SPOOK HILL
AREA DRAINAGE MASTER PLAN
UPDATE

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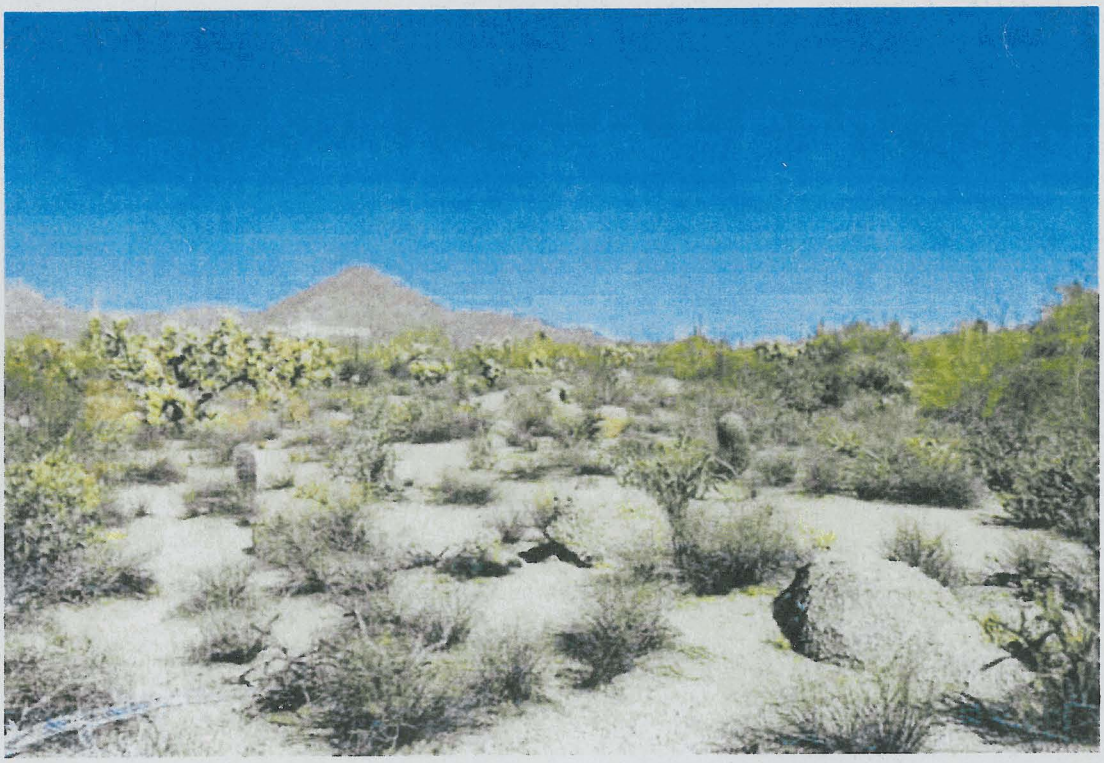
EXISTING CONDITIONS
SEDIMENTATION ANALYSIS

FCD CONTRACT NO. 99-43

March 2000



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Executive Summary

This memorandum presents existing condition sediment yield estimates for the Spook Hill Area Drainage Master Plan (ADMP) Update study area. Sediment yield is the volume of soil material and stream sediment transported from a watershed through its stream network. Sediment yield is an important design parameter for flood control structures, because sediment deposition in dams, reservoirs, or floodways reduces the storage or transport capacity. Reduced capacity of flood control structures increases the likelihood of a spillover during floods, increasing the chance of injuries, damage to the structure itself, downstream property damage, and even loss of human life.

Sediment yield and existing condition sediment impacts were evaluated using a variety of standard engineering methodologies, geomorphic interpretation of landforms, field data, historical records, and engineering judgment. Engineering methodologies used to predict sediment yield included the following:

- Renard Equation
- Dendy-Bolton Equation
- Flaxman Equations
- PSIAC Method
- MUSLE Method

These methods use variables such as watershed area, geology, soil characteristics, vegetative cover, slope, topography, climate, runoff, and land use and management. Predicted sediment yields range from 0.07 acre-feet/square mile/year to 0.64 acre-feet/square mile/year, as shown in Table Ex-1. Comparisons with field, historical maintenance records, and published sediment yield data from elsewhere in Arizona indicate that the Flaxman, PSIAC, and MUSLE equations provide the most appropriate results for the study area.

Table Ex-1. Spook Hill ADMP Update
Summary of Results of Sediment Yield Predictive Equations

Method	Average Sediment Yield (ac-ft/mi^2/yr)
Renard	0.64
Dendy-Bolton	0.63
Flaxman (1974)	0.13
PSIAC	0.20
MUSLE	0.07

The geomorphic characteristics of the study area indicate that the western area is likely to deliver greater quantities of sediment than the eastern area. Moreover, the nature of the sediment delivered is also likely to differ. The western area appears to be dominated by bedload sediments and, under natural conditions, is more widely distributed spatially with less well-defined stream systems. The eastern area delivers a higher proportion of suspended sediments that will flow through the system more easily without deposition in the existing flood control structures. Additionally, the location of sediment inflows in the

eastern area will be limited primarily to readily identifiable washes with relatively low width to depth ratios. This interpretation of the watershed geomorphology impacts on sediment yield was supported by the results of the engineering methodologies listed in Table Ex-1.

Other key findings from the sedimentation investigation included the following:

- Sediment yield for individual subbasins varies within the watershed. The MUSLE, PSIAC, and Flaxman method results reflect internal variation in the study area.
- The largest average annual sediment yields are predicted in the basins dominated by the steepest and longest slopes and little vegetative cover.
- The smallest sediment yields are predicted for the developed basins (i.e. residential) with low slopes.
- Watersheds located closer to the mountain slopes will deliver greater sediment quantities than similar sized watersheds or even the same watersheds at concentration points located further downstream on the piedmont.
- The representation of internal variation and close agreement with empirically measured sediment deposits in the field suggest that a combination of the MUSLE, PSIAC, and Flaxman results should be considered for planning level sediment yields.
- The parameterization of the MUSLE, PSIAC, and Flaxman methods also allows for examination of future conditions impacts on sediment yield in the alternatives phase of the ADMP Update.

It is recommended that the mean of the average annual sediment yield for the subbasins contributing to each FRS be used as the planning level sediment yield. The average annual sediment yield for each structure and the entire Spook Hill ADMP is presented in Table Ex-2.

Table Ex-2. Spook Hill ADMP Update
Flood Control Structures and Average Annual Sediment Yield

Structure	Flaxman Avg. Ann. Sed. Yield (ac-ft/mi^2/yr)	PSIAC Avg. Ann. Sed. Yield (ac-ft/mi^2/yr)	MUSLE Avg. Ann. Sed. Yield (ac-ft/mi^2/yr)	**Recommended Planning Sed. Yield (ac-ft/mi^2/yr)**
Apache Junction FRS	0.07	0.16	0.04	**0.07**
Signal Butte FRS*	0.09	0.17	0.07	**0.11**
Spook Hill FRS	0.14	0.22	0.07	**0.14**
Spook Hill FW	0.16	0.22	0.09	**0.16**
Average for Spook Hill ADMP Study Area	**0.13**	**0.20**	**0.07**	**0.13**

*Includes Pass Mountain Diversion sediment despite fact that none has entered Signal Butte FRS since construction.

Sediment yield estimates for specific design floods were also computed for the study area. The MUSLE method served as the method for computation of the 2-, 10-, and 100-year event sediment yields. The 100-year 24-hour flood sediment yield is about six times greater than the average annual sediment yield estimates. Table Ex-3 summarizes the sediment yield results for specific design floods.

Table Ex-3. Spook Hill ADMP Update Flood Control Structures and the Recommended T-year Sediment Yield, in ac-ft/mi^2						
Structure	2-year	5-year	10-year	25-year	50-year	100-year
Apache Junction FRS	0.04	0.10	0.17	0.28	0.39	0.54
Signal Butte FRS	0.06	0.17	0.27	0.46	0.63	0.86
Spook Hill FRS	0.08	0.19	0.29	0.45	0.58	0.74
Spook Hill FW	0.08	0.20	0.32	0.52	0.80	0.94
Average for all subbasins in the Spook Hill ADMP	**0.07**	**0.19**	**0.30**	**0.46**	**0.67**	**0.82**

Based on the sediment yield results summarized in Tables Ex-2 and Ex-3, recommended storage volumes were computed for each existing flood control structure. In addition, the storage pool volume remaining in each structure after an assumed design life of 100 years was computed by subtracting the 100-year 24-hour water storage volume from the total existing storage volume and the total 100 year sediment inflow volume, as shown in Table Ex-4.

Table Ex-4. Spook Hill ADMP Update Recommended Sediment Volumes for Planning 100 year design life assuming 10 10-yr events and 2 100-yr events in addition to 100 average annual volumes.						
Structure	Drainage Area (sq.mi.)	Total Sediment Yield Volume (ac-ft)	Total Storage* Volume (ac-ft)	100-yr 24-hr Runoff Volume (ac-ft)	Volume Remaining (ac-ft)	No. of Times**
Apache Junction FRS	5.8	54	676	375	247	4.6
Signal Butte FRS	10.64	155	1665	952	558	3.6
Spook Hill FRS	13.68	241	1391	1306	-156	-0.6

* Total storage volumes from McLain Harbors mapping done for FCDMC under FCD No. 93-51.
** Number of times the scenario of sediment delivery can occur before the 100-yr 24-hr storm water runoff volume no longer fits within the dam without flowing over the emergency spillway.

The results show the following:

- A regular sediment removal program does not need to be considered for planning at either Apache Junction or Signal Butte FRS. The current FCDMC maintenance practice of keeping the principle outlet clear and assuring positive drainage to the outlet is sufficient for successful FRS operation and should continue.
- Some type of sediment removal program for Spook Hill FRS is needed. This report suggest that a 15 year maintenance schedule would be appropriate to assure continued safe operation of the Spook Hill FRS. Again, regular maintenance of the low flow channel along the dam will continue to be required.
- Finally, the results indicate that a 4 year cycle of sediment removal from the Spook Hill Floodway sediment basin be used. Discussions with FCD maintenance personnel indicate that a similar schedule is already in place.

Introduction

This report describes the existing conditions sediment yield estimates for the Spook Hill Area Drainage Master Plan Update study area. The methods and results of the sediment yield calculations for the watershed contributing to the Buckhorn-Mesa flood control structures are summarized. Finally, the implications of the results for the Drainage Master Plan are discussed.

