DRAFT Technical Memorandum

Sediment Analysis

Subject: **Sediment Analysis**

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Reference:

1 Purpose

This Technical Memorandum (TM) presents the results of the sediment balance task conducted for Phase 2 of the Stream Management Master Plan (SMMP). An analysis was conducted on the overall watershed sediment yield and in-stream sediment transport based on hydrologic modeling conducted by Schaaf & Wheeler (*Hydrologic Procedures and Design Discharges*, December 1997) and West Yost & Associates (*Technical Memorandum No. 5 Task E: Evaluation of Problem Areas & Identification of Solutions*, November 2001) and a sediment geomorphology study conducted by Ayres Associates (*Zone 7 Water Agency Geomorphic and Sediment Transport Evaluation*, December 2001). The analysis was conducted to assess the effect of flood management recommendations, developed during Phase 1 of the SMMP and outlined in the Interim Report (*Zone 7 Stream Management Master Plan Phase 1 Interim Report*, March 2004), on overall sediment yield or output at the outlet of Arroyo de la Laguna (ADLL). The analysis is to answer three questions:

1. What is the sediment yield today?
2. What will be the sediment yield at full build-out development conditions if recommended channel improvements are not implemented?
3. What will be the sediment yield at full build-out development conditions if recommended SMMP improvements are implemented?

It is important to note that the scope for this task did not include new modeling efforts or field measurements such as sediment sampling. Data needed for the analysis including design hydrology, channel geometry, and sediment particle size distributions were obtained from previous studies, as mentioned above.

2 The Five Scenarios

In order to answer the three questions posed above, five scenarios were developed based on differing development and channel conditions. These are summarized in Table 1 below.

Table 1 – Sediment Analysis Scenarios

Scenario	Development Condition	Channel Condition
A	Full Build-Out	Full Channel Conveyance Capacity[1]
B	Existing Development	Full Channel Conveyance Capacity[1]
C	Existing Development	Existing Channel Conveyance Capacity[2]
D	Full Build-Out	Existing Channel Conveyance Capacity[2]
E	Full Build-Out	SMMP Improvements

[1] Assumes channels have adequate capacity to convey flows generated during a 100-year rainfall event.
[2] Existing channel capacities based on hydrologic modeling conducted by West Yost & Associates (West Yost & Associates, March 2002). For Arroyo las Positas, existing channel capacity through the Las Positas Golf Course reach is 1,800 cfs. For Arroyo Mocho, existing channel capacity through the Chain of Lakes is 900 cfs.

The first scenario (Scenario A) was used as a reference since the hydrologic modeling conducted by Schaaf & Wheeler (Schaaf & Wheeler, June 2000) and the sediment geomorphology study conducted by Ayres Associates (Ayres Associates, December 2001) were both based on these conditions. This land use scenario reflects full build-out as outlined by the Urban Growth Boundary presented in general plans for the Cities of Dublin, Pleasanton, Livermore, San Ramon, and the County of Alameda. A map of the Urban Growth Boundary is shown in Figure 1. The total area falling within the Urban Growth Boundary was calculated to be 76 square miles, or approximately 18% of the watershed's area (430 square miles). This scenario also assumes that channels have adequate capacity to convey flows generated during a 100-year rainfall event. All flow is therefore assumed to be confined to the channels thereby eliminating bank overtopping and flooding on adjacent floodplains.

Scenario B reflects existing land use conditions as outlined by existing land use and city boundary maps presented in general plans. The total area falling within city boundaries was estimated to be approximately 52 square miles, or 12% of the watershed's area. A map of the current city limits and the Urban Growth Boundary is shown in Figure 2. There is therefore an expected urban growth of approximately 24 square miles, or an increase of 46% in urbanized area. The increase in impervious areas will have an effect on peak flood flows and sediment yield from these watersheds. Scenario B assumes that channels have adequate capacity to convey flows generated during a 100-year rainfall event. As in Scenario A, all flow is assumed to be confined to the channels thereby eliminating bank overtopping and flooding on adjacent floodplains.

Scenario C represents present conditions in the watershed. As in Scenario B, existing development conditions are assumed. However, in this case, the current floodplain was assumed to be present and channel capacities were obtained from modeling conducted by West Yost & Associates. For Arroyo las Positas, existing capacity through the Las Positas Golf Course was set at 1,800 cfs (West Yost & Associates, March 2002). For Arroyo Mocho, the channel capacity was set at 900 cfs (West Yost & Associates, March 2002). Results from Scenario C will be used to answer question number one.

Scenario D represents future conditions at full build-out assuming improvements to the channels are not implemented. As in Scenario A, this land use scenario reflects full build-out as outlined by the Urban Growth Boundary presented in general plans. Channel capacities through Arroyo las Positas and Arroyo Mocho are the same as those of Scenario C. However, in this case, the floodplain is expanded due to increased flows resulting from an increase in impervious surfaces. Results from Scenario D will be used to answer question number two.

Scenario E represents future conditions resulting from implementation of flood management recommendations outlined in the Zone 7 Phase 1 Interim Report (RMC, March 2004). The main improvement to the flood control system likely to significantly affect flows through the channels is the regional storage of flood flows at the Chain of Lakes. Results from Scenario E will be used to answer question number three.

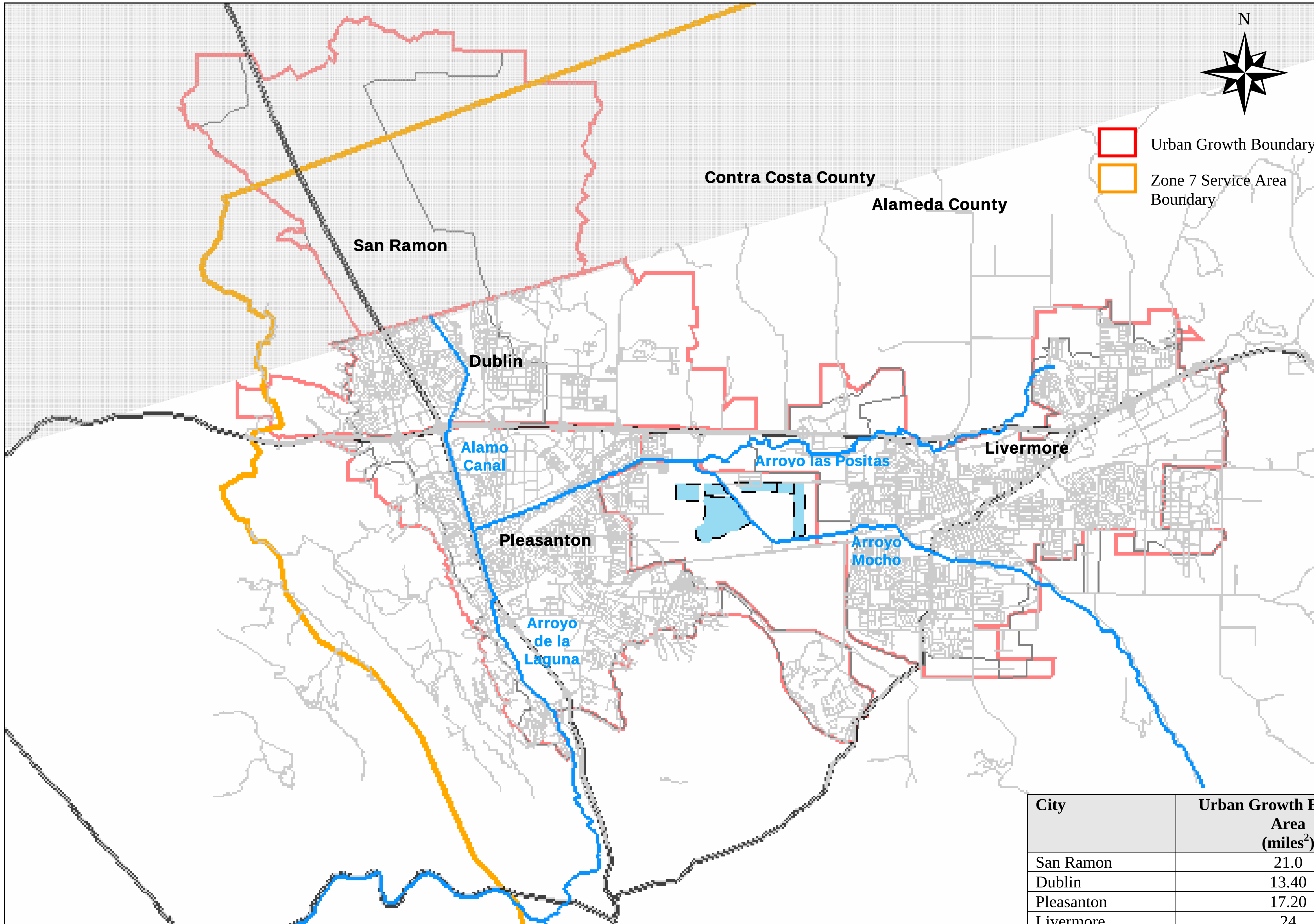
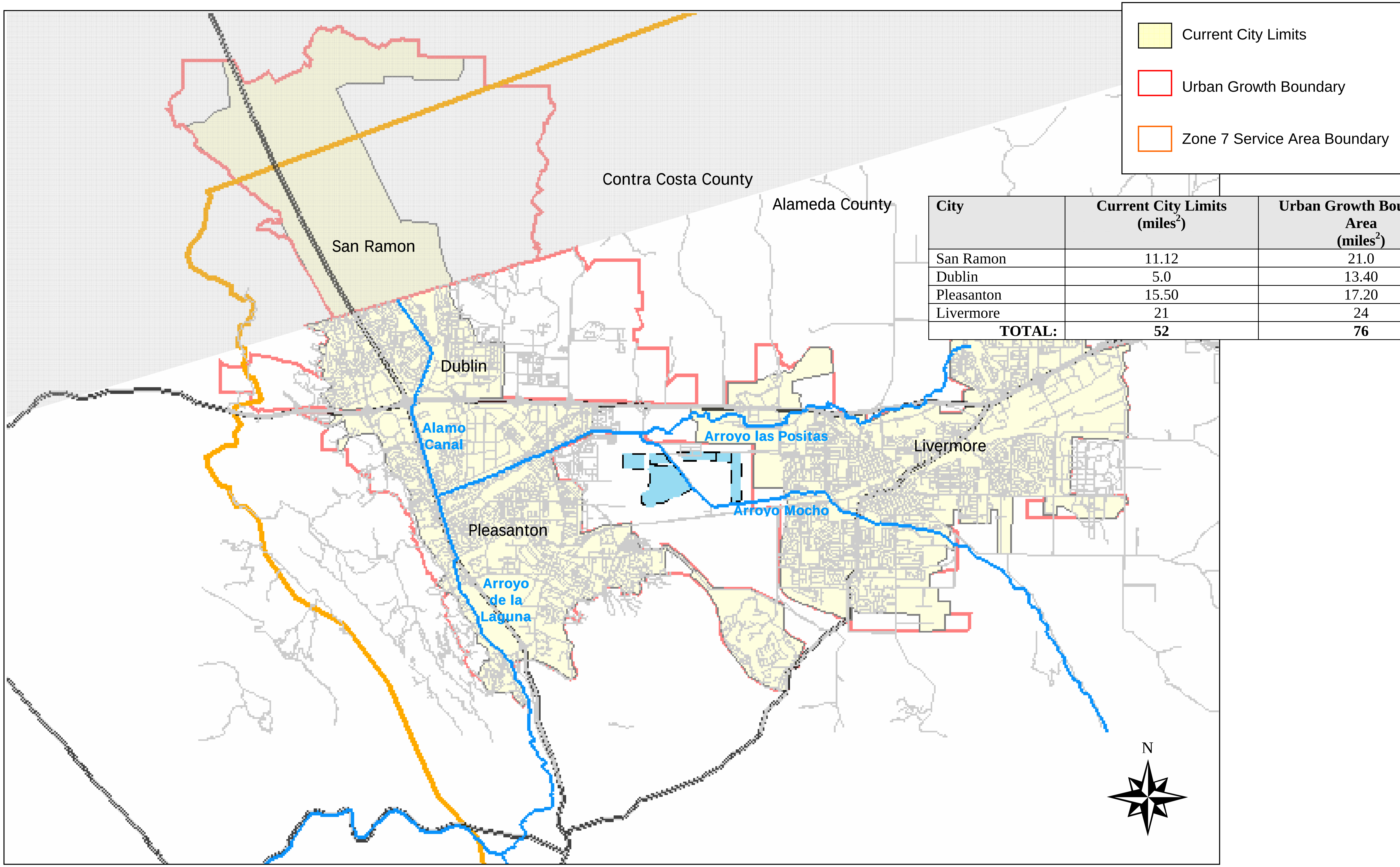


Figure 1: Urban Growth Boundary

City	Urban Growth Boundary Area (miles^2)
San Ramon	21.0
Dublin	13.40
Pleasanton	17.20
Livermore	24
TOTAL:	**76**



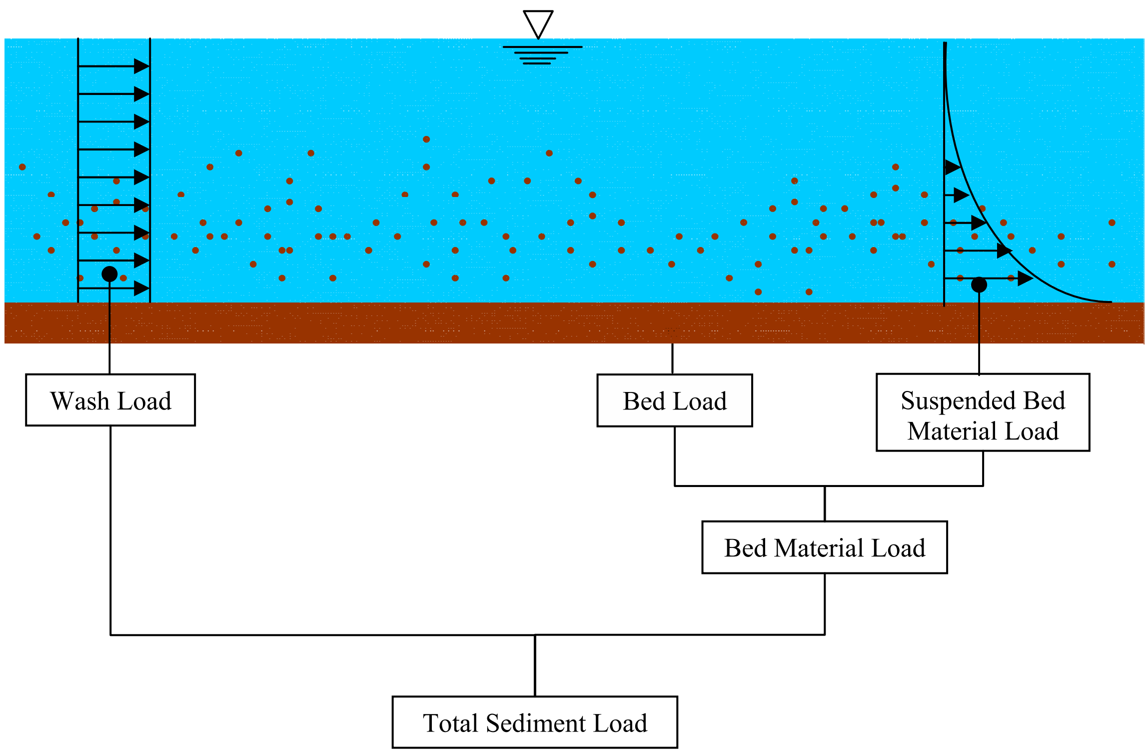
City	Current City Limits (miles^2)	Urban Growth Boundary Area (miles^2)
San Ramon	11.12	21.0
Dublin	5.0	13.40
Pleasanton	15.50	17.20
Livermore	21	24
TOTAL:	**52**	**76**

Figure 2: Current City Limits

3 Components of Sediment Load

The total sediment load at a specific location along a channel consists of sediment eroded from overland areas and sediment eroded from the channel banks and bed. Sediment derived from overland erosion is usually composed of fine particles carried mostly in suspension (wash load) (RCE, November 1994). Sediment eroded from the channel banks and bed is composed of coarser particles such as sand, gravel, and cobbles. This material is transported through the channel as bed load by various means including rolling, sliding, saltation, and surface creep (RCE, November 1994). The various components of the total sediment load carried in a channel are shown in Figure 3.

Figure 3 – Components of Total Sediment Load



The amount of sediment derived from overland erosion (wash load) is dependent on various climatic and physical characteristics of the watershed. It is controlled by the availability of erodible soils in the watershed and is therefore not dependent on the hydraulic conditions in the stream. The wash load component of the total sediment load will be calculated using the Pacific Southwest Inter-Agency Committee (PSIAC) Method (PSIAC, 1968). This method was developed to estimate sediment yields, or the volume of sediment derived from overland erosion. Details of this method will be discussed in Section 4 (Wash Load Analysis).

The primary source of sand and coarser sediment material is from channel bank and bed erosion. This load is carried as bed material load and is dependent on the character of the sediment (i.e. size distribution), channel geometry, and channel hydraulic conditions. Bed material load analysis involves the use of an empirically derived transport capacity equation. This equation will be used in conjunction with the continuity principle (conservation of mass) to determine the vertical adjustment of the channel, or the aggradation/degradation of the channel bed. Details of the methodology used will be discussed in Section 5 (Bed Material Load Analysis).

4 Wash Load Analysis

4.1 Methodology

The average annual wash load (suspended sediment yield) carried in Zone 7 channels and exiting the watershed at the outlet of ADLL will be based on a watershed-wide sediment mass balance. Soils eroded from the overland areas will constitute the suspended sediment input into the system and will be estimated using the PSIAC method. Sediment sinks in the system will vary based on development conditions and SMMP Program implementation. These sinks may include the volume of sediment carried in floodwaters and deposited on adjacent floodplains when bank overtopping occurs or the volume of sediment settling in detention storage at the Chain of Lakes upon implementation of the SMMP Program regional storage solution. The resulting, overall suspended sediment yield will be the total sediment input minus the total sinks.

The PSIAC method estimates wash load or suspended sediment input into the stream by evaluating the condition of the watershed, and more specifically, by rating nine factors including surface geology, soils, climate, runoff, topography, ground cover, land use, upland erosion, and channel erosion and sediment transport. Each factor is assigned a yield level of high, moderate, or low. This level is in turn assigned a numerical value representing the relative significance in the overall rating (i.e. 0 to 10, -10 to 10, and 0 to 25). A yield rating is then calculated which equals the sum of the yield values for each factor. Based on this yield rating, the watershed is assigned a yield class (1 to 5). Each yield class is in turn assigned an average annual yield rate (acre-feet/mile^2-year). This method is intended for broad-planning purposes to obtain an order-of-magnitude estimate of wash load. A copy of the reference describing the PSIAC method is attached in Appendix B.

The PSIAC method was used by Ayres Associates as part of their geomorphic and sediment transport evaluation to estimate sediment yield rates for five types of ground cover: urban, grassland, urban/grassland, forest/grassland, and urban/forest (Ayres Associates, 2001). Areas draining into Zone 7 channels were then assigned a sediment yield rate based on the predominant ground cover type. Table 2 below lists the predominant ground cover types in the watershed and corresponding sediment yield rates as derived by Ayres Associates.

Table 2 – Sediment Yield Rates by Ground Cover Type (Ayres Associates, 2001)

Predominant Ground Cover	Sediment Yield Rate (Acre-feet/mile^2)
Urban	0.29
Grassland	0.93
Urban/Grassland	0.61
Forest/Grassland	0.46
Urban/Forest	0.38

These sediment yield rates were verified by re-classifying each ground cover type utilizing guidelines published by the PSIAC.

Arc Info 8.0®, a Geographical Information System (GIS) software, was used to delineate areas draining into the channels. A map of resulting sub-watersheds and corresponding drainage areas is shown in Figure 4. The area draining into Arroyo del Valle was not included in the analysis since it was assumed that all soils eroded from the upland watershed would be trapped behind the Del Valle Reservoir.

Similarly, the Chain of Lakes area was not included in the analysis since it was assumed that eroded soils would be trapped in existing and future gravel mining pits and would therefore not contribute to the wash loads in Arroyo las Positas or Arroyo Mocho.

As described in Section 2, Scenario A assumes full build-out development conditions. City and county general plans were reviewed to obtain the urban growth boundary area. This area was mapped in GIS and overlaid on the sub-watershed map. As illustrated in Figure 5, each sub-watershed was then classified by ground cover type. Some sub-watersheds were assigned two types of ground cover (i.e. urban and grassland, etc.). The areas within each sub-watershed corresponding to the ground cover classification were then calculated using GIS. The resulting sediment input (acre-feet/year) was calculated by multiplying the average annual sediment yield rates (acre-feet/mile^2-year) by the corresponding drainage areas (mile^2). Results of these calculations are shown in Appendix C and summarized in Table 3.

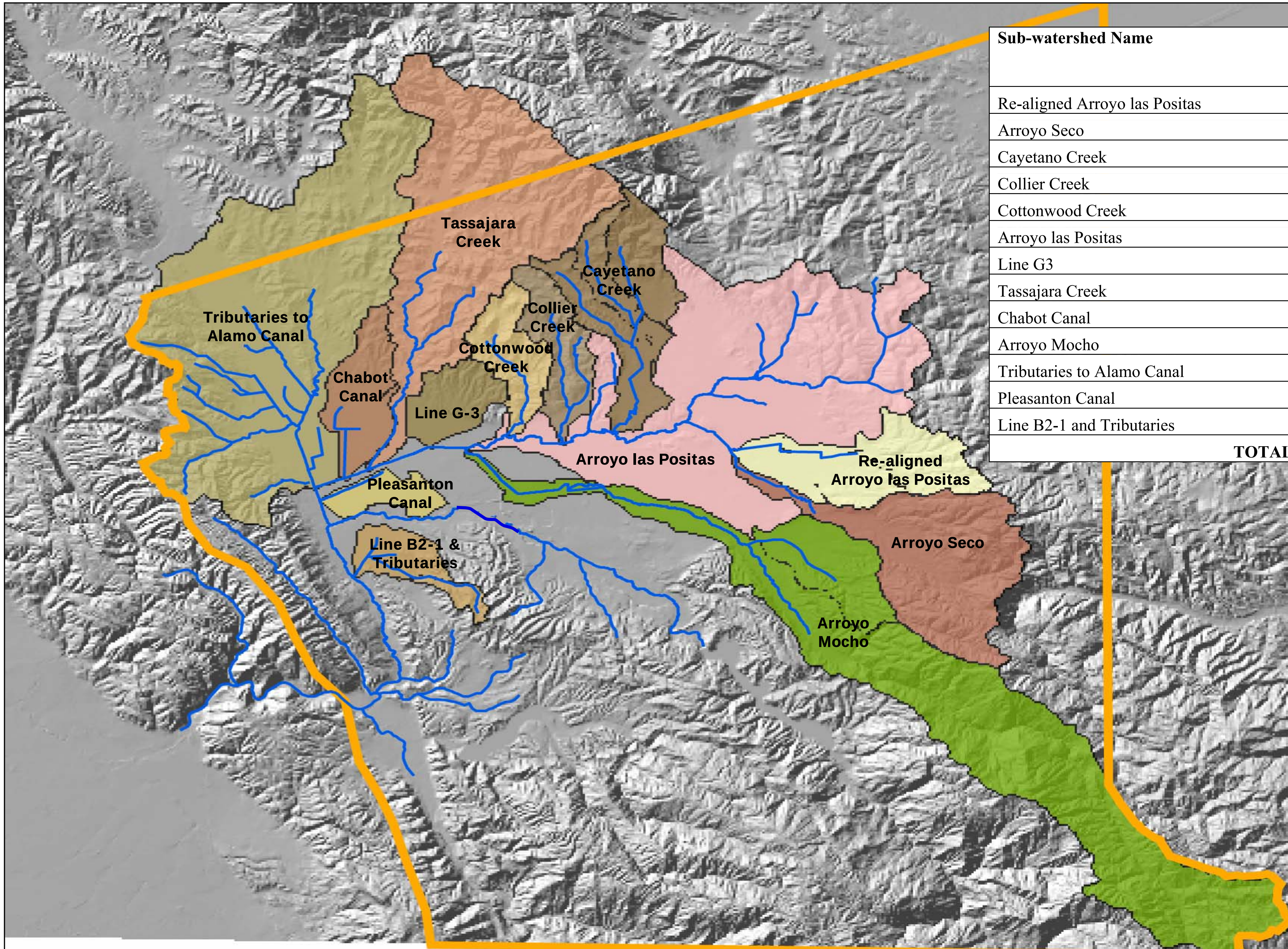
Scenario B assumes existing development conditions and full design channel capacities. As in Scenario A, city general plans were reviewed to obtain existing city boundaries. City boundaries were mapped and overlaid on the sub-watershed map. Once again, sub-watersheds were classified by ground cover type and areas were obtained. Channels were assumed to have adequate capacity to convey the 100-year flood flows. As a result, it was assumed that no flooding would occur around Arroyo las Positas or Arroyo Mocho. Suspended sediment input estimates for this scenario are shown in Appendix C and summarized in Table 3.

Scenario C assumes existing development conditions and channel capacities. Figure 6 shows the current 100-year floodplain around Chain of Lakes. Both Arroyo las Positas and Arroyo Mocho are currently under capacity. Flooding will therefore occur during a 100-year rainfall event. However, flooding is also likely to occur during higher frequency rainfall events. The amount of sediment carried in floodwaters overtopping the channel banks represents the sediment sink component of the mass balance. In order to quantify the amount of sediment deposited on the adjacent floodplain on any given year, two questions need to be answered:

- When does bank overtopping occur?
- Over the long term, how much sediment will be deposited on the floodplain on any one year?

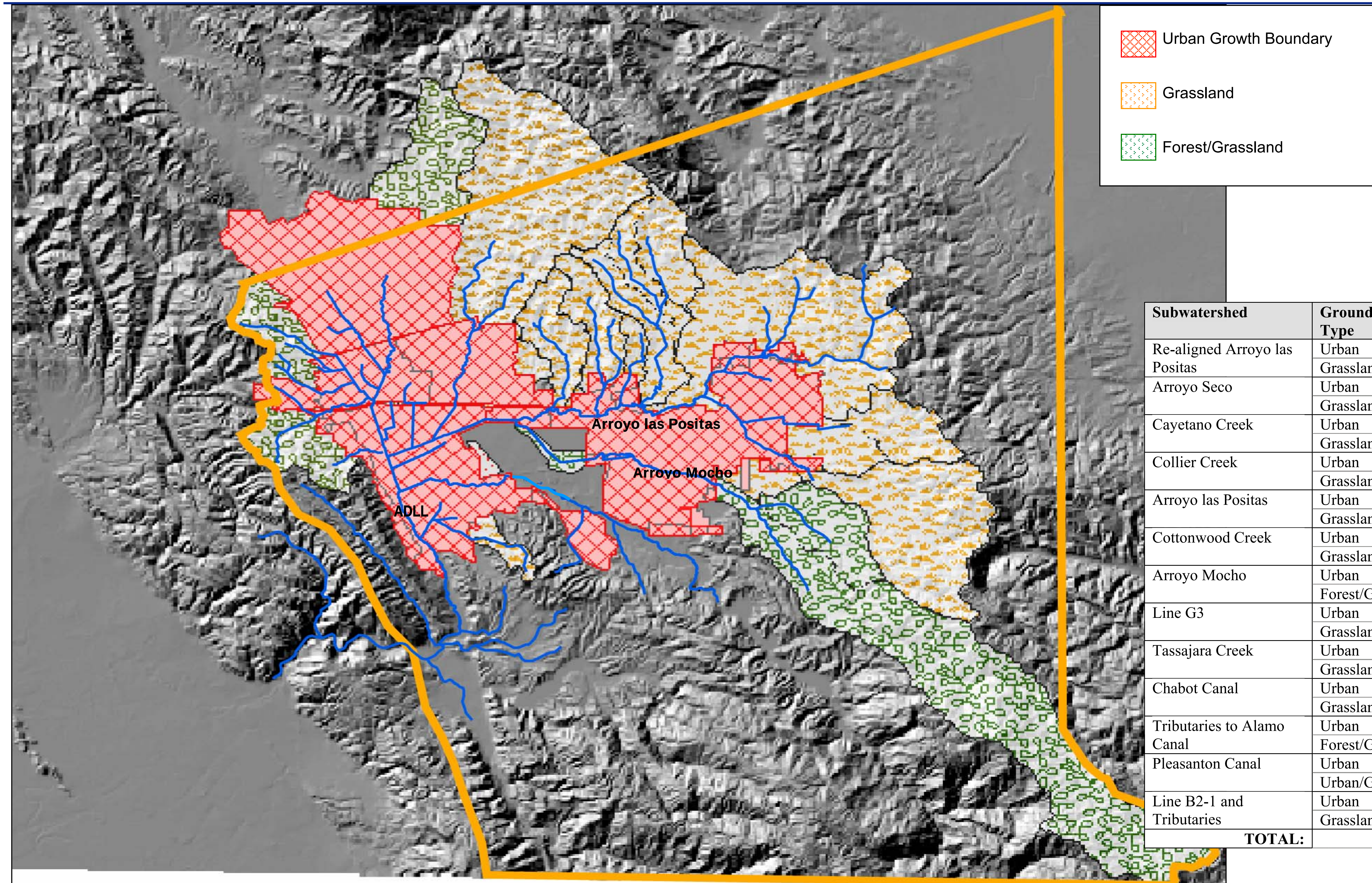
Flood frequency curves were plotted to answer the first question. Flows during a 100, 15, and 2-year events were plotted against their respective exceedance probabilities (Schaaf & Wheeler, 1997). A line of best fit was then drawn and used to determine the exceedance probability for the existing channel capacities of Arroyo las Positas and Arroyo Mocho. These flood frequency curves are shown in Appendix D. The Arroyo las Positas reach along Las Positas Golf Course has a current capacity of 1,800 cfs (West Yost & Associates, March 2002). Based on its flood frequency curve, this reach can accommodate flows up to a 3-year event. The Arroyo Mocho reach through the Chain of Lakes has a current capacity of 900 cfs (West Yost & Associates, March 2002). Based on its flood frequency curve, this reach can accommodate flows up to a 4-year event. Accounting for remaining freeboard in the channels, it was assumed that bank overtopping would occur at or above a 5-year event for both channels at these locations.

Data from a U.S. Geological Service (USGS) suspended sediment gage was obtained to determine the mass of sediment carried in a 5-year event. The only suspended sediment gage in the watershed is located at Alameda Creek near Niles Canyon, downstream of the confluence with ADLL (USGS Station ID 11179000). Available data includes daily mean stream flow discharge (cfs), daily mean suspended sediment concentration (mg/L), and daily mean suspended sediment discharge (tons/day) for a fourteen-year period of record (1959 to 1973). The range of mean daily flows obtained was divided into class intervals. The number of observations (frequency) corresponding to each class interval was then tabulated. Flows representing a 5-year storm event or greater ranged from 3,820 cfs to 7,890 cfs. From the suspended sediment load (tons/day) data, it was determined that over a fourteen year period of record, 27% of the total suspended sediment load was due to storms equal to or greater than a 5-year event. This percentage is an average annual amount over a long period of time and was applied to flows through Arroyo las Positas and Arroyo Mocho. It was therefore assumed that 27% of the sediment reaching Arroyo las Positas at Las Positas Golf Course and Arroyo Mocho at the Chain of Lakes would be deposited on the floodplain on any one year. In this case, the sediment input will be the eroded soils from overland areas, while the sediment sink will be the 27% being deposited on the floodplain. The resulting suspended sediment yield will equal the input minus the sinks. Suspended sediment input, sink estimates, and resulting suspended sediment yield for this scenario are shown in Appendix C and summarized in Table 3.



