0.29	3.30	0	36	0	Low	No
FSI-Developed-4	763	0.28	3.31	0	37	0	Low	No
FSI-Forest-1	186	0.33	4.62	0.13	37	7.2	Medium	No
FSI-Forest-2	217	0.35	4.47	0.13	39	7.9	Medium	No
FSI-Forest-3	262	0.37	4.71	0.13	40	9.2	High	No
FSI-Forest-4	111	0.36	4.73	0.13	40	9.2	High	No
FSI-Other-1	266	0.31	3.11	0.13	24	2.9	Low	No
FSI-Other-2	81	0.30	3.29	0.13	25	3.1	Low	No
FSI-Other-3	56	0.31	3.04	0.13	27	3.2	Low	No
FSI-Other-4	15	0.29	3.57	0.13	33	4.4	Low	No
FSI-Scrub/Shrub-1	2241	0.27	4.46	0.13	29	4.5	Low	No
FSI-Scrub/Shrub-2	3911	0.28	4.96	0.13	31	5.7	Medium	No

Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
FSI-Scrub/Shrub-3	7590	0.29	5.05	0.13	34	6.3	Medium	No
FSI-Scrub/Shrub-4	3502	0.30	5.14	0.13	37	7.5	Medium	No
FSI-Unknown-1	1117	0.29	2.83	0.13	27	3.0	Low	No
FSI-Unknown-2	780	0.30	3.44	0.13	32	4.3	Low	No
FSI-Unknown-3	855	0.29	3.41	0.13	31	4.0	Low	No
FSI-Unknown-4	285	0.28	3.21	0.13	32	3.7	Low	No
FSP-Agricultural/Grass-1	13	0.22	2.22	0.13	40	2.5	Low	No
FSP-Agricultural/Grass-2	3	0.22	2.59	0.13	40	3.0	Low	No
FSP-Agricultural/Grass-3	2	0.22	2.69	0.13	40	3.2	Low	No
FSP-Agricultural/Grass-4	0	0.20	2.94	0.12	40	2.9	Low	No
FSP-Developed-1	180	0.26	2.85	0	40	0	Low	No
FSP-Developed-2	13	0.25	2.69	0	40	0	Low	No
FSP-Developed-3	8	0.21	2.25	0	40	0	Low	No
FSP-Developed-4	0	0.21	2.29	0	40	0	Low	No
FSP-Forest-1	8	0.22	2.29	0.14	40	2.9	Low	No
FSP-Forest-2	5	0.20	2.22	0.14	40	2.5	Low	No
FSP-Forest-3	0	0.20	2.22	0.14	40	2.5	Low	No
FSP-Other-1	1307	0.20	2.38	0.14	40	2.7	Low	No
FSP-Other-2	34	0.21	2.36	0.14	40	2.7	Low	No
FSP-Other-3	8	0.22	2.56	0.13	40	3.0	Low	No
FSP-Other-4	0	0.43	4.35	0.12	40	9.3	High	No
FSP-Scrub/Shrub-1	147	0.23	2.68	0.14	40	3.3	Low	No
FSP-Scrub/Shrub-2	18	0.23	2.55	0.14	40	3.3	Low	No

Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
FSP-Scrub/Shrub-3	4	0.20	2.23	0.14	40	2.6	Low	No
FSP-Scrub/Shrub-4	0	0.20	1.70	0.12	40	1.7	Low	No
FSP-Unknown-1	40	0.20	1.87	0.13	40	1.9	Low	No
FSP-Unknown-2	5	0.20	1.99	0.12	40	2.0	Low	No
FSP-Unknown-3	1	0.20	2.39	0.12	40	2.4	Low	No
O-Agricultural/Grass-1	2433	0.20	2.93	0.14	34	2.8	Low	No
O-Agricultural/Grass-2	112	0.21	3.44	0.14	32	3.2	Low	No
O-Agricultural/Grass-3	30	0.23	3.89	0.13	32	3.8	Low	No
O-Agricultural/Grass-4	1	0.26	6.47	0.13	37	7.9	Medium	No
O-Developed-1	8327	0.27	1.37	0	39	0	Low	No
O-Developed-2	474	0.25	2.12	0	40	0	Low	No
O-Developed-3	157	0.26	3.07	0	41	0	Low	No
O-Developed-4	26	0.24	3.89	0	41	0	Low	No
O-Forest-1	235	0.22	6.15	0.13	43	7.6	Medium	No
O-Forest-2	67	0.21	5.07	0.13	45	6.6	Medium	No
O-Forest-3	45	0.21	5.43	0.13	47	7.3	Medium	No
O-Forest-4	20	0.20	5.95	0.13	59	9.0	High	No
O-Other-1	9362	0.25	3.86	0.13	36	4.3	Low	No
O-Other-2	344	0.24	3.32	0.13	35	3.5	Low	No
O-Other-3	120	0.23	4.86	0.13	35	5.0	Low	No
O-Other-4	37	0.22	5.64	0.13	39	6.6	Medium	No
O-Scrub/Shrub-1	688	0.22	4.83	0.13	40	5.7	Medium	No
O-Scrub/Shrub-2	224	0.22	5.80	0.13	36	6.3	Medium	No

Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
O-Scrub/Shrub-3	209	0.22	6.47	0.13	41	7.5	Medium	No
O-Scrub/Shrub-4	96	0.22	6.62	0.13	44	8.2	Medium	No
O-Unknown-1	1236	0.28	1.60	0.12	26	1.5	Low	No
O-Unknown-2	62	0.27	1.48	0.13	36	1.8	Low	No
O-Unknown-3	15	0.29	3.52	0.13	38	4.9	Low	No
O-Unknown-4	7	0.34	3.87	0.12	40	6.6	Medium	No

GLU Nomenclature: Geology – Land Cover – Slope Category

Geology Categories:

CB	Coarse Bedrock
CSI	Coarse Sedimentary Impermeable
CSP	Coarse Sedimentary Permeable
FB	Fine Bedrock
FSI	Fine Sedimentary Impermeable
FSP	Fine Sedimentary Permeable
O	Other

Slope Categories:

1	0%-10%
2	10% - 20%
3	20% - 40%
4	> 40%

Appendix 2:

- Relevant Maps of Hydromodification Screening Reports (References [2] and [3]).
- General Satellite Exhibit with Location of Site-Visit Photos of Contributing Areas to POCs 13B, 19 and 26; Dec. 2016)
- Photographic Records of December 2016 Site Visit
- Aerial Photography of the Location of POC-13B, POC-19 and POC-26
- New Updated Letter by Geologist (Leighton & Associates Inc. Dated 12/15/16 that Supersedes previous Geology Letter Dated 6/10/16 and Revised 10/5/16)