Objective

The objective of this analysis was to estimate sediment yield for the existing condition for the Spook Hill Area Drainage Master Plan (ADMP) study area. The results of these analyses will be used to evaluate flood control design alternatives.

Scope

This study was performed by JE Fuller / Hydrology & Geomorphology, Inc. (JEF) under contract with Wood, Patel, & Associates, Inc. (Wood/Patel) for the Flood Control District of Maricopa County (FCDMC). This study is limited in its scope to planning level analyses of sediment yield in the Spook Hill ADMP study area.

Limitations/Assumptions

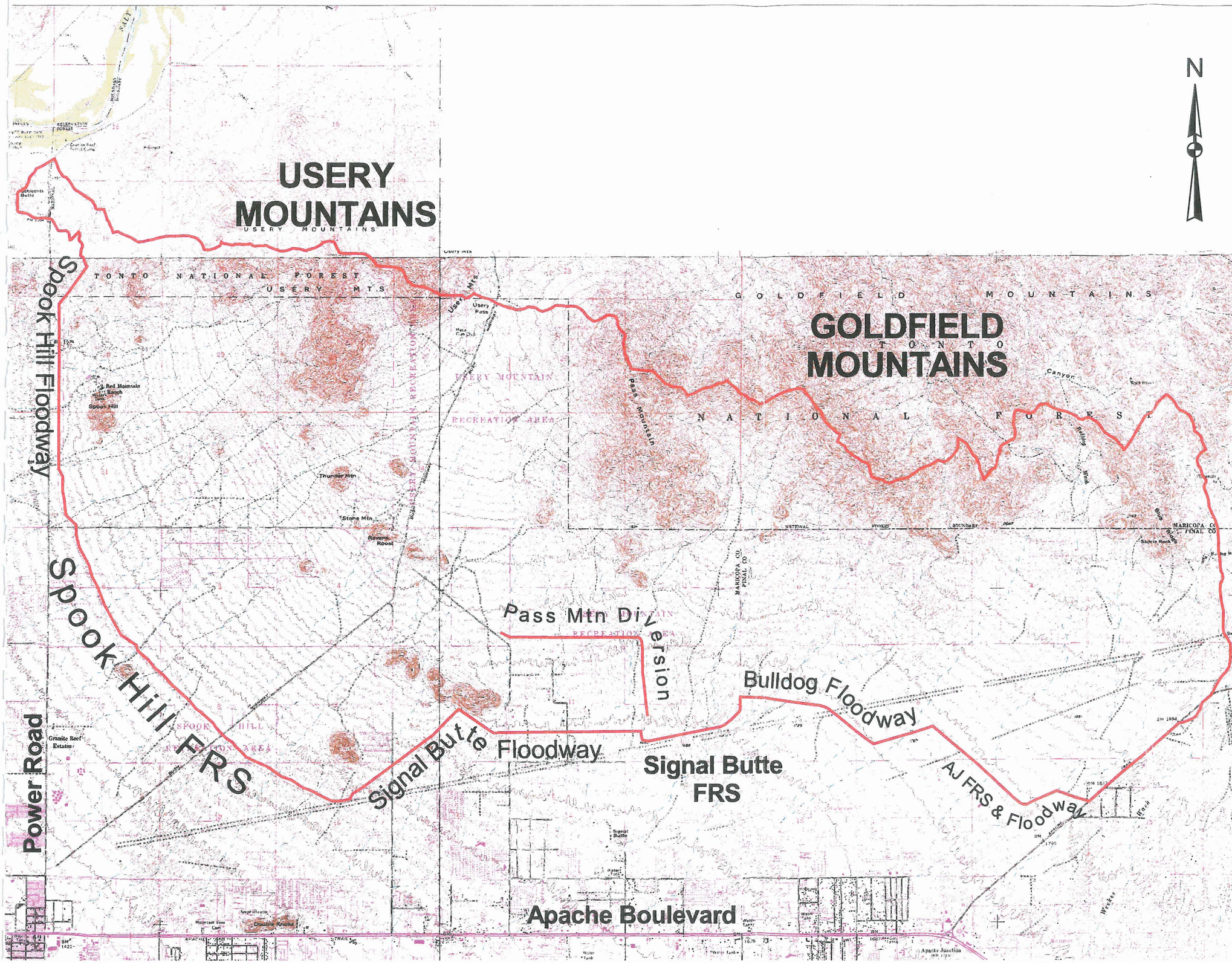
The validity of the analyses presented is limited to the Spook Hill ADMP study area. The assumptions made in the estimation of parameters for the sediment yield calculations are based on data provided to JEF by Wood/Patel, data collected by JEF, and engineering judgment. In particular, the subwatershed hydrologic parameters such as drainage basin area, land use, and soil distributions, and responses to storm rainfall were taken from the HEC-1 analyses provided by Wood/Patel (2000).

Additionally, the methods used in this study are based on regional methods identified in the literature as suitable to the semi-arid southwest. While these methods are appropriate for planning level studies like the ADMP, more detailed investigation is recommended for any final design resulting from this study.

Description of Study Area

Location

The study area is located in eastern Maricopa and northwestern Pinal Counties. The watershed generally coincides with the Soil Conservation Service project area known as the Buckhorn-Mesa Watershed. The limits of the study watershed are shown in Figure 1. The watershed generally drains the Usery and Goldfield Mountains. Most of the watershed drains from the mountains south to the flood control structures that make up



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Spook Hill
Area Drainage Master Plan
Update

March 2000

LEGEND

Study Area

SCALE

2000 0 2000 4000 6000 Feet

Figure 1 - Location Map

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the southern and western limit of the watershed and study area. The far western portion of the study area flows west into the Spook Hill Flood Retarding Structure or Floodway.

Structures & Development

The downstream limits of the study watershed lie along the flood control structures built by the Soil Conservation Service (SCS), now Natural Resource Conservation Service (NRCS), between 1979 and 1988. Four earthen dams and five floodway channels collect storm runoff from the 33 square mile watershed. These structures capture floodwater and route it to a single outlet that flows into the Salt River. Figure 1 shows the location of these flood control structures.

The project was conceived in the early 1960s after 33 floods were recorded in the area between 1910 and 1960. These floods varied in magnitude and damaged land, homes, businesses, and roads. In the years between project conception and construction, the area from Mesa east to Apache Junction underwent tremendous growth, increasing the need for flood protection.

Starting from the east, the Apache Junction Floodway collects runoff into the Apache Junction (AJ) Flood Retarding Structure (FRS). The 1,500-foot floodway diverts floodwater from washes east of the dam and into the reservoir area. The dam itself is 1.6 miles long and has a maximum height of about 27 feet. The total drainage area to the Apache Junction FRS is 5.8 square miles. The storage volume of Apache Junction FRS is 676 acre-feet (McLain Harbors 1993). The reservoir drains via a small, ungated concrete pipe outlet into a concrete channel called the Bulldog Floodway.

The 1.7 mile long Bulldog Floodway increases in capacity as it extends westward, collecting additional natural washes before flowing into the Signal Butte FRS. The Signal Butte FRS also collects storm runoff from an area directed into it by the Pass Mountain Diversion Dam and Outlet, which is a 1.2 mile long earth embankment and a 2,800 foot outlet drain that diverts floodwaters from a four square mile area to the Signal Butte FRS. The combined drainage area into the Signal Butte FRS, not including the Apache Junction FRS watershed, is 10.6 square miles. The Signal Butte FRS is a 1.3-mile long earthen dam that rises as much as 36 feet above the surrounding ground. The storage volume of Signal Butte FRS is 1,665 acre-feet (McLain Harbors 1993). The Signal Butte FRS drains through an outlet tower into the 2.7-mile long Signal Butte floodway.

The Signal Butte Floodway channel flows west at a low gradient as an earthen channel for about 1.6 miles before entering a steeper concrete lined channel that flows southwest and drains into the Spook Hill FRS. The Spook Hill FRS collects floodwaters from another 13.7 square miles of drainage area. The storage volume of Spook Hill FRS is 1,391 acre-feet (McLain Harbors 1993). The Spook Hill FRS drains into the Spook Hill Floodway, which flows north to the Salt River. The unlined Spook Hill Floodway collects another 2.9 square miles of the watershed along its course to the Salt River where it enters just upstream from Granite Reef Dam.

Sediment basins are located at the downstream end of all the floodway channels. The Signal Butte FRS does not discharge to the Signal Butte Floodway until it reaches about one quarter of its total storage volume. Consequently, no sediment escapes the Signal Butte FRS during the more frequent runoff events. Moreover, the only sediments escaping the Signal Butte flood pool and continuing downstream will be those held in suspension long enough to make it out the high level outlet tower. Similarly, the Spook Hill FRS only drains via a small 1 ft by 1 ft gated opening into the Spook Hill Floodway when the pool is below about the 11-foot stage. Sediment discharges from the Spook Hill FRS for frequent events are therefore also limited. The Spook Hill Floodway is a 2-mile long earthen channel which flows generally north to the Salt River where it flows into another sediment basin before entering the Salt River just upstream from Granite Reef Dam.