Sub-watershed Name	**Area (miles^2)**
Re-aligned Arroyo las Positas	8.91
Arroyo Seco	14.62
Cayetano Creek	11.02
Collier Creek	4.75
Cottonwood Creek	4.33
Arroyo las Positas	37.80
Line G3	3.73
Tassajara Creek	27.06
Chabot Canal	5.25
Arroyo Mocho	39.13
Tributaries to Alamo Canal	43.48
Pleasanton Canal	2.36
Line B2-1 and Tributaries	3.43
TOTAL AREA:	**206**

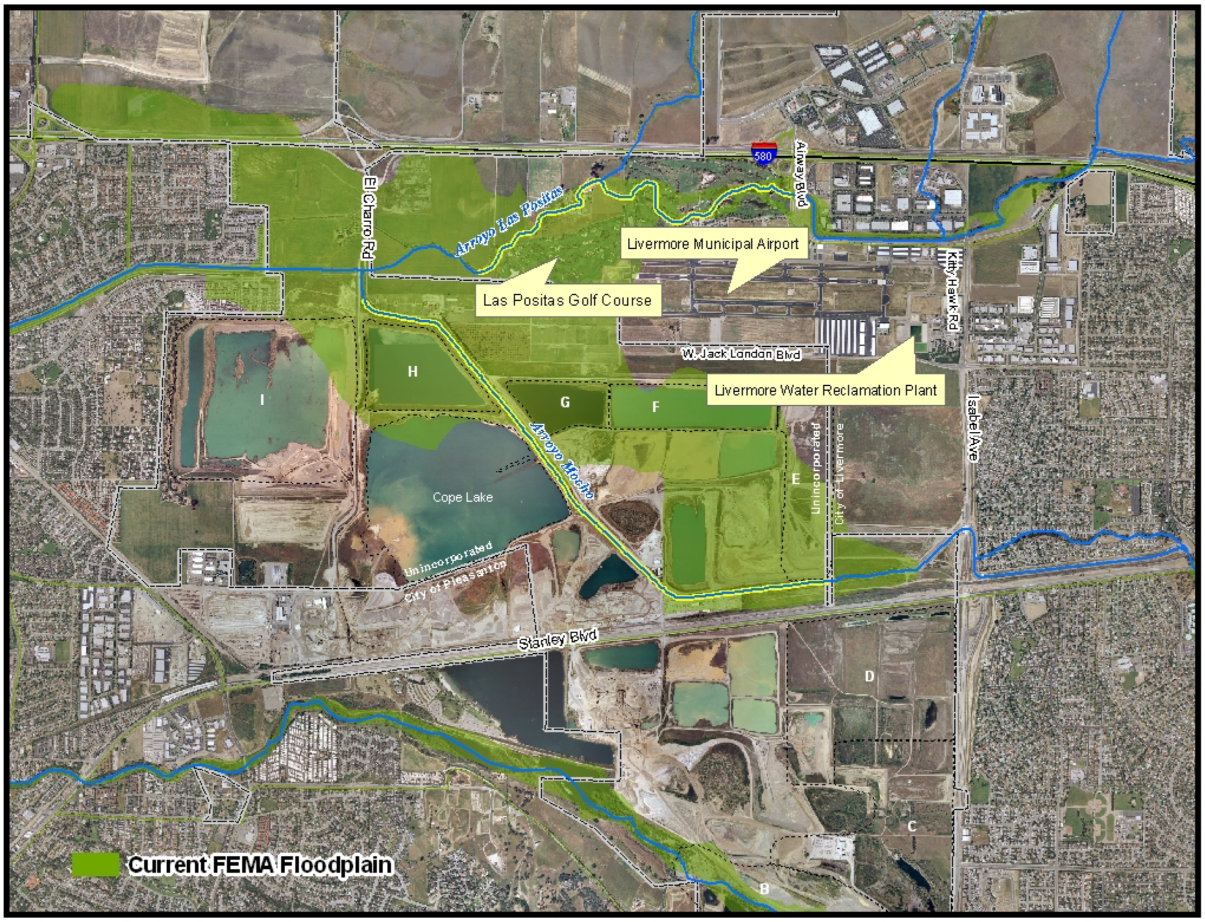
Figure 4: Wash Load Analysis Sub-watersheds



Subwatershed	Ground Cover Type	Sediment Yield (Acre-feet/year)
Re-aligned Arroyo las Positas	Urban	0.44
	Grassland	6.87
Arroyo Seco	Urban	0.20
	Grassland	13.0
Cayetano Creek	Urban	0.0005
	Grassland	10.2
Collier Creek	Urban	0.19
	Grassland	3.8
Arroyo las Positas	Urban	4.0
	Grassland	22.3
Cottonwood Creek	Urban	0.004
	Grassland	4.0
Arroyo Mocho	Urban	0.57
	Forest/Grassland	17.1
Line G3	Urban	0.80
	Grassland	0.90
Tassajara Creek	Urban	0.70
	Grassland	23.0
Chabot Canal	Urban	1.50
	Grassland	0.11
Tributaries to Alamo Canal	Urban	7.70
	Forest/Grassland	7.80
Pleasanton Canal	Urban	0.57
	Urban/Grassland	0.24
Line B2-1 and Tributaries	Urban	0.6
	Grassland	1.3
TOTAL:		**128**

Figure 5: Scenario A Sub-watershed Ground Cover Type

Figure 6 – Existing 100-year Flood Plain Around Chain of Lakes



Scenario D assumes full build-out development conditions and existing channel capacities. This scenario would apply if channel improvements were not implemented. As in Scenario C, it was assumed that 27% of suspended sediment loads reaching Arroyo las Positas and Arroyo Mocho would be deposited on the floodplain on any one year. Suspended sediment input, sink estimates, and resulting suspended sediment yield for this scenario are shown in Appendix C and summarized in Table 3.

Scenario E assumes full build-out development conditions and implementation of SMMP Program improvements, as described in the Zone 7 SMMP Phase 1 Interim Report (RMC, 2004). The only SMMP Program improvement likely to affect the watershed's total suspended sediment yield is the regional storage of flood flows at the Chain of Lakes. The proposed detention ponds will trap sediment suspended in waters overtopping the channel banks. However, they will not trap bed material load since this portion of the total sediment load is not transported in suspension and will therefore remain in the channels. Sediment basins were not considered in the wash load analysis since they will not trap sediment suspended in the water column. However, they will trap bed material load and will therefore affect the bed material transport capacity analysis discussed in Section 5 (Bed Material Load Analysis). As in Scenarios C and D, diversion of flows from Arroyo las Positas and Arroyo Mocho into the Chain of Lakes will occur at or above a 5-year event. As a result, it was assumed that the same percentage of suspended sediment (i.e. 27%) would become trapped at the Chain of Lakes on any one year. Suspended sediment input, sink estimates, and resulting suspended sediment yield for this scenario are shown in Appendix C and summarized in Table 3.

4.2 Results

Results of the wash load analysis for all five scenarios are summarized in Table 3 below.

Table 3 – Wash Load Analysis Results for Scenarios A through E

Scenario	Sediment Input (Acre-feet/year)	Sediment Sink (Acre-feet/year)	Sediment Output/Yield (Acre-feet/year)	Assumptions
A	128	0	128	- Future build-out development conditions (urban growth boundary) - Full design channel capacities therefore no flooding around Arroyo las Positas or Arroyo Mocho
B	136	0	136	- Existing development conditions (city boundaries) - Full design channel capacities therefore no flooding around Arroyo las Positas or Arroyo Mocho
C	136	22	114	- Existing development conditions (city boundaries) - Flooding occurs at or above a 5-year storm event - 27% of suspended sediment load settles on floodplain at any one given year
D	128	21	107	- Future build-out development conditions (urban growth boundary) - Flooding occurs at or above a 5-year storm

Scenario	Sediment Input (Acre-feet/year)	Sediment Sink (Acre-feet/year)	Sediment Output/Yield (Acre-feet/year)	Assumptions
				event - 27% of suspended sediment load settles on floodplain at any one given year
E	128	21	107	- Future build-out development conditions (urban growth boundary) - Diversion of flows into the Chain of Lakes occurs at or above a 5-year storm event - 27% of suspended sediment load settles in detention ponds

A summary table of suspended sediment yields in acre-feet per year, cubic yards per year, tons per year, and tons per acre per year is given in Table 4 below. The PSIAC method calculates sediment yield as a volumetric load rate. However, the volumetric load can be converted to a mass load by assuming a suspended sediment density equal to that of uniform inorganic silt (0.0495 tons/ft^3 or 99 lbs/ft^3) (Lambe and Whitman, 1969).

Table 4 – Wash Load Analysis Results Expressed as Volumetric and Mass Load Rates

Scenario	Sediment Output/Yield (AF/year)	Sediment Output/Yield ($yards^3$/year)	Sediment Output/Yield (tons/year)	Sediment Output/Yield[1] (tons/acre-year)
A - (Full Build-Out + Full Channel Conveyance Capacity)	128	206,000	275,500	2.09
B - (Existing Develop. + Full Channel Conveyance Capacity)	136	212,000	283,300	2.15
C - (Exist. Develop. + Exist. Channel Conveyance Capacity)	114	184,000	246,100	1.87
D - (Full Build-Out + Exist. Channel Conveyance Capacity)	107	172,000	229,700	1.74
E - (Full Build-Out + SMMP Improvements)	107	172,000	229,700	1.74
[1] Based on a total surface area of 206 square miles.				

Urbanization tends to increase runoff and decrease sediment yield since the area of ground cover types with the highest sediment yield rates (i.e. grasslands and urban/grasslands) decreases and is replaced by ground cover types with low erosion potential. This explains the decrease in sediment yield for Scenario B, when compared to Scenario A, or for Scenario D, when compared to Scenario C. In addition, floodplains act as a sediment sink since suspended sediment is carried in waters overtopping channel banks and is then deposited on the adjacent lands. In Scenario A and B, it was assumed that the channels had sufficient capacity to convey the 100-year rainfall event flows and the sediment suspended in those flows. As a result, scenarios A and B have higher sediment yields exiting the watershed when compared to scenarios C and D. The suspended sediment yield in Scenario E equals that of Scenario D. Both scenarios share the same development and channel design conditions. However, in Scenario E, the suspended sediment is being concentrated in the storage ponds at the Chain of Lakes instead of being allowed to settle on the adjacent floodplains. From a sediment yield perspective, the Chain of Lakes regional storage solution provides a controlled environment to manage suspended sediment in the watershed.

The sediment yield from the watershed is considered to be of medium magnitude. Low sediment yields are generally considered to range between 0.41 to 1.21 tons/acre–year (Annandale, 2002). High sediment yields are generally considered to be on the order of 4.05 tons/acre-year or above (Annandale, 2002).

The PSIAC method has been used to quantify sediment yield in various watersheds in the Bay Area including the Pajaro River watershed, spanning parts of Santa Cruz, Monterey, San Benito, and Santa Clara counties (Annandale, 2002) and the Upper Penitencia Creek watershed in eastern Santa Clara Valley (PWA, 2003). Sediment yields from these watersheds and Zone 7 channels have been presented in Table 5 for comparison purposes.

Table 5 – Sediment Yields from Pajaro River and Upper Penitencia Creek Watersheds

	Zone 7 Channels[1]	Pajaro River Watershed[2]	Upper Penitencia Creek Watershed[3]
Sediment Output/Yield (tons/acre-year)	1.74 to 2.15	1.17	2.3 to 3.7

[1] Calculated value, as shown in Table 4.
[2] Annandale, George W. Pajaro River Watershed Study Technical Memorandum No. 1.2.4. Prepared for the Pajaro River Watershed Flood Prevention Authority. February 13, 2002.
[3] Philip Williams & Associates, Ltd. Upper Penitencia Creek Reconnaissance Level Sediment Assessment: Existing Conditions Summary. Prepared for the U.S. Army Corps of Engineers San Francisco District. April 4, 2003.

5 Bed Material Load Analysis

5.1 Methodology

Bed material load is composed of sand and coarser sediment material eroded from the channel banks and bed. The quantity of bed load transported through the channel will depend on the bed load transport capacity of the channel and the sediment supply. A sediment transport capacity relationship was developed by Ayres Associates utilizing regression analysis, the Meyer-Peter and Muller bed load equation, and the Zeller and Fullerton Power Function Relation (Ayres Associates, 2001). The relationship is a function of variables known to influence sediment transport capacity (i.e. channel hydrology, channel geometry, and sediment size and gradation). This relationship is given by:

$$q_t = 0.000157 \frac{Gr^{0.45} V^{3.65}}{D_{50}^{0.61} d^{0.29}}$$

Where q_t = unit width total load transport capacity (cfs/ft)

Gr = gradation coefficient of the bed material = $\frac{1}{2}\left(\frac{D_{84}}{D_{50}} + \frac{D_{50}}{D_{16}}\right)$

V = average velocity (ft/s)

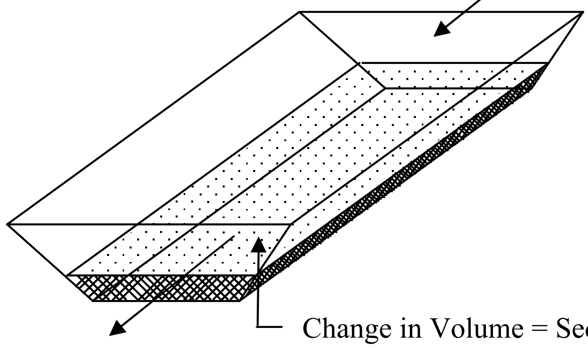
D_{50} = bed material size of which fifty percent of the sediment load by weight is smaller (mm)

d = hydraulic depth (ft)

The sediment transport capacity in units of tons/day can be calculated by multiplying q_t by the water surface top width, number of seconds per day, and bed material average density. The average density used to represent fine to coarse sand was 0.0545 tons per cubic feet or 109 lbs per cubic feet (Lambe and Whitman, 1969).

The vertical adjustment of the channel is due to removal of sediment from the channel bed (degradation) or deposition of sediment on the channel bed (aggradation). The magnitude of adjustment will be based on conservation of mass and will be dependent on the difference between the amount of sediment transported into the reach (supply) and the amount of sediment transported out of the reach (reach capacity). This continuity concept is illustrated in Figure 7 below.

Figure 7 – Bed Material Load Continuity Concept



If the change in bed material volume in the reach is negative (Sediment Outflow > Sediment Inflow), then the reach capacity is greater than the sediment supply. The reach will attain a state of equilibrium (i.e. reach capacity) by supplementing the Sediment Inflow with bank and/or bed material. The reach is therefore degrading or eroding. Conversely, if the change in volume is positive (Sediment Outflow < Sediment Inflow) then the sediment supply is greater than the reach capacity. As a result, the excess sediment is deposited on the channel bed resulting in an aggradating reach. The channel will adjust until a state of static equilibrium is attained (i.e. when the Sediment Inflow equals the Sediment Outflow). Channel adjustments may include changes in gradation of the bed material, changes in cross-sectional area (width and depth), and changes in the channel bed slope. The sediment transport analysis discussed above will evaluate the long-term degradation or aggradation potential of the channel. However, it will not identify the specific channel adjustments resulting from the estimated trend.

Due to data limitations on channel geometric and hydraulic characteristics, only the main channels draining into Arroyo de la Laguna were considered for the analysis (i.e. Arroyo Mocho, Arroyo las Positas, and Alamo Canal). In addition, channel geometric data for the downstream reach of Arroyo las Positas (Reach H-1) is representative of the old channel alignment and does not reflect the latest modifications or upgrades to the reach.

The first step in the continuity analysis was delineation of these channels into a number of reaches. As seen in Figure 8, Arroyo las Positas, Arroyo Mocho, Alamo Canal, and Arroyo de la Laguna were divided into six, thirteen, one, and eight reaches respectively, ranging in length from 1,100 feet (Alamo Canal) to 12,700 feet (Arroyo Mocho). Delineation of these reaches mirrored the reach delineation developed by Ayres Associates and was based on common physical characteristics of the channel including bottom width, slope, and top width. After reach delineation, characteristic geometric and hydraulic information was obtained from Ayres Associates (Ayres Associates, December 2001), Schaaf & Wheeler (Schaaf & Wheeler, June 2000), and West Yost Associates (West Yost Associates, November 2001) for each reach. After establishing representative geometric and hydraulic characteristics, the bed load transport capacity was calculated for each reach. The conservation of mass principle was then applied on a reach-by-reach basis by assuming that the sediment inflow to any given reach was equal to the sediment capacity of the adjacent upstream reach. In order to establish an upstream sediment boundary condition, the upstream reach of all ADLL tributaries (Arroyo Mocho, Arroyo las Positas, and Alamo Canal) was assumed to be in equilibrium (i.e. not aggrading or degrading) and was therefore designated as a supply reach.

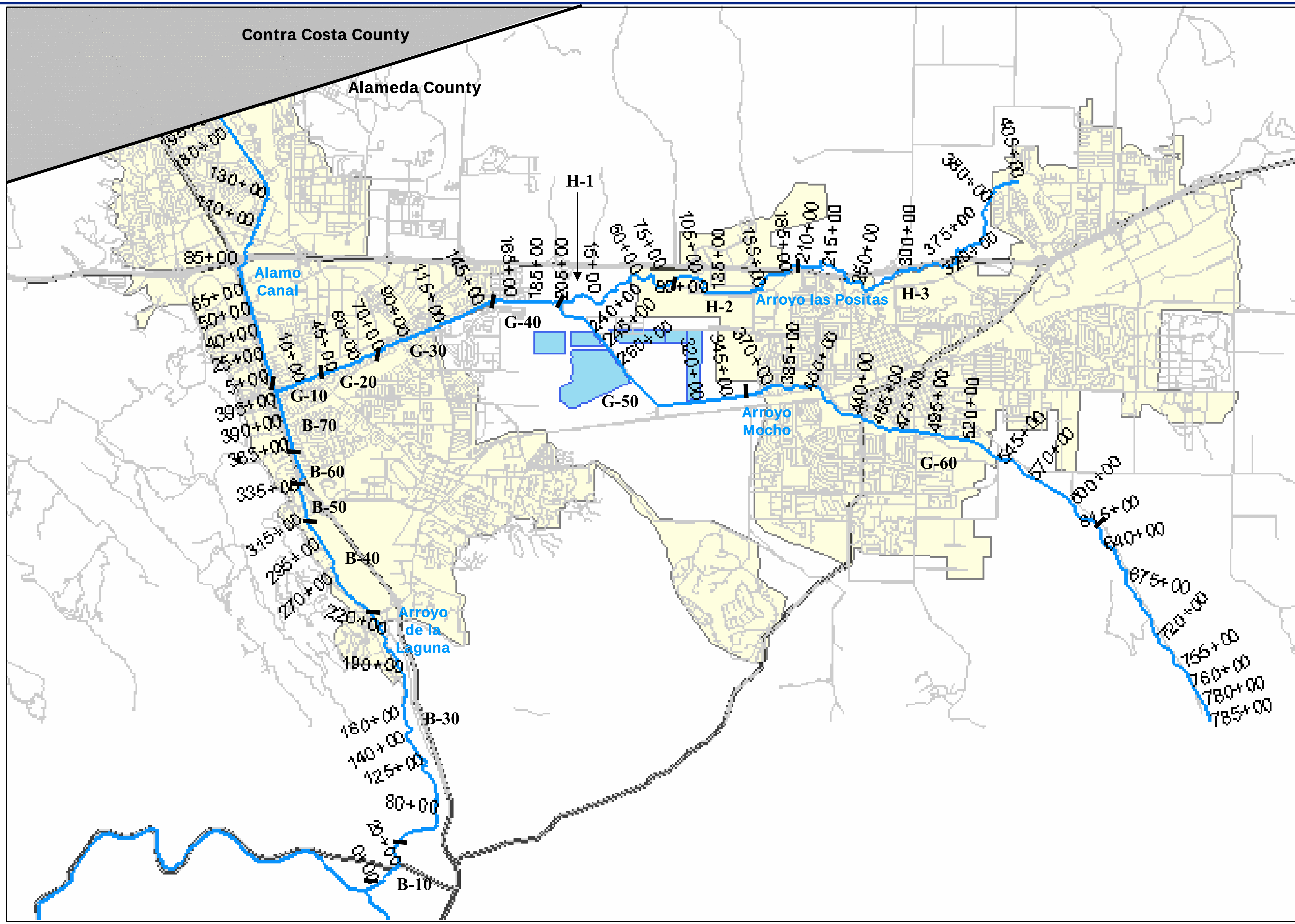


Figure 8: Reach Delineation

5.2 Technical Assumptions

The same five scenarios were again considered based on differing development and channel conditions. The points below describe technical assumptions taken under each scenario. Channels were always assumed to be clean or free of sediment deposition. In addition, channel geometries (bottom width, side slopes, and bed slopes) were obtained from the Ayres Associates report and were assumed to be uniform for all scenarios and in accordance with the 1966 Flood Control Master Plan. Similarly, data on sediment characteristics (gradation and size) was also obtained from the Ayres Associates report and was assumed to be uniform for all five scenarios. Flows for scenarios A and E were obtained from existing modeling conducted by Schaaf & Wheeler and West Yost & Associates. Flows for the remaining scenarios were calculated from interpolation of existing data. Flows for all reaches under each scenario are shown in Appendix E.

- **Scenario A - Full Build-Out Development + Full Channel Conveyance Capacity**
  Data for this scenario was obtained from the Ayres Associates analysis as presented in their report (*Zone 7 Water Agency Geomorphic and Sediment Transport Evaluation*, December 2001). Hydraulic data (i.e. velocity and flow depth) was based on ultimate, full build-out hydrology as presented in Table 1 of Schaaf & Wheeler's draft report (*Zone 7 Special Drainage Area 7-1 Program Update of Channel Improvement Costs, June 2000*). It was assumed that all flow was confined to the channels thereby eliminating bank overtopping or lost of flow to storage on the flood plain. Non-uniform flow was assumed and all channels were assumed to be impacted by backwater conditions during the 100-year rainfall event. Flow depths during the 100-year event were obtained from hydraulic modeling conducted by West Yost & Associates and presented in Table TM5A-5 of TM No. 5 Appendices (*Technical Memorandum No. 5: Task E: Evaluation of Problem Areas & Identification of Solutions Appendices, November 2001*).

  No flooding was predicted during the 2-year rainfall events. As a result, flow in the channels was assumed to be uniform and the normal depth was calculated using Manning's equation.

- **Scenario B – Existing Development + Full Channel Conveyance Capacity**
  Hydraulic data was based on existing hydrology as presented in Table 1 of the December 1997 Schaaf & Wheeler report (*Hydrologic Procedures and Design Discharges*). Again, all flow was assumed to be contained within the channel. Non-uniform flow was assumed and all channels were assumed to be impacted by back-water conditions during the 100-year rainfall event. Flow depths during the 100-year event were calculated from interpolation of depths provided in Table TM5A-5 of TM No. 5 Appendices (*Technical Memorandum No. 5: Task E: Evaluation of Problem Areas & Identification of Solutions Appendices, November 2001*). The flow velocity was calculated by utilizing the continuity relationship (Q=VA).

  No flooding was predicted during the 2-year rainfall events. As a result, flow in the channels was assumed to be uniform and the normal depth was calculated using Manning's equation.

- **Scenario C – Existing Development + Existing Channel Conveyance Capacity**
  In this case, hydraulic data was based on a combination of existing hydrology, as in Scenario B, and existing channel capacities. This scenario assumed that the flood plain was present and resulted in attenuation of peak flows during the 100-year rainfall event. Non-uniform flow was assumed in the downstream end of Arroyo Mocho (Reach G-10) and Arroyo de la Laguna (Reach B-70 to B-10). These reaches were assumed to be impacted by backwater conditions during the 100-year rainfall event. Flow depths during the 100-year event were calculated from interpolation of depths provided in Table TM5A-12 of TM No. 5 Appendices (*Technical Memorandum No. 5: Task E: Evaluation of Problem Areas & Identification of Solutions Appendices, November 2001*). The flow velocity was calculated by utilizing the continuity

relationship (Q=VA). Uniform flow was assumed for reaches not impacted by backwater conditions and depths were calculated using Manning's equation.

No flooding was predicted during the 2-year rainfall events. As a result, flow in the channels was assumed to be uniform and the normal depth was calculated using Manning's equation.

- **Scenario D – Full Build-Out Development + Existing Channel Conveyance Capacity** Hydraulic data was based on a combination of ultimate, full build-out hydrology and existing channel capacities. The flow was not assumed to be contained within the channel. Instead, the floodplain at build-out was assumed to be present to attenuate peak flows. As a result, the downstream end of Arroyo Mocho (Reach G-10) and Arroyo de la Laguna (Reach B-70 to B-10) were assumed to be impacted by backwater conditions during a 100-year rainfall event. Channel flows for these reaches were assumed to be non-uniform and flow depths were based on modeling conducted by West Yost & Associates using a step backwater computational model (HEC-RAS) (*Technical Memorandum No. 5: Task E: Evaluation of Problem Areas & Identification of Solutions Appendices, November 2001*). The flow velocity was calculated by utilizing the continuity relationship (Q=VA). Uniform flow was assumed for remaining reaches (i.e. Arroyo las Positas and most of Arroyo Mocho). Depths and velocities for these reaches were calculated using Manning's equation.

  As in Scenario C, flooding was not predicted to occur during the 2-year rainfall event. As a result, flow in the channels during a 2-year event was assumed to be uniform and the normal depth was calculated using Manning's equation.

- **Scenario E – Full Build-Out Development + Implementation of SMMP Program** Hydraulic data was based on a combination of ultimate, full build-out hydrology and flows resulting from 5,000 acre-feet of storage at the Chain of Lakes during a 100-year rainfall event. This regional storage solution was recommended in Phase 1 of the SMMP Program and is described in more detail in the *Zone 7 SMMP Phase 1 Interim Report* (RMC, March 2004). The purpose of storage at Chain of Lakes is to attenuate peak flows and offset the capacity deficiencies through Arroyo Mocho and Arroyo las Positas. The flow was still assumed to be non-uniform at the downstream end of Arroyo Mocho (Reach G-10) and Arroyo de la Laguna. Backwater depths were obtained from Table TM5A-23 of the West Yost & Associates' TM No. 5 Appendices. The flow velocity was calculated by utilizing the continuity relationship (Q=VA). Uniform flow was assumed for remaining reaches (i.e. Arroyo las Positas and most of Arroyo Mocho). Depths and velocities for these reaches were calculated using Manning's equation.

  Flooding was not predicted to occur during the 2-year storm events. As a result, flow in the channels during a 2-year event was assumed to be uniform and the normal depth was calculated using Manning's equation.

Results of the bed material load transport analysis will be reviewed as part of *Subtask 1.4: SMMP Project Refinement* to determine the adequacy of recommended sediment basins. The Zone 7 SMMP Phase 1 Interim Report proposed construction of in-stream sediment basins at aggradational reaches along Arroyo las Positas (near Airway Boulevard), Arroyo Mocho (at Robertson Park, near Stanley Boulevard, and downstream of the confluence with Tassajara Creek), and Alamo Canal (near the confluence with Arroyo Mocho). Location and size of these sediment basins was determined from field observations and was therefore based on existing development conditions and channel conveyance capacities. An analysis of the adequacy of proposed sediment basins and recommended changes to the location and size of those basins will be conducted as part of *Subtask 1.4: SMMP Project Refinement* activities.

A summary of assumptions taken under each scenario is shown in Table 6.

Table 6 – Summary of Technical Assumptions Taken for Bed Load Transport Analysis

Scenario	Development Conditions	Channel Condition	References for data on:			Assumptions	
			Channel Geometry (Bottom Width, Side Slope, Bed Slope)	**Sediment Characteristics**	**Hydrology**	**Hydraulic Analysis (Velocity and Flow Depth)**	
A	Full Build-Out	Full Conveyance Capacity	Ayres Associates, 2001	Ayres Associates, 2001	Table 1 Schaaf & Wheeler (June 2000) Table TM5A-5 of West Yost & Associates, November 2001	2-year: Manning's Equation (uniform flow at normal depth) 100-year: Continuity Relationship (non-uniform flow impacted by backwater condition. Flow depth obtained from Table TM5A-5 of West Yost & Associates, November 2001)	• All flow is confined to channels. There is no bank overtopping or flow lost to storage on flood plain. • Channels impacted by backwater conditions during 100-year storm event. Non-uniform flow along channels during 100-year storm event. • Channels flowing at normal depth during 2-year storm event. Uniform flow along channels during 2-year storm event.
B	Existing	Full Conveyance Capacity	Ayres Associates, 2001	Ayres Associates, 2001	Table 1, Schaaf & Wheeler (December 1997) Table TM5A-5 of West Yost & Associates, November 2001	2-year: Manning's Equation (uniform flow at normal depth) 100-year: Continuity Relationship (non-uniform flow impacted by backwater condition. Flow depth calculated by interpolation from Table TM5A-5 of West Yost & Associates, November 2001)	• All flow is confined to channels. There is no bank overtopping or flow lost to storage on flood plain. • Channels impacted by backwater conditions during 100-year storm event. Non-uniform flow along channels during 100-year storm event. • Channels flowing at normal depth during 2-year storm event. Uniform flow along channels during 2-year storm event.
C	Existing	Existing Conveyance Capacity	Ayres Associates, 2001	Ayres Associates, 2001	Table 1, Schaaf & Wheeler (December 1997) Figure 4.2, RMC Interim Report (March 2004)	2-year: Manning's Equation (uniform flow at normal depth) 100-year: Continuity Relationship (non-uniform flow impacted by backwater condition for Reach G-10 on Arroyo Mocho and all reaches along Arroyo de la Laguna. Flow depth calculated by interpolation from Table TM5A-12 of West Yost & Associates, November 2001).	• Bank overtopping occurs resulting in storage of flows on current flood plain. • Reach G-10 on Arroyo Mocho and all reaches along Arroyo de la Laguna impacted by backwater conditions during 100-year storm event. Non-uniform flow along these reaches during 100-year storm event. • Remaining channels flowing at normal depth during a 100-year storm event. • Channels flowing at normal depth during 2-year storm event. Uniform flow along channels during 2-year storm event.
D	Full Build-Out	Existing Conveyance Capacity	Ayres Associates, 2001	Ayres Associates, 2001	Table 1 Schaaf & Wheeler (June 2000) Figure 4.2, RMC Interim Report (March 2004)	2-year: Manning's Equation (uniform flow at normal depth) 100-year: Continuity Relationship (non-uniform flow impacted by backwater condition for Reach G-10 on Arroyo Mocho and Arroyo de la Laguna. Flow depth obtained from West Yost & Associates, November 2001)	• Bank overtopping occurs resulting in storage of flows on ultimate, full build-out flood plain. • Reach G-10 on Arroyo Mocho and Arroyo de la Laguna impacted by backwater conditions during 100-year storm event. Non-uniform flow along these reaches during 100-year storm event. • Remaining channels flowing at normal depth during a 100-year storm event. • Channels flowing at normal depth during 2-year storm event. Uniform flow along channels during 2-year storm event.
E	Full Build-Out	Implementation of SMMP Program	Ayres Associates, 2001	Ayres Associates, 2001	Table TM5A-27, West Yost & Associates (November 2001)	2-year: Manning's Equation (uniform flow at normal depth) 100-year: Continuity Relationship (non-uniform flow impacted by backwater condition for Reach G-10 on Arroyo Mocho and Arroyo de la Laguna. Flow depth obtained from West Yost & Associates, November 2001)	• Bank overtopping occurs resulting in diversion of 5,000 acre-feet of storage at Chain of Lakes during 100-year storm event. • Reach G-10 on Arroyo Mocho and Arroyo de la Laguna impacted by backwater conditions during 100-year storm event. Non-uniform flow along these reaches during 100-year storm event. • Remaining channels flowing at normal depth during a 100-year storm event. • Channels flowing at normal depth during 2-year storm event. Uniform flow along channels during 2-year storm event.

5.3 Results

The bed load transport calculations and results for all five scenarios are shown in Appendix E. As previously discussed, the purpose of this sediment balance task is to answer three questions:

1. What is the sediment yield today?
2. What will be the sediment yield at full build-out development conditions if recommended channel improvements are not implemented?
3. What will be the sediment yield at full build-out development conditions if recommended SMMP improvements are implemented?

In order to answer these questions, the discussion on bed load transport results is focused on Scenarios C, D, and E. Results for Scenarios A and B are shown in Appendix E.

Scenario C – Existing Development + Existing Channel Conveyance Capacity

Results of the reach-based bed load transport analysis for Scenario C are summarized in Table 7 and illustrated in Figure 9. A plus (+) sign indicates aggradation whereas a negative (-) sign indicates degradation. Calculations performed and results are shown in Appendix E.

Table 7 – Scenario C Bed Load Transport Analysis Results

Line	Reach	US Station	DS Station	Sediment Imbalance 2-year Event (yards^3/event)	Sediment Imbalance 100-year Event (yards^3/event)
Arroyo las Positas (Line H)	H-3	227+00	208+00	Upstream Sediment Boundary Condition	Upstream Sediment Boundary Condition
	H-2	208+00	92+00	+1,400	+69,000
	H-1	92+00	0+00	-13,000	-110,000
Arroyo Mocho (Line G)	G-60	620+00	552+00	Upstream Sediment Boundary Condition	Upstream Sediment Boundary Condition
	G-60	552+00	350+00	+140	+9,700
	G-50	350+00	176+86	-200	+47,000
	G-40	173+50	150+00	+9,100	+75,000
	G-30	150+00	70+00	+4,500	+35,000
	G-20	70+00	40+00	+490	-970
	G-10	40+00	0+00	-450	-980
Alamo Canal (Line F)	F-10	11+00	0	Upstream Sediment Boundary Condition	Upstream Sediment Boundary Condition
Arroyo de la Laguna (Line B)	B-70	392+00	373+00	-68,000	+16,000
	B-60	373+00	335+00	+3,800	+4,100
	B-50	335+00	307+90	+53,000	-8,800
	B-40	307+90	238+20	+6,900	-58,000
	B-30	238+20	32+25	-4,200	-29,000
	B-10	32+25	2+00	-12,000	-170,000

Line H (Arroyo las Positas)

In accordance with the analysis conducted by Ayres and Associates, Reach H-3 (station 227+00 to 208+00) was selected to be the upstream sediment boundary condition. It was therefore assumed to be geomorphically stable so that the sediment delivered from it would, over the long term, equal its sediment transport capacity. Reach H-2 (station 208+00 to 92+00) results indicate that this is a general area of sediment aggradation with approximately 1,400 cubic yards of sediment being deposited during a 2-year rainfall event over 11,600 feet of channel running along Airway Boulevard and through the Las Positas Golf Course. Results for the downstream reach of Arroyo las Positas (Reach H-1, from station 92+00 to 0+00) indicate a degradational reach possibly due to the sudden contraction of the channel from 28 feet immediately upstream (Reach H-2) to 10 feet at Reach H-1. The largest sediment imbalance occurs at the downstream reach (Reach H-1, from station 35+00 to 0+00) with -12,000 cubic yards of sediment being eroded from the channel during a 2-year event. These results are consistent with field observations as identified in the *Zone 7 SMMP Phase 1 Interim Report* (RMC, March 2004) including recorded sedimentation occurring downstream of the Interstate 580 crossing and along Airway Boulevard.