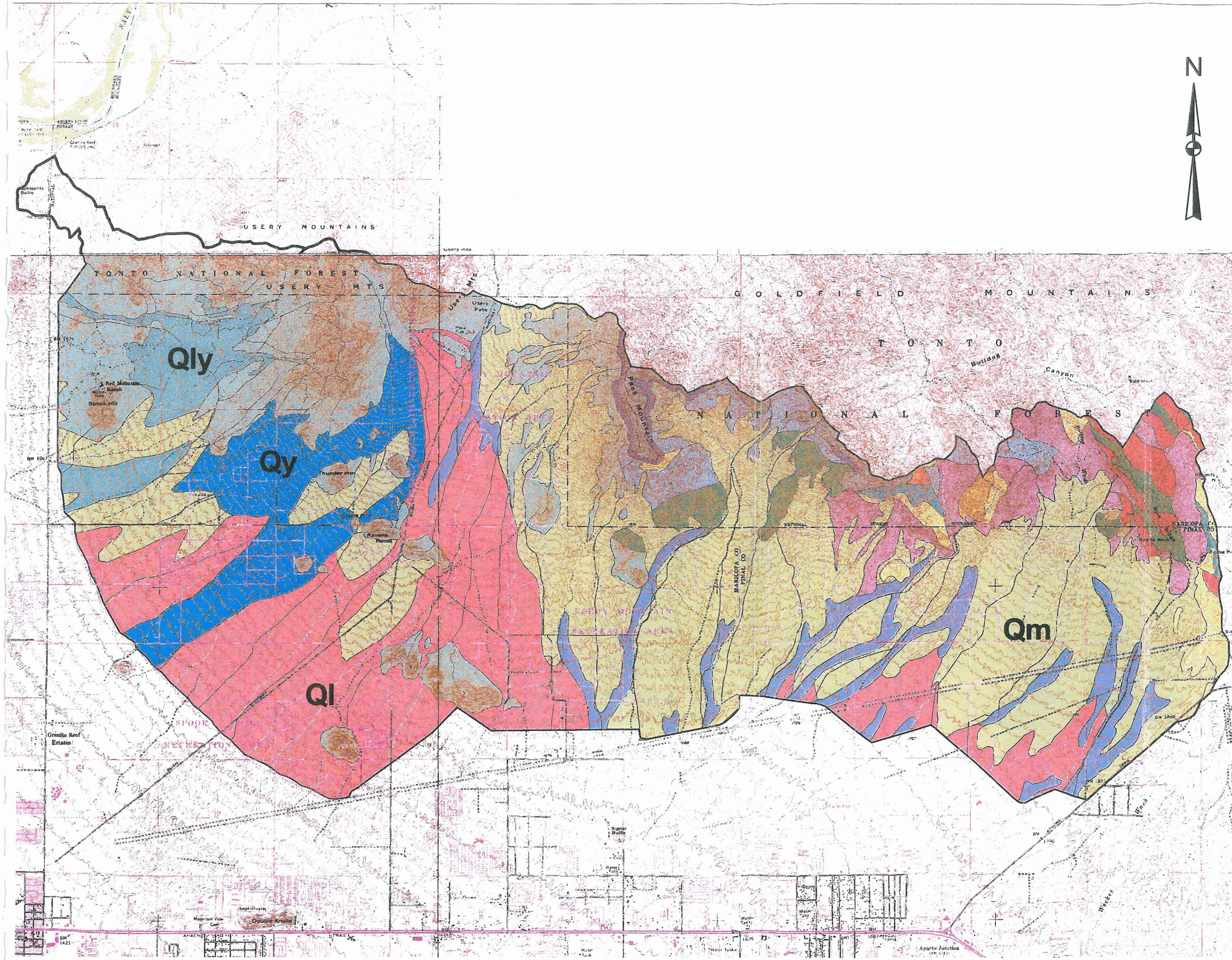
Precipitation/Climate

The Spook Hill study area watershed is located in the Sonoran Desert, and it is characterized by two rainy seasons. Total average annual rainfall averages about 9 inches, which is generally divided about equally between the summer monsoon and winter seasons. The two seasons are contrasted by the intensity and source of the rainfall events. Winter precipitation is generally associated with frontal storms from the Pacific Ocean with lower rainfall intensities and longer durations. Summer rainfall is typically associated with short duration but intense thunderstorms fed by moisture from the south from the Gulf of California or Gulf of Mexico. A third significant rainfall generating mechanism sometimes occurs in late September or early October when heavily moisture laden air masses from dissipating tropical storms or hurricanes enter central Arizona. These events can produce unusually high precipitation amounts from a combination of high intensity and medium duration rainfalls.

Bedrock Geology

The geology of the study area is mapped in Figure 2. The Usery Mountains, which make up the west half of the northern boundary of the study area, and the inselbergs south of the mountain front, with the exception of Signal Butte, are composed of solid coarse-grained Proterozoic-aged (570-2,500 million years before present) granite. Signal Butte is composed of basalt of middle Tertiary age (24-37 million years before present). The Usery Mountains and their associated inselbergs are unfaulted, in contrast to the faulted nature of the Goldfield Mountains east of Pass Mountain.

The Goldfield Mountains are faulted and are composed of several rock types. They are predominantly composed of granite of Proterozoic age (570-2,500 Ma), but the granites are more varied than the granite in the Usery Mountains, ranging from fine- to coarse-grained. There are also significant amounts of Tertiary age (24-37 Ma) rhyolite and tuff. The rhyolites and tuffs appear to be associated with the faulting. There are also small amounts of the Signal Butte basalt in the vicinity of Saddle Rock on the eastern edge of the study area (Skotnicki and Ferguson, 1997).



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Subbasin

Geologic Map Unit

	Ql		Tdt
	Qly		Tfb
	Qm		Trlt
	Qs		Trp
	Qy		Tsl
	Qyc		Xge
	Tab		Xgf
	Td		YXgg
	Tdm		YXgu

See following page for desciption of each map unit.

Source: Kneale, Sean, 1998
Geologic Map of the
Mesa 30' x 60' Quadrangle, Arizona
Arizona Geological Survey, Tucson, AZ
Digital Information Series, DI-11.

SCALE

2000 0 2000 4000 6000 Feet

Figure 2 - Geology Map

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Qs Surficial deposits (Quaternary) -- Undifferentiated surficial deposits, generally in mountain areas; includes talus, colluvium and various ages of alluvium.

Qyc Active alluvium (Holocene) -- Very young deposits in the channels of ephemeral streams draining piedmonts, mountain areas, and basin floors are labeled Qyc. Qyc deposits are composed of minimally oxidized sand, silt, pebbles, cobbles, and boulders. Qyc de

Qy Low terrace and alluvial fan deposits (Holocene) -- Holocene alluvial deposits that have incipient soil development are mapped as Qy. Unit Qy consists primarily of low terraces along active washes in the montane and upper piedmont areas and broad alluvial

Ql moderately dissected alluvial fan and terrace deposits (Late Pleistocene) -- Late Pleistocene alluvial fan surfaces and terraces with moderate soil development are mapped as unit Ql. These deposits are common along mountain streams and on piedmonts. Ql un

Qly Mixed piedmont gravels (Holocene to Middle Pleistocene) -- Qly is a composite map unit that contains both late Pleistocene (Ql) and Holocene (Qy and Qyc) deposits. Qly is used in a few piedmont areas in the northern part of the Mesa Quadrangle where it is

Qm Dissected alluvial-fan and terrace deposits (Middle Pleistocene) -- Dissected middle Pleistocene alluvial-fan and terrace deposits with strong soil development. Relict Qm alluvial fans cover much of the middle and upper piedmonts throughout the Mesa Quadr

Trp unit of Pass Mountain (Early Miocene) -- Light gray crystal-rich (20-30% phenocrysts) rhyodacite lava containing 1-6 mm-diameter phenocrysts of plagioclase, biotite, and hornblende. The unit crops out at the western end of the Goldfield Mountains where i

Trlt tuff (Early Miocene) -- Crystal-poor, commonly light tan or yellow-gray, non-welded, lithic tuff associated with lavas in the unit of Tule Canyon.

Tab quartz-phyric mafic lava (Miocene) -- Mineralogically diverse mafic lava that contains subhedral 1-5 mm phenocrysts of iddingsite after olivine, hornblende and/or pyroxene, biotite, and quartz (all in variable amounts), in a purple to gray aphanitic matri

Td Dacite (Early Miocene) -- Dacite, latite, andesite, and trachyandesite lavas. A complex sequence of lava flows with variable phenocryst assemblages. Generally crystal-rich (30-60% phenocryst) containing plagioclase, biotite, + hornblende, pyroxene, and qu

Tdt tuff (Early Miocene) -- Tuff related to lavas in the unit of Government Well.

Tdm Mafic lavas (Early Miocene) -- Intermediate to mafic lavas southeast of the Superstition Cauldron: 1) Mafic lava flows typically contain less than 10% plagioclase and lesser amounts of altered mafic minerals (probably pyroxenes or amphiboles). 2) Mafic

Tfb Unit of Bull Dog Canyon (Early Miocene) -- Crystal-poor intrusive rhyolite lava that contains 5-7% phenocrysts of sanidine, plagioclase, and traces of biotite and quartz. The type area for this unit is a lava dome dissected by Bulldog Canyon where the ca

Tsl Sedimentary rocks, Clastic (Late Oligocene to Miocene) -- Pre-volcanic clastic rocks in central Arizona have been previously included in the Whitetail Formation [Ransome, 1904]. In view of the fact that the namesake location is now labeled Eastwater Canyo

YXgg porphyritic granite of Goldfield (Middle Proterozoic or Early Proterozoic) -- Coarse-grained granite to syenite and quartz monzonite. The rock consists of light gray to pink K-feldspar phenocrysts up to 2 cm diameter in a medium- to coarse-grained groundm

YXgu Porphyritic granitoid of the Usery Mountains (Early Proterozoic) -- Coarse-grained, porphyritic granitic rock containing 1-3 cm long blue-gray K-feldspar phenocrysts in a matrix of anhedral to subhedral 2-15 mm diameter light gray plagioclase, clear-gray

Xge Equigranular, medium- to coarse-grained granite (Early Proterozoic) -- Mostly medium-grained, equigranular to coarse-grained, slightly K-feldspar porphyritic granite or granodiorite. Consists of subhedral milky gray to clear quartz, light gray plagioclas

From metadata for Kneale, Sean (1998), Geologic Map of Mesa 30' x 60' Quadrangle, AZGS Digital Information Series, DI-11.
See also Skotnicki and Ferguson (1997), Bedrock Geologic Map of the Apache Junction and Buckhorn Quadrangles, Maricopa and Pinal Counties, Arizona, AZGS Open-File Report 96-8

Depth to bedrock

As indicated in Pearthree and Huckleberry (1994), the depth to bedrock in most of the study area is relatively shallow. Bedrock exposures in stream channels are common throughout the area. Field observations show that the depth to bedrock in the east half of the study area is slightly greater than in the western portions. Also the depth to bedrock is less near the mountain front than near the flood control structures. However, caliche hardpan is more prominent in the eastern portion of the study area, especially in the basins captured by the Apache Junction FRS (Figure 3). In the Usery Mountains Recreation Area granite bedrock is frequently exposed at the surface. Where alluvium covers the bedrock in these areas, the depth to bedrock is very shallow, often only three to four feet (Figure 4).

Figure 3. Caliche exposed at cut along McKellips Rd., about 0.25 miles west of Tomahawk Rd.in Apache Junction FRS subwatershed.

Figure 4. Bedrock exposed in wash on pediment in Usery Mountain Park. Banks are about 3 feet high, illustrating shallow depth of bedrock.

Erosivity of bedrock – source of sediment

The differences in geology and geomorphology between the east and west areas contribute to a difference in the sediment yield potential of each area. This may be a function of the erosivity of the bedrock, its rate of physical and chemical weathering, and the cohesiveness of the stream banks. The grus mantle in the western portions of the study area are derived both from the granitic hills as well as from weathering in place. Moss (1977) suggests that weathering in place may be the more dominant mechanism in the land forming process on a pediment surface. However, the stream transport of sediments within the distributary stream channels is a more important component of the sediment source delivered over engineering time scales.