Line G (Arroyo Mocho)

Reach G-60 (station 620+00 to 552+00) was selected to be the upstream sediment boundary condition. Results for Reach G-60 (station 620+00 to 350+00) show a general zone of channel aggradation. The stretch of Arroyo Mocho between Wente Street and Stanley Boulevard (Reach G-60, from station 552+00 to 350+00) is generally aggrading with 180 cubic yards of sediment being deposited during a 2-year event. Aggradation is most severe between stations 425+00 and 410+00 (from the Holmes Street crossing to the Stanley Boulevard crossing), with 1,200 cubic yards being deposited along the 1,500-foot stretch of Line G-60. Degradation occurs immediately downstream (Reach G-60, from station 410+00 to 350+00), with 910 cubic yards being eroded from the channel during a 2-year event. However, overall, Reach G-60 remains a slightly aggradational reach. Results indicate an area of degradation along Arroyo Mocho at Reach G-50 (station 350+00 to 176+86) with an estimated 200 cubic yards of sediment being degraded along approximately 17,300 feet of channel during a 2-year event. However, the sediment carrying capacity of Reach G-50 increases with higher flows during larger magnitudes events. As a result, this reach becomes aggradational with approximately 47,000 cubic yards of sediment being deposited during a 100-year rainfall event.

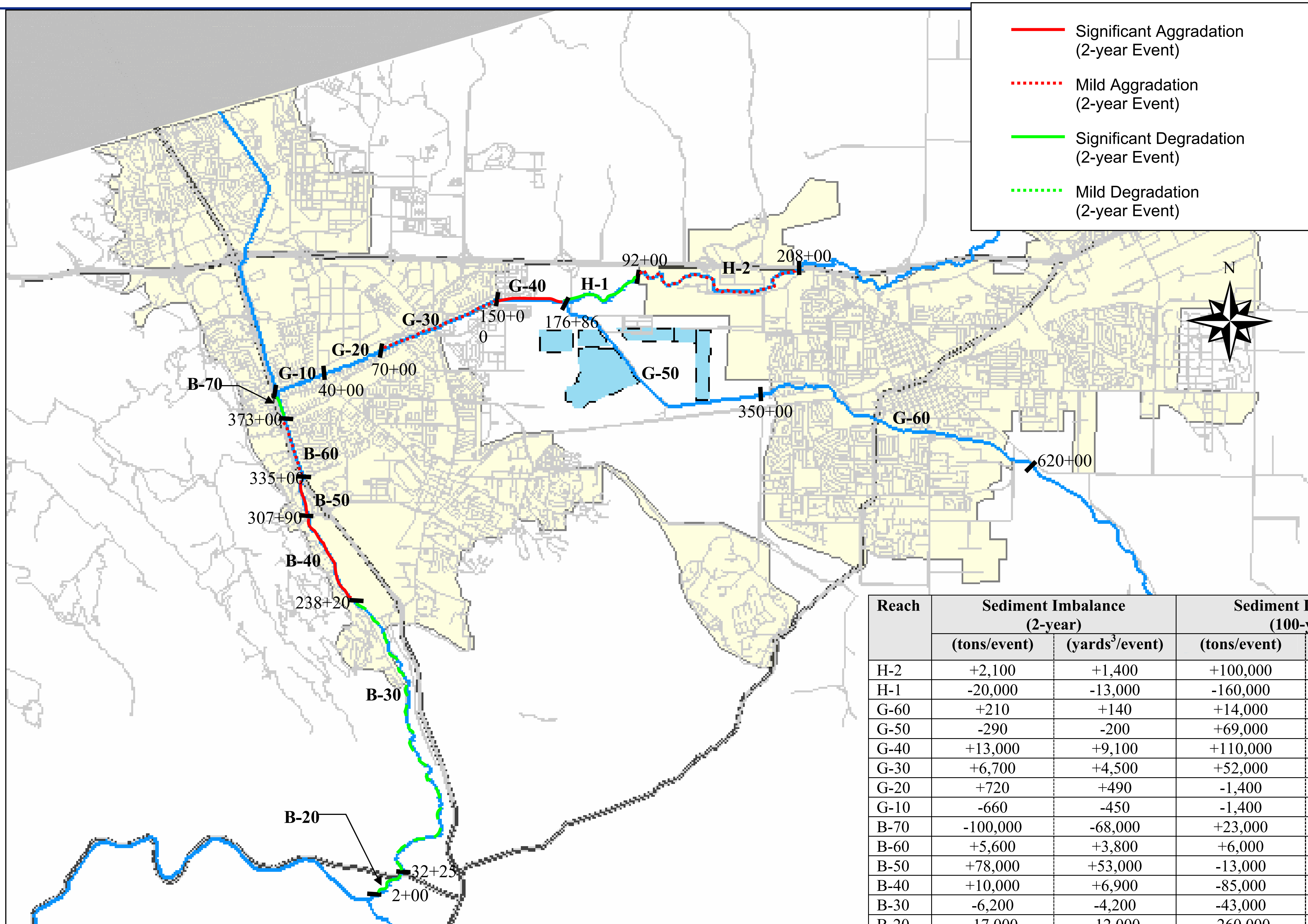
Results for the remaining reaches in Arroyo Mocho indicate general aggradation with severe aggradation occurring just downstream of the confluence with Arroyo las Positas (Reach G-40). Mild channel degradation occurs at the downstream reach of Arroyo Mocho (Reach G-10) with -450 cubic yards of sediment being eroded along 4,000 feet of channel during a 2-year event.

Line F (Alamo Canal)

Information on sediment size and channel geometry for Alamo Canal was limited to the reach immediately upstream of the confluence with Arroyo Mocho. As a result, this reach was assumed to be stable so that the sediment delivered to Arroyo de la Laguna was equal to its sediment transport capacity.

Line B (Arroyo de la Laguna)

For a 2-year event, results indicate channel degradation at the upstream reach of Arroyo de la Laguna (Reach B-70), followed by channel aggradation for the middle reaches (Reach B-60, B-50, and B-40) and channel degradation for the downstream reaches (Reach B-30 and B-10). These results are consistent with field observations, in particular the observed severe bank erosion occurring in the downstream portions of ADLL, near Verona Bridge at station 195+00, or Reach B-30. A total of 12,000 cubic yards of bed load material is estimated to exit Arroyo de la Laguna during a 2-year event. This figure increases to 170,000 cubic yards during a 100-year rainfall event.



Reach	Sediment Imbalance (2-year)		Sediment Imbalance (100-year)	
	(tons/event)	(yards^3/event)	(tons/event)	(yards^3/event)
H-2	+2,100	+1,400	+100,000	+69,000
H-1	-20,000	-13,000	-160,000	-110,000
G-60	+210	+140	+14,000	+9,700
G-50	-290	-200	+69,000	+47,000
G-40	+13,000	+9,100	+110,000	+75,000
G-30	+6,700	+4,500	+52,000	+35,000
G-20	+720	+490	-1,400	-970
G-10	-660	-450	-1,400	-980
B-70	-100,000	-68,000	+23,000	+16,000
B-60	+5,600	+3,800	+6,000	+4,100
B-50	+78,000	+53,000	-13,000	-8,800
B-40	+10,000	+6,900	-85,000	-58,000
B-30	-6,200	-4,200	-43,000	-29,000
B-20	-17,000	-12,000	-260,000	-170,000

Figure 9: Scenario C Bed Load Transport Analysis

Scenario D – Full Build-Out Development + Existing Channel Conveyance Capacity

Results of the reach-based bed load transport analysis for Scenario D are summarized in Table 8 and illustrated in Figure 10. Calculations performed and results are shown in Appendix E.

Table 8 – Scenario D Bed Load Transport Analysis Results

Line	Reach	US Station	DS Station	Sediment Imbalance 2-year Event (yards^3/event)	Sediment Imbalance 100-year Event (yards^3/event)
Arroyo las Positas (Line H)	H-3	227+00	208+00	Upstream Sediment Boundary Condition	Upstream Sediment Boundary Condition
	H-2	208+00	92+00	+3,000	+77,000
	H-1	92+00	0+00	-28,000	-110,000
Arroyo Mocho (Line G)	G-60	620+00	552+00	Upstream Sediment Boundary Condition	Upstream Sediment Boundary Condition
	G-60	552+00	350+00	+230	+10,000
	G-50	350+00	176+86	-52	+50,000
	G-40	173+50	150+00	+21,000	+75,000
	G-30	150+00	70+00	+7,600	+35,000
	G-20	70+00	40+00	+800	-970
	G-10	40+00	0+00	-740	+4,800
Alamo Canal (Line F)	F-10	11+00	0	Upstream Sediment Boundary Condition	Upstream Sediment Boundary Condition
Arroyo de la Laguna (Line B)	B-70	392+00	373+00	-100,000	+17,000
	B-60	373+00	335+00	+5,600	+540
	B-50	335+00	307+90	+78,000	-11,000
	B-40	307+90	238+20	+10,000	-57,000
	B-30	238+20	32+25	-6,300	-48,000
	B-10	32+25	2+00	-18,000	-120,000

Line H (Arroyo las Positas)

Reach H-3 (station 227+00 to 208+00) was selected to be the upstream sediment boundary condition. Reach H-2 (station 208+00 to 92+00) results indicate that this is a general area of sediment aggradation with approximately 3,000 cubic yards of sediment being deposited during a 2-year rainfall event over 11,600 feet of channel running along Airway Boulevard and through the Las Positas Golf Course. Results for the downstream reach of Arroyo las Positas (Reach H-1, from station 92+00 to 0+00) indicate a degradational reach again due to the sudden contraction of the channel from 28 feet immediately upstream (Reach H-2) to 10 feet at Reach H-1. As in Scenario C, the largest sediment imbalance occurs at the downstream reach (Reach H-1, from station 35+00 to 0+00) with -25,000 cubic yards of sediment being eroded from the channel during a 2-year event. This may be due to the sudden expansion of the channel from 10 feet immediately upstream (Reach H-1, from station 92+00 to 35+00) to 30 feet at Reach H-1 (station 35+00 to 0+00). The sudden channel expansion increases the sediment carrying capacity of the stream. However, because of the constriction upstream, not enough sediment is being delivered and the channel compensates by eroding from its banks or bed. These results are consistent with field observations as identified in the *Zone 7 SMMP Phase 1 Interim Report* (RMC, March 2004) including recorded sedimentation occurring downstream of the Interstate 580 crossing and along Airway Boulevard.

Line G (Arroyo Mocho)

Reach G-60 (station 620+00 to 552+00) was selected to be the upstream sediment boundary condition. Results for Reach G-60 (station 620+00 to 350+00) show a general zone of channel aggradation. As in Scenario C, the stretch of Arroyo Mocho between Wente Street and Stanley Boulevard (Reach G-60, from station 552+00 to 350+00) is generally aggrading with 230 cubic yards of sediment being deposited during a 2-year event. Aggradation is most severe between stations 425+00 and 410+00 (from the Holmes Street crossing to the Stanley Boulevard crossing), with 1,800 cubic yards being deposited along the 1,500-foot stretch of Line G-60. Degradation occurs immediately downstream (Reach G-60, from station 410+00 to 350+00), with 1,400 cubic yards being eroded from the channel during a 2-year event. However, overall, Reach G-60 remains a slightly aggradational reach. Results indicate a stable reach along Arroyo Mocho at Reach G-50 (station 350+00 to 176+86) with an estimated 52 cubic yards of sediment being degraded along approximately 17,300 feet of channel during a 2-year event. However, the sediment carrying capacity of Reach G-50 increases with higher flows during larger magnitudes events. As a result, this reach becomes less stable with aggradation occurring during a 100-year event.

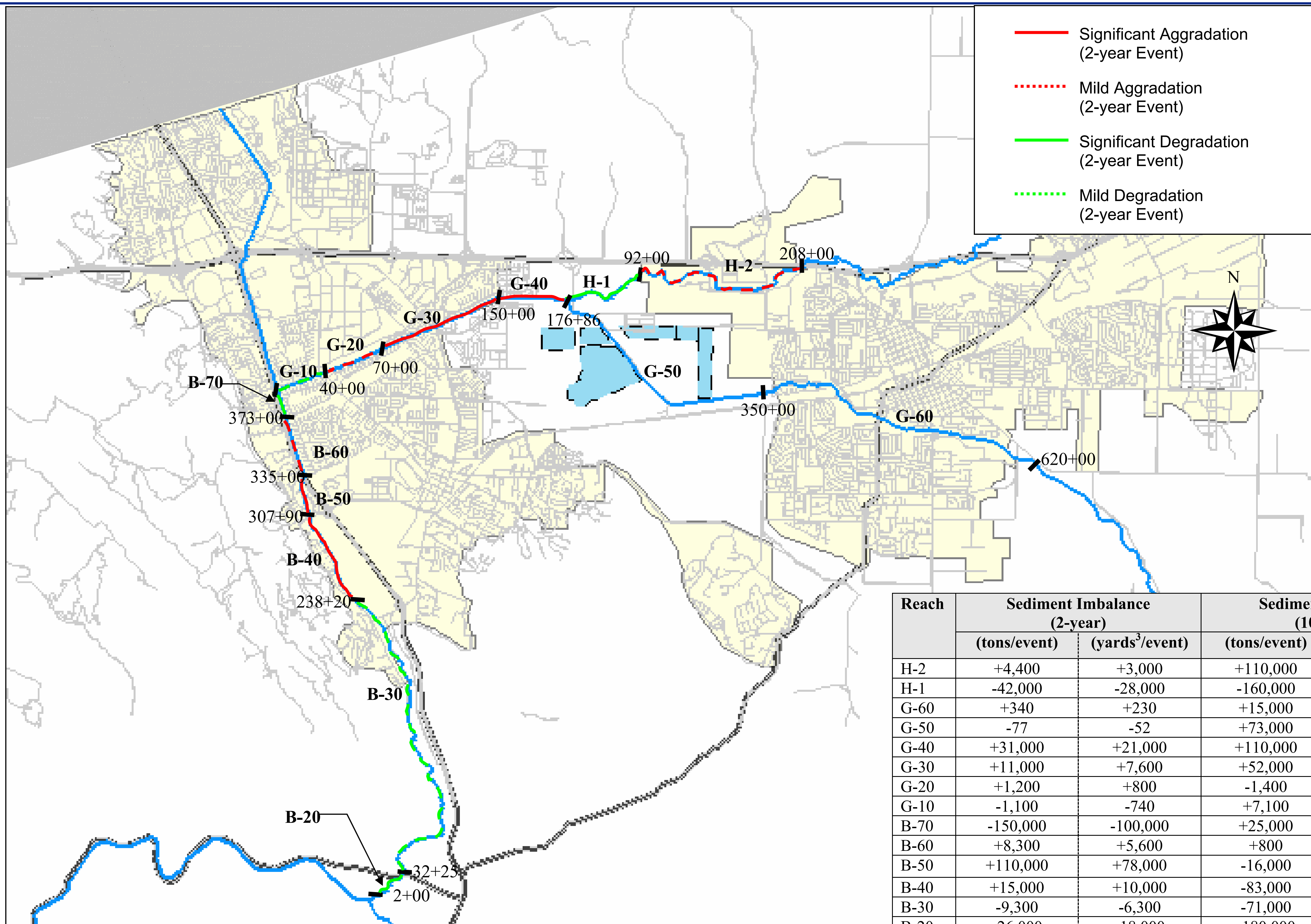
Results for the remaining reaches in Arroyo Mocho indicate general aggradation with severe aggradation occurring just downstream of the confluence with Arroyo las Positas (Reach G-40). Mild channel degradation occurs at the downstream reach of Arroyo Mocho (Reach G-10) with 740 cubic yards of sediment being eroded along 4,000 feet of channel during a 2-year event. In contrast to results for Scenario C, this reach becomes aggradational with an increase in flows. As seen in Appendix E, the backwater depth for this reach under Scenario D is 18.68 feet, compared to a depth of 15.31 feet under Scenario C. This increase in depth is due to higher flows in ADLL for Scenario D, which are affected by backwater conditions. The higher depth in Scenario D translates to an increased sediment carrying capacity when compared to that of Scenario C.

Line F (Alamo Canal)

Information on sediment size and channel geometry for Alamo Canal was limited to the reach immediately upstream of the confluence with Arroyo Mocho. As a result, this reach was assumed to be stable so that the sediment delivered to Arroyo de la Laguna was equal to its sediment transport capacity.

Line B (Arroyo de la Laguna)

For a 2-year event, results indicate channel degradation at the upstream reach of Arroyo de la Laguna (Reach B-70), followed by channel aggradation for the middle reaches (Reach B-60, B-50, and B-40) and channel degradation for the downstream reaches (Reach B-30 and B-10). These results are consistent with field observations, in particular the observed severe bank erosion occurring in the downstream portions of ADLL, near Verona Bridge at station 195+00, or Reach B-30. A total of 18,000 cubic yards of bed load material is estimated to exit Arroyo de la Laguna during a 2-year event. This figure increases to 120,000 cubic yards during a 100-year rainfall event.



Reach	Sediment Imbalance (2-year)		Sediment Imbalance (100-year)	
	(tons/event)	(yards³/event)	(tons/event)	(yards³/event)
H-2	+4,400	+3,000	+110,000	+77,000
H-1	-42,000	-28,000	-160,000	-110,000
G-60	+340	+230	+15,000	+10,000
G-50	-77	-52	+73,000	+50,000
G-40	+31,000	+21,000	+110,000	+75,000
G-30	+11,000	+7,600	+52,000	+35,000
G-20	+1,200	+800	-1,400	-970
G-10	-1,100	-740	+7,100	+4,800
B-70	-150,000	-100,000	+25,000	+17,000
B-60	+8,300	+5,600	+800	+540
B-50	+110,000	+78,000	-16,000	-11,000
B-40	+15,000	+10,000	-83,000	-57,000
B-30	-9,300	-6,300	-71,000	-48,000
B-20	-26,000	-18,000	-180,000	-120,000

Figure 10: Scenario D Bedload Transport Analysis

Scenario E – Full Build-Out Development + Implementation of SMMP Program

The Zone 7 SMMP Interim Report proposed construction of in-stream sediment basins at several identified aggradational reaches along Arroyo las Positas, Arroyo Mocho, and Alamo Canal. Table 9 below summarizes the location and size of these sediment basins. These were derived from field observations and are therefore based on existing development conditions and channel conveyance capacities.

Table 9 – Location and Size of Sediment Basins Proposed in Zone 7 SMMP Interim Report

Project No.	Reach	US Station	DS Station	Location	Size (acre-feet)
R.5-3	H-2	195+00	155+00	North of I-580 & downstream of confluence with Cayetano Creek	2.8
R.5-3	H-1	95+00	55+00	Downstream of confluence with Cayetano Creek	2.8
R.3-2	G-60	547+00	536+00	Robertson Park	16
R.3-6	G-60	390+00	360+00	Along Arroyo Mocho	7.35
R.9-7	F-10	0+00	5+00	Upstream of Interstate 580 crossing	1.84

An analysis of the adequacy of the proposed sediment basins was not conducted as part of this study. However, results from the sediment load analysis will be reviewed as part of *Subtask 1.4: SMMP Project Refinement* and recommendations on sediment basin locations, sizes, and maintenance schedule will be developed based on these results. For the purposes of this study, it was assumed that the proposed location and size of the sediment basins as presented in the *Zone 7 SMMP Phase 1 Interim Report* were adequate. The potential volumetric load of bed material to be detained in each sediment basin was assumed to be equal to the basin's volume. In addition, it was assumed that the basins would be drained once a year. The resulting volumetric loads of retained bed material are shown in Table 10 below. Results of the long-term, reach-based bed load transport analysis for Scenario E are also summarized in Table 10 and illustrated in Figure 11. Details of the calculations performed are shown in Appendix E.

Table 10 – Scenario E Bed Load Transport Analysis Results

Line	Reach	US Station	DS Station	Sediment Imbalance 2-year Event (yards^3/event)	Sediment Imbalance 100-year Event (yards^3/event)	Sediment Basin Capacity (yards^3)
Arroyo las Positas (Line H)	H-3	227+00	208+00	Upstream Sediment Boundary Condition	Upstream Sediment Boundary Condition	-
	H-2	208+00	92+00	+3,000	+78,000	4,500
	H-1	92+00	0+00	-28,000	-91,000	4,500
Arroyo Mocho (Line G)	G-60	620+00	552+00	Upstream Sediment Boundary Condition	Upstream Sediment Boundary Condition	-
	G-60	552+00	350+00	+230	+10,000	25,800
	G-50	350+00	176+86	-52	+46,000	-
	G-40	173+50	150+00	+21,000	+60,000	-
	G-30	150+00	70+00	+7,600	+37,000	-
	G-20	70+00	40+00	+800	-850	-

Line	Reach	US Station	DS Station	Sediment Imbalance 2-year Event (yards^3/event)	Sediment Imbalance 100-year Event (yards^3/event)	Sediment Basin Capacity (yards^3)
	G-10	40+00	0+00	-740	+4,800	-
Alamo Canal (Line F)	F-10	11+00	0	Upstream Sediment Boundary Condition		-
Arroyo de la Laguna (Line B)	B-70	392+00	373+00	-100,000	+17,000	-
	B-60	373+00	335+00	+5,600	+580	-
	B-50	335+00	307+90	+78,000	-11,000	-
	B-40	307+90	238+20	+10,000	-58,000	-
	B-30	238+20	32+25	-6.300	-49,000	-
	B-10	32+25	2+00	-18,000	-120,000	-

Line H (Arroyo las Positas)

The upstream reach of Arroyo las Positas (Reach H-3, from station 227+00 to station 208+00) was assumed to be stable so that the sediment delivered from this reach was equal to its sediment transport capacity. Reach H-2 (from station 208+00 to station 92+00) is shown to be aggradating with approximately 3,000 cubic yards of sediment being deposited during a 2-year event from station 208+00 (below I-580, at Airway Boulevard and Rotan Road) to 92+00 (at Las Positas Golf Course). During a 100-year storm event, the sediment transport capacity of reach H-2 (3.31 cfs), from Station 208+00 to 143+00, is greatly reduced compared to the adjacent upstream reach (25.17 cfs), possibly due to lower slope, or greater width of the channel bottom resulting in a reduction in flow velocity (4.82 ft/s vs. 7.97 ft/s upstream). The last reach in Arroyo las Positas (Reach H-1, from station 92+00 to station 0+00) is shown to be degrading. This may be due to the sudden constriction of the channel cross sectional area (490 ft^2 at the upstream reach to 175 ft^2 at Reach H-1 during a 2-year event), resulting in considerably higher flow velocities (2.25 ft/s at the upstream reach compared to 4.83 at Reach H-1) and sediment transport capacities (0.26 cfs at the upstream reach compared to 1.29 cfs at Reach H-1 for a 2-year storm event).

Line G (Arroyo Mocho)

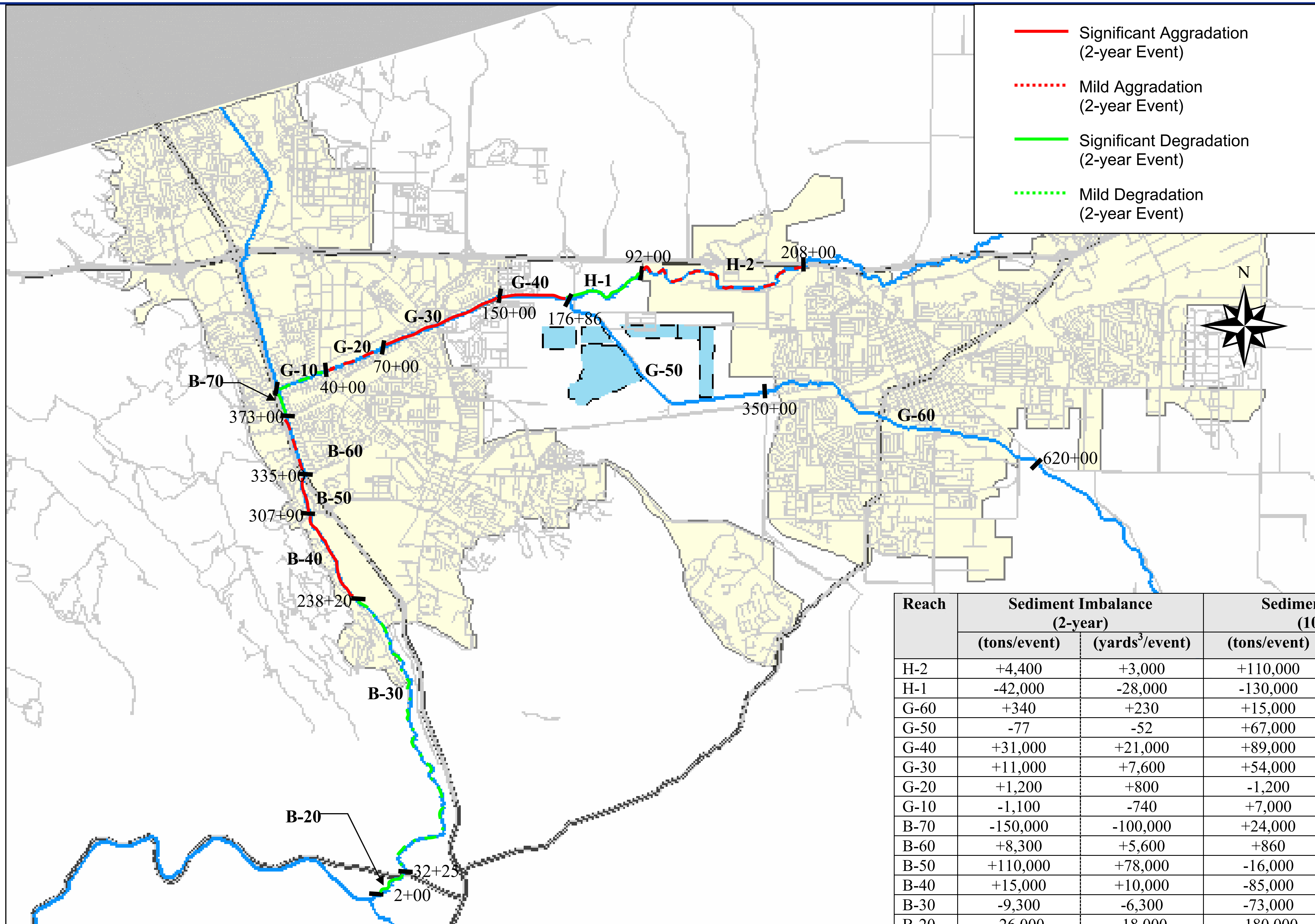
The upstream reach of Arroyo Mocho (Reach G-60, from station 620+00 to station 552+00) was assumed to be stable. As in Scenario D, the stretch of Arroyo Mocho between Wente Street and Stanley Boulevard (Reach G-60, from station 552+00 to 350+00) is generally aggrading with 230 cubic yards of sediment being deposited during a 2-year event. Aggradation is most severe between stations 425+00 and 410+00 (from the Holmes Street crossing to the Stanley Boulevard crossing), with 1,800 cubic yards being deposited along the 1,500-foot stretch of Line G-60. Degradation occurs immediately downstream (Reach G-60, from station 410+00 to 350+00), with 1,400 cubic yards being eroded from the channel during a 2-year event. However, overall, Reach G-60 remains a slightly aggradational reach. The sediment imbalance for the reach immediately upstream of the confluence of Arroyo las Positas and Arroyo Mocho (Reach G-50, from station 210+00 to station 176+86) is almost negligible during a 2-year event (-930 cubic yards over approximately 17,000 feet of channel). The reaches downstream of this confluence are shown to be aggradating except for Reach G10 during a 2-year storm event (station 40+00 to 0+00), and Reach G-20 during a 100-year storm event.

Line F (Alamo Canal)

Information on sediment size and channel geometry for Alamo Canal was limited to the reach immediately upstream of the confluence with Arroyo Mocho. As a result, this reach was assumed to be stable so that the sediment delivered to Arroyo de la Laguna was equal to its sediment transport capacity.

Line B (Arroyo de la Laguna)

The reach at Arroyo de la Laguna immediately downstream of the confluence of Arroyo Mocho and Alamo Canal is shown to be degrading. The channel then goes through a cycle of aggradation (Reach B-60, B-50, and B-40 from station 373+00 to station 238+20) and degradation (Reach B-30 and B-10). The reaches immediately upstream of the confluence with Alameda Creek are shown to be degrading, with the greatest sediment imbalance occurring at the outlet reach (-18,000 cubic yards for a 2-year event).



Reach	Sediment Imbalance (2-year)		Sediment Imbalance (100-year)	
	(tons/event)	($yards^3$/event)	(tons/event)	($yards^3$/event)
H-2	+4,400	+3,000	+110,000	+78,000
H-1	-42,000	-28,000	-130,000	-91,000
G-60	+340	+230	+15,000	+10,000
G-50	-77	-52	+67,000	+46,000
G-40	+31,000	+21,000	+89,000	+60,000
G-30	+11,000	+7,600	+54,000	+37,000
G-20	+1,200	+800	-1,200	-850
G-10	-1,100	-740	+7,000	+4,800
B-70	-150,000	-100,000	+24,000	+17,000
B-60	+8,300	+5,600	+860	+580
B-50	+110,000	+78,000	-16,000	-11,000
B-40	+15,000	+10,000	-85,000	-58,000
B-30	-9,300	-6,300	-73,000	-49,000
B-20	-26,000	-18,000	-180,000	-120,000

Figure 11: Scenario E Bed Load Transport Analysis

5.4 Summary of 2-year Rainfall Event Results

Bed load transport results for the 2-year rainfall event for all three scenarios are summarized in Table 11 below.

Table 11 – Summary of Bed Load Transport Results for the 2-year Rainfall Event

Line	Reach	US Station	DS Station	Sediment Imbalance		
				Scenario C (yards^3/event)	Scenario D (yards^3/event)	Scenario E (yards^3/event)
Arroyo las Positas (Line H)	H-3	227+00	208+00	Upstream Sediment Boundary Condition	Upstream Sediment Boundary Condition	Upstream Sediment Boundary Condition
	H-2	208+00	92+00	+1,400	+3,000	+3,000
	H-1	92+00	0+00	-13,000	-28,000	-28,000
Arroyo Mocho (Line G)	G-60	620+00	552+00	Upstream Sediment Boundary Condition	Upstream Sediment Boundary Condition	Upstream Sediment Boundary Condition
	G-60	552+00	350+00	+140	+230	+230
	G-50	350+00	176+86	-200	-52	-52
	G-40	173+50	150+00	+9,100	+21,000	+21,000
	G-30	150+00	70+00	+4,500	+7,600	+7,600
	G-20	70+00	40+00	+490	+800	+800
	G-10	40+00	0+00	-450	-740	-740
Alamo Canal (Line F)	F-10	11+00	0	Upstream Sediment Boundary Condition	Upstream Sediment Boundary Condition	Upstream Sediment Boundary Condition
Arroyo de la Laguna (Line B)	B-70	392+00	373+00	-68,000	-100,000	-100,000
	B-60	373+00	335+00	+3,800	+5,600	+5,600
	B-50	335+00	307+90	+53,000	+78,000	+78,000
	B-40	307+90	238+20	+6,900	+10,000	+10,000
	B-30	238+20	32+25	-4,200	-6,300	-6.300
	B-10	32+25	2+00	-12,000	-18,000	-18,000

As shown above, degradation and aggradation trends under Scenario C are generally milder than that of Scenario D or Scenario E. This is due to an increase in impervious cover under full build-out development conditions resulting in a reduction in lag time and an increase in peak flows. Larger peak flows augment the channels' sediment transport capacities resulting in an overall increase in aggradation or degradation trends.

Degradation and aggradation trends under scenarios D and E are the same due to the similarity in flows under both scenarios for a 2-year rainfall event. As previously discussed, Reach H-2 along Arroyo las Positas and Reach G-50 along Arroyo Mocho have adequate channel capacity to accommodate flows up to a 3-year and 4-year rainfall event, respectively. Even if these channels were not improved, they would still have enough capacity to convey the 2-year event flows. The *Zone 7 SMMP Phase 1 Interim Report* does not recommend channel improvements to either Arroyo las Positas nor Arroyo Mocho. Instead, deficient channel capacities are addressed by diversion of flows into the Chain of Lakes when bank overtopping occurs. As discussed in Section 4, bank overtopping occurs under a 5-year or greater event. As a result, flows through these channels under a 2-year event are equal to those of Scenario D. Because sediment transport capacity is largely dependent on hydraulic conditions in the channel, the aggradation and degradation trends are also equal under both scenarios.

6 Limitations of Sediment Load Analysis

It is important to note that the scope for this task did not include new modeling efforts or field measurements such as sediment sampling. Data needed for the analysis including design hydrology, channel geometries, and sediment particle size distributions were obtained from previous studies conducted by Schaaf & Wheeler, West Yost & Associates, and Ayres Associates. The analyses conducted are based on static, empirically derived equations and is adequate for broad-planning purposes to obtain an order-of-magnitude estimate of sediment load. In the case of the bed material load analysis, the hydraulic conditions in the channel cannot be updated as bed elevation changes along the channel. As a result, specific parameters in the transport equation are static and cannot change based on aggradation or degradation in the channel. In addition, SMMP improvements such as bank stabilization cannot be factored into the analysis. The analysis will describe general trends of channel aggradation or degradation but it will not specify whether channel erosion is originating from the bed or banks.

7 Conclusions

The total sediment load consists of the sediment eroded from overland areas (wash load) and the sediment eroded from the channel banks and bed (bed material load). As discussed in Section 4 (Wash Load Analysis), the suspended sediment yield exiting the watershed at the downstream reach of ADLL on an annual average basis was calculated using the PSIAC method. Bed material load was calculated by utilizing a bed load transport equation in conjunction with the continuity principle. Bed load was calculated on an event basis for the 2-year or 100-year rainfall events. In order to determine the long-term average bed load exiting the watershed at ADLL, a bed material load frequency curve would have to be developed utilizing bed load for a range of frequency events including the 2, 5, 10, 25, 50, and 100-year rainfall events. The area under the curve would represent the mean annual bed load and would be approximated by the following relation:

$$Y_s = 0.015Y_{s100} + 0.015Y_{s50} + 0.04Y_{s25} + 0.08Y_{s10} + 0.2Y_{S5} + 0.4Y_{s2}$$

Due to limitations in flow data for the 5, 10, 25 and 50-year events, the bed material load frequency curve could not be developed. As a result, the long-term mean annual bed load could not be calculated. Instead, the total sediment load will be presented as wash load and bed material load as show in Table 12 below.

Table 12 – Summary of Wash Load and Bed Material Load Exiting the Watershed

	Wash Load		Bed Material Load (2-year Event)		Bed Material Load (100-year Event)	
Scenario	**(tons/year)**	**(yards^3/year)**	**(tons/event)**	**(yards^3/event)**	**(tons/event)**	**(yards^3/event)**
C	246,000	184,000	17,000	12,000	260,000	170,000
D	230,000	172,000	26,000	18,000	180,000	120,000
E	230,000	172,000	26,000	18,000	180,000	120,000

As previously discussed, the purpose of the sediment load analysis was to answer three questions:

1. What is the sediment yield today?

   As seen in Table 12, the sediment yield today will be equal to the sediment load exiting ADLL under Scenario C, or 184,000 cubic yards of suspended sediment per year and 12,000 cubic yards of bed load during a 2-year event.

2. What will be the sediment yield at full build-out development conditions if recommended channel improvements are not implemented?

As seen in Table 12, the sediment yield in the future without implementation of channel improvements will be equal to the sediment load exiting ADLL under Scenario D, or 172,000 cubic yards of suspended sediment per year and 18,000 cubic yards of bed load during a 2-year event.

3. What will be the sediment yield at full build-out development conditions if recommended SMMP improvements are implemented?

   As seen in Table 12, the sediment yield in the future with implementation of the regional storage solution at the Chain of Lakes will be similar to that of Scenario D. The difference between Scenario D and E will be the management of flows and sediment in the watershed. Under Scenario D, flows will overtop the banks onto the adjacent floodplain resulting in flooding around Las Positas Golf Course and along Stanley Boulevard. Suspended sediment carried in the floodwaters will settle onto the floodplain. Under Scenario E, flows will not be allowed to overtop the banks. Instead, they will be diverted into the Chain of Lakes for temporary storage thereby alleviating the flooding around the Chain of Lakes area. The channels will still carry the same suspended sediment and bed load as in Scenario C. However, suspended sediment carried in water overtopping the bank will now settle in the storage ponds. As a result, sediment accumulation in detention storage should be looked at in more detail under the sediment maintenance program. Aggradation/degradation trends under Scenario D and E will also be similar. However, after construction of sediment basins the excess bed material load being deposited along aggradational reaches will be managed. After review of the degradational trends in Scenario E, the bank stabilization and grade control measures recommended in the Zone 7 SMMP Phase 1 Interim Report will be revisited as part of Subtask 1.4 (*SMMP Project Refinement*) to match field observation and results of the bed load transport analysis for Scenario E.

8 Recommendations

The following tasks are recommended as part of Phase 2 of the SMMP Program:

- Consider suspended sediment accumulation in the Chain of Lakes detention ponds.
- Re-visit location and size of recommended sediment basins. Develop a maintenance schedule based on aggradation trends of Scenario E.
- Re-visit bank stabilization and grade control measures in ADLL based on natural grade of stream, field observations, and degradation trends of Scenario E.

The following tasks are recommended for future phases of the SMMP Program:

- Conduct field verification of actual channel geometry. As discussed in Section 5, channel geometries (bottom width, side slopes, and bed slopes) were obtained from the Ayres Associates report and were assumed to be uniform for all scenarios and in accordance with the 1966 Flood Control Master Plan. In order to model actual conditions in the channel, a survey of existing channel geometries needs to be conducted. Data on actual channel geometries would be used to re-evaluate the sediment loads under scenarios C, and D, and E.
- Develop MIKE-11 sediment model in concert with development of an updated HEC-RAS model to simulate conditions under scenarios C, D, and E. These models would be used as a tool in conjunction with the stream Operations & Maintenance program.

Appendix A

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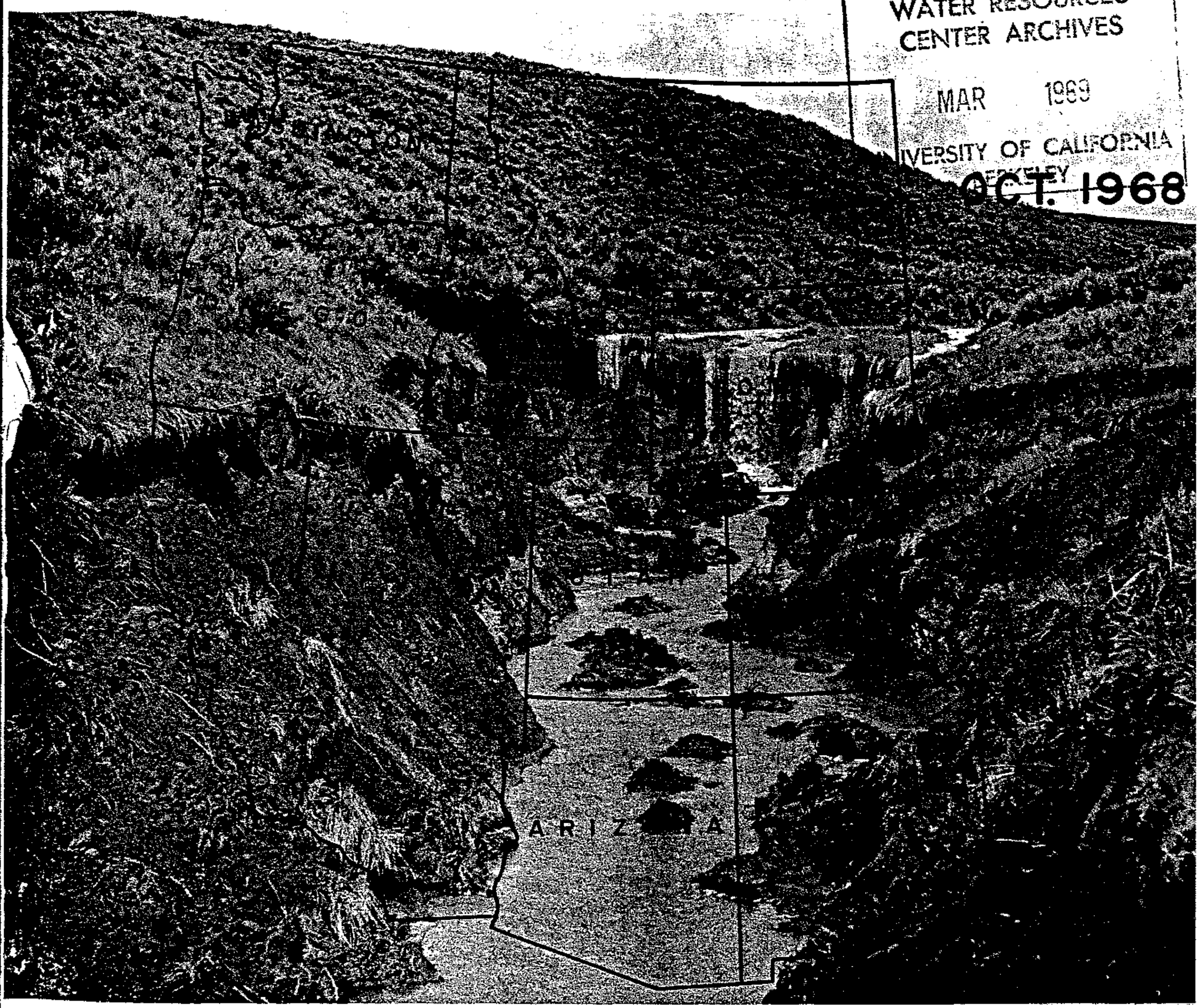
Appendix B

Pacific Southwest
INTER - AGENCY COMMITTEE

Report of the Water Management Subcommittee

OCT. 1968



FACTORS AFFECTING SEDIMENT YIELD AND MEASURES FOR THE REDUCTION OF EROSION AND SEDIMENT YIELD

PACIFIC SOUTHWEST INTER-AGENCY COMMITTEE

REPORT

of the

WATER MANAGEMENT SUBCOMMITTEE

on

FACTORS AFFECTING SEDIMENT YIELD IN THE PACIFIC SOUTHWEST AREA

and

SELECTION AND EVALUATION OF MEASURES FOR REDUCTION OF EROSION AND SEDIMENT YIELD

October 1968

FACTORS AFFECTING SEDIMENT YIELD IN THE PACIFIC SOUTHWEST AREA

Recommendations of the Water Management Subcommittee
Sedimentation Task Force, PSIAC
October 1968

Introduction

The material that follows is suggested for use in the evaluation of sediment yield in the Pacific Southwest. It is intended as an aid to the estimation of sediment yield for the variety of conditions encountered in this area.

The classifications and companion guide material are intended for broad planning purposes only, rather than for specific projects where more intensive investigations of sediment yield would be required. For these purposes it is recommended that map delineations be for areas no smaller than 10 square miles.

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It is suggested that actual measurements of sediment yield be used to the fullest extent possible. This descriptive material and the related numerical evaluation system would best serve its purpose as a means of delineating boundaries between sediment yield areas and in extrapolation of existing data to areas where none is available.

This may involve a plotting of known sediment yield data on work maps. Prepared materials such as geologic and soil maps, topographic, climatic, vegetative type and other references would be used as aids in delineation of boundaries separating yield classifications. A study of the general relationships between known sediment yield rates and the watershed conditions that produce them would be of substantial benefit in projecting data to areas without information.

Sediment Yield Classification

It is recommended that sediment yields in the Pacific Southweat area be divided into five classes of average annual yield in acre-feet per square mile. These are as follows:

Classification	1	> 3.0	acre-feet/square mile	
	2	1.0 - 3.0	"	"
	3	0.5 - 1.0	"	"
	4	0.2 - 0.5	"	"
	5	< 0.2	"	"

Nine factors are recommended for consideration in determining the sediment yield classification. These are geology, soils, climate, runoff, topography, ground cover, land use, upland erosion, and channel erosion and sediment transport.

Characteristics of each of the nine factors which give that factor high, moderate, or low sediment yield level are shown on the attached table. The sediment yield characteristic of each factor is assigned a numerical value representing its relative significance in the yield rating. The yield rating is the sum of values for the appropriate characteristics for each of the nine factors. Conversion to yield classes should be as follows:

Rating	Class
>100	1
75 - 100	2
50 - 75	3
25 - 50	4
0 - 25	5

Guidelines which accompany the table are an integral part of the procedure. They describe the characteristics of factors which influence sediment yield and these are summarized in the space provided on the table.

The factors are generally described, for purposes of avoiding complexity, as independently influencing the amount of sediment yield. The variable impact of any one factor is the result of influence by the others. To account for this variable influence in any one area would require much more intensive investigational procedures than are available for broad planning purposes.

Assumed that 9 factors are independent

To briefly indicate the interdependence of the factors discussed separately, ground cover is used as an example. If there is no vegetation, litter or rock fragments protecting the surface, the rock, soil, and topography express their uniqueness on erosion and sediment yield. If the surface is very well protected by cover, the characteristics of the other factors are obscured by this circumstance. In similar vein, an arid region has a high potential for erosion and sediment yield because of little or no ground cover, sensitive soils and rugged topography. Given very low intensity rainfall and rare intervals of runoff, the sediment yield could be quite low.

Each of the 9 factors shown on the table are paired influences with the exception of topography. That is, geology and soils are directly related as are climate and runoff, ground cover and land use, and upland and channel erosion. Ground cover and land use have a negative influence under average or better conditions. Their impact on sediment yield is therefore indicated as a negative influence when affording better protection than this average.

It is recommended that the observer follow a feedback process whereby he checks the sum of the values on the table A through G with the sum of H and I. In most instances high values in the former should correspond to high values in the latter. If they do not, either special erosion conditions exist or the A-G factors should be re-evaluated.

Check $\Sigma A-G$ & $\Sigma H-I$. In general, high $\Sigma A-G$ should be accompanied by high $\Sigma H-I$

Although only the high, moderate and low sediment yield levels are shown on the attached table, interpolation between these levels may be made.

Surface Geology

Over much of the southwest area, the effect of surface geology on erosion is readily apparent. The weaker and softer rocks are more easily eroded and generally yield more sediment than do the harder more resistant types. Sandstones and similar coarse-textured rocks that disintegrate to form permeable soils erode less than shales and related mudstones and siltstones under the same conditions of precipitation. On the other hand, because of the absence of cementing agents in some soils derived from sandstone, large storms may produce some of the highest sediment yields known.

The widely distributed marine shales, such as the Mancos and shale members of the Moenkopi Formation, constitute a group of highly erodible formations. The very large areal extent of the shales and their outwash deposits gives them a rank of special importance in relation to erosion. Few of the shale areas are free from erosion. Occasionally, because of slope or cover conditions, metamorphic rocks and highly fractured and deeply weathered granites and granodiorites produce high sediment yield. Limestone and volcanic outcrop areas are among the most stable found within the western lands. The principal reason for this appears to be the excellent infiltration characteristics, which allow most precipitation to percolate into the underlying rock.

In some areas all geologic formations are covered with alluvial or colluvial material which may have no relation to the underlying geology. In such areas the geologic factor would have no influence and should be assigned a value of 0 in the rating.

Soils

Soil formation in the Pacific Southwest generally has not had climatic conditions conducive to rapid development. Therefore, the soils are in an immature stage of development and consist essentially of physically weathered rock materials. The presence of sodium carbonate (black alkali) in a soil tends to cause the soil particles to disperse and renders such a soil susceptible to erosion.

There are essentially three inorganic properties--sand, silt, and clay--which may in any combination give soil its physical characteristics. Organic substances plus clay provide the binding material which tends to hold the soil separates together and form aggregates. Aggregate formation and stability of these aggregates are the resistant properties of soil against erosion. Unstable aggregates or single grain soil materials can be very erodible.

Climate and living organisms acting on parent material, as conditioned by relief or topography over a period of time, are the essential factors for soil development. Any one of these factors may overshadow or depress another in a given area and cause a difference in soil formation. For instance, climate determines what type of vegetation and animal population will be present in an area, and this will have a definite influence or determine the type of soil that evolves. As an example, soils developing under a forest canopy are much different from soils developing in a grassland community.

The raw, shaley type areas (marine shales) of the Pacific Southwest have very little, if any, soil development. Colluvial-alluvial fan type areas are usually present at the lower extremities of the steeper sloping shale areas. Infiltration and percolation are usually minimal on these areas due to the fine textured nature of the soil material. This material is easily dispersed and probably has a high shrink-swell capacity. Vegetation is generally sparse, and consists of a salt desert shrub type.

There are areas that contain soils with definite profile development and also stony soils that contain few fines which constitutes an improved physical condition for infiltration and plant growth over the fine textured shaley areas. These areas usually occur at higher and more moist elevations where bare, hard crystalline rocks provide the soil parent material. Vegetation and other ground cover, under these circumstances, provide adequate protection against the erosive forces and thus low sediment yield results.

In arid and semi-arid areas an accumulation of rock fragments (desert pavement) or calcareous material (caliche) is not uncommon. These layers can offer substantial resistance to erosion processes.

The two extreme conditions of sediment yield areas have been described. Intermediate situations would contain some features of the two extremes. One such situation might be an area of predominately good soil development that contains small areas of badlands. This combination would possibly result in an intermediate classification.

<u>Climate and Runoff</u>

Climatic factors are paramount in soil and vegetal development and determine the quantity and discharge rate of runoff. The same factors constitute the forces that cause erosion and resultant sediment yield. Likewise, temperature, precipitation, and particularly the distribution of precipitation during the growing season, affect the quantity and quality of the ground cover as well as soil development. The quantity and intensity of precipitation determine the amount and discharge rates of runoff and resultant detachment of soil and the transport media for sediment yield. The intensity of prevailing and seasonal winds affects precipitation pattern, snow accumulation and evaporation rate.

Snow appears to have a minor effect on upland slope erosion since raindrop impact is absent and runoff associated with snow melt is generally in resistant mountain systems.

Frontal storms in which periods of moderate to high intensity precipitation occur can produce the highest sediment yields within the Southwest. In humid and subhumid areas the impact of frontal storms on sediment may be greatest on upland slopes and unstable geologic areas where slides and other downhill soil movement can readily occur.

Convective thunderstorm activity in the Southwest has its greatest influence on erosion and sedimentation in Arizona and New Mexico and portions of the adjoining states. High rainfall intensities on low density cover or easily dispersed soils produces high sediment yields. The average annual sediment yield is usually kept within moderate bounds by infrequent occurrence of thunderstorms in any one locality.

High runoff of rare frequency may cause an impact on average annual sediment yield for a long period of time in a watershed that is sensitive to erosion, or it may have little effect in an insensitive watershed. For example, sediment that has been collecting in the bottom of a canyon and on side slopes for many years of low and moderate flows may be swept out during the rare event, creating a large change in the indicated sediment yield rate for the period of record.

In some areas the action of freezing and thawing becomes important in the erosion process. Impermeable ice usually forms in areas of fine textured soils where a supply of moisture is available before the advent of cold weather. Under these conditions the ice often persists throughout the winter and is still present when the spring thaw occurs. In some instances water tends to run over the surface of the ice and not detach soil particles, but it is possible for the ice in a surface layer to thaw during a warm period and create a very erodible situation. Spring rains with ice at shallow depth may wash away the loose material on the surface.

In some areas of the Pacific Southwest, particularly those underlain by marine shale, freezing and thawing alters the texture of soil near the surface, and thus changes the infiltration characteristics. These areas generally do not receive enough snow or have cold enough temperatures to build a snow pack for spring melt. Later in the year soil in a loosened condition is able to absorb a large part of the early rainfall. As rains occur during the summer, the soil becomes compacted on the surface, thus allowing more water to run off and affording a greater chance for erosion.

Topography

Watershed slopes, relief, floodplain development, drainage patterns, orientation and size are basic items to consider in connection with topography. However, their influence is closely associated with geology, soils, and cover.

Generally, steep slopes result in rapid runoff. The rimrock and badlands, common in portions of the Pacific Southwest, consist of steep slopes of soft shales usually maintained by the presence of overlying cap rock. As the soft material is eroded, the cap rock is undercut and falls, exposing more soft shales to be carried away in a continuing process. However, high sediment yields from these areas are often modified by the temporary deposition of sediment on the intermediate floodplains.

The high mountain ranges, although having steep slopes, produce varying quantities of sediment depending upon the type of parent materials, soil development, and cover which directly affect the erosion processes.

Southerly exposed slopes generally erode more rapidly than do the northerly exposed slopes due to greater fluctuation of air and soil temperatures, more frequent freezing and thawing cycles, and usually less ground cover.

The size of the watershed may or may not materially affect the sediment yield per unit area. Generally, the sediment yield is inversely related to the watershed size because the larger areas usually have less overall slope, smaller proportions of upland sediment sources, and more opportunity for the deposition of upstream derived sediments on floodplains and fans. In addition, large watersheds are less affected by small convective type storms. However, under other conditions, the sediment yield may not decrease as the watershed size increases. There is little change in mountainous areas of relatively uniform terrain. There may be an increase of sediment yield as the watershed size increases if downstream watersheds or channels are more susceptible to erosion than upstream areas.

Ground Cover

Ground cover is described as anything on or above the surface of the ground which alters the effect of precipitation on the soil surface and profile. Included in this factor are vegetation, litter, and rock fragments. A good ground cover dissipates the energy of rainfall before it strikes the soil surface, delivers water to the soil at a relatively uniform rate, impedes the flow of water, and promotes infiltration by the action of roots within the soil. Conversely, the absence of ground cover, whether through natural growth habits or the effect of overgrazing or fire, leave the land surface open to the worst effects of storms.

In certain areas, small rocks or rock fragments may be so numerous on the surface of the ground that they afford excellent protection for any underlying fine material. These rocks absorb the energy of falling rain and are resistant enough to prevent cutting by flowing water.

The Pacific Southwest is made up of land with all classes of ground cover. The high mountain areas generally have the most vegetation, while many areas in the desert regions have practically none. The abundance of vegetation is related in a large degree to precipitation. If vegetative ground cover is destroyed in areas where precipitation is high, abnormally high erosion rates may be experienced.

Differences in vegetative type have a variable effect on erosion and sediment yield, even though percentages of total ground cover may be the same. For instance, in areas of pinyon-juniper forest having the same percentage of ground cover as an area of grass, the absence of understory in some of the pinyon-juniper stands would allow a higher erosion rate than in the area of grass.

Land Use

The use of land has a widely variable impact on sediment yield, depending largely on the susceptibility of the soil and rock to erosion, the amount of stress exerted by climatic factors and the type and intensity of use. Factors other than the latter have been discussed in appropriate places in this guide.

In almost all instances use either removes or reduces the amount of natural vegetative cover which reflects the varied relationships within the environment. Activities which remove all vegetation for parts of each year for several years or permanently are cultivation, urban development and road construction. Grazing, logging, mining, and fires artifically induce permanent or temporary reduction in cover density.

High erosion hazard sites, because of the geology, soils, climate, etc., are also of high hazard from the standpoint of type and intensity of use. For example, any use which reduces cover density on a steep slope with erodible soils and severe climatic conditions will strongly affect sediment yield. The extent of this effect will depend on the area and intensity of use relative to the availability of sediment from other causes. Construction of roads or urban development with numerous cut and fill slopes through a large area of widespread sheet or gully erosion will probably not cause a change in sediment yield classification. Similar construction and continued disturbance in an area of good vegetative response to a favorable climate can raise yield by one or more classifications.

Use of the land has its greatest potential impact on sediment yield where a delicate balance exists under natural conditions. Alluvial valleys of fine, easily dispersed soils from shales and sandstones are highly vulnerable to erosion where intensive grazing and trailing by livestock have occurred. Valley trenching has developed in many of these valleys and provides a large part of the sediment in high yield classes from these areas.

A decline in vegetative density is not the only effect of livestock on erosion and sediment yield. Studies at Badger Wash, Colorado, which is underlain by Mancos shale, have indicated that sediment yield from ungrazed watersheds is appreciably less than from those that are grazed. This difference is attributed to absence of soil trampling in the ungrazed areas since the density of vegetation has not noticeably changed since exclusion began.

Areas in the arid and semi-arid portions of the Southwest that are surfaced by desert pavement are much less sensitive to grazing and other use, since the pavement affords a substitute for vegetative cover.

In certain instances the loss or deterioration of vegetative cover may have little noticeable on-site impact but may increase off-site erosion by acceleration of runoff. This could be particularly evident below urbanized areas where accelerated runoff from pavement and rooftops has increased the stress on downstream channels. Widespread destruction of cover by poor logging practices or by brush and timber fires frequently increases channel erosion as well as that on the directly affected watershed slopes. On the other hand, cover disturbances under favorable conditions, such as a cool, moist climate, frequently result in a healing of erosion sources within a few years.

Upland Slope Erosion

This erosion form occurs on sloping watershed lands beyond the confines of valleys. Sheet erosion which involves the removal of a thin layer of soil over an extensive area is usually not visible to the eye. This erosion form is evidenced by the formation of rills. Experience indicates that soil loss from rill erosion can be seen if it amounts to about 5 tons or more per acre. This is equivalent in volume per square mile to approximately 2 acre-feet.

Wind erosion from upland slopes and the deposition of the eroded material in stream channels may be a significant factor. The material so deposited in channels is readily moved by subsequent runoff.

Downslope soil movement due to creep can be an important factor in sediment yield on steep slopes underlain by unstable geologic formations.

Significant gully erosion as a sediment contributor is evidenced by the presence of numerous raw cuts along the hill slopes. Deep soils on moderately steep to steep slopes usually provide an environment for gully development.

Processes of slope erosion must be considered in the light of factors which contribute to its development. These have been discussed in previous sections.

Channel Erosion and Sediment Transport

If a stream is ephemeral, runoff in traversing the dry alluvial bed may be drastically reduced by transmission losses (absorption by channel alluvium). This decrease in the volume of flow results in a decreased potential to move sediment. Sediment may be deposited in the streambed from one or a series of relatively small flows only to be picked up and moved on in a subsequent larger flow. Sediment concentrations, determined from field measurements at consecutive stations, have generally been shown to increase many fold for instances of no tributary inflow. Thus, although water yield per unit area will decrease with increasing drainage area, the sediment yield per unit area may remain nearly constant or may even increase with increasing drainage area.

In instances of convective precipitation in a watershed with perennial flow, the role of transmission losses is not as significant as in watersheds with ephemeral flow, but other channel factors, such as the shape of the channel, may be important.

For frontal storm runoff the flow durations are generally much longer than for convective storms, and runoff is often generated from the entire basin. In such instances, sediment removed from the land surfaces is generally carried out of the area by the runoff. Stream channel degradation and/or aggradation must be considered in such cases, as well as bank scour. Because many of the stream beds in the Pacific Southwest are composed of fine-grained alluvium in well defined channels, the potential for sediment transport is limited only by the amount and duration of runoff. Large volumes of sediment may thus be moved by these frontal storms because of the longer flow durations.

The combination of frontal storms of long duration with high intensity and limited areal-extent convective activity will generally be in the highest class for sediment movement in the channels. Storms of this type generally produce both the high peak flows and the long durations necessary for maximum sediment transport.

Sediment yield may be substantially affected by the degree of channel development in a watershed. This development can be described by the channel cross sections, as well as by geomorphic parameters such as drainage density, channel gradients and width-depth ratio. The effect of these geomorphic parameters is difficult to evaluate primarily because of the scarcity of sediment transport data in the Pacific Southwest.

If the cross section of a stream is such as to keep the flow within defined banks, then the sediment from an upstream point is generally transported to a downstream point without significant losses. Confinement of the flow within alluvial banks can result in a high erosional capability of a flood flow, especially the flows with long return periods. In most channels with wide floodplains, deposition on the floodplain during floods is often significant, and the transport is thus less than that for a within bank flow. The effect of this transport capability can be explained in terms of tractive force which signifies the hydraulic stress exerted by the flow on the bed of the stream. This average bed-shear stress is obtained as the product of the specific weight of the fluid, hydraulic radius, and energy gradient slope. Thus, greater depth results in a greater bed shear and a greater potential for moving sediment. By the same reasoning, steep slopes (the energy slope and bed slope are assumed to be equivalent) also result in high bed-shear stress.

The boundary between sediment yield classifications in much of the Pacific Southwest may be at the mountain front, with the highest yield designation on the alluvial plain if there is extensive channel erosion. In contrast, many mountain streams emerge from canyon reaches and then spread over fans or valley flats. Here water depths can decrease from many feet to only a few inches in short distances with a resultant loss of the capacity to transport sediment. Sediment yield of the highest classification can thus drop to the lowest in such a transition from a confined channel to one that has no definition.

Channel bank and bed composition may greatly influence the sediment yield of a watershed. In many areas within the Pacific Southwest, the channels in valleys dissect unconsolidated material which may contribute significantly to the stream sediment load. Bank sloughing during periods of flow, as well as during dry periods, piping, and bank scour generally add greatly to the sediment load of the stream and often change upward the sediment yield classification of the watershed. Field examination for areas of head cutting, aggradation or degradation, and bank cutting are generally necessary prior to classification of the transport expectancy of a stream. Geology plays a significant role in such an evaluation. Geologic controls in channels can greatly affect the stream regimen by limiting degradation and headcuts. Thus, the transport capacity may be present, but the supply of sediment from this source is limited.

Man-made structures can also greatly affect the transport characteristics of the stream. For example, channel straightening can temporarily upset the channel equilibrium and cause an increase in channel gradient and an increase in the stream velocity and the shear stress. Thus, the sediment transport capacity of the stream may be temporarily increased. Structures such as debris dams, lined channels, drop spillways, and detention dams may drastically reduce the sediment transport.