Piedmont versus pediment

Downhill from the steep mountain areas of the Usery and Goldfield Mountains is a sloping plain of erosion bedrock surfaces and deposits of alluvial sediments. The erosional bedrock surfaces are known as pediments (Figure 5), while the entire gently sloping plain at the mountain front is collectively referred to as a piedmont.

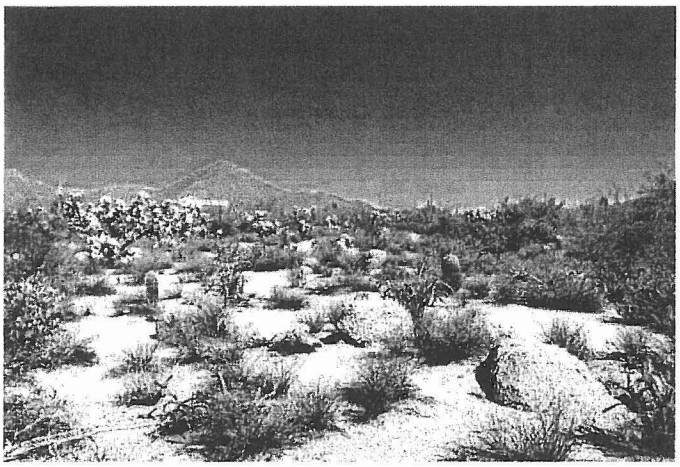


Figure 5. Overview of pediment surface in Usery Mountain Recreation Area.

The Spook Hill area is well known for the Spook Pediment located in the western third of the study area. A pediment is an erosional bedrock surface thought to form by subsurface weathering of bedrock and removal of the weathered material by surface runoff (Moss, 1977). The result is a long broadly sloping surface beginning abruptly at a break in slope at the base of the steep mountain front. The pediment surface slopes outward away from the mountains where it slowly becomes covered by progressively thicker alluvial sediments derived from the mountains and the pediment surface itself. Once the sediments become thicker, the landform becomes an alluvial fan. Pearthree and Huckleberry (1994) indicate that the point at which the pediment becomes an alluvial fan is where bedrock dives off steeply at a range-bounding geologic fault. The exact location of this boundary in the Spook Hill study area is uncertain due to the lack of sufficient subsurface data. However, Pearthree and Huckleberry (1974) suggest that a reasonable

boundary can be identified where inselbergs stop and exposures of bedrock are no longer visible in stream cuts.

The Spook Hill ADMP study area has a distinctive difference between the eastern half to two-thirds of the study area and the western parts (Figure 2). The eastern piedmont is characterized by entrenched tributary channels flowing through middle Pleistocene-aged alluvium. In the western half of the study area, piedmont surfaces are generally younger and less entrenched. One explanation for this contrast may be the differing lithologies of the Goldfield and Usery Mountains. While both are composed of granites, the Goldfield Mountains contain much more faulting as well as significant areas of Tertiary volcanic rocks. The different lithologies may be contributing to higher clay contents in the piedmont soils in the two areas. Higher clay content allows for the streams to entrench and form narrower and deeper channels than the shallow channels in the western area, which flow through less cohesive, coarser materials. Therefore, it may be expected that sediment yield and sediment transport processes between the eastern and western parts of the study area will differ somewhat due to the contrasting geologic and hydraulic settings.

Fluvial Geomorphology

Internal storage of sediment within active channels and the floodplain is an important aspect of the investigation of sediment yield. Based on field observations, the internal storage in the far eastern portion of the study area (upstream of Apache Junction FRS) is dominated by bed storage and localized inset distributary areas. As one moves farther west, washes are generally distributary, with broad areas of internal sediment storage. Sediment sizes in the west vary along the piedmont with the larger sands and fine gravels located in the upper to middle parts of the surface and finer grained material (silts and fine sands) dominating the lower portions of the piedmont.

The mountainous parts of the watershed are quite steep and rocky and are capable of producing significant runoff during infrequent rains. Most of the watershed is drained by relatively confined tributary washes. However, the west central third of the study area contains locations of systems of shallow braided or distributary washes flowing through a relatively thinly veneered bedrock pediment. The most active of these braided areas are located in soil units 90, Momoli gravelly sandy loam; 115, Tremant-Antho complex; and 118, Tremant-Rillito complex.

Drainage pattern implications

As mentioned above, the contrast of geology between the eastern and western portions of the study area are also expressed in a difference in planimetric drainage pattern on the piedmont (Figures 6a and 6b). The eastern part of the study area is dominated by entrenched tributary drainages. The washes in the western part of the study area are generally shallower and distributary. The tributary drainage system in the eastern part of the study area will provide a more efficient sediment delivery system than the distributary western drainage network, and the sediment will be delivered in more discrete and identifiable locations, namely the mouths of the entrenched streams.

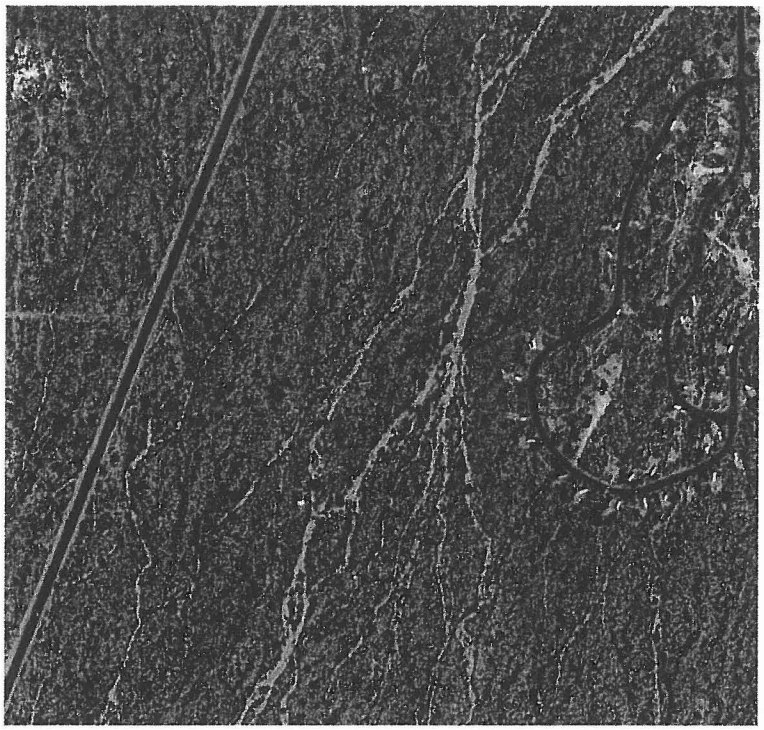


Figure 6a. Example of distributary drainage pattern in western portion of Usery Mountain Park. Approximate scale: 1 inch = 800 feet.

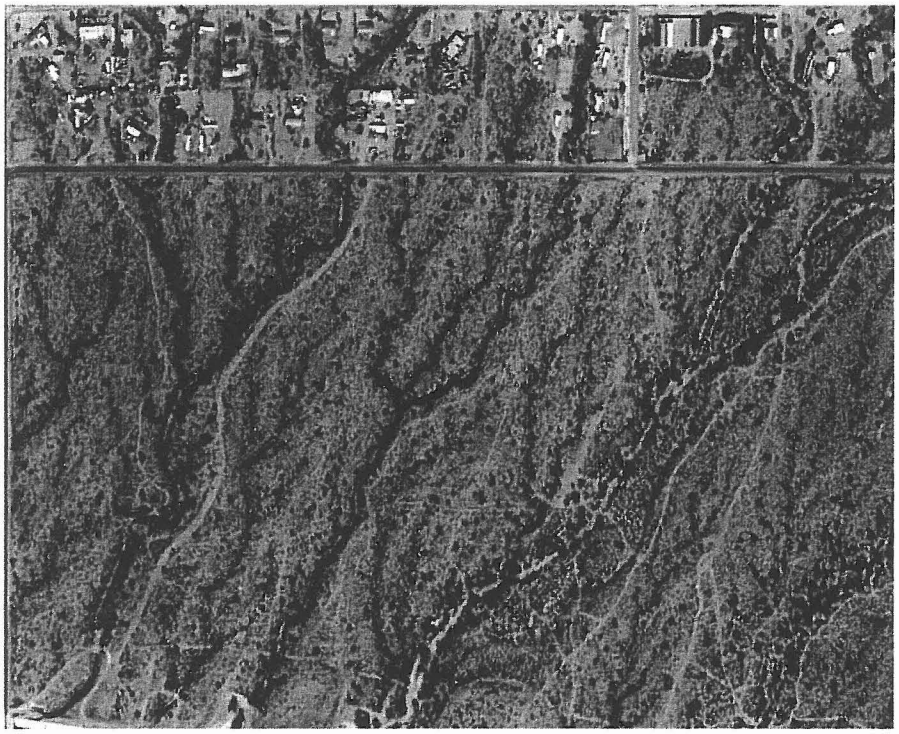


Figure 6b. Example of tributary drainage in eastern part of study area near Meridian Rd. and McKellips Blvd. Approximate scale: 1 inch = 800 feet.

Historical channel changes

Most of the channels within the study area are entrenched into older geomorphic surfaces. The eastern half of the area, in particular the basins draining into the Apache Junction and Signal Butte FRSs, is characterized by tributary networks of entrenched channels. West of Signal Butte FRS, the channels are generally shallower and braided and exhibit a distributary channel network.

Comparison of aerial photographs from 1972 (Camp, 1986) and 1999 (Kenny, 1999) reveal that most channel pattern changes are the result of residential development rather than natural channel migration or alluvial fan processes. Several developments in the western half of the study area have completely reworked the pre-existing drainage network, leaving only slight traces or none at all of the former natural system. Washes are often filled in to grade land for development, with artificial channels constructed around the development to redirect flow (Figure 7). The largest of these developments is the Las Sendas community near Spook Hill, east of the Spook Hill Floodway and north of McDowell Road (Figure 1). Residential development in the eastern half of the study area has also impacted natural washes, but to a lesser extent than development in the western half of the study area. Many minor washes have been graded over in the residential areas north of Bulldog Floodway and Apache Junction FRS. A few of the major washes have been affected by the development, but for the most part are still continuous.