Appendix C

Scenario A
Full Build-Out Development + Full Channel Conveyance Capacity

Name	Predominant Ground Cover	Yield Rate (Acre-ft/mile^2- year)	Area (ft^2)	Area (acres)	Area (miles^2)	Sediment Yield (Acre-ft)	Sediment Yield (ft^3/year)	Sediment Yield (tons/year)	Sediment Yield (yards^3/year)
Line B2-1 and Tributaries	Urban	0.29	57,715,298	1,325	2.07	0.600375192	26,152	1,295	969
	Grassland	0.93	37,972,375	872	1.36	1.266731316	55,179	2,731	2,044
			95,687,673	*2,197*	*3*	*2*	*81,331*	*4,026*	*3,012*
Re-aligned Arroyo las Positas	Urban	0.29	42,202,775	969	1.51	0.439008377	19,123	947	708
	Grassland	0.93	206,088,520	4,731	7.39	6.874965871	299,474	14,824	11,092
	Total:		*248,291,295*	*5,700*	*9*	*7*	*318,597*	*15,771*	*11,800*
Arroyo Seco	Urban	0.29	18,326,869	421	0.66	0.190642656	8,304	411	308
	Grassland	0.93	389,312,756	8,937	13.96	12.98719556	565,722	28,003	20,953
	Total:		*407,639,625*	*9,358*	*15*	*13*	*574,027*	*28,414*	*21,260*
Cayetano Creek	Urban	0.29	*50,478*	*1*	*0.00*	*0.000525092*	*23*	*1*	*1*
	Grassland	0.93	307,076,248	*7,050*	*11.01*	*10.24384437*	*446,222*	*22,088*	*16,527*
	Total:		*307,126,726*	*7,051*	*11*	*10*	*446,245*	*22,089*	*16,528*
Tassajara Creek	Urban	0.29	67,195,710	1,543	2.41	0.698993836	30,448	1,507	1,128
	Grassland	0.93	687,211,738	15,776	24.65	22.9248929	998,608	49,431	36,985
	Total:		*754,407,448*	*17,319*	*27*	*24*	*1,029,057*	*50,938*	*38,113*
Cottonwood Creek	Urban	0.29	356,599	8	0.01	0.003709469	162	8	6
	Grassland	0.93	*120,283,036*	2,761	4.31	4.012556205	174,787	8,652	6,474
	Total:		*120,639,635*	*2,770*	*4*	*4*	*174,949*	*8,660*	*6,480*
Line G3	Urban	0.29	77,052,237	1,769	2.76	0.801524955	34,914	1,728	1,293
	Grassland	0.93	26,886,474	617	0.96	0.896913572	39,070	1,934	1,447
			103,938,711	*2,386*	*4*	*2*	*73,984*	*3,662*	*2,740*
Collier Creek	Urban	0.29	18,634,828	428	0.67	0.193846155	8,444	418	313
	Grassland	0.93	113,697,290	2,610	4.08	3.792860404	165,217	8,178	6,119
	Total:		*132,332,118*	*3,038*	*5*	*4*	*173,661*	*8,596*	*6,432*
Chabot Canal	Urban	0.29	143,135,859	3,286	5.13	1.488950451	64,859	3,211	2,402
	Grassland	0.93	3,191,654	73	0.11	0.106471289	4,638	230	172
	Total:		*146,327,513*	*3,359*	*5*	*2*	*69,497*	*3,440*	*2,574*
Tributaries to Alamo Canal	Urban	0.29	740,122,399	16,991	26.55	7.699018158	335,369	16,601	12,421
	Forest/Grassland	0.46	472,043,802	10,837	16.93	7.78886057	339,283	16,794	12,566
	Total:		*1,212,166,201*	*27,828*	*43*	*15*	*674,652*	*33,395*	*24,987*
Pleasanton Canal	Urban	0.29	54,908,517	1,261	1.97	0.571178053	24,881	1,232	921
	Urban/Grassland	0.61	10,969,626	252	0.39	0.24002443	10,455	518	387
	Total:		*65,878,143*	*1,512*	*2*	*1*	*35,336*	*1,749*	*1,309*
Arroyo las Positas	Urban	0.29	386,679,958	8,877	13.87	4.022383355	175,215	8,673	6,489
	Grassland	0.93	667,011,406	15,312	23.93	22.25102426	969,255	47,978	35,898
	Total:		*1,053,691,364*	*24,189*	*38*	*26*	*1,144,470*	*56,651*	*42,388*
Arroyo Mocho	Urban	0.29	55,233,789	1,268	1.98	0.574561651	25,028	1,239	927
	Forest/Grassland	0.46	1,035,509,305	23,772	37.14	17.08620589	744,275	36,842	27,566
	Total:		*1,090,743,094*	*25,040*	*39*	*18*	*769,303*	*38,081*	*28,493*
TOTAL:			**5,738,869,546**	**131,746**	**206**	**128**	**5,565,106**	**275,473**	**206,115**

Sediment Yield (tons/acre-year) **2.09**

Scenario B
Existing Development + Full Channel Conveyance Capacity

Name	Predominant Ground Cover	Yield Rate (Acre-ft/mile^2- year)	Area (ft^2)	Area (acres)	Area (miles^2)	Sediment Yield (Acre-ft)	Sediment Yield (ft^3/year)	Sediment Yield (tons/year)	Sediment Yield (yards^3/year)
Line B2-1 and Tributaries	Urban	0.29	56,547,085	1,298	2.03	0.588223022	25,623	1,268	949
	Grassland	0.93	39,140,588	899	1.40	1.305702069	56,876	2,815	2,107
			95,687,673	*2,197*	*3*	*2*	*82,499*	*4,084*	*3,056*
Re-aligned Arroyo las Positas	Urban	0.29	42,364,662	973	1.52	0.440692376	19,197	950	711
	Grassland	0.93	205,926,633	4,727	7.39	6.869565461	299,238	14,812	11,083
	Total:		*248,291,295*	*5,700*	*9*	*7*	*318,435*	*15,763*	*11,794*
Arroyo Seco	Urban	0.29	17,744,061	407	0.64	0.184580079	8,040	398	298
	Grassland	0.93	389,895,564	8,951	13.99	13.00663762	566,569	28,045	20,984
	Total:		*407,639,625*	*9,358*	*15*	*13*	*574,609*	*28,443*	*21,282*
Cayetano Creek	Grassland	0.93	*307,126,726*	*7,051*	*11.02*	*10.24552829*	*446,295*	*22,092*	*16,529*
Tassajara Creek	Urban	0.29	11,193,529	257	0.40	0.116439096	5,072	251	188
	Grassland	0.93	743,213,919	17,062	26.66	24.79308568	1,079,987	53,459	39,999
	Total:		*754,407,448*	*17,319*	*27*	*25*	*1,085,059*	*53,710*	*40,187*
Cottonwood Creek	Urban	0.29	346,538	8	0.01	0.003604809	157	8	6
	Grassland	0.93	*120,293,097*	*2,762*	*4.31*	*4.012891837*	*174,802*	*8,653*	*6,474*
	Total:		*120,639,635*	*2,770*	*4*	*4*	*174,959*	*8,660*	*6,480*
Line G3	Urban	0.29	4,157,422	95	0.15	0.043246992	1,884	93	70
	Grassland	0.93	99,781,289	2,291	3.58	3.328632557	144,995	7,177	5,370
			103,938,711	*2,386*	*4*	*3*	*146,879*	*7,271*	*5,440*
Collier Creek	Urban	0.29	11,745,859	270	0.42	0.122184634	5,322	263	197
	Grassland	0.93	120,586,259	2,768	4.33	4.02267149	175,228	8,674	6,490
	Total:		*132,332,118*	*3,038*	*5*	*4*	*180,550*	*8,937*	*6,687*
Chabot Canal	Urban	0.29	60,942,550	1,399	2.19	0.633946223	27,615	1,367	1,023
	Grassland	0.93	85,384,963	1,960	3.06	2.848381401	124,075	6,142	4,595
	Total:		*146,327,513*	*3,359*	*5*	*3*	*151,690*	*7,509*	*5,618*
Tributaries to Alamo Canal	Urban	0.29	453,053,484	10,401	16.25	4.712824529	205,291	10,162	7,603
	Forest/Grassland	0.46	759,112,718	17,427	27.23	12.5255815	545,614	27,008	20,208
	Total:		*1,212,166,201*	*27,828*	*43*	*17*	*750,905*	*37,170*	*27,811*
Pleasanton Canal	Urban	0.29	54,927,215	1,261	1.97	0.571372554	24,889	1,232	922
	Urban/Grassland	0.61	10,950,928	251	0.39	0.239615306	10,438	517	387
	Total:		*65,878,143*	*1,512*	*2*	*1*	*35,327*	*1,749*	*1,308*
Arroyo las Positas	Urban	0.29	336,866,093	7,733	12.08	3.504201697	152,643	7,556	5,653
	Grassland	0.93	716,825,271	16,456	26	24	1,041,641	51,561	-5,653
	Total:		*1,053,691,364*	*24,189*	*38*	*27*	*1,194,284*	*59,117*	*0*
Arroyo Mocho	Urban	0.29	46,350,058	1,064	1.66	0.482149902	21,002	1,040	778
	Forest/Grassland	0.46	1,044,393,036	23,976	37.46	17.23279005	750,660	37,158	27,802
	Total:		*1,090,743,094*	*25,040*	*39*	*18*	*771,663*	*38,197*	*28,580*
TOTAL:			**5,738,869,546**	**131,746**	**206**	**136**	**5,913,154**	**292,701**	**174,773**
							Sediment Yield (tons/acre-year)	**2.22**	

Scenario C
Existing Development + Existing Channel Conveyance Capacity

Name	Predominant Ground Cover	Yield Rate (Acre-ft/mile^2- year)	Area (ft^2)	Area (acres)	Area (miles^2)	Sediment Yield (Acre-ft)	Sediment Yield (ft^3/year)	Sediment Yield (tons/year)	Sediment Yield (yards^3/year)
Re-aligned Arroyo las Positas	Urban	0.29	42,364,662	973	1.52	0.440692376	19,197	950	711
	Grassland	0.93	205,926,633	4,727	7.39	6.869565461	299,238	14,812	11,083
	Total:		*248,291,295*	*5,700*	*9*	*7*	*318,435*	*15,763*	*11,794*
Arroyo Seco	Urban	0.29	17,744,061	407	0.64	0.184580079	8,040	398	298
	Grassland	0.93	389,895,564	8,951	13.99	13.00663762	566,569	28,045	20,984
	Total:		*407,639,625*	*9,358*	*15*	*13*	*574,609*	*28,443*	*21,282*
Cayetano Creek	Grassland	0.93	*307,126,726*	*7,051*	*11.02*	*10.24552829*	*446,295*	*22,092*	*16,529*
Collier Creek	Urban	0.29	11,745,859	270	0.42	0.122184634	5,322	263	197
	Grassland	0.93	120,586,259	2,768	4.33	4.02267149	175,228	8,674	6,490
	Total:		*132,332,118*	*3,038*	*5*	*4*	*180,550*	*8,937*	*6,687*
Arroyo las Positas	Urban	0.29	336,866,093	7,733	12.08	3.504201697	152,643	7,556	5,653
	Grassland	0.93	716,825,271	16,456	26	24	1,041,641	51,561	38,579
	Total:		*1,053,691,364*	*24,189*	*38*	*27*	*1,194,284*	*59,117*	*44,233*
Total Sediment Yield draining to Arroyo las Positas reach adjacent to Las Poisitas Golf Course:						62	2,714,173	134,352	100,525
27% (Total Sediment Yield draining to Arroyo las Positas reach adjacent to Las Poisitas Golf Course):						17	732827	36275	27142
Remaining Sediment Yield at outlet of Arroyo las Positas:						**45**	**1,981,346**	**98,077**	**73,383**
Cottonwood Creek	Urban	0.29	346,538	8	0.01	0.003604809	157	8	6
	Grassland	0.93	*120,293,097*	*2,762*	*4.31*	*4.012891837*	*174,802*	*8,653*	*6,474*
	Total:		*120,639,635*	*2,770*	*4*	*4*	*174,959*	*8,660*	*6,480*
Arroyo Mocho	Urban	0.29	46,350,058	1,064	1.66	0.482149902	21,002	1,040	778
	Forest/Grassland	0.46	1,044,393,036	23,976	37.46	17.23279005	750,660	37,158	27,802
	Total:		*1,090,743,094*	*25,040*	*39*	*18*	*771,663*	*38,197*	*28,580*
Total Sediment Yield draining to Arroyo Mocho:						18	771,663	38,197	28,580
27% (Total Sediment Yield draining to Arroyo Mocho):						5	208,349	10,313	7,717
Remaining Sediment Yield at Outlet of Arroyo Mocho:						**13**	**563,314**	**27,884**	**20,863**
Line G3	Urban	0.29	4,157,422	95	0.15	0.043246992	1,884	93	70
	Grassland	0.93	99,781,289	2,291	3.58	3.328632557	144,995	7,177	5,370
			103,938,711	*2,386*	*4*	*3*	*146,879*	*7,271*	*5,440*
Tassajara Creek	Urban	0.29	11,193,529	257	0.40	0.116439096	5,072	251	188
	Grassland	0.93	743,213,919	17,062	26.66	24.79308568	1,079,987	53,459	39,999
	Total:		*754,407,448*	*17,319*	*27*	*25*	*1,085,059*	*53,710*	*40,187*
Chabot Canal	Urban	0.29	60,942,550	1,399	2.19	0.633946223	27,615	1,367	1,023
	Grassland	0.93	85,384,963	1,960	3.06	2.848381401	124,075	6,142	4,595
	Total:		*146,327,513*	*3,359*	*5*	*3*	*151,690*	*7,509*	*5,618*
Tributaries to Alamo Canal	Urban	0.29	453,053,484	10,401	16.25	4.712824529	205,291	10,162	7,603
	Forest/Grassland	0.46	759,112,718	17,427	27.23	12.5255815	545,614	27,008	20,208
	Total:		*1,212,166,201*	*27,828*	*43*	*17*	*750,905*	*37,170*	*27,811*
Pleasanton Canal	Urban	0.29	54,927,215	1,261	1.97	0.571372554	24,889	1,232	922
	Urban/Grassland	0.61	10,950,928	251	0.39	0.239615306	10,438	517	387
	Total:		*65,878,143*	*1,512*	*2*	*1*	*35,327*	*1,749*	*1,308*
Line B2-1 and Tributaries	Urban	0.29	56,547,085	1,298	2.03	0.588223022	25,623	1,268	949
	Grassland	0.93	39,140,588	899	1.40	1.305702069	56,876	2,815	2,107
			95,687,673	*2,197*	*3*	*2*	*82,499*	*4,084*	*3,056*
TOTAL:			**5,738,869,546**	**131,746**	**206**	**114**	**4,971,978**	**246,113**	**184,147**
							Sediment Yield (tons/acre-year)	**1.87**	

Scenario D

Full Build-Out Development + Existing Channel Conveyance Capacity

Name	Predominant Ground Cover	Yield Rate (Acre-ft/mile^2-year)	Area (ft^2)	Area (acres)	Area (miles^2)	Sediment Yield (Acre-ft)	Sediment Yield (ft^3/year)	Sediment Yield (tons/year)	Sediment Yield (yards^3/year)
Re-aligned Arroyo las Positas	Urban	0.29	42,202,775	969	1.51	0.439008377	19,123	947	708
	Grassland	0.93	206,088,520	4,731	7.39	6.874965871	299,474	14,824	11,092
	Total:		248,291,295	5,700	8.91	7	318,597	15,771	11,800
Arroyo Seco	Urban	0.29	18,326,869	421	0.66	0.190642656	8,304	411	308
	Grassland	0.93	389,312,756	8,937	13.96	12.98719556	565,722	28,003	20,953
	Total:		407,639,625	9,358	14.62	13	574,027	28,414	21,260
Cayetano Creek	Urban	0.29	50,478	1	0.0018	0.000525092	23	1	1
	Grassland	0.93	307,076,248	*7,050*	*11.01*	*10.24384437*	*446,222*	*22,088*	*16,527*
	Total:		*307,126,726*	*7,051*	*11*	*10*	*446,245*	*22,089*	*16,528*
Collier Creek	Urban	0.29	18,634,828	428	0.67	0.193846155	8,444	418	313
	Grassland	0.93	113,697,290	2,610	4.08	3.792860404	165,217	8,178	6,119
	Total:		132,332,118	3,038	4.75	4	173,661	8,596	6,432
Arroyo las Positas	Urban	0.29	386,679,958	8,877	13.87	4.022383355	175,215	8,673	6,489
	Grassland	0.93	667,011,406	15,312	23.93	22.25102426	969,255	47,978	35,898
	Total:		1,053,691,364	24,189	37.80	26	1,144,470	56,651	42,388
Total Sediment Yield draining to Arroyo las Positas reach adjacent to Las Poisitas Golf Course:						61	2,656,999	131,521	98,407
27% (Total Sediment Yield draining to Arroyo las Positas reach adjacent to Las Poisitas Golf Course):						16	717,390	35,511	26,570
Remaining Sediment Yield at outlet of Arroyo las Positas:						**45**	**1,939,609**	**96,011**	**71,837**
Cottonwood Creek	Urban	0.29	356,599	8	0.01	0.003709469	162	8	6
	Grassland	0.93	120,283,036	2,761	4.31	4.012556205	174,787	8,652	6,474
	Total:		120,639,635	2,770	4.33	4	174,949	8,660	6,480
Arroyo Mocho	Urban	0.29	55,233,789	1,268	1.98	0.574561651	25,028	1,239	927
	Forest/Grassland	0.46	1,035,509,305	23,772	37.14	17.08620589	744,275	36,842	27,566
	Total:		1,090,743,094	25,040	39.13	17.66076755	769,303	38,081	28,493
Total Sediment Yield draining to Arroyo Mocho:						18	769,303	38,081	28,493
27% (Total Sediment Yield draining to Arroyo Mocho):						5	207,712	10,282	7,693
Remaining Sediment Yield at Outlet of Arroyo Mocho:						**13**	**561,591**	**27,799**	**20,800**
Line G3	Urban	0.29	77,052,237	1,769	2.76	0.801524955	34,914	1,728	1,293
	Grassland	0.93	26,886,474	617	0.96	0.896913572	39,070	1,934	1,447
			103,938,711	2,386	3.73	2	73,984	3,662	2,740
Tassajara Creek	Urban	0.29	67,195,710	1,543	2.41	0.698993836	30,448	1,507	1,128
	Grassland	0.93	687,211,738	15,776	24.65	22.9248929	998,608	49,431	36,985
	Total:		754,407,448	17,319	27.06	24	1,029,057	50,938	38,113
Chabot Canal	Urban	0.29	143,135,859	3,286	5.13	1.488950451	64,859	3,211	2,402
	Grassland	0.93	3,191,654	73	0.11	0.106471289	4,638	230	172
	Total:		146,327,513	3,359	5.25	2	69,497	3,440	2,574
Tributaries to Alamo Canal	Urban	0.29	740,122,399	16,991	26.55	7.699018158	335,369	16,601	12,421
	Forest/Grassland	0.46	472,043,802	10,837	16.93	7.78886057	339,283	16,794	12,566
	Total:		1,212,166,201	27,828	43.48	15	674,652	33,395	24,987
Pleasanton Canal	Urban	0.29	54,908,517	1,261	1.97	0.571178053	24,881	1,232	921
	Urban/Grassland	0.61	10,969,626	252	0.39	0.24002443	10,455	518	387
	Total:		65,878,143	1,512	2.36	1	35,336	1,749	1,309
Line B2-1 and Tributaries	Urban	0.29	57,715,298	1,325	2.07	0.600375192	26,152	1,295	969
	Grassland	0.93	37,972,375	872	1.36	1.266731316	55,179	2,731	2,044
			95,687,673	2,197	3.43	2	81,331	4,026	3,012
TOTAL:			**5,738,869,546**	**131,746**	**206**	**107**	**4,640,005**	**229,680**	**171,852**
							Sediment Yield (tons/acre-year)	**1.74**	

Scenario E Full Build-Out Development + Implementation of SMMP Program									
Name	**Predominant Ground Cover**	**Yield Rate (Acre-ft/mile^2-year)**	**Area (ft^2)**	**Area (acres)**	**Area (miles^2)**	**Sediment Yield (Acre-ft)**	**Sediment Yield (ft^3/year)**	**Sediment Yield (tons/year)**	**Sediment Yield (yards^3/year)**
Re-aligned Arroyo las Positas	Urban	0.29	42,202,775	969	1.51	0.439008377	19,123	947	708
	Grassland	0.93	206,088,520	4,731	7.39	6.874965871	299,474	14,824	11,092
	Total:		248,291,295	5,700	8.91	7	318,597	15,771	11,800
Arroyo Seco	Urban	0.29	18,326,869	421	0.66	0.190642656	8,304	411	308
	Grassland	0.93	389,312,756	8,937	13.96	12.98719556	565,722	28,003	20,953
	Total:		407,639,625	9,358	14.62	13	574,027	28,414	21,260
Cayetano Creek	Urban	0.29	50,478	1	0.0018	0.000525092	23	1	1
	Grassland	0.93	307,076,248	*7,050*	*11.01*	*10.24384437*	*446,222*	*22,088*	*16,527*
	Total:		*307,126,726*	*7,051*	*11*	*10*	*446,245*	*22,089*	*16,528*
Collier Creek	Urban	0.29	18,634,828	428	0.67	0.193846155	8,444	418	313
	Grassland	0.93	113,697,290	2,610	4.08	3.792860404	165,217	8,178	6,119
	Total:		132,332,118	3,038	4.75	4	173,661	8,596	6,432
Arroyo las Positas	Urban	0.29	386,679,958	8,877	13.87	4.022383355	175,215	8,673	6,489
	Grassland	0.93	667,011,406	15,312	23.93	22.25102426	969,255	47,978	35,898
	Total:		1,053,691,364	24,189	37.80	26	1,144,470	56,651	42,388
Total Sediment Yield draining to Arroyo las Positas reach adjacent to Las Poisitas Golf Course:						61	2,656,999	131,521	98,407
27% to storage at Chain of Lakes:						16	717,390	35,511	26,570
Remaining Sediment Yield at outlet of Arroyo las Positas:						**45**	**1,939,609**	**96,011**	**71,837**
Cottonwood Creek	Urban	0.29	356,599	8	0.01	0.003709469	162	8	6
	Grassland	0.93	120,283,036	2,761	4.31	4.012556205	174,787	8,652	6,474
	Total:		120,639,635	2,770	4.33	4	174,949	8,660	6,480
Arroyo Mocho	Urban	0.29	55,233,789	1,268	1.98	0.574561651	25,028	1,239	927
	Forest/Grassland	0.46	1,035,509,305	23,772	37.14	17.08620589	744,275	36,842	27,566
	Total:		1,090,743,094	25,040	39.13	17.66076755	769,303	38,081	28,493
Total Sediment Yield draining to Arroyo Mocho:						18	769,303	38,081	28,493
27% to storage at Chain of Lakes:						5	207,712	10,282	7,693
Remaining Sediment Yield at Outlet of Arroyo Mocho:						**13**	**561,591**	**27,799**	**20,800**
Line G3	Urban	0.29	77,052,237	1,769	2.76	0.801524955	34,914	1,728	1,293
	Grassland	0.93	26,886,474	617	0.96	0.896913572	39,070	1,934	1,447
			103,938,711	2,386	3.73	2	73,984	3,662	2,740
Tassajara Creek	Urban	0.29	67,195,710	1,543	2.41	0.698993836	30,448	1,507	1,128
	Grassland	0.93	687,211,738	15,776	24.65	22.9248929	998,608	49,431	36,985
	Total:		754,407,448	17,319	27.06	24	1,029,057	50,938	38,113
Chabot Canal	Urban	0.29	143,135,859	3,286	5.13	1.488950451	64,859	3,211	2,402
	Grassland	0.93	3,191,654	73	0.11	0.106471289	4,638	230	172
	Total:		146,327,513	3,359	5.25	2	69,497	3,440	2,574
Tributaries to Alamo Canal	Urban	0.29	740,122,399	16,991	26.55	7.699018158	335,369	16,601	12,421
	Forest/Grassland	0.46	472,043,802	10,837	16.93	7.78886057	339,283	16,794	12,566
	Total:		1,212,166,201	27,828	43.48	15	674,652	33,395	24,987
Pleasanton Canal	Urban	0.29	54,908,517	1,261	1.97	0.571178053	24,881	1,232	921
	Urban/Grassland	0.61	10,969,626	252	0.39	0.24002443	10,455	518	387
	Total:		65,878,143	1,512	2.36	1	35,336	1,749	1,309
Line B2-1 and Tributaries	Urban	0.29	57,715,298	1,325	2.07	0.600375192	26,152	1,295	969
	Grassland	0.93	37,972,375	872	1.36	1.266731316	55,179	2,731	2,044
			95,687,673	2,197	3.43	2	81,331	4,026	3,012
TOTAL:			**5,738,869,546**	**131,746**	**206**	**107**	**4,640,005**	**229,680**	**171,852**
							Sediment Yield (tons/acre-year)	**1.74**	

Appendix D

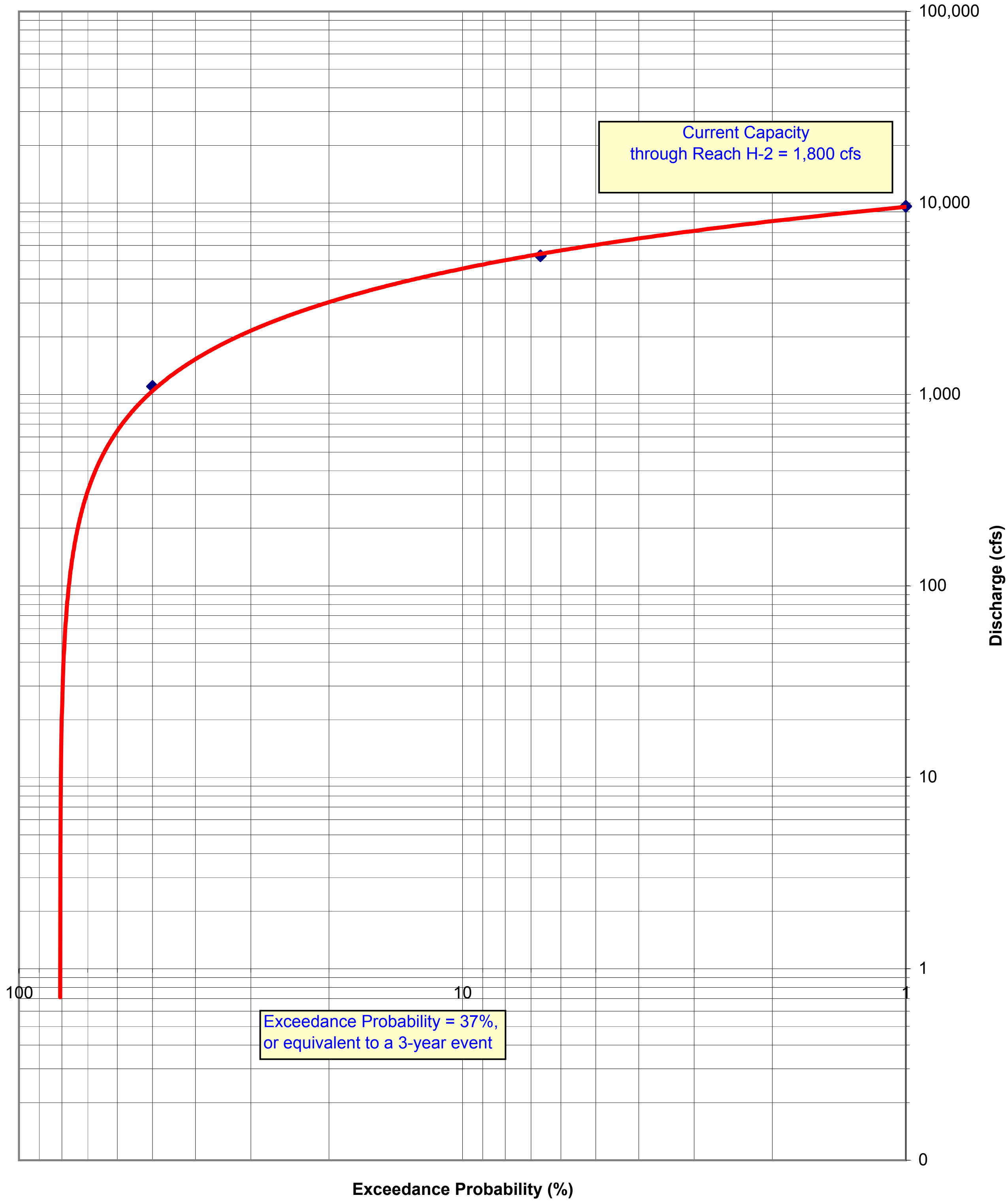
Future Flows @ Las Positas Golf Course on Arroyo las Positas (Location H-2) (Schaaf & Wheeler, June 2000)			
Flows		Exceedance Probability	x-Year Event
(cfs)			
	1	100	1
1,100	2	50	2
	3	33.33333333	3
	4	25	4
	5	20	5
	6	16.66666667	6
	7	14.28571429	7
	8	12.5	8
	9	11.11111111	9
	10	10	10
	11	9.090909091	11
	12	8.333333333	12
	13	7.692307692	13
	14	7.142857143	14
5,300	15	6.666666667	15
	16	6.25	16
	17	5.882352941	17
	18	5.555555556	18
	19	5.263157895	19
	20	5	20
	21	4.761904762	21
	22	4.545454545	22
	23	4.347826087	23
	24	4.166666667	24
	25	4	25
	26	3.846153846	26
	27	3.703703704	27
	28	3.571428571	28
	29	3.448275862	29
	30	3.333333333	30
	31	3.225806452	31
	32	3.125	32
	33	3.03030303	33
	34	2.941176471	34
	35	2.857142857	35
	36	2.777777778	36
	37	2.702702703	37
	38	2.631578947	38
	39	2.564102564	39
	40	2.5	40
	41	2.43902439	41
	42	2.380952381	42
	43	2.325581395	43
	44	2.272727273	44
	45	2.222222222	45
	46	2.173913043	46
	47	2.127659574	47
	48	2.083333333	48
	49	2.040816327	49
	50	2	50
	51	1.960784314	51
	52	1.923076923	52
	53	1.886792453	53
	54	1.851851852	54
	55	1.818181818	55
	56	1.785714286	56
	57	1.754385965	57
	58	1.724137931	58
	59	1.694915254	59
	60	1.666666667	60
	61	1.639344262	61
	62	1.612903226	62
	63	1.587301587	63
	64	1.5625	64
	65	1.538461538	65
	66	1.515151515	66
	67	1.492537313	67
	68	1.470588235	68
	69	1.449275362	69
	70	1.428571429	70
	71	1.408450704	71
	72	1.388888889	72
	73	1.369863014	73
	74	1.351351351	74
	75	1.333333333	75
	76	1.315789474	76
	77	1.298701299	77
	78	1.282051282	78
	79	1.265822785	79
	80	1.25	80

Future Flows @ Cope Lake on Arroyo Mocho (Location G-50) (Schaaf & Wheeler, June 2000)			
Flows		Exceedance Probability	x-Year Event
(cfs)			
	1	100	1
370	2	50	2
	3	33.33333333	3
	4	25	4
	5	20	5
	6	16.66666667	6
	7	14.28571429	7
	8	12.5	8
	9	11.11111111	9
	10	10	10
	11	9.090909091	11
	12	8.333333333	12
	13	7.692307692	13
	14	7.142857143	14
2,300	15	6.666666667	15
	16	6.25	16
	17	5.882352941	17
	18	5.555555556	18
	19	5.263157895	19
	20	5	20
	21	4.761904762	21
	22	4.545454545	22
	23	4.347826087	23
	24	4.166666667	24
	25	4	25
	26	3.846153846	26
	27	3.703703704	27
	28	3.571428571	28
	29	3.448275862	29
	30	3.333333333	30
	31	3.225806452	31
	32	3.125	32
	33	3.03030303	33
	34	2.941176471	34
	35	2.857142857	35
	36	2.777777778	36
	37	2.702702703	37
	38	2.631578947	38
	39	2.564102564	39
	40	2.5	40
	41	2.43902439	41
	42	2.380952381	42
	43	2.325581395	43
	44	2.272727273	44
	45	2.222222222	45
	46	2.173913043	46
	47	2.127659574	47
	48	2.083333333	48
	49	2.040816327	49
	50	2	50
	51	1.960784314	51
	52	1.923076923	52
	53	1.886792453	53
	54	1.851851852	54
	55	1.818181818	55
	56	1.785714286	56
	57	1.754385965	57
	58	1.724137931	58
	59	1.694915254	59
	60	1.666666667	60
	61	1.639344262	61
	62	1.612903226	62
	63	1.587301587	63
	64	1.5625	64
	65	1.538461538	65
	66	1.515151515	66
	67	1.492537313	67
	68	1.470588235	68
	69	1.449275362	69
	70	1.428571429	70
	71	1.408450704	71
	72	1.388888889	72
	73	1.369863014	73
	74	1.351351351	74
	75	1.333333333	75
	76	1.315789474	76
	77	1.298701299	77
	78	1.282051282	78
	79	1.265822785	79
	80	1.25	80

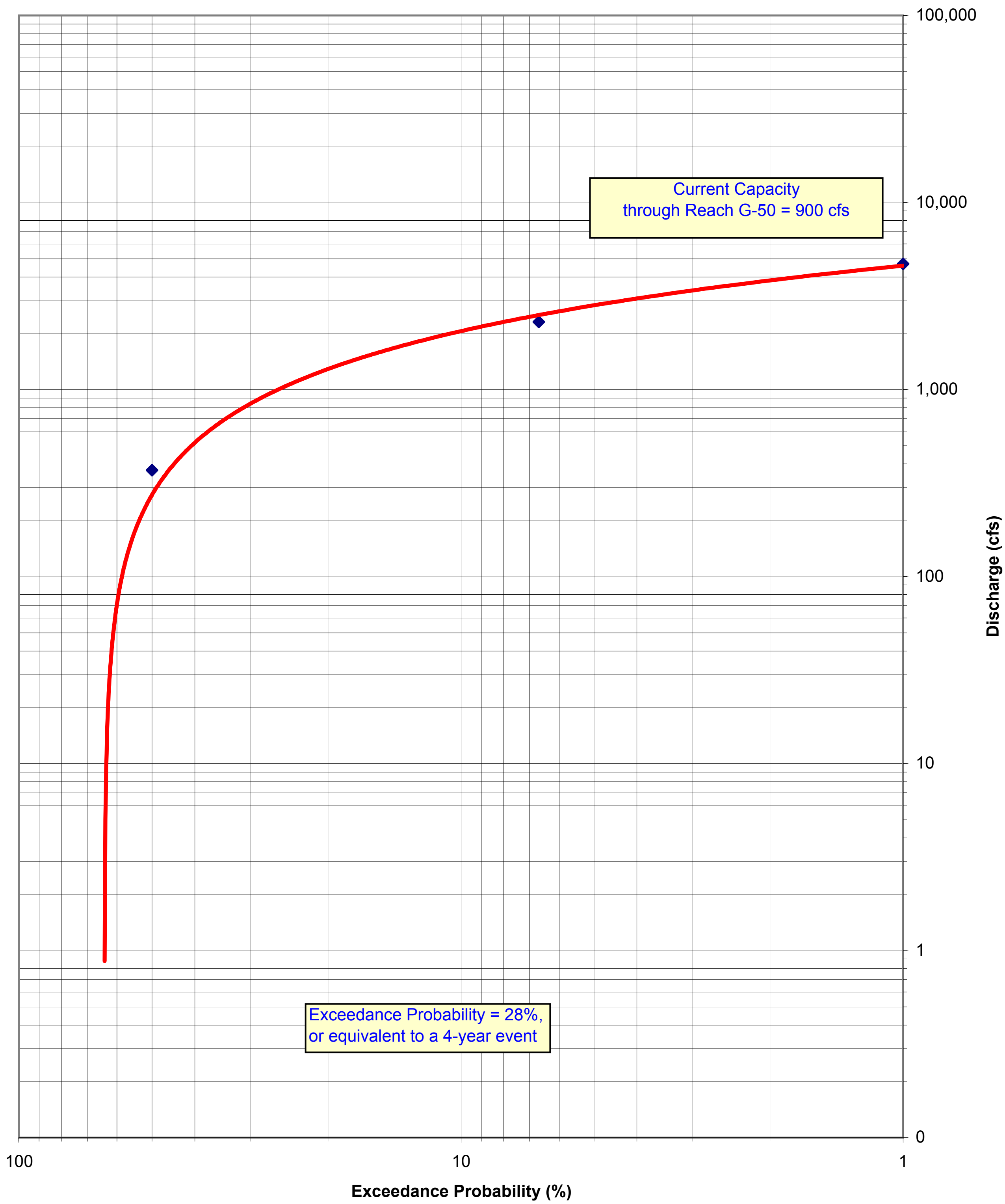
Future Flows @ Las Positas Golf Course on Arroyo las Positas (Location H-2) (Schaaf & Wheeler, June 2000)			
Flows (cfs)		Exceedance Probability	x-Year Event
	81	1.234567901	81
	82	1.219512195	82
	83	1.204819277	83
	84	1.19047619	84
	85	1.176470588	85
	86	1.162790698	86
	87	1.149425287	87
	88	1.136363636	88
	89	1.123595506	89
	90	1.111111111	90
	91	1.098901099	91
	92	1.086956522	92
	93	1.075268817	93
	94	1.063829787	94
	95	1.052631579	95
	96	1.041666667	96
	97	1.030927835	97
	98	1.020408163	98
	99	1.01010101	99
9,600	100	1	100