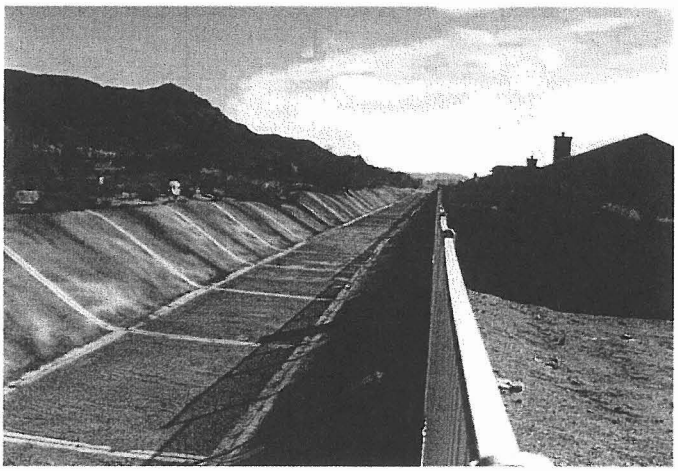


Figure 7. Artificial diversion channel parallel to the southern boundary of Usery Mountain Recreation Area. Water is diverted both east and west in this channel; the divide is located just past the sediment visible in the center of the photo.

Urbanization

The study area has been and continues to urbanize. The primary form of urbanization is residential development. These developments have been in the form of both large master planned communities as well as extensive areas of single lot type development. The impacts on sediment delivery and transport from these two types of development differ. Master planned communities have reorganized natural drainage courses more significantly than the smaller developments.

Another contrast in the style of development is between the jurisdictions of Maricopa and Pinal Counties. The far eastern third of the study area lies within Pinal County where there is currently no retention requirement. Consequently, urbanization of the watershed will result in increased frequency and magnitude of storm runoff. However, most of the developable parts of Pinal County in the study area have already been developed, so further changes to the hydrologic response of this part of the area are not expected to be significant.

Within Maricopa County, new development is required to retain the 100-year 2-hour runoff volume. This requirement generally results in a reduction of runoff from newly urbanized areas. However, much of the development in Maricopa County has occurred prior to the institution of the retention requirement. Also, retention associated with single lot development is often found not to be effective over longer periods of time as owners have been known to fill in low areas originally designed to act as retention basins.

Urbanization is limited in areal extent. Much of the study area lies within the Usery Mountain Recreation Area, municipal parks, or the Tonto National Forest and remains off limits to development for the immediate future. Most future residential development will likely occur behind Spook Hill Floodway and Spook Hill FRS, as more land in these watersheds is not reserved for recreational purposes. While it is possible that portions of the National Forest could be transferred to private ownership, most of the Forest areas within the study area are also areas of relatively steep mountain slopes not conducive to dense urbanization.

Observations by maintenance personnel (Loy, 1999) indicate that sediment yield increases during times of construction activity associated with urbanization. However, it was also noted that yield slowed to more common undeveloped levels after a few years. These local observations mirror similar trends noted elsewhere by other researchers (Knighton, 1984).

Summary

The geomorphic contrasts between the eastern and western portions of the Spook Hill ADMP study area are important considerations when evaluating sediment impacts on flood control alternatives.

The analysis of geomorphic influences on sediment yield led to the following conclusions:

- The western half of the study area is likely to deliver greater quantities of sediment than the eastern half. The nature of the sediment delivered is also likely to differ.
- The western area is dominated by bedload sediments and, under natural conditions, is more widely distributed spatially in its location.
- The eastern area delivers a higher proportion of suspended sediments that will flow through the system more easily.
- The location of sediment inflows in the eastern area will be limited primarily to readily identifiable washes with relatively low width to depth ratios.
- Internal storage is greater in the western half of the study area than in the eastern half due to the shallow, distributary nature of washes in the western half.
- The western half of the study area has greater potential for urban development than the eastern half. Therefore, future conditions in the western half are likely to differ more from current conditions than in the eastern half.

Data Sources

Mapping

The topographic mapping considered in these analyses came from two sources. The first was the USGS 7.5 minute quadrangles. The maps for the Spook Hill ADMP study area have 10 foot contour interval data on the piedmont. The second source of topographic data considered was the 2-foot contour data from FCD Project No. 93-51 (McLain-Harbors). These data were limited in extent to the area immediately adjacent to the flood control storage pools. Although these data do not cover much of the study area, they provided the basis for comparison to the SCS design data for the dams.

Aerial photographs – recent & historical

Two sets of aerial photographs were analyzed for changes in channel continuity and morphology due mostly to residential development in the study area. The oldest photos were taken in 1972 and 1973 and orthorectified for use as SCS soil maps. These orthorectified photos were available at a scale of 1:24,000. The second set of aerial photographs was produced specifically for this study by Kenny Aerial in 1999. The photos were not orthorectified. The scale of these photographs was approximately 1:6,000.

Previous Reports

Previous reports on sediment yield both in the study area and regionally were consulted to provide a context for the results of these analyses. The reports are discussed in more detail following the presentation of sediment yield results determined by JEF.

Data provided by Wood/Patel

Wood Patel and Associates provided subbasin data used by JEF in the sediment yield analyses. These data included the subbasin delineations and geometric characteristics such as area, slope, and flow path lengths (Figure 8). Wood/Patel also provided HEC-1 rainfall/runoff model results for the 100-year 6-hour and 100-year 24-hour storms. The peak discharges and runoff volumes computed by these models were also used in the sediment yield analysis (see Appendix).

Sediment Yield

Introduction

Sediment yield is the amount of solid material moved by water past a particular point in a stream system, or alternately, the amount of material deposited in an enclosed basin. Sediment yield includes both particles small enough to be carried for a while in suspension by the supporting action of turbulence (suspended load), and particles moved close to or at the bottom of the channel by rolling, sliding, or bouncing (bedload). When water is trapped behind flood retention structures its velocity is reduced and the sediment that it carried is deposited. Sediment yield is a major concern for public officials in charge of maintaining the effectiveness of flood control structures, because sedimentation behind dams or in floodways reduces the volume of water that can be stored or transported by the system. A reduction in effective volume increases the likelihood of a spillover in larger runoff events, increasing the chance of injuries, loss of human life, or property damage downstream, or damage to the structure itself.

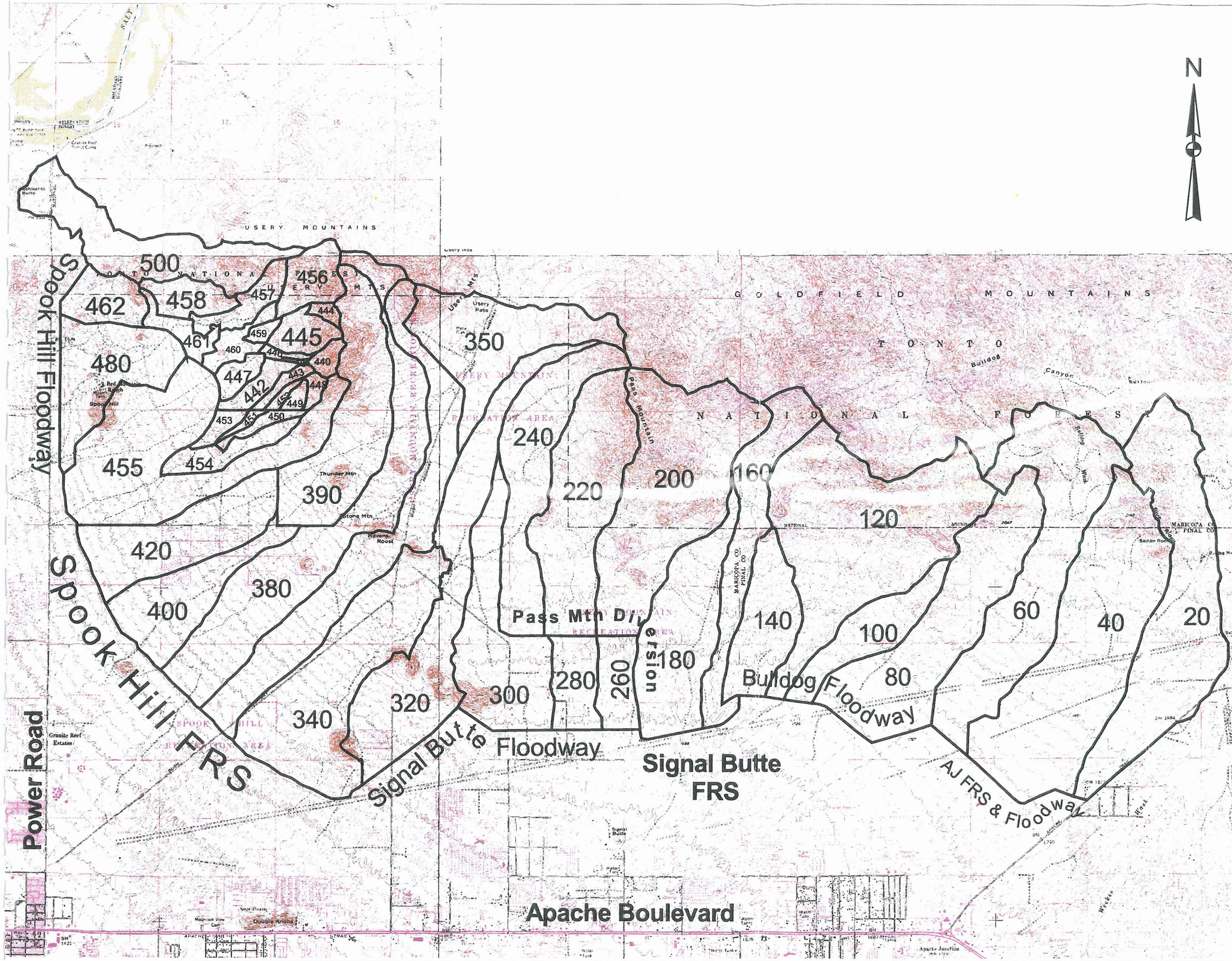
Average annual sediment yield vs. event-based sediment yield

Sediment yield can be examined in two different ways. The first of these is by average annual sediment yield, which is the volume of sediment delivered to a point on average every year. Computations of average annual sediment yield take into account sediment yields from all possible runoff events. Therefore, if large events have not occurred for some time in the basin then the average annual sediment yield may overpredict the actual sediment yield observed by direct measurements, since it is taking into account sediment yields from events that have not occurred. Conversely, average annual sediment yields are much less than yields for large single events.

Flood Control District of Maricopa County

Spook Hill
Area Drainage Master Plan
Update

March 2000



LEGEND

280 Subbasin

SCALE

2000 0 2000 4000 6000 Feet

Figure 8 - Subbasin Map

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Second, event-based sediment yields are the sediment yields that are generated by runoff events of various frequencies, such as the 2-year flood versus the 100-year flood. These predictions can be useful in estimating sediment yields during a particular design event.

Review of Sediment Yield Methods

Predictive Methods

Estimates of sediment yield can be made using a variety of methods developed over the years. Some of the most commonly used and accepted methods are listed below. Following the list is a brief description of each method.

- Renard Equation (1972, 1975)
- Dendy-Bolton Equation (1976)
- Flaxman Equation (1972, 1974)
- Pacific Southwest Inter-Agency Committee (PSIAC) Method(1968, revised 1991)
- Modified Universal Soil Loss Equation (MUSLE)

Renard equation

Renard (1972) and Renard and Laursen (1975) developed an equation for predicting sediment yield from semiarid rangeland in the southwestern United States. The model used to develop the simplified relationship simulated individual hydrographs for semiarid watersheds and the resulting sediment transport for the simulated hydraulic conditions. The simplified equation relates average annual sediment yield to drainage area. The Renard equation is appropriate for the study area since it was calibrated using data from the U.S. Southwest.

Dendy-Bolton equation

The Dendy and Bolton (1976) equation for average annual sediment yield is based on regression equations developed from sedimentation data from over 800 reservoirs in the United States. The equation relates drainage area and average annual runoff to sediment yield. The regression equations used average values of grouped data, so the application of the equation to specific watersheds is subject to a certain amount of possible error. Local variations such as topography, soils, geology, vegetation, and land use may have a more substantial impact on sediment yield than runoff or drainage area. Dendy and Bolton state that actual sediment yield from specific watersheds may vary 10 to 100 times the value predicted by their method.

Flaxman equation

Flaxman (1972) developed a regression equation relating sediment yield to four factors. These factors were (1) the ratio of average annual precipitation to average annual temperature, (2) average watershed slope, (3) percent of soil particles greater than 1.0

mm, and (4) a soil aggregation index. The data set included 27 watersheds in the western United States ranging from 12 to 54 square miles in size. Flaxman (1974) added a term to the equation that represented the 50% chance (2-year) peak discharge. The Flaxman method is generally applicable to the study area since both the 1972 and 1974 equations were developed with data from the semiarid and arid west.

Pacific Southwest Inter-Agency Committee (PSIAC) method

The PSIAC (1968, ADWR 1985) procedure was developed for planning level analyses of sedimentation in the southwest United States. The PSIAC method uses generalized watershed characteristics including geology, soils, climate, runoff, topography, ground cover, land use, upland erosion, and channel erosion to predict sedimentation rates. The PSIAC method is recommended for planning level sedimentation studies of drainage areas approximately 10 square miles in area. In tests conducted by Renard and Stone (1981) at the Walnut Gulch Experimental Watershed the PSIAC method generally agreed with measured sediment yield compared to the Flaxman, Renard, Dendy-Bolton, and MUSLE methods.

Modified Universal Soil Loss Equation (MUSLE)

The Modified Universal Soil Loss Equation (MUSLE) was developed by the U.S. Soil Conservation Service to predict rates of soil erosion, and is also commonly used to predict the sediment yield in the semiarid Southwest (Renard and Stone, 1981; ADWR, 1985). MUSLE can be used to estimate sediment supplied from individual design storms as well as for average annual sediment production. A revised Universal Soil Loss Equation (RUSLE) was developed using more data from the semiarid and arid southwest. However, RUSLE was designed to estimate soil loss, not sediment yield (Renard, 1997).

Verification Methods

JEF used several methods to verify the predictive methods and constrain the sediment yield values. These included:

- Flood Control District of Maricopa County Maintenance Data
- Field Measurements
- Assumed Sediment Yields

Flood Control District of Maricopa County maintenance data

Anecdotal records (Loy, 1999) of maintenance schedules and the amount of sediment removed from the floodways and the low flow channels behind the flood retention structures are available from recollections of long-time Flood Control District maintenance personnel. Although it may be difficult to develop a specific quantity of sediment from these recollections, their basin-specific knowledge was used to formulate a range of sediment yield estimates to verify the computed estimates from the various equations discussed above.

Field measurements

Sediment has accumulated in the Bulldog Floodway, Signal Butte FRS, Pass Mountain Diversion, and Spook Hill Floodway portions of the Spook Hill ADMP. Empirical measurements were made of these sediment accumulations and used to verify the predicted values from the equations and methods discussed above. Measurements of area from aerial photographs were used in conjunction with field measurements to determine sediment volumes.

Assumed sediment yield

Assumed sediment yield values can be applied to the Spook Hill ADMP subbasins from which final sediment volumes can be calculated and theoretically distributed in detention areas. The depths of the distributed sediment can be compared to the actual depths in the basin to constrain the predicted sediment yield values. Alternately, the volumes calculated from the assumed sediment yields can be compared to volumes measured in the field to constrain sediment yield values.

Selection of Methods

Application of all the methods discussed above was appropriate to determine and verify sediment yield in the Spook Hill ADMP. Five of the methods, the Renard equation, Dendy-Bolton equation, Flaxman equation, PSIAC method, and the MUSLE, provided average annual sediment yield values. The MUSLE also provided event-based sediment yields.

Application of Sediment Yield Methods

JEF decided to use the following predictive methods to estimate sediment yield in the Spook Hill ADMP study area:

- Renard Equation (1972, 1975)
- Dendy-Bolton Equation (1976)
- Flaxman Equation (1972, revised 1974)
- Pacific Southwest Inter-Agency Committee Method (PSIAC) (1968, revised 1991)
- Modified Universal Soil Loss Equation (MUSLE)

A detailed description of the equation or procedure used in each method follows. Sources of data are also discussed.

Renard Equation

Renard (1972) and Renard and Laursen (1975) developed an equation for predicting sediment yield from semiarid rangeland in the southwestern United States. The model used to develop the simplified relationship simulated individual hydrographs for semiarid watersheds and the resulting sediment transport for the simulated hydraulic conditions. The simplified equation relating average annual sediment yield to drainage area is

$$Y = 0.001846\ A_a^{-0.1187} \qquad (1)$$

where Y = average annual sediment yield in acre-feet/acre/year
A_a = drainage area in acres.

The Renard equation is appropriate for estimating sediment yield in the Spook Hill study area since it was calibrated using data from the U.S. Southwest. However, it should be noted that tests of the equation against measured sediment yield values in the Walnut Gulch Experimental Watershed indicated that the Renard Equation over-predicts sediment yield (Renard and Stone, 1981). Drainage area values were taken from the Wood/Patel HEC-1 model. The drainage areas for individual subbasins and for each FRS can be found in the appendix.

Dendy-Bolton Equation

The Dendy and Bolton (1976) equation for average annual sediment yield is based on regression equations developed from sedimentation data from over 800 reservoirs in the United States. The equation relates drainage area and average annual runoff to sediment yield in the following equation:

$$S = 1280\ Q^{0.46}\ (1.43 - 0.26 \log A) \qquad (2)$$

where S = sediment yield in tons/square mile/year
Q = annual runoff in inches
A = watershed area in square miles.

Renard (1977) developed a relationship for average annual runoff for the Walnut Gulch Experimental Watershed, which can be considered analogous to Sonoran Desert conditions in the Spook Hill study area. The relationship is

$$Q = 0.4501\ A^{-0.1449} \qquad (3)$$

where Q = annual runoff in inches
A = watershed area in square miles.

By substituting equation (3) into equation (2) the equation is simplified to only one independent variable as follows:

$$S = 887\ A^{-0.0667}\ (1.43 - 0.26 \log A) \qquad (4)$$

Again, drainage area values were taken from the Wood/Patel HEC-1 model to solve equation (4) for sediment yield. The drainage areas for individual subbasins and for each FRS can be found in the appendix.

Flaxman Method

Flaxman (1972) developed a regression equation relating sediment yield to four factors. These factors were the ratio of average annual precipitation to average annual temperature, average watershed slope, percent of soil particles greater than 1.0 mm, and a soil aggregation index. The data set included 27 watersheds in the western United States ranging from 12 to 54 square miles in size. Flaxman (1974) added a term to the equation that represented the 50% chance (2-year) peak discharge. Both Flaxman equations were developed using data from the semiarid and arid west, so the Flaxman method is generally applicable to the Spook Hill ADMP. However, it should be noted that sub-basin size in the Spook Hill study area averages 0.69 square miles, less than the areas of the basins used to calibrate the equation. Basins in the Spook Hill area are comparable in area to those in the Walnut Gulch Test Area where the 1974 Flaxman Equation was compared to measured sediment yields (Renard and Stone, 1981). In those comparisons the 1974 Flaxman equation predicted sediment yields that were closer to the measured yields than the 1972 equation.

The regression equation Flaxman developed in 1972 was

$$\log (Y+100) = 6.21301 - 2.19113 \log (X_1+100) + 0.06034 \log (X_2+100) - 0.01644 \log (X_3+100) + 0.04250\ (X_4+100) \qquad (5)$$

where Y = sediment yield in acre-feet per square mile per year
X_1 = the ratio of average annual precipitation (inches) to average annual Temperature (^oF)
X_2 = the average watershed slope (%)
X_3 = soil particles greater than 1 mm in diameter (%)
X_4 = a measure of soil aggregation based on the percent clay and soil pH.

Flaxman (1974) modified the regression equation to reflect the 2-year peak discharge in cubic feet per second per square mile (csm). The revised equation was

$$\log (Y+100) = 524.37321 - 270.65625 \log (X_1+100) + 6.41730 \log (X_2+100) - 1.70177 \log (X_3+100) + 4.03317\ (X_4+100) + 0.99248\ (X_5+100) \qquad (6)$$

where $Y, X_1 - X_4$ = same as 1972 equation
X_5 = 2-year peak discharge (csm).

Precipition:Temperature Ratio (X_1)

Precipitation and temperature data were collected from the Falcon Field Station reported on the Western Regional Climate Center web site. Falcon Field was the station nearest to the study area. Two distinct but overlapping periods of record were reported for the Falcon Field station. Temperature and precipitation measurements for the two periods are presented in Table 1. ALERT precipitation data was collected from the Flood Control District of Maricopa County (FCDMC) for comparison to the Falcon Field data. The ALERT measurement presented in Table 4 is an average of several stations located within the Spook Hill study area.

Table 1. Spook Hill ADMP Update Climate Data

	Falcon Field 1948-1976	Falcon Field 1961-1990	ALERT Data 1989-1999
Average Daily Temperature (°F)	67.4	67.0	n/a
Average Annual Precipitation (in)	8.08	8.24	8.56

Temperature and precipitation data from Falcon Field for the 1961-1990 period were selected for use in the Flaxman equation. The 1961-1990 period is a compromise between the drier 1948-1976 period and the wetter 1989-1999 period.