Future Flows @ Cope Lake on Arroyo Mocho (Location G-50) (Schaaf & Wheeler, June 2000)			
Flows (cfs)		Exceedance Probability	x-Year Event
	81	1.234567901	81
	82	1.219512195	82
	83	1.204819277	83
	84	1.19047619	84
	85	1.176470588	85
	86	1.162790698	86
	87	1.149425287	87
	88	1.136363636	88
	89	1.123595506	89
	90	1.111111111	90
	91	1.098901099	91
	92	1.086956522	92
	93	1.075268817	93
	94	1.063829787	94
	95	1.052631579	95
	96	1.041666667	96
	97	1.030927835	97
	98	1.020408163	98
	99	1.01010101	99
4,700	100	1	100

Future Flows @ Las Positas Golf Course on Arroyo las Positas (Location H-2)
(Schaaf & Wheeler, June 2000)



Future Flows at Cope Lake on Arroyo Mocho (Location G-50)
(Schaaf & Wheeler, June 2000)



Appendix E

100-Year Flows

		FUTURE BUILD-OUT + FULL CONVEYANCE CAPACITY	EXISTING DEVELOPMENT CONDITIONS + FULL CONVEYANCE CAPACITY		EXISTING DEVELOPMENT CONDITIONS + EXISTING CHANNEL CAPACITY		FUTURE BUILD-OUT + EXISTING CHANNEL CAPACITY		FUTURE BUILD-OUT + IMPLEMENTATION OF SMMP PROGRAM	
	Location	Future Flows	Existing Flows	Resulting Flows	Existing Channel Capacities	Resulting Flows (peak at Arroyo Mocho)	Existing Channel Capacities	Resulting Flows	Flows through Channels w/ Storage	Resulting Flows
Arroyo Mocho	G-60	4,700	4,500	4,500		4,500		4,700		4,700
	G-50	4,700	4,700	4,700	900	900	900	900	1,300	1,300
	G-40	12,700	11,600	11,600		3,200		3,200		3,300
	G-30	13,100		12,000	16,200	3,600	16,200	3,600		3,700
	G-20	16,500		15,100		7,700		7,700	7,800	7,800
	G-10	16,900	15,300	15,500	18,200	8,100	18,200	8,100		8,200
Arroyo las Positas	H-3	9,000		8,200		8,200		9,000		9,000
	H-2	9,600		8,700	1,800	1,800	1,800	1,800	1,500	1,500
	H-1	10,100	9,200	9,200		2,300		2,300		2,000
Arroyo de la Laguna	F-10	6,500		5,400	8,500	5,400	8,500	6,500		6,500
	B-70	23,400	20,900	20,900		13,500		14,600		14,700
	B-60	23,400		20,900	19,600	15,000	19,600	16,200	16,300	16,300
	B-50	25,500	22,700	22,700	18,700	17,200	18,700	18,600	18,700	18,700
	B-40	25,800		23,000		17,500		18,900		19,000
	B-30	26,100		23,300		17,800		19,200		19,300
	B-10	27,000		24,100		18,600		20,100		20,200
		Schaaf & Wheeler, June 2000 (Table 1)	RMC, TM#2, December 2003 (Figure B-3)	Resulting Flows (Calculated)	RMC Interim Report, March 2004 (Figure 4.2)	Resulting Flows (Calculated)	RMC Interim Report, March 2004 (figure 4.2)	Resulting Flows (Calculated)	West Yost & Associates, November 2001 (Table TM5A-27)	Resulting Flows (Calculated)

2-Year Flows

		FUTURE BUILD-OUT + FULL CONVEYANCE CAPACITY	EXISTING DEVELOPMENT CONDITIONS + FULL CONVEYANCE CAPACITY		EXISTING DEVELOPMENT CONDITIONS + EXISTING CHANNEL CAPACITY			FUTURE BUILD-OUT + EXISTING CHANNEL CAPACITY			FUTURE BUILD-OUT + IMPLEMENTATION OF SMMP PROGRAM	
	Location	Future Flows	Existing Flows	Resulting Flows	Existing Channel Capacities	Flows Existing Development Conditions + Full Conveyance Capacity	Resulting Flows	Existing Channel Capacities	Flows Future Build-Out + Full Conveyance Capacity	Resulting Flows	Flows through Channels w/ Storage	Resulting Flows
Arroyo Mocho	G-60	350	245	245		245	250		350	350	350	350
	G-50	370	610	300	900	300	300	900	370	370	370	370
	G-40	1,400		1,000		1,000	1,000		1,400	1,400	1,400	1,400
	G-30	1,600	730	1,100	16,200	1,100	1,100	16,200	1,600	1,600	1,600	1,600
	G-20	2,000	970	1,400		1,400	1,400		2,000	2,000	2,000	2,000
	G-10	2,200		1,500	18,200	1,500	1,500	18,200	2,200	2,200	2,200	2,200
Arroyo las Positas	H-3	1,000	530	530		530	530		1,000	1,000	1,000	1,000
	H-2	1,100		600	1,800	600	600	1,800	1,100	1,100	1,100	1,100
	H-1	1,200		700		700	700		1,200	1,200	1,200	1,200
Arroyo de la Laguna	F-10	1,500		1,200	8,500	1,200	1,200	8,500	1,500	1,500	1,500	1,500
	B-70	3,700		2,700		2,700	2,700		3,700	3,700	3,700	3,700
	B-60	3,700		2,700	19,600	2,700	2,700	19,600	3,700	3,700	3,700	3,700
	B-50	4,100		3,000	18,700	3,000	3,000	18,700	4,100	4,100	4,100	4,100
	B-40	4,200		3,100		3,100	3,100		4,200	4,200	4,200	4,200
	B-30	4,400		3,200		3,200	3,200		4,400	4,400	4,400	4,400
	B-10	4,600		3,300		3,300	3,300		4,600	4,600	4,600	4,600
		Schaaf & Wheeler, June 2000 (Table 1)	Schaaf & Wheeler, December 1997 (Table 1)	Resulting Flows (Calculated)	RMC Interim Report, March 2004 (Figure 4.2)	Schaaf & Wheeler, December 1997 (Table 1)	Resulting Flows (Calculated)	RMC Interim Report, March 2004 (Figure 4.2)	Schaaf & Wheeler, June 2000 (Table 1)	Resulting Flows (Calculated)	Future Build-Out + Existing Channel Capacity	Resulting Flows (Calculated)

Scenario A: Full Build-Out Development + Full Conveyance Capacity

	CHANNEL DATA									FLOW DATA									BED MATERIAL DATA					SEDIMENT TRANSPORT DATA						SUMMARY RESULTS	
	Line	Channel Name	US Station	DS Station	[L] Reach Length (ft)	[b] Bottom Width (ft)	[z] Side Slopes (_H:1V)	[S] Bed Slope	Manning's n	Event (yr)	[Q] Flow (cfs)	[d] Manning Depth (ft)	[d] Backwater Depth (WYA)[1] (ft)	[A] Area (ft^2)	[P] Wetted Perimeter (ft)	[R_h] Hydraulic Radius (ft)	Top Width (ft)	[V] Velocity (ft/s)	d_{16} (mm)	d_{50} (mm)	d_{84} (mm)	d_{90} (mm)	Gr	Reach Capacity (cfs/ft)	Reach Capacity (cfs)	Reach Capacity (ft^3/event)	Aggradation/ Degradation (cfs)	Aggradation/ Degradation (tons/event)	Aggradation/ Degradation (yards^3/event)	Aggradation/ Degradation 2-year Event by Reach (tons/event)	Aggradation/ Degradation 100-year Event by Reach (tons/event)
H-3	H	Arroyo las Positas	22,700	20,800	1,900	30	10.00	0.004300	0.045	2-year	1,000	3.78	-	255.76	105.88	2.42	105.50	3.91	0.60	6.50	11.30	11.30	6.29	0.0113	1.19	102,982		[Boundary Condition]		[Bounday Condition]	[Bounday Condition]
			22,700	20,800	1,900	30	10.00	0.004300	0.037	100-year	9,000	-	12.40	1,909.60	279.24	6.84	278.00	4.71	0.60	6.50	11.30	11.30	6.29	0.0158	4.40	380,452					
H-2	H	Arroyo las Positas	20,800	14,300	6,500	70	3.00	0.002900	0.045	2-year	1,100	3.58	-	288.87	92.63	3.12	91.47	3.81	0.50	2.60	9.00	10.10	4.33	0.0154	1.41	121,666	-0.22	-1.0E+03	-6.9E+02	4.4E+03	-2.6E+07
			20,800	14,300	6,500	70	3.00	0.002900	0.037	100-year	9,600	-	11.48	1,198.97	142.61	8.41	138.88	8.01	0.50	2.60	9.00	10.10	4.33	0.1658	23.02	1,988,971	-18.62	-8.8E+04	-6.0E+04		
H-2	H	Arroyo las Positas	14,300	12,500	1,800	40	10.00	0.002700	0.045	2-year	1,100	4.08	-	329.66	122.01	2.70	121.60	3.34	0.50	2.60	9.00	10.10	4.33	0.0092	1.12	96,418	0.29	1.4E+03	9.4E+02		
			14,300	12,500	1,800	40	10.00	0.002700	0.036	100-year	9,600	-	9.53	1,289.41	231.55	5.57	230.60	7.45	0.50	2.60	9.00	10.10	4.33	0.1342	30.94	2,673,131	-7.92	-3.7E+04	-2.5E+04		
H-2	H	Arroyo las Positas	12,500	9,200	3,300	28	9.00	0.000800	0.044	2-year	1,100	5.98	-	489.83	136.37	3.59	135.71	2.25	0.50	2.60	9.00	10.10	4.33	0.0019	0.26	22,696	0.85	4.0E+03	2.7E+03		
			12,500	9,200	3,300	28	9.00	0.000800	0.033	100-year	9,600	-	4.10	266.09	102.25	2.60	101.80	36.08	0.50	2.60	9.00	10.10	4.33	54.3812	5,536.00	478,310,772	-5,505.07	-2.6E+07	-1.8E+07		
H-1	H	Arroyo las Positas	9,200	3,500	5,700	10	2.00	0.002500	0.045	2-year	1,200	8.93	-	248.56	49.91	4.98	45.70	4.83	0.50	2.60	9.00	10.10	4.33	0.0281	1.29	111,089	-1.02	-4.8E+03	-3.3E+03	-4.2E+04	2.5E+07
			9,200	3,500	5,700	10	2.00	0.002500	0.036	100-year	10,100	-	9.37	269.29	51.90	5.19	47.48	37.51	0.50	2.60	9.00	10.10	4.33	49.3018	2,340.85	202,249,274	3,195.16	1.5E+07	1.0E+07		
H-1	H	Arroyo las Positas	3,500	0	3,500	30	5.50	0.012000	0.044	2-year	1,200	3.54	-	174.95	69.55	2.52	68.91	6.86	0.50	2.60	9.00	10.10	4.33	0.1327	9.15	790,278	-7.86	-3.7E+04	-2.5E+04		
			3,500	0	3,500	30	5.50	0.012000	0.035	100-year	10,100	-	9.05	721.96	131.18	5.50	129.55	13.99	0.50	2.60	9.00	10.10	4.33	1.3614	176.37	15,238,250	2,164.48	1.0E+07	6.9E+06		
G-60	G	Arroyo Mocho	62,000	55,200	6,800	130	1.25	0.008800	0.042	2-year	350	0.88	-	115.37	132.82	0.87	132.20	3.03	1.60	10.40	12.30	13.00	3.84	0.0041	0.54	46,717		[Boundary Condition]		[Bounday Condition]	[Bounday Condition]
			62,000	55,200	6,800	130	1.25	0.008800	0.036	100-year	4,700	-	10.23	1,460.72	162.75	8.98	155.58	3.22	1.60	10.40	12.30	13.00	3.84	0.0025	0.39	33,621					
G-60	G	Arroyo Mocho	55,200	42,500	12,700	40	1.50	0.008000	0.043	2-year	350	1.85	-	79.13	46.67	1.70	45.55	4.41	1.60	10.40	12.30	13.00	3.84	0.0129	0.59	50,953	-0.05	-2.3E+02	-1.6E+02	3.4E+02	6.1E+02
			55,200	42,500	12,700	40	1.50	0.008000	0.036	100-year	4,700	-	13.06	778.25	87.09	8.94	79.18	6.04	1.60	10.40	12.30	13.00	3.84	0.0232	1.84	158,714	-1.45	-6.8E+03	-4.6E+03		
G-60	G	Arroyo Mocho	42,500	41,000	1,500	60	1.50	0.000880	0.044	2-year	350	2.86	-	183.66	70.30	2.61	68.57	1.91	1.60	10.40	12.30	13.00	3.84	0.0005	0.04	3,170	0.55	2.6E+03	1.8E+03		
			42,500	41,000	1,500	60	1.50	0.000880	0.036	100-year	4,700	-	14.00	1,134.00	110.48	10.26	102.00	4.14	1.60	10.40	12.30	13.00	3.84	0.0058	0.59	50,709	1.25	5.9E+03	4.0E+03		
G-60	G	Arroyo Mocho	41,000	35,000	6,000	65	1.50	0.007100	0.043	2-year	350	1.44	-	96.71	70.19	1.38	69.32	3.62	1.60	10.40	12.30	13.00	3.84	0.0068	0.47	40,474	-0.43	-2.0E+03	-1.4E+03		
			41,000	35,000	6,000	65	1.50	0.007100	0.036	100-year	4,700	-	16.18	1,444.39	123.34	11.71	113.54	3.25	1.60	10.40	12.30	13.00	3.84	0.0023	0.26	22,382	0.33	1.5E+03	1.0E+03		
G-50	G	Arroyo Mocho	35,000	31,000	4,000	40	2.00	0.003800	0.044	2-year	370	2.40	-	107.52	50.73	2.12	49.60	3.44	1.60	10.40	12.30	13.00	3.84	0.0049	0.24	20,924	0.23	1.1E+03	7.2E+02	-7.7E+01	2.1E+01
			35,000	31,000	4,000	40	2.00	0.003800	0.037	100-year	4,700	-	11.69	740.91	92.28	8.03	86.76	6.34	1.60	10.40	12.30	13.00	3.84	0.0287	2.49	214,883	-2.23	-1.0E+04	-7.1E+03		
G-50	G	Arroyo Mocho	31,000	21,200	9,800	60	2.00	0.003500	0.045	2-year	370	1.97	-	125.96	68.81	1.83	67.88	2.93	1.60	10.40	12.30	13.00	3.84	0.0029	0.19	16,834	0.05	2.2E+02	1.5E+02		
			31,000	21,200	9,800	60	2.00	0.003500	0.038	100-year	4,700	-	12.27	1,037.31	114.87	9.03	109.08	4.53	1.60	10.40	12.30	13.00	3.84	0.0083	0.90	78,004	1.58	7.5E+03	5.1E+03		
G-50	G	Arroyo Mocho	21,200	17,686	3,514	70	3.00	0.007700	0.045	2-year	370	1.42	-	105.45	78.98	1.34	78.52	3.52	1.60	10.40	12.30	13.00	3.84	0.0062	0.48	41,883	-0.29	-1.4E+03	-9.3E+02		
			21,200	17,686	3,514	70	3.00	0.007700	0.038	100-year	4,700	-	14.19	1,597.37	159.75	10.00	155.14	2.94	1.60	10.40	12.30	13.00	3.84	0.0016	0.25	22,000	0.65	3.1E+03	2.1E+03		
G-40	G	Arroyo Mocho	17,350	15,000	2,350	60	2.50	0.008100	0.048	2-year	1,400	3.48	-	239.08	78.74	3.04	77.40	5.86	1.40	6.00	10.50	10.60	3.02	0.0382	2.96	255,602	6.67	3.1E+04	2.1E+04	3.1E+04	8.2E+05
			17,350	15,000	2,350	60	2.50	0.008100	0.039	100-year	12,700	-	20.93	2,350.96	172.71	13.61	164.65	5.40	1.40	6.00	10.50	10.60	3.02	0.0169	2.78	240,426	173.84	8.2E+05	5.6E+05		
G-30	G	Arroyo Mocho	15,000	12,686	2,314	60	2.60	0.000810	0.047	2-year	1,600	7.14	-	560.95	99.78	5.62	97.13	2.85	1.40	6.00	10.50	10.60	3.02	0.0022	0.22	18,838	2.74	1.3E+04	8.8E+03	1.1E+04	-2.3E+04
			15,000	12,686	2,314	60	2.60	0.000810	0.038	100-year	13,100	-	17.89	1,905.54	159.67	11.93	153.03	6.87	1.40	6.00	10.50	10.60	3.02	0.0426	6.53	563,764	-3.74	-1.8E+04	-1.2E+04		
G-30	G	Arroyo Mocho	12,686	10,151	2,535	60	2.00	0.001400	0.046	2-year	1,600	6.17	-	446.00	87.58	5.09	84.66	3.59	1.40	6.00	10.50	10.60	3.02	0.0054	0.46	39,555	-0.24	-1.1E+03	-7.7E+02		
			12,686	10,151	2,535	60	2.00	0.001400	0.038	100-year	13,100	-	17.18	1,621.10	136.83	11.85	128.72	8.08	1.40	6.00	10.50	10.60	3.02	0.0778	10.02	865,615	-3.49	-1.6E+04	-1.1E+04		
G-30	G	Arroyo Mocho	10,151	7,000	3,151	60	2.00	0.001660	0.045	2-year	1,600	5.80	-	415.28	85.94	4.83	83.20	3.86	1.40	6.00	10.50	10.60	3.02	0.0072	0.60	51,489	-0.14	-6.5E+02	-4.4E+02		
			10,151	7,000	3,151	60	2.00	0.001660	0.038	100-year	13,100	-	18.19	1,753.15	141.35	12.40	132.76	7.47	1.40	6.00	10.50	10.60	3.02	0.0575	7.64	659,812	2.38	1.1E+04	7.6E+03		
G-20	G	Arroyo Mocho	7,000	4,000	3,000	60	2.00	0.000940	0.047	2-year	2,000	7.94	-	602.67	95.52	6.31	91.77	3.32	1.40	6.00	10.50	10.60	3.02	0.0038	0.35	29,985	0.25	1.2E+03	8.0E+02	1.2E+03	-1.4E+03
			7,000	4,000	3,000	60	2.00	0.000940	0.039	100-year	16,500	-	21.49	2,213.04	156.11	14.18	145.96	7.46	1.40	6.00	10.50	10.60	3.02	0.0544	7.94	685,640	-0.30	-1.4E+03	-9.6E+02		
G-10	G	Arroyo Mocho	4,000	0	4,000	60	2.00	0.001300	0.047	2-year	2,200	7.65	-	575.77	94.20	6.11	90.59	3.82	1.40	6.00	10.50	10.60	3.02	0.0064	0.58	50,060	-0.23	-1.1E+03	-7.4E+02	-1.1E+03	1.5E+04
			4,000	0	4,000	60	2.00	0.001300	0.039	100-year	16,900	-	24.27	2,634.27	168.54	15.63	157.08	6.42	1.40	6.00	10.50	10.60	3.02	0.0303	4.76	411,562	3.17	1.5E+04	1.0E+04		
F-10	F	Alamo Canal	1,100	0	1,100	30	2.50	0.001420	0.047	2-year	1,500	8.04	-	402.80	73.30	5.50	70.20	3.72	0.50	2.10	10.10	10.90	4.50	0.0130	0.91	78,779		[Boundary Condition]		[Bounday Condition]	[Bounday Condition]
			1,100	0	1,100	30	2.50	0.001420	0.038	100-year	6,500	-	15.34	1,048.49	112.61	9.31	106.70	6.20	0.50	2.10	10.10	10.90	4.50	0.0695	7.41	640,269					
B-70	B	Arroyo de la Laguna	39,200	37,300	1,900	80	2.00	0.007500	0.043	2-year	3,700	5.06	-	456.01	102.63	4.44	100.24	8.11	0.50	1.00	3.70	10.00	2.85	0.3269	32.77	2,831,142	-31.28	-1.5E+05	-1.0E+05	-1.5E+05	2.2E+04
			39,200	37,300	1,900	80	2.00	0.007500	0.037	100-year	23,400	-	31.71	4,547.85	221.81	20.50	206.84	5.15	0.50	1.00	3.70	10.00	2.85	0.0365	7.54	651,669	4.63	2.2E+04	1.5E+04		
B-60	B	Arroyo de la Laguna	37,300	33,500	3,800	80	2.00	0.007500	0.044	2-year	3,700	5.13	-	463.03	102.94	4.50	100.52	7.99	0.50	1.00	3.70	10.00	2.85	0.3084	31.00	2,678,807	1.76	8.3E+03	5.6E+03	8.3E+03	1.1E+04
			37,300	33,500	3,800	80	2.00	0.007500	0.038	100-year	23,400	-	34.22	5,079.62	233.04	21.80	216.88	4.61	0.50	1.00	3.70	10.00	2.85	0.0238	5.17	446,403	2.38	1.1E+04	7.6E+03		
B-50	B	Arroyo de la Laguna	33,500	30,790	2,710	55	1.50	0.001900	0.044	2-year	4,100	10.11	-	708.94	91.43	7.75	85.32	5.78	0.50	1.00	3.70	10.00	2.85	0.0778	6.64	573,472	24.37	1.1E+05	7.8E+04	1.1E+05	-3.4E+04
			33,500	30,790	2,710	55	1.50	0.001900	0.038	100-year	25,500	-	36.56	4,015.75	186.82	21.50	164.68	6.35	0.50	1.00	3.70	10.00	2.85	0.0754	12.42	1,072,966	-7.25	-3.4E+04	-2.3E+04		
B-40	B	Arroyo de la Laguna	30,790	23,820	6,970	30	1.50	0.001200	0.045	2-year	4,200	15.35	-	814.09	85.35	9.54	76.06	5.16	0.50	1.00	3.70	10.00	2.85	0.0454	3.46	298,530	3.18	1.5E+04	1.0E+04	1.5E+04	-1.4E+05
			30,790	23,820	6,970	30	1.50	0.001200	0.038	100-year	25,800	-	34.03	2,757.96	152.70	18.06	132.09	9.35	0.50	1.00	3.70	10.00	2.85	0.3167	41.83	3,614,004	-29.41	-1.4E+05	-9.4E+04		
B-30	B	Arroyo de la Laguna	23,820	17,845	5,975	40	1.00	0.001700	0.045	2-year	4,400	13.60	-	729.09	78.47	9.29	67.20	6.03	0.50	1.00	3.70	10.00	2.85	0.0834	5.60	484,003	-2.15	-1.0E+04	-6.9E+03	-9.3E+03	-2.0E+05
			23,820	17,845	5,975	40	1.00	0.001700	0.037	100-year	26,100	-	30.07	2,107.00	125.05	16.85	100.14	12.39	0.50	1.00	3.70	10.00	2.85	0.9147	91.60	7,914,092	-49.77	-2.3E+05	-1.6E+05		
B-30	B	Arroyo de la Laguna	17,845	9,960	7,885	50	2.00	0.002500	0.047	2-year	4,400	10.24	-	722.08	95.81	7.54	90.98	6.09	0.80	2.40	5.60	7.00	2.67	0.0534	4.85	419,472	0.75	3.5E+03	2.4E+03		
			17,845	9,960	7,885	50	2.00	0.002500	0.038	100-year	26,100	-	26.87	2,787.49	170.17	16.38	157.48	9.36	0.80	2.40	5.60	7.00	2.67	0.1936	30.49	2,633,997	61.11	2.9E+05	2.0E+05		
B-30	B	Arroyo de la Laguna	9,960	3,225	6,735	30	2.00	0.002800	0.047	2-year	4,400	12.20	-	663.92	84.57	7.85	78.81	6.63	0.80	2.40	5.60	7.00	2.67	0.0689	5.43	469,097	-0.57	-2.7E+03	-1.8E+03		
			9,960	3,225	6,735	30	2.00	0.002800	0.038	100-year	26,100	-	25.07	2,009.11	142.12	14.14	130.28	12.99	0.80	2.40	5.60	7.00	2.67	0.6526	85.03	7,346,287	-54.54	-2.6E+05	-1.7E+05		
B-10	B	Arroyo de la Laguna	3,225	200	3,025	10	3.00	0.005000	0.047	2-year	4,600	12.37	-	583.00	88.25	6.61	84.24	7.89	0.80	2.40	5.60	7.00	2.67	0.1299	10.94	945,445	-5.51	-2.6E+04	-1.8E+04	-2.6E+04	-3.2E+05
			3,225	200	3,025	10	3.00	0.005000	0.037	100-year	27,000	-	23.23	1,851.20	156.92	11.80	149.38	14.59	0.80	2.40	5.60	7.00	2.67	1.0181	152.08	13,139,620	-67.05	-3.2E+05	-2.1E+05		

[1] West Yost & Associates, November 2001 (Table TM5A-5 of Appendices)

Scenario B: Existing Development + Full Conveyance Capacity

	CHANNEL DATA									FLOW DATA									BED MATERIAL DATA					SEDIMENT TRANSPORT DATA						SUMMARY RESULTS	
	Line	Channel Name	US Station	DS Station	[L] Reach Length (ft)	[b] Bottom Width (ft)	[z] Side Slopes (_H:1V)	[S] Bed Slope	Manning's n	Event (yr)	[Q] Flow (cfs)	[d] Manning Depth (ft)	[d] Backwater Depth (WYA)[1] (ft)	[A] Area (ft^2)	[P] Wetted Perimeter (ft)	[R_h] Hydraulic Radius (ft)	Top Width (ft)	[V] Velocity (ft/s)	d_{16} (mm)	d_{50} (mm)	d_{84} (mm)	d_{90} (mm)	Gr	Reach Capacity (cfs/ft)	Reach Capacity (cfs)	Reach Capacity (ft^3/event)	Aggradation/ Degradation (cfs)	Aggradation/ Degradation (tons/event)	Aggradation/ Degradation ($yards^3$/event)	Aggradation/ Degradation 2-year Event by Reach (tons/event)	Aggradation/ Degradation 100-year Event by Reach (tons/event)
H-3	H	Arroyo las Positas	22,700	20,800	1,900	30	10.00	0.004300	0.045	2-year	530	2.78	-	160.77	85.90	1.87	85.62	3.30	0.60	6.50	11.30	11.30	6.29	0.0066	0.57	49,086		[Boundary Condition]		[Bounday Condition]	[Bounday Condition]
			22,700	20,800	1,900	30	10.00	0.004300	0.037	100-year	8,200	-	12.24	1,865.38	276.02	6.76	274.80	4.40	0.60	6.50	11.30	11.30	6.29	0.0123	3.39	292,742					
H-2	H	Arroyo las Positas	20,800	14,300	6,500	70	3.00	0.002900	0.045	2-year	600	2.51	-	194.94	85.90	2.27	85.08	3.08	0.50	2.60	9.00	10.10	4.33	0.0079	0.67	57,850	-0.10	-4.8E+02	-3.2E+02	2.1E+03	-1.4E+07
			20,800	14,300	6,500	70	3.00	0.002900	0.037	100-year	8,700	-	10.99	1,131.64	139.51	8.11	135.94	7.69	0.50	2.60	9.00	10.10	4.33	0.1447	19.67	1,699,814	-16.29	-7.7E+04	-5.2E+04		
H-2	H	Arroyo las Positas	14,300	12,500	1,800	40	10.00	0.002700	0.045	2-year	600	3.02	-	212.00	100.70	2.11	100.40	2.83	0.50	2.60	9.00	10.10	4.33	0.0055	0.55	47,329	0.12	5.7E+02	3.9E+02		
			14,300	12,500	1,800	40	10.00	0.002700	0.036	100-year	8,700	-	9.40	1,259.60	228.94	5.50	228.00	6.91	0.50	2.60	9.00	10.10	4.33	0.1024	23.35	2,017,706	-3.68	-1.7E+04	-1.2E+04		
H-2	H	Arroyo las Positas	12,500	9,200	3,300	28	9.00	0.000800	0.044	2-year	600	4.54	-	312.62	110.22	2.84	109.72	1.92	0.50	2.60	9.00	10.10	4.33	0.0012	0.13	11,190	0.42	2.0E+03	1.3E+03		
			12,500	9,200	3,300	28	9.00	0.000800	0.033	100-year	8,700	-	4.32	288.92	106.24	2.72	105.76	30.11	0.50	2.60	9.00	10.10	4.33	27.6903	2,928.53	253,024,927	-2,905.18	-1.4E+07	-9.3E+06		
H-1	H	Arroyo las Positas	9,200	3,500	5,700	10	2.00	0.002500	0.045	2-year	700	6.96	-	166.48	41.13	4.05	37.84	4.21	0.50	2.60	9.00	10.10	4.33	0.0183	0.69	59,720	-0.56	-2.6E+03	-1.8E+03	-2.2E+04	1.3E+07
			9,200	3,500	5,700	10	2.00	0.002500	0.036	100-year	9,200	-	8.92	248.33	49.89	4.98	45.68	37.05	0.50	2.60	9.00	10.10	4.33	47.8152	2,184.20	188,714,542	744.33	3.5E+06	2.4E+06		
H-1	H	Arroyo las Positas	3,500	0	3,500	30	5.50	0.012000	0.044	2-year	700	2.67	-	119.31	59.85	1.99	59.37	5.88	0.50	2.60	9.00	10.10	4.33	0.0818	4.85	419,438	-4.16	-2.0E+04	-1.3E+04		
			3,500	0	3,500	30	5.50	0.012000	0.035	100-year	9,200	-	8.94	707.78	129.95	5.45	128.34	13.00	0.50	2.60	9.00	10.10	4.33	1.0448	134.09	11,585,248	2,050.11	9.7E+06	6.6E+06		
G-60	G	Arroyo Mocho	62,000	55,200	6,800	130	1.25	0.008800	0.042	2-year	245	0.71	-	93.06	132.28	0.70	131.78	2.63	1.60	10.40	12.30	13.00	3.84	0.0026	0.34	29,662		[Boundary Condition]		[Bounday Condition]	[Bounday Condition]
			62,000	55,200	6,800	130	1.25	0.008800	0.036	100-year	4,500	-	9.93	1,414.16	161.79	8.74	154.83	3.18	1.60	10.40	12.30	13.00	3.84	0.0024	0.38	32,410					
G-60	G	Arroyo Mocho	55,200	42,500	12,700	40	1.50	0.008000	0.043	2-year	245	1.50	-	63.38	45.41	1.40	44.50	3.87	1.60	10.40	12.30	13.00	3.84	0.0086	0.38	32,942	-0.04	-1.8E+02	-1.2E+02	2.1E+02	6.1E+02
			55,200	42,500	12,700	40	1.50	0.008000	0.036	100-year	4,500	-	12.82	759.33	86.22	8.81	78.46	5.93	1.60	10.40	12.30	13.00	3.84	0.0218	1.71	147,591	-1.33	-6.3E+03	-4.3E+03		
G-60	G	Arroyo Mocho	42,500	41,000	1,500	60	1.50	0.000880	0.044	2-year	245	2.31	-	146.60	68.33	2.15	66.93	1.67	1.60	10.40	12.30	13.00	3.84	0.0004	0.02	2,038	0.36	1.7E+03	1.1E+03		
			42,500	41,000	1,500	60	1.50	0.000880	0.036	100-year	4,500	-	13.62	1,095.46	109.11	10.04	100.86	4.11	1.60	10.40	12.30	13.00	3.84	0.0056	0.57	48,927	1.14	5.4E+03	3.7E+03		
G-60	G	Arroyo Mocho	41,000	35,000	6,000	65	1.50	0.007100	0.043	2-year	245	1.16	-	77.69	69.20	1.12	68.49	3.15	1.60	10.40	12.30	13.00	3.84	0.0044	0.30	25,849	-0.28	-1.3E+03	-8.8E+02		
			41,000	35,000	6,000	65	1.50	0.007100	0.036	100-year	4,500	-	15.82	1,403.71	122.04	11.50	112.46	3.21	1.60	10.40	12.30	13.00	3.84	0.0022	0.24	21,132	0.32	1.5E+03	1.0E+03		
G-50	G	Arroyo Mocho	35,000	31,000	4,000	40	2.00	0.003800	0.044	2-year	300	2.12	-	93.79	49.48	1.90	48.48	3.20	1.60	10.40	12.30	13.00	3.84	0.0039	0.19	16,157	0.11	5.3E+02	3.6E+02	-3.3E+02	-4.7E+01
			35,000	31,000	4,000	40	2.00	0.003800	0.037	100-year	4,700	-	11.69	740.91	92.28	8.03	86.76	6.34	1.60	10.40	12.30	13.00	3.84	0.0287	2.49	214,883	-2.24	-1.1E+04	-7.2E+03		
G-50	G	Arroyo Mocho	31,000	21,200	9,800	60	2.00	0.003500	0.045	2-year	300	1.75	-	110.79	67.80	1.63	66.98	2.72	1.60	10.40	12.30	13.00	3.84	0.0023	0.15	13,049	0.04	1.7E+02	1.2E+02		
			31,000	21,200	9,800	60	2.00	0.003500	0.038	100-year	4,700	-	12.27	1,037.31	114.87	9.03	109.08	4.53	1.60	10.40	12.30	13.00	3.84	0.0083	0.90	78,004	1.58	7.5E+03	5.1E+03		
G-50	G	Arroyo Mocho	21,200	17,686	3,514	70	3.00	0.007700	0.045	2-year	300	1.25	-	92.19	77.91	1.18	77.50	3.25	1.60	10.40	12.30	13.00	3.84	0.0048	0.37	31,980	-0.22	-1.0E+03	-7.0E+02		
			21,200	17,686	3,514	70	3.00	0.007700	0.038	100-year	4,700	-	14.19	1,597.37	159.75	10.00	155.14	2.94	1.60	10.40	12.30	13.00	3.84	0.0016	0.25	22,000	0.65	3.1E+03	2.1E+03		
G-40	G	Arroyo Mocho	17,350	15,000	2,350	60	2.50	0.008100	0.048	2-year	1,000	2.86	-	191.68	75.37	2.54	74.28	5.20	1.40	6.00	10.50	10.60	3.02	0.0263	1.95	168,752	3.27	1.5E+04	1.0E+04	1.5E+04	6.2E+05
			17,350	15,000	2,350	60	2.50	0.008100	0.039	100-year	11,600	-	19.58	2,133.24	165.44	12.89	157.90	5.44	1.40	6.00	10.50	10.60	3.02	0.0176	2.79	240,790	131.56	6.2E+05	4.2E+05		
G-30	G	Arroyo Mocho	15,000	12,686	2,314	60	2.60	0.000810	0.047	2-year	1,100	5.79	-	434.11	92.23	4.71	90.08	2.53	1.40	6.00	10.50	10.60	3.02	0.0015	0.14	12,053	1.81	8.5E+03	5.8E+03	7.4E+03	-2.3E+04
			15,000	12,686	2,314	60	2.60	0.000810	0.038	100-year	12,000	-	17.60	1,861.38	158.06	11.78	151.52	6.45	1.40	6.00	10.50	10.60	3.02	0.0339	5.13	443,602	-2.35	-1.1E+04	-7.5E+03		
G-30	G	Arroyo Mocho	12,686	10,151	2,535	60	2.00	0.001400	0.046	2-year	1,100	4.97	-	347.20	82.20	4.22	79.86	3.17	1.40	6.00	10.50	10.60	3.02	0.0037	0.29	25,199	-0.15	-7.2E+02	-4.9E+02		
			12,686	10,151	2,535	60	2.00	0.001400	0.038	100-year	12,000	-	16.30	1,509.38	132.90	11.36	125.20	7.95	1.40	6.00	10.50	10.60	3.02	0.0745	9.32	805,512	-4.19	-2.0E+04	-1.3E+04		
G-30	G	Arroyo Mocho	10,151	7,000	3,151	60	2.00	0.001660	0.045	2-year	1,100	4.67	-	323.50	80.87	4.00	78.66	3.40	1.40	6.00	10.50	10.60	3.02	0.0048	0.38	32,743	-0.09	-4.1E+02	-2.8E+02		
			10,151	7,000	3,151	60	2.00	0.001660	0.038	100-year	12,000	-	17.02	1,600.56	136.12	11.76	128.08	7.50	1.40	6.00	10.50	10.60	3.02	0.0594	7.60	656,941	1.72	8.1E+03	5.5E+03		
G-20	G	Arroyo Mocho	7,000	4,000	3,000	60	2.00	0.000940	0.047	2-year	1,400	6.48	-	472.95	88.99	5.31	85.93	2.96	1.40	6.00	10.50	10.60	3.02	0.0026	0.23	19,616	0.15	7.2E+02	4.9E+02	7.2E+02	3.1E+03
			7,000	4,000	3,000	60	2.00	0.000940	0.039	100-year	15,100	-	20.67	2,094.70	152.44	13.74	142.68	7.21	1.40	6.00	10.50	10.60	3.02	0.0486	6.94	599,367	0.67	3.1E+03	2.1E+03		
G-10	G	Arroyo Mocho	4,000	0	4,000	60	2.00	0.001300	0.047	2-year	1,500	6.15	-	444.22	87.48	5.08	84.58	3.38	1.40	6.00	10.50	10.60	3.02	0.0043	0.37	31,717	-0.14	-6.6E+02	-4.5E+02	-6.6E+02	1.4E+04
			4,000	0	4,000	60	2.00	0.001300	0.039	100-year	15,500	-	23.58	2,526.83	165.45	15.27	154.32	6.13	1.40	6.00	10.50	10.60	3.02	0.0260	4.01	346,176	2.93	1.4E+04	9.4E+03		
F-10	F	Alamo Canal	1,100	0	1,100	30	2.50	0.001420	0.047	2-year	1,200	7.17	-	343.62	68.61	5.01	65.85	3.50	0.50	2.10	10.10	10.90	4.50	0.0107	0.71	60,944		[Boundary Condition]		[Bounday Condition]	[Bounday Condition]
			1,100	0	1,100	30	2.50	0.001420	0.038	100-year	5,400	-	16.98	1,230.20	121.44	10.13	114.90	4.39	0.50	2.10	10.10	10.90	4.50	0.0191	2.20	189,878					
B-70	B	Arroyo de la Laguna	39,200	37,300	1,900	80	2.00	0.007500	0.043	2-year	2,700	4.21	-	371.76	98.81	3.76	96.82	7.26	0.50	1.00	3.70	10.00	2.85	0.2301	22.28	1,925,197	-21.21	-1.0E+05	-6.8E+04	-1.0E+05	-8.1E+03
			39,200	37,300	1,900	80	2.00	0.007500	0.037	100-year	20,900	-	28.87	3,976.55	209.11	19.02	195.48	5.26	0.50	1.00	3.70	10.00	2.85	0.0405	7.92	683,912	-1.71	-8.1E+03	-5.5E+03		
B-60	B	Arroyo de la Laguna	37,300	33,500	3,800	80	2.00	0.007500	0.044	2-year	2,700	4.26	-	377.29	99.06	3.81	97.05	7.15	0.50	1.00	3.70	10.00	2.85	0.2171	21.07	1,820,648	1.21	5.7E+03	3.9E+03	5.7E+03	1.1E+04
			37,300	33,500	3,800	80	2.00	0.007500	0.038	100-year	20,900	-	31.09	4,420.38	219.04	20.18	204.36	4.73	0.50	1.00	3.70	10.00	2.85	0.0269	5.50	475,595	2.41	1.1E+04	7.7E+03		
B-50	B	Arroyo de la Laguna	33,500	30,790	2,710	55	1.50	0.001900	0.044	2-year	3,000	8.46	-	572.26	85.48	6.69	80.37	5.24	0.50	1.00	3.70	10.00	2.85	0.0573	4.61	397,883	16.47	7.8E+04	5.3E+04	7.8E+04	-1.8E+04
			33,500	30,790	2,710	55	1.50	0.001900	0.038	100-year	22,700	-	35.62	3,862.28	183.43	21.06	161.86	5.88	0.50	1.00	3.70	10.00	2.85	0.0573	9.27	801,231	-3.77	-1.8E+04	-1.2E+04		
B-40	B	Arroyo de la Laguna	30,790	23,820	6,970	30	1.50	0.001200	0.045	2-year	3,100	13.13	-	652.15	77.32	8.43	69.38	4.75	0.50	1.00	3.70	10.00	2.85	0.0352	2.45	211,260	2.16	1.0E+04	6.9E+03	1.0E+04	-1.1E+05
			30,790	23,820	6,970	30	1.50	0.001200	0.038	100-year	23,000	-	33.02	2,626.08	149.06	17.62	129.06	8.76	0.50	1.00	3.70	10.00	2.85	0.2512	32.42	2,800,736	-23.14	-1.1E+05	-7.4E+04		
B-30	B	Arroyo de la Laguna	23,820	17,845	5,975	40	1.00	0.001700	0.045	2-year	3,200	11.34	-	582.20	72.07	8.08	62.68	5.50	0.50	1.00	3.70	10.00	2.85	0.0625	3.92	338,526	-1.47	-6.9E+03	-4.7E+03	-6.2E+03	-1.2E+05
			23,820	17,845	5,975	40	1.00	0.001700	0.037	100-year	23,300	-	29.27	2,027.53	122.79	16.51	98.54	11.49	0.50	1.00	3.70	10.00	2.85	0.7010	69.08	5,968,426	-36.66	-1.7E+05	-1.2E+05		
B-30	B	Arroyo de la Laguna	17,845	9,960	7,885	50	2.00	0.002500	0.047	2-year	3,200	8.60	-	577.75	88.45	6.53	84.39	5.54	0.80	2.40	5.60	7.00	2.67	0.0396	3.35	289,044	0.57	2.7E+03	1.8E+03		
			17,845	9,960	7,885	50	2.00	0.002500	0.038	100-year	23,300	-	26.27	2,693.73	167.48	16.08	155.08	8.65	0.80	2.40	5.60	7.00	2.67	0.1459	22.63	1,954,979	46.45	2.2E+05	1.5E+05		
B-30	B	Arroyo de la Laguna	9,960	3,225	6,735	30	2.00	0.002800	0.047	2-year	3,200	10.38	-	526.75	76.41	6.89	71.51	6.08	0.80	2.40	5.60	7.00	2.67	0.0526	3.76	325,175	-0.42	-2.0E+03	-1.3E+03		
			9,960	3,225	6,735	30	2.00	0.002800	0.038	100-year	23,300	-	24.85	1,980.55	141.13	14.03	129.40	11.76	0.80	2.40	5.60	7.00	2.67	0.4556	58.96	5,093,836	-36.33	-1.7E+05	-1.2E+05		
B-10	B	Arroyo de la Laguna	3,225	200	3,025	10	3.00	0.005000	0.047	2-year	3,300	10.76	-	454.71	78.03	5.83	74.54	7.26	0.80	2.40	5.60	7.00	2.67	0.0997	7.43	642,065	-3.67	-1.7E+04	-1.2E+04	-1.7E+04	-4.4E+05
			3,225	200	3,025	10	3.00	0.005000	0.037	100-year	24,100	-	21.74	1,635.28	147.50	11.09	140.44	14.74	0.80	2.40	5.60	7.00	2.67	1.0780	151.39	13,079,895	-92.43	-4.4E+05	-3.0E+05		

[1] Calculated by interpolation from flows provided in Table TM5A-5 of West Yost & Associates, November 2001 (Appendices)

Scenario C: Existing Development + Existing Channel Capacity

	CHANNEL DATA									FLOW DATA									BED MATERIAL DATA					SEDIMENT TRANSPORT DATA						SUMMARY RESULTS	
	Line	Channel Name	US Station	DS Station	[L] Reach Length (ft)	[b] Bottom Width (ft)	[z] Side Slopes (_H:1V)	[S] Bed Slope	Manning's n	Event (yr)	[Q] Flow (cfs)	[d] Manning Depth (ft)	[d] Backwater Depth (WYA)[1] (ft)	[A] Area (ft^2)	[P] Wetted Perimeter (ft)	[R_h] Hydraulic Radius (ft)	Top Width (ft)	[V] Velocity (ft/s)	d_{16} (mm)	d_{50} (mm)	d_{84} (mm)	d_{90} (mm)	Gr	Reach Capacity (cfs/ft)	Reach Capacity (cfs)	Reach Capacity (ft^3/event)	Aggradation/ Degradation (cfs)	Aggradation/ Degradation (tons/event)	Aggradation/ Degradation ($yards^3$/event)	Aggradation/ Degradation 2-year Event by Reach (tons/event)	Aggradation/ Degradation 100-year Event by Reach (tons/event)
H-3	H	Arroyo las Positas	22,700	20,800	1,900	30	10.00	0.004300	0.045	2-year	530	2.78	-	160.77	85.90	1.87	85.62	3.30	0.60	6.50	11.30	11.30	6.29	0.0066	0.57	49,086		[Boundary Condition]		[Bounday Condition]	[Bounday Condition]
			22,700	20,800	1,900	30	10.00	0.004300	0.037	100-year	8,200	8.88	-	1,053.91	208.39	5.06	207.50	7.78	0.60	6.50	11.30	11.30	6.29	0.1088	22.57	1,949,991					
H-2	H	Arroyo las Positas	20,800	14,300	6,500	70	3.00	0.002900	0.045	2-year	600	2.47	-	190.78	85.59	2.23	84.79	3.04	0.50	2.60	9.00	10.10	4.33	0.0076	0.64	55,500	-0.07	-3.5E+02	-2.4E+02	2.1E+03	1.0E+05
			20,800	14,300	6,500	70	3.00	0.002900	0.037	100-year	8,200	4.25	-	351.69	96.88	3.63	95.50	5.12	0.50	2.60	9.00	10.10	4.33	0.0433	4.14	357,322	18.43	8.7E+04	5.9E+04		
H-2	H	Arroyo las Positas	14,300	12,500	1,800	40	10.00	0.002700	0.045	2-year	600	2.97	-	207.41	99.78	2.08	99.48	2.80	0.50	2.60	9.00	10.10	4.33	0.0053	0.53	45,671	0.11	5.4E+02	3.6E+02		
			14,300	12,500	1,800	40	10.00	0.002700	0.036	100-year	1,800	4.64	-	401.16	133.30	3.01	132.84	4.48	0.50	2.60	9.00	10.10	4.33	0.0259	3.45	297,771	0.69	3.2E+03	2.2E+03		
H-2	H	Arroyo las Positas	12,500	9,200	3,300	28	9.00	0.000800	0.044	2-year	600	4.47	-	304.99	108.96	2.80	108.46	1.90	0.50	2.60	9.00	10.10	4.33	0.0011	0.12	10,761	0.40	1.9E+03	1.3E+03		
			12,500	9,200	3,300	28	9.00	0.000800	0.033	100-year	1,800	6.56	-	570.25	146.72	3.89	145.99	3.16	0.50	2.60	9.00	10.10	4.33	0.0065	0.95	82,340	2.49	1.2E+04	8.0E+03		
H-1	H	Arroyo las Positas	9,200	3,500	5,700	10	2.00	0.002500	0.045	2-year	700	6.62	-	153.85	39.61	3.88	36.48	4.09	0.50	2.60	9.00	10.10	4.33	0.0168	0.61	52,837	-0.49	-2.3E+03	-1.6E+03	-2.0E+04	-1.6E+05
			9,200	3,500	5,700	10	2.00	0.002500	0.036	100-year	2,300	10.81	-	341.97	58.36	5.86	53.25	6.73	0.50	2.60	9.00	10.10	4.33	0.0893	4.75	410,808	-3.80	-1.8E+04	-1.2E+04		
H-1	H	Arroyo las Positas	3,500	0	3,500	30	5.50	0.012000	0.044	2-year	700	2.52	-	110.53	58.17	1.90	57.72	5.69	0.50	2.60	9.00	10.10	4.33	0.0740	4.27	368,933	-3.66	-1.7E+04	-1.2E+04		
			3,500	0	3,500	30	5.50	0.012000	0.035	100-year	2,300	4.39	-	237.31	79.03	3.00	78.24	9.71	0.50	2.60	9.00	10.10	4.33	0.4424	34.61	2,990,621	-29.86	-1.4E+05	-9.6E+04		
G-60	G	Arroyo Mocho	62,000	55,200	6,800	130	1.25	0.008800	0.042	2-year	250	0.72	-	94.25	132.31	0.71	131.80	2.65	1.60	10.40	12.30	13.00	3.84	0.0027	0.35	30,468		[Boundary Condition]		[Bounday Condition]	[Bounday Condition]
			62,000	55,200	6,800	130	1.25	0.008800	0.036	100-year	4,500	3.72	-	500.48	141.90	3.53	139.29	9.00	1.60	10.40	12.30	13.00	3.84	0.1431	19.93	1,721,611					
G-60	G	Arroyo Mocho	55,200	42,500	12,700	40	1.50	0.008000	0.043	2-year	250	1.51	-	63.82	45.44	1.40	44.53	3.89	1.60	10.40	12.30	13.00	3.84	0.0087	0.39	33,401	-0.03	-1.6E+02	-1.1E+02	2.1E+02	1.4E+04
			55,200	42,500	12,700	40	1.50	0.008000	0.036	100-year	4,500	7.45	-	380.94	66.84	5.70	62.34	11.81	1.60	10.40	12.30	13.00	3.84	0.3159	19.69	1,701,422	0.23	1.1E+03	7.5E+02		
G-60	G	Arroyo Mocho	42,500	41,000	1,500	60	1.50	0.000880	0.044	2-year	250	2.34	-	148.28	68.42	2.17	67.01	1.68	1.60	10.40	12.30	13.00	3.84	0.0004	0.02	2,084	0.36	1.7E+03	1.2E+03		
			42,500	41,000	1,500	60	1.50	0.000880	0.036	100-year	4,500	11.31	-	870.66	100.79	8.64	93.94	5.17	1.60	10.40	12.30	13.00	3.84	0.0137	1.29	111,262	18.40	8.7E+04	5.9E+04		
G-60	G	Arroyo Mocho	41,000	35,000	6,000	65	1.50	0.007100	0.043	2-year	250	1.18	-	78.79	69.25	1.14	68.54	3.18	1.60	10.40	12.30	13.00	3.84	0.0045	0.31	26,605	-0.28	-1.3E+03	-9.1E+02		
			41,000	35,000	6,000	65	1.50	0.007100	0.036	100-year	4,500	5.92	-	437.54	86.35	5.07	82.77	10.29	1.60	10.40	12.30	13.00	3.84	0.2040	16.88	1,458,534	-15.59	-7.3E+04	-5.0E+04		
G-50	G	Arroyo Mocho	35,000	31,000	4,000	40	2.00	0.003800	0.044	2-year	300	2.12	-	93.79	49.48	1.90	48.48	3.20	1.60	10.40	12.30	13.00	3.84	0.0039	0.19	16,157	0.12	5.7E+02	3.9E+02	-2.9E+02	6.9E+04
			35,000	31,000	4,000	40	2.00	0.003800	0.037	100-year	900	3.64	-	172.10	56.28	3.06	54.56	5.23	1.60	10.40	12.30	13.00	3.84	0.0199	1.08	93,696	15.80	7.4E+04	5.1E+04		
G-50	G	Arroyo Mocho	31,000	21,200	9,800	60	2.00	0.003500	0.045	2-year	300	1.75	-	110.79	67.80	1.63	66.98	2.72	1.60	10.40	12.30	13.00	3.84	0.0023	0.15	13,049	0.04	1.7E+02	1.2E+02		
			31,000	21,200	9,800	60	2.00	0.003500	0.038	100-year	900	3.02	-	199.44	73.51	2.71	72.08	4.51	1.60	10.40	12.30	13.00	3.84	0.0122	0.88	76,265	0.20	9.5E+02	6.5E+02		
G-50	G	Arroyo Mocho	21,200	17,686	3,514	70	3.00	0.007700	0.045	2-year	300	1.25	-	92.19	77.91	1.18	77.50	3.25	1.60	10.40	12.30	13.00	3.84	0.0048	0.37	31,980	-0.22	-1.0E+03	-7.0E+02		
			21,200	17,686	3,514	70	3.00	0.007700	0.038	100-year	900	2.17	-	165.86	83.71	1.98	83.01	5.43	1.60	10.40	12.30	13.00	3.84	0.0265	2.20	189,699	-1.31	-6.2E+03	-4.2E+03		
G-40	G	Arroyo Mocho	17,350	15,000	2,350	60	2.50	0.008100	0.048	2-year	1,000	2.74	-	183.17	74.76	2.45	73.70	5.08	1.40	6.00	10.50	10.60	3.02	0.0243	1.79	154,806	2.85	1.3E+04	9.1E+03	1.3E+04	1.1E+05
			17,350	15,000	2,350	60	2.50	0.008100	0.039	100-year	3,200	4.97	-	360.29	86.79	4.15	84.87	8.88	1.40	6.00	10.50	10.60	3.02	0.1574	13.36	1,154,368	23.45	1.1E+05	7.5E+04		
G-30	G	Arroyo Mocho	15,000	12,686	2,314	60	2.60	0.000810	0.047	2-year	1,100	5.79	-	434.56	92.26	4.71	90.11	2.54	1.40	6.00	10.50	10.60	3.02	0.0016	0.14	12,075	1.65	7.8E+03	5.3E+03	6.7E+03	5.2E+04
			15,000	12,686	2,314	60	2.60	0.000810	0.038	100-year	3,600	9.92	-	850.83	115.26	7.38	111.57	4.23	1.40	6.00	10.50	10.60	3.02	0.0086	0.96	82,923	12.40	5.8E+04	4.0E+04		
G-30	G	Arroyo Mocho	12,686	10,151	2,535	60	2.00	0.001400	0.046	2-year	1,100	4.97	-	347.60	82.23	4.23	79.88	3.17	1.40	6.00	10.50	10.60	3.02	0.0037	0.29	25,251	-0.15	-7.2E+02	-4.9E+02		
			12,686	10,151	2,535	60	2.00	0.001400	0.038	100-year	3,600	8.77	-	680.03	99.22	6.85	95.08	5.29	1.40	6.00	10.50	10.60	3.02	0.0202	1.92	165,924	-0.96	-4.5E+03	-3.1E+03		
G-30	G	Arroyo Mocho	10,151	7,000	3,151	60	2.00	0.001660	0.045	2-year	1,100	4.67	-	323.66	80.88	4.00	78.67	3.40	1.40	6.00	10.50	10.60	3.02	0.0048	0.38	32,772	-0.09	-4.1E+02	-2.8E+02		
			10,151	7,000	3,151	60	2.00	0.001660	0.038	100-year	3,600	8.36	-	641.38	97.39	6.59	93.44	5.61	1.40	6.00	10.50	10.60	3.02	0.0254	2.37	204,774	-0.45	-2.1E+03	-1.4E+03		
G-20	G	Arroyo Mocho	7,000	4,000	3,000	60	2.00	0.000940	0.047	2-year	1,400	6.48	-	473.04	88.99	5.32	85.93	2.96	1.40	6.00	10.50	10.60	3.02	0.0026	0.23	19,623	0.15	7.2E+02	4.9E+02	7.2E+02	-1.4E+03
			7,000	4,000	3,000	60	2.00	0.000940	0.039	100-year	7,700	15.06	-	1,357.33	127.35	10.66	120.24	5.67	1.40	6.00	10.50	10.60	3.02	0.0222	2.67	230,917	-0.30	-1.4E+03	-9.7E+02		
G-10	G	Arroyo Mocho	4,000	0	4,000	60	2.00	0.001300	0.047	2-year	1,500	6.15	-	444.22	87.48	5.08	84.58	3.38	1.40	6.00	10.50	10.60	3.02	0.0043	0.37	31,717	-0.14	-6.6E+02	-4.5E+02	-6.6E+02	-1.4E+03
			4,000	0	4,000	60	2.00	0.001300	0.039	100-year	8,100	-	15.31	1,387.39	128.47	10.80	121.24	5.84	1.40	6.00	10.50	10.60	3.02	0.0246	2.98	257,366	-0.31	-1.4E+03	-9.8E+02		
F-10	F	Alamo Canal	1,100	0	1,100	30	2.50	0.001420	0.047	2-year	1,200	7.17	-	343.29	68.58	5.01	65.83	3.50	0.50	2.10	10.10	10.90	4.50	0.0107	0.70	60,849		[Boundary Condition]		[Bounday Condition]	[Bounday Condition]
			1,100	0	1,100	30	2.50	0.001420	0.038	100-year	5,400	13.69	-	879.04	103.71	8.48	98.44	6.14	0.50	2.10	10.10	10.90	4.50	0.0694	6.83	590,288					
B-70	B	Arroyo de la Laguna	39,200	37,300	1,900	80	2.00	0.007500	0.043	2-year	2,700	4.21	-	371.76	98.81	3.76	96.82	7.26	0.50	1.00	3.70	10.00	2.85	0.2301	22.28	1,925,197	-21.21	-1.0E+05	-6.8E+04	-1.0E+05	2.3E+04
			39,200	37,300	1,900	80	2.00	0.007500	0.037	100-year	13,500	-	22.89	2,879.10	182.37	15.79	171.56	4.69	0.50	1.00	3.70	10.00	2.85	0.0286	4.90	423,293	4.91	2.3E+04	1.6E+04		
B-60	B	Arroyo de la Laguna	37,300	33,500	3,800	80	2.00	0.007500	0.044	2-year	2,700	4.26	-	377.39	99.06	3.81	97.05	7.15	0.50	1.00	3.70	10.00	2.85	0.2172	21.08	1,821,539	1.20	5.6E+03	3.8E+03	5.6E+03	6.0E+03
			37,300	33,500	3,800	80	2.00	0.007500	0.038	100-year	15,000	-	26.43	3,511.49	198.20	17.72	185.72	4.27	0.50	1.00	3.70	10.00	2.85	0.0195	3.62	312,776	1.28	6.0E+03	4.1E+03		
B-50	B	Arroyo de la Laguna	33,500	30,790	2,710	55	1.50	0.001900	0.044	2-year	3,000	8.45	-	572.18	85.48	6.69	80.36	5.24	0.50	1.00	3.70	10.00	2.85	0.0573	4.60	397,786	16.48	7.8E+04	5.3E+04	7.8E+04	-1.3E+04
			33,500	30,790	2,710	55	1.50	0.001900	0.038	100-year	17,200	-	31.39	3,204.45	168.18	19.05	149.17	5.37	0.50	1.00	3.70	10.00	2.85	0.0427	6.37	550,028	-2.75	-1.3E+04	-8.8E+03		
B-40	B	Arroyo de la Laguna	30,790	23,820	6,970	30	1.50	0.001200	0.045	2-year	3,100	13.13	-	652.15	77.32	8.43	69.38	4.75	0.50	1.00	3.70	10.00	2.85	0.0352	2.45	211,260	2.16	1.0E+04	6.9E+03	1.0E+04	-8.5E+04
			30,790	23,820	6,970	30	1.50	0.001200	0.038	100-year	17,500	-	28.94	2,124.49	134.34	15.81	116.82	8.24	0.50	1.00	3.70	10.00	2.85	0.2086	24.37	2,105,663	-18.01	-8.5E+04	-5.8E+04		
B-30	B	Arroyo de la Laguna	23,820	17,845	5,975	40	1.00	0.001700	0.045	2-year	3,200	11.34	-	582.20	72.07	8.08	62.68	5.50	0.50	1.00	3.70	10.00	2.85	0.0625	3.92	338,526	-1.47	-6.9E+03	-4.7E+03	-6.2E+03	-4.3E+04
			23,820	17,845	5,975	40	1.00	0.001700	0.037	100-year	17,800	-	25.18	1,641.23	111.22	14.76	90.36	10.85	0.50	1.00	3.70	10.00	2.85	0.5928	53.57	4,628,346	-29.20	-1.4E+05	-9.3E+04		
B-30	B	Arroyo de la Laguna	17,845	9,960	7,885	50	2.00	0.002500	0.047	2-year	3,200	8.60	-	577.92	88.46	6.53	84.40	5.54	0.80	2.40	5.60	7.00	2.67	0.0397	3.35	289,186	0.57	2.7E+03	1.8E+03		
			17,845	9,960	7,885	50	2.00	0.002500	0.038	100-year	17,800	-	23.67	2,304.04	155.86	14.78	144.68	7.73	0.80	2.40	5.60	7.00	2.67	0.0996	14.40	1,244,536	39.16	1.8E+05	1.3E+05		
B-30	B	Arroyo de la Laguna	9,960	3,225	6,735	30	2.00	0.002800	0.047	2-year	3,200	10.38	-	526.75	76.41	6.89	71.51	6.08	0.80	2.40	5.60	7.00	2.67	0.0526	3.76	325,175	-0.42	-2.0E+03	-1.3E+03		
			9,960	3,225	6,735	30	2.00	0.002800	0.038	100-year	17,800	-	23.00	1,748.00	132.86	13.16	122.00	10.18	0.80	2.40	5.60	7.00	2.67	0.2751	33.56	2,899,920	-19.16	-9.0E+04	-6.1E+04		
B-10	B	Arroyo de la Laguna	3,225	200	3,025	10	3.00	0.005000	0.047	2-year	3,300	10.76	-	454.78	78.04	5.83	74.55	7.26	0.80	2.40	5.60	7.00	2.67	0.0997	7.43	642,229	-3.67	-1.7E+04	-1.2E+04	-1.7E+04	-2.6E+05
			3,225	200	3,025	10	3.00	0.005000	0.037	100-year	18,600	-	20.36	1,447.19	138.77	10.43	132.16	12.85	0.80	2.40	5.60	7.00	2.67	0.6667	88.11	7,612,551	-54.54	-2.6E+05	-1.7E+05		

[1] Calculated by interpolation from flows provided in Table TM5A-12 of West Yost & Associates, November 2001 (Appendices)