Watershed Slope (X_2)

The adjusted slope for each subbasin used in the Wood/Patel HEC-1 model was converted to a percent slope and used for the X_2 variable in the Flaxman equation. The adjusted slopes for each subbasin can be found in the appendix.

Percent Soil Particles Greater than 1 mm (X_3)

Soil data were obtained from the *Soil Survey of Aguila-Carefree Area, Parts of Maricopa and Pinal Counties, Arizona* (Camp, 1986). The percent of particles greater than 1 mm (X_3) was derived from the Percentage Passing Sieve Number 10 column in Table 13 (Engineering Index Properties). The number 10 sieve (1.1 mm) approximates the 1 mm characteristic. The weighted average of percent soil particles for each subbasin can be found in the appendix.

Aggregation Factor (X_4)

The aggregation factor is a percent value based on the percent clay in the soil modified by the soil pH. For the aggregation factor (X_4) percent clay and pH were taken from Table 14 (Physical and Chemical Properties of Soils) in the *Soil Survey of Aguila-Carefree Area, Parts of Maricopa and Pinal Counties, Arizona* (Camp, 1986). All values were referenced from the top horizon of the soil profile. If pH is less than 7.0 the aggregation factor is assigned a negative value; if pH is greater than 7.0 a positive value is assigned. However, if the percent of coarse particles in the soil (i.e. greater than 1.0 mm) exceeds

25%, then the aggregation factor is assigned a value of zero. For all soils in the Spook Hill ADMP the aggregation factor is zero due to the sediment size distribution.

2-Year Peak Discharge (X_5)

The 2-year peak discharge was determined by applying the Region 13 (Thomas et al. 1997) Q2:Q100 ratio to the 100-year 24-hour peak discharge calculated by the HEC-1 model provided by Wood/Patel. The Spook Hill study area is located on the border of Region 12 and Region 13. Region 13 was selected as more appropriate for determining higher frequency storm events for two reasons. First, the Region 13 100-year equation more closely approximated the 100-year flow provided by the Wood/Patel HEC-1 model for a sampling of subbasins. Second, the lower threshold of watershed mean elevations included in the Region 12 analysis was approximately 2,000 ft above mean sea level (msl). A majority of the subbasins in the study area were less than 2,000 ft above msl, thus elevations in the study area fit within the range of elevation values in Region 13 better than in Region 12. The results for subbasin 100 are presented in Table 2. The results for the remaining subbasins are presented in the appendix.

Table 2. Spook Hill ADMP Update
Q_T Estimates Based on Wood/Patel HEC-1 100-Year 24-Hour Peak
Sub-Basin 100

Discharge Event	Region 13 Regression Equation Q (cfs)	Q_T:Q100 Ratio	Q_T Estimate (cfs)
Q100	754	1.00	389[1]
Q2	79	0.105	41[2]

[1]Discharge provided by Wood/Patel HEC-1 model
[2]Calculated using Q_T:Q100 ratio

PSIAC

The PSIAC procedure involves evaluating several watershed characteristics, assigning a rating number based on the evaluation, and calculating a sediment yield based on the assigned ratings. The following characteristics are utilized in estimating sediment yield:

- Surface Geology
- Soils
- Climate
- Runoff
- Topography
- Effective Ground Cover
- Land Type and Management Quality
- Upland Erosion
- Channel Erosion and Sediment Transport

PSIAC Surface Geology

The surface geology of the Spook Hill ADMP study area consists of unconsolidated alluvial deposits on the piedmont and volcanic rocks in the Usery and Goldfield Mountains. The Utah update (Interagency Team, 1991) to the PSIAC sediment yield estimation method assigns a factor of between 0 (low sediment yields) and 5 (high sediment yields) to surficial geology. If the surface is made up of alluvial or colluvial deposits the rating assigned is zero. Guidelines for the assigning of a surface geology rating factor are presented in Table 3.

Table 3. Spook Hill ADMP Update Surface Geology Characteristics Related to PSIAC Surface Geology Rating Factor (Adapted from Interagency Report, 1991)

Characteristic	Rating
Marine shales and related mudstones and siltstones	High (5)
Rocks of medium hardness Moderately weathered Moderately fractured	Medium (3)
Massive, hard formations	Low (0)

The generally massive but weathered granites indicated by geologic maps (Skotnicki and Ferguson, 1997) and field observations suggested surface geology rating factors of between 2 and 3 for areas of exposed bedrock. Most of the study area is covered by alluvial deposits, which receive a rating of 0. A surface geology map (Figure XX) was overlaid by a subbasin map in ArcView GIS, and the percent of each subbasin where bedrock or alluvium was exposed at the surface was calculated. A weighted average for each subbasin was then calculated. Final surface geology ratings ranged between 0 and 2. The appendix presents the results for each subbasin.

PSIAC Soil Rating Factor Analysis

Soils in the Spook Hill area are described in the *Soil Survey of Aguila-Carefree Area* (Camp, 1986). The goal of this analysis is to assign a PSIAC rating factor to each of the soil series located in the Spook Hill ADMP study area. The following soil series are located in the study area:

Antho
Carizzo
Cipriano
Ebon
Gachado
Gran
Gunsight
Lomitas
Maripo
Momoli
Pinamt
Rillito
Sun City
Tremant
Wickenberg

The PSIAC sediment yield procedure takes into account several soil characteristics to assign a rating number to the soil. These factors include texture, clay aggregation, shrink-swell potential, rockiness, and organic matter. The ways in which these factors affect the PSIAC rating are presented in Table 4. The rating can range from 0 (the lowest amount of sediment yield) to 10 (the highest amount of sediment yield).

Table 4. Spook Hill ADMP Update
Soil Characteristics Related to
PSIAC Soil Rating Factor
(Adapted from Interagency Report, 1991)

Characteristic	Rating
Fine-textured soil High shrink-swell characteristics Poorly aggregated clays	High (10)
Medium-textured soil Occasional rock fragments	Medium (5)
Coarse-textured soil High percentage of rock fragments Aggregated clays High in organic materials	Low (0)

The characteristics of each soil series relevant to the assignment of PSIAC ratings were taken from *Soil Survey of Aguila-Carefree Area* (Camp, 1986) and are summarized in Table 5.

Table 5. Spook Hill ADMP Update
Soil Series Characteristics for PSAIC Soil Rating

Soil Series	Texture	% Rock Fragments > 3 inches	Clay Aggregation	Shrink-Swell Potential	Organic Material
Antho	Sandy loam	0	Poor	Low	Low
Carrizo	Very gravelly sand	5	Poor	Low	Low
Cipriano	Very gravelly loam	7.5	Poor	Low	Low
Ebon	Very gravelly loam	0	Poor	Low-moderate	Low
Gachado	Very gravelly loam	7.5	Poor	Low	Low
Gran	Very gravelly sandy loam	0	Poor	Low-moderate	Low
Gunsight	Very gravelly sandy loam	5	Poor	Low	Low
Lomitas	Very gravelly sandy loam	15	Poor	Low	Low
Maripo	Sandy loam	0	Poor	Low	Low
Momoli	Gravelly sandy loam	2.5	Poor	Low	Low
Pinamt	Extremely gravelly sandy loam	7.5	Poor	Low	Low
Rillito	Loam	0	Poor	Low	Low
Sun City	Gravelly loam	2.5	Poor	Low-moderate	Low
Tremant	Gravelly loam	2.5	Poor	Low	Low
Wickenberg	Gravelly sandy loam	0	Poor	Low	Low

The soils are generally classified as loams, or medium-textured soils, that are assigned a rating of 5. Sandy loams can be assigned a slightly higher rating of 6. A sand soil dominated by sand will be assigned a rating of 7. The combination of poorly aggregating clays but low shrink-swell potential (low amounts of clay, loams less than approximately 25% clay) can be considered to cancel each other out, thus not affecting the final rating.

Low organic material reduces the binding effects in the soil so rating numbers would be increased, perhaps by one. Increasing percentages of rocky material would tend to decrease the rating factor, and thus decrease the sediment yield. Since the "gravelly" portion of the texture description is a modifier to the more dominant loam, it was assumed that the loam dominates the soil factor. Only those soils with very gravelly or extremely gravelly texture modifiers would have their soil ratings decreased by one. Additionally if the percent of rock fragments greater than 3 inches exceeded 7%, the rating factor was decreased by an additional one point (Table 6).

Table 6. Spook Hill ADMP Update
Soil Series PSAIC Soil Ratings

Soil Series	Texture	% Rock Fragments > 3 inches	Gravel Modifier	Organic Material	Final Soil Rating
Antho	6	0	0	+1	7
Carrizo	7	0	-1	+1	7
Cipriano	5	-1	-1	+1	4
Ebon	5	0	-1	+1	5
Gachado	5	-1	-1	+1	4
Gran	6	0	-1	+1	6
Gunsight	6	0	-1	+1	6
Lomitas	6	-1	-1	+1	5
Maripo	6	0	0	+1	7
Momoli	6	0	0	+1	7
Pinamt	6	-1	-1	+1	5
Rillito	5	0	0	+1	6
Sun City	5	0	0	+1	6
Tremant	5	0	0	+1	6
Wickenberg	6	0	0	+1	7

The Spook Hill ADMP area has been divided into detailed soil map units by the SCS Soil Survey (see Table 7 and Appendix). Each detailed soil map unit is composed of certain percentages of soil series. A weighted average of the PSIAC rating based on each soil series' percent contribution to the detailed soil map unit was determined.

Wood/Patel provided an Excel spreadsheet listing the percent area each detailed soil map unit covered in each watershed. Using the detailed soil map unit PSAIC ratings (Table 6 and 7) and the percent area, a weighted soil factor PSIAC rating was determined for each watershed. A soil map of the study area and the results for each subbasin are provided in the appendix.