Scenario D: Full Build-Out Development + Existing Channel Capacity

	CHANNEL DATA									FLOW DATA									BED MATERIAL DATA					SEDIMENT TRANSPORT DATA						SUMMARY RESULTS	
	Line	Channel Name	US Station	DS Station	[L] Reach Length (ft)	[b] Bottom Width (ft)	[z] Side Slopes (_H:1V)	[S] Bed Slope	Manning's n	Event (yr)	[Q] Flow (cfs)	[d] Manning Depth (ft)	[d] Backwater Depth (WYA)[1] (ft)	[A] Area (ft^2)	[P] Wetted Perimeter (ft)	[R_h] Hydraulic Radius (ft)	Top Width (ft)	[V] Velocity (ft/s)	d_{16} (mm)	d_{50} (mm)	d_{84} (mm)	d_{90} (mm)	Gr	Reach Capacity (cfs/ft)	Reach Capacity (cfs)	Reach Capacity (ft^3/event)	Aggradation/ Degradation (cfs)	Aggradation/ Degradation (tons/event)	Aggradation/ Degradation ($yards^3$/event)	Aggradation/ Degradation 2-year Event by Reach (tons/event)	Aggradation/ Degradation 100-year Event by Reach (tons/event)
H-3	H	Arroyo las Positas	22,700	20,800	1,900	30	10.00	0.004300	0.045	2-year	1,000	3.78	-	255.76	105.88	2.42	105.50	3.91	0.60	6.50	11.30	11.30	6.29	0.0113	1.19	102,982		[Boundary Condition]		[Bounday Condition]	[Bounday Condition]
			22,700	20,800	1,900	30	10.00	0.004300	0.037	100-year	9,000	9.24	-	1,129.90	215.62	5.24	214.70	7.97	0.60	6.50	11.30	11.30	6.29	0.1172	25.17	2,174,439					
H-2	H	Arroyo las Positas	20,800	14,300	6,500	70	3.00	0.002900	0.045	2-year	1,100	3.58	-	288.87	92.63	3.12	91.47	3.81	0.50	2.60	9.00	10.10	4.33	0.0154	1.41	121,666	-0.22	-1.0E+03	-6.9E+02	4.4E+03	1.1E+05
			20,800	14,300	6,500	70	3.00	0.002900	0.037	100-year	1,800	4.25	-	351.69	96.88	3.63	95.50	5.12	0.50	2.60	9.00	10.10	4.33	0.0433	4.14	357,322	21.03	9.9E+04	6.7E+04		
H-2	H	Arroyo las Positas	14,300	12,500	1,800	40	10.00	0.002700	0.045	2-year	1,100	4.08	-	329.66	122.01	2.70	121.60	3.34	0.50	2.60	9.00	10.10	4.33	0.0092	1.12	96,418	0.29	1.4E+03	9.4E+02		
			14,300	12,500	1,800	40	10.00	0.002700	0.036	100-year	1,800	4.64	-	401.43	133.34	3.01	132.88	4.48	0.50	2.60	9.00	10.10	4.33	0.0260	3.45	298,085	0.69	3.2E+03	2.2E+03		
H-2	H	Arroyo las Positas	12,500	9,200	3,300	28	9.00	0.000800	0.044	2-year	1,100	5.98	-	489.83	136.37	3.59	135.71	2.25	0.50	2.60	9.00	10.10	4.33	0.0019	0.26	22,696	0.85	4.0E+03	2.7E+03		
			12,500	9,200	3,300	28	9.00	0.000800	0.033	100-year	1,800	6.56	-	570.25	146.72	3.89	145.99	3.16	0.50	2.60	9.00	10.10	4.33	0.0065	0.95	82,340	2.50	1.2E+04	8.0E+03		
H-1	H	Arroyo las Positas	9,200	3,500	5,700	10	2.00	0.002500	0.045	2-year	1,200	8.93	-	248.56	49.91	4.98	45.70	4.83	0.50	2.60	9.00	10.10	4.33	0.0281	1.29	111,089	-1.02	-4.8E+03	-3.3E+03	-4.2E+04	-1.6E+05
			9,200	3,500	5,700	10	2.00	0.002500	0.036	100-year	2,300	10.82	-	342.08	58.37	5.86	53.26	6.73	0.50	2.60	9.00	10.10	4.33	0.0893	4.76	411,006	-3.80	-1.8E+04	-1.2E+04		
H-1	H	Arroyo las Positas	3,500	0	3,500	30	5.50	0.012000	0.044	2-year	1,200	3.54	-	174.95	69.55	2.52	68.91	6.86	0.50	2.60	9.00	10.10	4.33	0.1327	9.15	790,278	-7.86	-3.7E+04	-2.5E+04		
			3,500	0	3,500	30	5.50	0.012000	0.035	100-year	2,300	4.38	-	237.07	78.99	3.00	78.20	9.70	0.50	2.60	9.00	10.10	4.33	0.4419	34.56	2,985,847	-29.80	-1.4E+05	-9.5E+04		
G-60	G	Arroyo Mocho	62,000	55,200	6,800	130	1.25	0.008800	0.042	2-year	350	0.88	-	115.37	132.82	0.87	132.20	3.03	1.60	10.40	12.30	13.00	3.84	0.0041	0.54	46,717		[Boundary Condition]		[Bounday Condition]	[Bounday Condition]
			62,000	55,200	6,800	130	1.25	0.008800	0.036	100-year	4,700	3.81	-	514.00	142.21	3.61	139.54	9.14	1.60	10.40	12.30	13.00	3.84	0.1507	21.03	1,816,817					
G-60	G	Arroyo Mocho	55,200	42,500	12,700	40	1.50	0.008000	0.043	2-year	350	1.85	-	79.13	46.67	1.70	45.55	4.41	1.60	10.40	12.30	13.00	3.84	0.0129	0.59	50,953	-0.05	-2.3E+02	-1.6E+02	3.4E+02	1.5E+04
			55,200	42,500	12,700	40	1.50	0.008000	0.036	100-year	4,700	7.63	-	392.53	67.51	5.81	62.89	11.97	1.60	10.40	12.30	13.00	3.84	0.3293	20.71	1,789,501	0.32	1.5E+03	1.0E+03		
G-60	G	Arroyo Mocho	42,500	41,000	1,500	60	1.50	0.000880	0.044	2-year	350	2.86	-	183.66	70.30	2.61	68.57	1.91	1.60	10.40	12.30	13.00	3.84	0.0005	0.04	3,170	0.55	2.6E+03	1.8E+03		
			42,500	41,000	1,500	60	1.50	0.000880	0.036	100-year	4,700	11.59	-	897.27	101.80	8.81	94.78	5.24	1.60	10.40	12.30	13.00	3.84	0.0143	1.35	117,043	19.36	9.1E+04	6.2E+04		
G-60	G	Arroyo Mocho	41,000	35,000	6,000	65	1.50	0.007100	0.043	2-year	350	1.44	-	96.71	70.19	1.38	69.32	3.62	1.60	10.40	12.30	13.00	3.84	0.0068	0.47	40,474	-0.43	-2.0E+03	-1.4E+03		
			41,000	35,000	6,000	65	1.50	0.007100	0.036	100-year	4,700	6.07	-	450.15	86.90	5.18	83.22	10.44	1.60	10.40	12.30	13.00	3.84	0.2137	17.78	1,536,256	-16.43	-7.7E+04	-5.3E+04		
G-50	G	Arroyo Mocho	35,000	31,000	4,000	40	2.00	0.003800	0.044	2-year	370	2.40	-	107.52	50.73	2.12	49.60	3.44	1.60	10.40	12.30	13.00	3.84	0.0049	0.24	20,924	0.23	1.1E+03	7.2E+02	-7.7E+01	7.3E+04
			35,000	31,000	4,000	40	2.00	0.003800	0.037	100-year	900	3.64	-	172.10	56.28	3.06	54.56	5.23	1.60	10.40	12.30	13.00	3.84	0.0199	1.08	93,696	16.70	7.9E+04	5.3E+04		
G-50	G	Arroyo Mocho	31,000	21,200	9,800	60	2.00	0.003500	0.045	2-year	370	1.97	-	125.96	68.81	1.83	67.88	2.93	1.60	10.40	12.30	13.00	3.84	0.0029	0.19	16,834	0.05	2.2E+02	1.5E+02		
			31,000	21,200	9,800	60	2.00	0.003500	0.038	100-year	900	3.02	-	199.44	73.51	2.71	72.08	4.51	1.60	10.40	12.30	13.00	3.84	0.0122	0.88	76,265	0.20	9.5E+02	6.5E+02		
G-50	G	Arroyo Mocho	21,200	17,686	3,514	70	3.00	0.007700	0.045	2-year	370	1.42	-	105.45	78.98	1.34	78.52	3.52	1.60	10.40	12.30	13.00	3.84	0.0062	0.48	41,883	-0.29	-1.4E+03	-9.3E+02		
			21,200	17,686	3,514	70	3.00	0.007700	0.038	100-year	900	2.17	-	165.61	83.69	1.98	82.99	5.42	1.60	10.40	12.30	13.00	3.84	0.0264	2.19	189,146	-1.31	-6.2E+03	-4.2E+03		
G-40	G	Arroyo Mocho	17,350	15,000	2,350	60	2.50	0.008100	0.048	2-year	1,400	3.48	-	239.08	78.74	3.04	77.40	5.86	1.40	6.00	10.50	10.60	3.02	0.0382	2.96	255,602	6.67	3.1E+04	2.1E+04	3.1E+04	1.1E+05
			17,350	15,000	2,350	60	2.50	0.008100	0.039	100-year	3,200	4.98	-	360.38	86.79	4.15	84.88	8.88	1.40	6.00	10.50	10.60	3.02	0.1575	13.37	1,154,856	23.38	1.1E+05	7.5E+04		
G-30	G	Arroyo Mocho	15,000	12,686	2,314	60	2.60	0.000810	0.047	2-year	1,600	7.14	-	560.95	99.78	5.62	97.13	2.85	1.40	6.00	10.50	10.60	3.02	0.0022	0.22	18,838	2.74	1.3E+04	8.8E+03	1.1E+04	5.2E+04
			15,000	12,686	2,314	60	2.60	0.000810	0.038	100-year	3,600	9.92	-	850.83	115.26	7.38	111.57	4.23	1.40	6.00	10.50	10.60	3.02	0.0086	0.96	82,923	12.41	5.8E+04	4.0E+04		
G-30	G	Arroyo Mocho	12,686	10,151	2,535	60	2.00	0.001400	0.046	2-year	1,600	6.17	-	446.00	87.58	5.09	84.66	3.59	1.40	6.00	10.50	10.60	3.02	0.0054	0.46	39,555	-0.24	-1.1E+03	-7.7E+02		
			12,686	10,151	2,535	60	2.00	0.001400	0.038	100-year	3,600	8.77	-	680.03	99.22	6.85	95.08	5.29	1.40	6.00	10.50	10.60	3.02	0.0202	1.92	165,924	-0.96	-4.5E+03	-3.1E+03		
G-30	G	Arroyo Mocho	10,151	7,000	3,151	60	2.00	0.001660	0.045	2-year	1,600	5.80	-	415.28	85.94	4.83	83.20	3.86	1.40	6.00	10.50	10.60	3.02	0.0072	0.60	51,489	-0.14	-6.5E+02	-4.4E+02		
			10,151	7,000	3,151	60	2.00	0.001660	0.038	100-year	3,600	8.36	-	641.38	97.39	6.59	93.44	5.61	1.40	6.00	10.50	10.60	3.02	0.0254	2.37	204,774	-0.45	-2.1E+03	-1.4E+03		
G-20	G	Arroyo Mocho	7,000	4,000	3,000	60	2.00	0.000940	0.047	2-year	2,000	7.94	-	602.67	95.52	6.31	91.77	3.32	1.40	6.00	10.50	10.60	3.02	0.0038	0.35	29,985	0.25	1.2E+03	8.0E+02	1.2E+03	-1.4E+03
			7,000	4,000	3,000	60	2.00	0.000940	0.039	100-year	7,700	15.06	-	1,357.33	127.35	10.66	120.24	5.67	1.40	6.00	10.50	10.60	3.02	0.0222	2.67	230,917	-0.30	-1.4E+03	-9.7E+02		
G-10	G	Arroyo Mocho	4,000	0	4,000	60	2.00	0.001300	0.047	2-year	2,200	7.65	-	575.77	94.20	6.11	90.59	3.82	1.40	6.00	10.50	10.60	3.02	0.0064	0.58	50,060	-0.23	-1.1E+03	-7.4E+02	-1.1E+03	7.1E+03
			4,000	0	4,000	60	2.00	0.001300	0.039	100-year	8,100	-	18.68	1,818.68	143.54	12.67	134.72	4.45	1.40	6.00	10.50	10.60	3.02	0.0086	1.16	100,506	1.51	7.1E+03	4.8E+03		
F-10	P	Alamo Canal	1,100	0	1,100	30	2.50	0.001420	0.047	2-year	1,500	8.05	-	403.16	73.32	5.50	70.23	3.72	0.50	2.10	10.10	10.90	4.50	0.0130	0.91	78,890		[Boundary Condition]		[Bounday Condition]	[Bounday Condition]
			1,100	0	1,100	30	2.50	0.001420	0.038	100-year	6,500	-	15.34	1,048.49	112.61	9.31	106.70	6.20	0.50	2.10	10.10	10.90	4.50	0.0695	7.41	640,269					
B-70	B	Arroyo de la Laguna	39,200	37,300	1,900	80	2.00	0.007500	0.043	2-year	3,700	5.06	-	456.01	102.63	4.44	100.24	8.11	0.50	1.00	3.70	10.00	2.85	0.3269	32.77	2,831,142	-31.28	-1.5E+05	-1.0E+05	-1.5E+05	2.5E+04
			39,200	37,300	1,900	80	2.00	0.007500	0.037	100-year	14,600	-	26.32	3,491.08	197.71	17.66	185.28	4.18	0.50	1.00	3.70	10.00	2.85	0.0181	3.35	289,149	5.23	2.5E+04	1.7E+04		
B-60	B	Arroyo de la Laguna	37,300	33,500	3,800	80	2.00	0.007500	0.044	2-year	3,700	5.13	-	463.03	102.94	4.50	100.52	7.99	0.50	1.00	3.70	10.00	2.85	0.3084	31.00	2,678,807	1.76	8.3E+03	5.6E+03	8.3E+03	8.0E+02
			37,300	33,500	3,800	80	2.00	0.007500	0.038	100-year	16,200	-	28.77	3,957.03	208.66	18.96	195.08	4.09	0.50	1.00	3.70	10.00	2.85	0.0163	3.18	274,503	0.17	8.0E+02	5.4E+02		
B-50	B	Arroyo de la Laguna	33,500	30,790	2,710	55	1.50	0.001900	0.044	2-year	4,100	10.11	-	708.94	91.43	7.75	85.32	5.78	0.50	1.00	3.70	10.00	2.85	0.0778	6.64	573,472	24.37	1.1E+05	7.8E+04	1.1E+05	-1.6E+04
			33,500	30,790	2,710	55	1.50	0.001900	0.038	100-year	18,600	-	33.09	3,462.37	174.31	19.86	154.27	5.37	0.50	1.00	3.70	10.00	2.85	0.0422	6.50	561,916	-3.33	-1.6E+04	-1.1E+04		
B-40	B	Arroyo de la Laguna	30,790	23,820	6,970	30	1.50	0.001200	0.045	2-year	4,200	15.35	-	814.09	85.35	9.54	76.06	5.16	0.50	1.00	3.70	10.00	2.85	0.0454	3.46	298,530	3.18	1.5E+04	1.0E+04	1.5E+04	-8.3E+04
			30,790	23,820	6,970	30	1.50	0.001200	0.038	100-year	18,900	-	30.54	2,315.24	140.11	16.52	121.62	8.16	0.50	1.00	3.70	10.00	2.85	0.1987	24.17	2,088,327	-17.67	-8.3E+04	-5.7E+04		
B-30	B	Arroyo de la Laguna	23,820	17,845	5,975	40	1.00	0.001700	0.045	2-year	4,400	13.60	-	729.09	78.47	9.29	67.20	6.03	0.50	1.00	3.70	10.00	2.85	0.0834	5.60	484,003	-2.15	-1.0E+04	-6.9E+03	-9.3E+03	-7.1E+04
			23,820	17,845	5,975	40	1.00	0.001700	0.037	100-year	19,200	-	26.48	1,760.39	114.90	15.32	92.96	10.91	0.50	1.00	3.70	10.00	2.85	0.5964	55.44	4,789,831	-31.27	-1.5E+05	-1.0E+05		
B-30	B	Arroyo de la Laguna	17,845	9,960	7,885	50	2.00	0.002500	0.047	2-year	4,400	10.24	-	722.08	95.81	7.54	90.98	6.09	0.80	2.40	5.60	7.00	2.67	0.0534	4.85	419,472	0.75	3.5E+03	2.4E+03		
			17,845	9,960	7,885	50	2.00	0.002500	0.038	100-year	19,200	-	24.48	2,422.54	159.48	15.19	147.92	7.93	0.80	2.40	5.60	7.00	2.67	0.1082	16.01	1,383,254	39.43	1.9E+05	1.3E+05		
B-30	B	Arroyo de la Laguna	9,960	3,225	6,735	30	2.00	0.002800	0.047	2-year	4,400	12.20	-	663.92	84.57	7.85	78.81	6.63	0.80	2.40	5.60	7.00	2.67	0.0689	5.43	469,097	-0.57	-2.7E+03	-1.8E+03		
			9,960	3,225	6,735	30	2.00	0.002800	0.038	100-year	19,200	-	23.51	1,810.74	135.14	13.40	124.04	10.60	0.80	2.40	5.60	7.00	2.67	0.3169	39.30	3,395,811	-23.29	-1.1E+05	-7.5E+04		
B-10	B	Arroyo de la Laguna	3,225	200	3,025	10	3.00	0.005000	0.047	2-year	4,600	12.37	-	583.00	88.25	6.61	84.24	7.89	0.80	2.40	5.60	7.00	2.67	0.1299	10.94	945,445	-5.51	-2.6E+04	-1.8E+04	-2.6E+04	-1.8E+05
			3,225	200	3,025	10	3.00	0.005000	0.037	100-year	20,100	-	21.78	1,640.91	147.75	11.11	140.68	12.25	0.80	2.40	5.60	7.00	2.67	0.5486	77.17	6,667,713	-37.87	-1.8E+05	-1.2E+05		

[1] West Yost & Associates, November 2001 (Table TM5A-23 of Appendices)

Scenario E: Full Build-Out Development + Implementation of SMMP Program

	CHANNEL DATA									FLOW DATA										BED MATERIAL DATA					SEDIMENT TRANSPORT DATA						SUMMARY RESULTS	
	Line	Channel Name	US Station	DS Station	[L] Reach Length (ft)	[b] Bottom Width (ft)	[z] Side Slopes (_H:1V)	[S] Bed Slope	Manning's n	Event (yr)	[Q] Flow (cfs)	[d] Manning Depth (ft)	[d] Backwater Depth (WYA)[1] (ft)	[A] Area (ft^2)	[P] Wetted Perimeter (ft)	[R_h] Hydraulic Radius (ft)	Top Width (ft)	[V] Velocity (ft/s)	d_{16} (mm)	d_{50} (mm)	d_{84} (mm)	d_{90} (mm)	Gr	Reach Capacity (cfs/ft)	Reach Capacity (cfs)	Reach Capacity (ft^3/event)	Aggradation/ Degradation (cfs)	Aggradation/ Degradation (tons/event)	Aggradation/ Degradation ($yards^3$/event)	Aggradation/ Degradation 2-year Event by Reach (tons/event)	Aggradation/ Degradation 100-year Event by Reach (tons/event)
H-3	H	Arroyo las Positas	22,700	20,800	1,900	30	10.00	0.004300	0.045	2-year	1,000	3.78	-	255.76	105.88	2.42	105.50	3.91	0.60	6.50	11.30	11.30	6.29	0.0113	1.19	102,982		[Boundary Condition]		[Bounday Condition]	[Bounday Condition]
			22,700	20,800	1,900	30	10.00	0.004300	0.037	100-year	9,000	9.24	-	1,129.90	215.62	5.24	214.70	7.97	0.60	6.50	11.30	11.30	6.29	0.1172	25.17	2,174,439					
H-2	H	Arroyo las Positas	20,800	14,300	6,500	70	3.00	0.002900	0.045	2-year	1,100	3.58	-	288.87	92.63	3.12	91.47	3.81	0.50	2.60	9.00	10.10	4.33	0.0154	1.41	121,666	-0.22	-1.0E+03	-6.9E+02	4.4E+03	1.1E+05
			20,800	14,300	6,500	70	3.00	0.002900	0.037	100-year	1,500	3.83	-	311.64	94.19	3.31	92.95	4.82	0.50	2.60	9.00	10.10	4.33	0.0356	3.31	286,127	21.86	1.0E+05	7.0E+04		
H-2	H	Arroyo las Positas	14,300	12,500	1,800	40	10.00	0.002700	0.045	2-year	1,100	4.08	-	329.66	122.01	2.70	121.60	3.34	0.50	2.60	9.00	10.10	4.33	0.0092	1.12	96,418	0.29	1.4E+03	9.4E+02		
			14,300	12,500	1,800	40	10.00	0.002700	0.036	100-year	1,500	4.26	-	351.25	125.52	2.80	125.10	4.27	0.50	2.60	9.00	10.10	4.33	0.0223	2.79	240,937	0.52	2.5E+03	1.7E+03		
H-2	H	Arroyo las Positas	12,500	9,200	3,300	28	9.00	0.000800	0.044	2-year	1,100	5.98	-	489.69	136.36	3.59	135.69	2.25	0.50	2.60	9.00	10.10	4.33	0.0019	0.26	22,686	0.85	4.0E+03	2.7E+03		
			12,500	9,200	3,300	28	9.00	0.000800	0.033	100-year	1,500	6.04	-	498.00	137.46	3.62	136.79	3.01	0.50	2.60	9.00	10.10	4.33	0.0056	0.77	66,567	2.02	9.5E+03	6.5E+03		
H-1	H	Arroyo las Positas	9,200	3,500	5,700	10	2.00	0.002500	0.045	2-year	1,200	8.93	-	248.56	49.91	4.98	45.70	4.83	0.50	2.60	9.00	10.10	4.33	0.0281	1.29	111,089	-1.02	-4.8E+03	-3.3E+03	-4.2E+04	-1.3E+05
			9,200	3,500	5,700	10	2.00	0.002500	0.036	100-year	2,000	10.16	-	308.05	55.44	5.56	50.64	6.49	0.50	2.60	9.00	10.10	4.33	0.0799	4.05	349,542	-3.28	-1.5E+04	-1.0E+04		
H-1	H	Arroyo las Positas	3,500	0	3,500	30	5.50	0.012000	0.044	2-year	1,200	3.54	-	174.78	69.52	2.51	68.89	6.86	0.50	2.60	9.00	10.10	4.33	0.1326	9.13	789,004	-7.85	-3.7E+04	-2.5E+04		
			3,500	0	3,500	30	5.50	0.012000	0.035	100-year	2,000	4.08	-	213.96	75.62	2.83	74.88	9.33	0.50	2.60	9.00	10.10	4.33	0.3909	29.27	2,529,051	-25.23	-1.2E+05	-8.1E+04		
G-60	G	Arroyo Mocho	62,000	55,200	6,800	130	1.25	0.008800	0.042	2-year	350	0.88	-	115.37	132.82	0.87	132.20	3.03	1.60	10.40	12.30	13.00	3.84	0.0041	0.54	46,717		[Boundary Condition]		[Bounday Condition]	[Bounday Condition]
			62,000	55,200	6,800	130	1.25	0.008800	0.036	100-year	4,700	3.81	-	514.00	142.21	3.61	139.54	9.14	1.60	10.40	12.30	13.00	3.84	0.1507	21.03	1,816,817					
G-60	G	Arroyo Mocho	55,200	42,500	12,700	40	1.50	0.008000	0.043	2-year	350	1.85	-	79.13	46.67	1.70	45.55	4.41	1.60	10.40	12.30	13.00	3.84	0.0129	0.59	50,953	-0.05	-2.3E+02	-1.6E+02	3.4E+02	1.5E+04
			55,200	42,500	12,700	40	1.50	0.008000	0.036	100-year	4,700	7.63	-	392.53	67.51	5.81	62.89	11.97	1.60	10.40	12.30	13.00	3.84	0.3293	20.71	1,789,501	0.32	1.5E+03	1.0E+03		
G-60	G	Arroyo Mocho	42,500	41,000	1,500	60	1.50	0.000880	0.044	2-year	350	2.86	-	183.73	70.30	2.61	68.57	1.91	1.60	10.40	12.30	13.00	3.84	0.0005	0.04	3,172	0.55	2.6E+03	1.8E+03		
			42,500	41,000	1,500	60	1.50	0.000880	0.036	100-year	4,700	11.59	-	897.27	101.80	8.81	94.78	5.24	1.60	10.40	12.30	13.00	3.84	0.0143	1.35	117,043	19.36	9.1E+04	6.2E+04		
G-60	G	Arroyo Mocho	41,000	35,000	6,000	65	1.50	0.007100	0.043	2-year	350	1.44	-	96.71	70.19	1.38	69.32	3.62	1.60	10.40	12.30	13.00	3.84	0.0068	0.47	40,474	-0.43	-2.0E+03	-1.4E+03		
			41,000	35,000	6,000	65	1.50	0.007100	0.036	100-year	4,700	6.07	-	450.15	86.90	5.18	83.22	10.44	1.60	10.40	12.30	13.00	3.84	0.2137	17.78	1,536,256	-16.43	-7.7E+04	-5.3E+04		
G-50	G	Arroyo Mocho	35,000	31,000	4,000	40	2.00	0.003800	0.044	2-year	370	2.40	-	107.52	50.73	2.12	49.60	3.44	1.60	10.40	12.30	13.00	3.84	0.0049	0.24	20,924	0.23	1.1E+03	7.2E+02	-7.7E+01	6.7E+04
			35,000	31,000	4,000	40	2.00	0.003800	0.037	100-year	1,300	4.50	-	220.38	60.12	3.67	57.99	5.90	1.60	10.40	12.30	13.00	3.84	0.0291	1.69	145,613	16.10	7.6E+04	5.2E+04		
G-50	G	Arroyo Mocho	31,000	21,200	9,800	60	2.00	0.003500	0.045	2-year	370	1.97	-	125.96	68.81	1.83	67.88	2.93	1.60	10.40	12.30	13.00	3.84	0.0029	0.19	16,834	0.05	2.2E+02	1.5E+02		
			31,000	21,200	9,800	60	2.00	0.003500	0.038	100-year	1,300	3.75	-	253.13	76.77	3.30	75.00	5.14	1.60	10.40	12.30	13.00	3.84	0.0185	1.39	119,753	0.30	1.4E+03	9.6E+02		
G-50	G	Arroyo Mocho	21,200	17,686	3,514	70	3.00	0.007700	0.045	2-year	370	1.42	-	105.45	78.98	1.34	78.52	3.52	1.60	10.40	12.30	13.00	3.84	0.0062	0.48	41,883	-0.29	-1.4E+03	-9.3E+02		
			21,200	17,686	3,514	70	3.00	0.007700	0.038	100-year	1,300	2.69	-	210.01	87.01	2.41	86.14	6.19	1.60	10.40	12.30	13.00	3.84	0.0402	3.46	298,884	-2.07	-9.8E+03	-6.6E+03		
G-40	G	Arroyo Mocho	17,350	15,000	2,350	60	2.50	0.008100	0.048	2-year	1,400	3.48	-	239.08	78.74	3.04	77.40	5.86	1.40	6.00	10.50	10.60	3.02	0.0382	2.96	255,602	6.66	3.1E+04	2.1E+04	3.1E+04	8.9E+04
			17,350	15,000	2,350	60	2.50	0.008100	0.039	100-year	3,300	5.06	-	367.78	87.26	4.21	85.31	8.97	1.40	6.00	10.50	10.60	3.02	0.1625	13.86	1,197,745	18.87	8.9E+04	6.0E+04		
G-30	G	Arroyo Mocho	15,000	12,686	2,314	60	2.60	0.000810	0.047	2-year	1,600	7.14	-	560.95	99.78	5.62	97.13	2.85	1.40	6.00	10.50	10.60	3.02	0.0022	0.22	18,838	2.74	1.3E+04	8.8E+03	1.1E+04	5.4E+04
			15,000	12,686	2,314	60	2.60	0.000810	0.038	100-year	3,700	10.07	-	867.40	116.08	7.47	112.34	4.27	1.40	6.00	10.50	10.60	3.02	0.0088	0.99	85,634	12.87	6.1E+04	4.1E+04		
G-30	G	Arroyo Mocho	12,686	10,151	2,535	60	2.00	0.001400	0.046	2-year	1,600	6.17	-	446.00	87.58	5.09	84.66	3.59	1.40	6.00	10.50	10.60	3.02	0.0054	0.46	39,555	-0.24	-1.1E+03	-7.7E+02		
			12,686	10,151	2,535	60	2.00	0.001400	0.038	100-year	3,700	8.91	-	692.90	99.82	6.94	95.62	5.34	1.40	6.00	10.50	10.60	3.02	0.0207	1.98	171,337	-0.99	-4.7E+03	-3.2E+03		
G-30	G	Arroyo Mocho	10,151	7,000	3,151	60	2.00	0.001660	0.045	2-year	1,600	5.80	-	415.28	85.94	4.83	83.20	3.86	1.40	6.00	10.50	10.60	3.02	0.0072	0.60	51,489	-0.14	-6.5E+02	-4.4E+02		
			10,151	7,000	3,151	60	2.00	0.001660	0.038	100-year	3,700	8.49	-	653.56	97.97	6.67	93.96	5.66	1.40	6.00	10.50	10.60	3.02	0.0261	2.45	211,512	-0.46	-2.2E+03	-1.5E+03		
G-20	G	Arroyo Mocho	7,000	4,000	3,000	60	2.00	0.000940	0.047	2-year	2,000	7.94	-	602.58	95.51	6.31	91.76	3.32	1.40	6.00	10.50	10.60	3.02	0.0038	0.35	29,977	0.25	1.2E+03	8.0E+02	1.2E+03	-1.2E+03
			7,000	4,000	3,000	60	2.00	0.000940	0.039	100-year	7,800	15.17	-	1,369.98	127.82	10.72	120.66	5.69	1.40	6.00	10.50	10.60	3.02	0.0225	2.71	234,427	-0.27	-1.2E+03	-8.5E+02		
G-10	G	Arroyo Mocho	4,000	0	4,000	60	2.00	0.001300	0.047	2-year	2,200	7.65	-	575.68	94.19	6.11	90.58	3.82	1.40	6.00	10.50	10.60	3.02	0.0064	0.58	50,046	-0.23	-1.1E+03	-7.4E+02	-1.1E+03	7.0E+03
			4,000	0	4,000	60	2.00	0.001300	0.039	100-year	8,200	-	18.68	1,818.68	143.54	12.67	134.72	4.51	1.40	6.00	10.50	10.60	3.02	0.0090	1.22	105,110	1.50	7.0E+03	4.8E+03		
F-10	P	Alamo Canal	1,100	0	1,100	30	2.50	0.001420	0.047	2-year	1,500	8.05	-	403.16	73.32	5.50	70.23	3.72	0.50	2.10	10.10	10.90	4.50	0.0130	0.91	78,890		[Boundary Condition]		[Bounday Condition]	[Bounday Condition]
			1,100	0	1,100	30	2.50	0.001420	0.038	100-year	6,500	-	15.34	1,048.49	112.61	9.31	106.70	6.20	0.50	2.10	10.10	10.90	4.50	0.0695	7.41	640,269					
B-70	B	Arroyo de la Laguna	39,200	37,300	1,900	80	2.00	0.007500	0.043	2-year	3,700	5.06	-	456.01	102.63	4.44	100.24	8.11	0.50	1.00	3.70	10.00	2.85	0.3269	32.77	2,831,142	-31.28	-1.5E+05	-1.0E+05	-1.5E+05	2.4E+04
			39,200	37,300	1,900	80	2.00	0.007500	0.037	100-year	14,700	-	26.32	3,491.08	197.71	17.66	185.28	4.21	0.50	1.00	3.70	10.00	2.85	0.0185	3.43	296,444	5.20	2.4E+04	1.7E+04		
B-60	B	Arroyo de la Laguna	37,300	33,500	3,800	80	2.00	0.007500	0.044	2-year	3,700	5.13	-	463.03	102.94	4.50	100.52	7.99	0.50	1.00	3.70	10.00	2.85	0.3084	31.00	2,678,807	1.76	8.3E+03	5.6E+03	8.3E+03	8.6E+02
			37,300	33,500	3,800	80	2.00	0.007500	0.038	100-year	16,300	-	28.77	3,957.03	208.66	18.96	195.08	4.12	0.50	1.00	3.70	10.00	2.85	0.0167	3.25	280,739	0.18	8.6E+02	5.8E+02		
B-50	B	Arroyo de la Laguna	33,500	30,790	2,710	55	1.50	0.001900	0.044	2-year	4,100	10.11	-	708.94	91.43	7.75	85.32	5.78	0.50	1.00	3.70	10.00	2.85	0.0778	6.64	573,472	24.37	1.1E+05	7.8E+04	1.1E+05	-1.6E+04
			33,500	30,790	2,710	55	1.50	0.001900	0.038	100-year	18,700	-	33.09	3,462.37	174.31	19.86	154.27	5.40	0.50	1.00	3.70	10.00	2.85	0.0430	6.63	573,021	-3.38	-1.6E+04	-1.1E+04		
B-40	B	Arroyo de la Laguna	30,790	23,820	6,970	30	1.50	0.001200	0.045	2-year	4,200	15.35	-	814.09	85.35	9.54	76.06	5.16	0.50	1.00	3.70	10.00	2.85	0.0454	3.46	298,530	3.18	1.5E+04	1.0E+04	1.5E+04	-8.5E+04
			30,790	23,820	6,970	30	1.50	0.001200	0.038	100-year	19,000	-	30.54	2,315.24	140.11	16.52	121.62	8.21	0.50	1.00	3.70	10.00	2.85	0.2026	24.64	2,128,940	-18.01	-8.5E+04	-5.8E+04		
B-30	B	Arroyo de la Laguna	23,820	17,845	5,975	40	1.00	0.001700	0.045	2-year	4,400	13.60	-	729.09	78.47	9.29	67.20	6.03	0.50	1.00	3.70	10.00	2.85	0.0834	5.60	484,003	-2.15	-1.0E+04	-6.9E+03	-9.3E+03	-7.3E+04
			23,820	17,845	5,975	40	1.00	0.001700	0.037	100-year	19,300	-	26.48	1,760.39	114.90	15.32	92.96	10.96	0.50	1.00	3.70	10.00	2.85	0.6078	56.50	4,881,517	-31.86	-1.5E+05	-1.0E+05		
B-30	B	Arroyo de la Laguna	17,845	9,960	7,885	50	2.00	0.002500	0.047	2-year	4,400	10.24	-	722.08	95.81	7.54	90.98	6.09	0.80	2.40	5.60	7.00	2.67	0.0534	4.85	419,472	0.75	3.5E+03	2.4E+03		
			17,845	9,960	7,885	50	2.00	0.002500	0.038	100-year	19,300	-	24.48	2,422.54	159.48	15.19	147.92	7.97	0.80	2.40	5.60	7.00	2.67	0.1103	16.32	1,409,733	40.18	1.9E+05	1.3E+05		
B-30	B	Arroyo de la Laguna	9,960	3,225	6,735	30	2.00	0.002800	0.047	2-year	4,400	12.20	-	663.92	84.57	7.85	78.81	6.63	0.80	2.40	5.60	7.00	2.67	0.0689	5.43	469,097	-0.57	-2.7E+03	-1.8E+03		
			9,960	3,225	6,735	30	2.00	0.002800	0.038	100-year	19,300	-	23.51	1,810.74	135.14	13.40	124.04	10.66	0.80	2.40	5.60	7.00	2.67	0.3229	40.06	3,460,814	-23.74	-1.1E+05	-7.6E+04		
B-10	B	Arroyo de la Laguna	3,225	200	3,025	10	3.00	0.005000	0.047	2-year	4,600	12.37	-	582.92	88.25	6.61	84.23	7.89	0.80	2.40	5.60	7.00	2.67	0.1299	10.94	945,232	-5.51	-2.6E+04	-1.8E+04	-2.6E+04	-1.8E+05
			3,225	200	3,025	10	3.00	0.005000	0.037	100-year	20,200	-	21.78	1,640.91	147.75	11.11	140.68	12.31	0.80	2.40	5.60	7.00	2.67	0.5586	78.58	6,789,594	-38.53	-1.8E+05	-1.2E+05		

[1] West Yost & Associates, November 2001 (Table TM5A-23 of Appendices)