Table 7. Spook Hill ADMP Detailed Soil Map Units		
Map Unit	Description	Weighted PSIAC Rating
3	Antho-Carrizo-Maripo complex	7
44	Ebon very gravelly loam, 1-8% slopes	5
45	Ebon very gravelly loam, 8-20% slopes	5
47	Ebon-Gunsight-Cipriano association, 3-25% slopes	5
48	Ebon-Pinamt complex, 3-20% slopes	5
49	Ebon-Pinamt complex, 20-40% slopes	5
52	Gachado-Lomitas-Rock outcrop complex, 7-55% slopes	4.3
61	Gran-Wickenburg complex, 1-10% slopes	6.5
63	Gran-Wickenburg-Rock outcrop complex, 10-65% slopes	6.5
68	Gunsight-Cipriano complex, 1-7% slopes	5.1
90	Momoli gravelly sandy loam, 1-5% slopes	7
98	Pinamt-Tremant complex, 1-10% slopes	5.4
101	Rillito loam, 0-3% slopes	6
110	Suncity-Cipriano complex, 1-7% slopes	5.3
112	Tremant gravelly sandy loams	6
113	Tremant gravelly loams	6
115	Tremant-Antho complex, 1-5% slopes	6.4
116	Tremant-Gunsight-Rillito complex, 1-5% slopes	6
118	Tremant-Rillito complex	6

PSIAC Climate

The PSIAC evaluation accounts for climate in its estimation of sediment yield. The frequency and intensity of storms are considered when assigning a rating factor to the climate characteristic. The rating factor can range from 0, the lowest amount of sediment yield, to 10, the highest amount of sediment yield. Considerations for assigning a value for the climate rating are presented in Table 8.

Spook Hill ADMP is in an arid climate, which places it in the low rating category (rating = 0) (Table 8). However, due to the annual occurrence of short but intense thunderstorms during the monsoon season, JEF felt that a slight increase in the rating was warranted. Therefore, the climate rating for the PSIAC evaluation was increased to 2.

Table 8. Spook Hill ADMP Update Climate Characteristics Related to PSIAC Climate Rating Factor (Adapted from Interagency Report, 1991)	
Characteristic	Rating
Storms of several days duration with short periods of intense rainfall Frequent intense convective storms Freeze-thaw occurrences	High (10)
Storms of moderate duration and intensity Infrequent convective storms	Medium (5)
Humid climate with low intensity rainfall Precipitation in form of snow Arid climate: low intensity storms Arid climate: rare convective storms	Low (0)

PSIAC Runoff Rating

The type of storm runoff experienced by the watershed is taken into account by the PSIAC method. The characteristics of an average storm are considered. Once again the rating can range from 0, the lowest sediment yield, to 10, the highest sediment yield. Table 9 lists the considerations for classifying the storm runoff and the corresponding rating values.

Table 9. Spook Hill ADMP Update Runoff Characteristics Related to PSIAC Runoff Rating Factor (Adapted from Interagency Report, 1991)	
Characteristic	Rating
High peak flows per unit area Large Volumes of flow per unit area	High (10)
Moderate peak flows per unit area Moderate volume of flow per unit area	Medium (5)
Low peak flows per unit area Low volume of runoff per unit area Rare runoff events	Low (0)

The study area experiences low volume of runoff per unit area (low rating) but at the same time the peak flows per unit area are high (high rating). JEF decided that the best way to factor in these apparently contradictory classifications was to assign a moderate rating of five to the study area.

PSIAC Topography

The PSIAC estimation method calls for the consideration of topography in determining the sediment yield from a watershed. The rating values are based on the slope of the land. Slopes less than 5% are assigned a rating of 0 (lowest sediment yield). Slopes greater than 30% are assigned a rating of 20 (highest sediment yield). Slopes between 5% and 30% are assigned a rating of 10 (medium sediment yield).

The three slope categories were delineated directly in ArcView GIS using digital topographic maps of the study area. The subbasins delineated by Wood-Patel were then overlaid on the slope categories to determine the percentages of each slope category in each subbasin. Using the percent areas and the rating factor assigned to each slope category, a weighted average of the slope factor was produced for each subbasin. A map of the slope delineation and results for each subbasin are provided in the appendix.

PSIAC Effective Ground Cover

The effective ground cover for the PSIAC has the capacity to reduce sediment yield. If the ground cover is sufficiently widespread, the rating factor is assigned a negative value, thus reducing the sediment yield. The effective groundcover is a combination of percent rock fragments in the soil's upper horizon (surface) and vegetation cover – areas where it is assumed sediment will not be produced because of either the protection of rock fragments or the anchoring of sediment by vegetation.

The rating values are assigned based on the following table:

Table 10. Spook Hill ADMP Update Ground Cover Characteristics Related to PSIAC Effective Ground Cover Rating Factor (Adapted from Interagency Report, 1991)

Characteristic	Rating
Ground cover does not exceed 20% Vegetation sparse, little or no litter No rock in surface soil cover	High (10)
Ground cover not exceeding 40% Noticeable litter If trees present, understory not well Developed	Medium (0)
Area completely protected by vegetation, rock fragments, and litter Little opportunity for rainfall to reach erodible material	Low (-10)

Assignments of ratings for each watershed began with the land use data and associated vegetation cover data provided by Wood/Patel and used in their parameterization of the HEC-1 models. The weighted average of the percent vegetation cover was combined with the percent of rock in the upper layer of the soil (Camp, 1986) to provide an estimate for the effective ground cover. The resulting percent of effective ground cover was then assigned a rating based on the rating chart prescribed by the PSIAC method (Interagency Team, 1991). The final percentages of effective ground cover ranged from 15% to 58%, with corresponding ratings of 10 to –3 respectively. A complete list of results is provided in the appendix.

PSIAC Land Type and Management Quality

The PSIAC method requires the analysis of land type and management quality. Table 11 presents the PSIAC recommendations for assigning a rating number for the land type factor. Again, the higher the rating number, the higher the sediment yield.

Table 11. Spook Hill ADMP Update Land Type Characteristics Related to PSIAC Land Type Rating Factor (Adapted from Interagency Report, 1991)

Characteristic	Rating
Almost all of area overgrazed or historic overgrazing impacts still active All of area recently burned Roads in need of O&M or improved design Almost all of area is badlands with minimal armor	High (10)
<50% of area overgrazed or with historic overgrazing impacts still active <50% area recently logged Ordinary road and other construction Almost all of area is badlands with 50% of area covered with armor	Medium (0)
No recent logging Good grazing management or historic overgrazing impact under control Badlands are totally armored	Low (-10)

Visual inspection of the land use in each subbasin guided the assignment of land type factors. Subbasins dominated by park land or undeveloped land were assigned low ratings. Subbasins dominated by residential development were assigned a medium rating. Final land type rating factors ranged from –10 to 0 (see appendix).

PSIAC Upland Erosion

The PSIAC method requires the analysis of the extent of upland erosion in the form of gully development. The PSIAC documentation provides recommendations for establishing a rating number for the upland erosion factor (Table 12).

Table 12. Spook Hill ADMP Update Upland Erosion Characteristics Related to PSIAC Upland Erosion Rating Factor (Adapted from Interagency Report, 1991)

Characteristic	Rating
More then 50% of the area characterized by concentrated flow erosion with increasing gully development	High (25)
About 25% of the area characterized by concentrated flow erosion with increasing gully development	Medium (10)
No apparent signs of erosion	Low (0)

Field observations by JEF personnel revealed that very little gullying was taking place in the study area. Rilling and gullying were more pronounced on steeper slopes, so it was deemed reasonable that areas of steeper slopes could be assigned a higher upland erosion factor. The final assignments based on slope were: 5 for slopes greater than 30%; 3 for slopes between 5 and 30 %; and 0 for slopes less than 5%. A weighted average of the upland erosion factor was calculated based on the percent area that each slope category occupied in each subbasin. The final upland erosion ratings ranged from 0 to 5 (see appendix).

Channel Erosion and Sediment Transport

PSIAC method documentation provides guidelines for the assignment of a channel erosion and sediment transport factor. The guidelines are presented in Table 13.

Table 13. Spook Hill ADMP Update Channel Erosion Characteristics Related to PSIAC Channel Erosion and Sediment Transport Rating Factor (Adapted from Interagency Report, 1991)

Characteristic	Rating
Eroding banks, continuously or at frequent intervals, with deep flows of long duration Active headcuts and degradation in tributary channels	High (25)
Moderate flow depths, medium flow duration with occasionally eroding banks or bed	Medium (10)
Wide shallow channels with flat gradients and short flow duration Channels in massive rock, large boulders, or well vegetated Artificially controlled channels	Low (0)

Field inspection of the subbasins in the Spook Hill ADMP combined with knowledge of the flow regime suggested that the channel erosion rating factor should trend towards the lower values. Flow durations in the Spook Hill study area are short. However, evidence of bank erosion was noted in the field. Channels in the western portion of the study area tended to be wider and shallower than channels in the eastern portion. Thus it was determined that subbasins east of Usery Pass should be assigned a channel erosion rating of 4, while subbasins east of Usery Pass should be assigned a rating of 2 (see appendix).

Summary

Once the rating factors were assigned to each of the nine subbasin characteristics, a sum of all the rating factors for the subbasin was calculated. The total for each subbasin is then compared to an annual sediment yield chart developed for the PSIAC procedure to determine sediment yield from the subbasin (Interagency Team, 1991). A copy of the chart is provided in the appendix.

Modified Universal Soil Loss Equation (MUSLE)

The Modified Universal Soil Loss Equation (MUSLE) was developed by the U.S. Soil Conservation Service to predict sediment yield, and is commonly used to predict sediment yield in the semiarid Southwest (Renard and Stone, 1981; ADWR, 1985). MUSLE can be used to estimate sediment supplied from individual design storms as well as for average annual sediment production. The equation developed for MUSLE is

$$Y_S = R_W \, K \, LS \, C \, P \qquad (7)$$

where Y_S = sediment yield in tons for the storm event,
R_W = storm runoff energy factor,
K = soil erodibility factor,
LS = slope length and gradient factor,
C = cover and management factor,
P = erosion control.

Guidelines for using MUSLE are presented in Appendix B of the *Design Manual for Engineering Analysis of Fluvial Systems* (ADWR, 1985). The sediment yield calculated with MUSLE for each probability storm event was then probability weighted and averaged to determine average annual sediment yield in tons. A density of 110 lbs/cubic foot (1.77 g/cm^3) estimated from data presented in the *Soil Survey of Aguila-Carefree Area, Parts of Maricopa and Pinal Counties, Arizona* (Camp,1986) was used to convert tons to acre-feet. Calculation sheets the average annual and event-based sediment yield for each subbasin are provided in the appendix.

Storm Runoff Energy Factor (R_W)

The storm runoff energy factor is determined by the equation

$$R_W = \alpha \, (V q_p)^{\beta} \qquad (8)$$

where R_W = storm runoff energy factor,
α, β = coefficients,
V = storm event runoff volume in acre-feet,
q_p = storm event peak flow in cfs.

Arizona Department of Water Resources (ADWR, 1985) recommends values for α and β of 95 and 0.56 respectively. Wood/Patel provided peak discharges for the 100-year 24-hour event for each sub-basin. The Q2, Q5, Q10, Q25, and Q50 were determined by applying a calculated Q_T:Q100 ratio for each basin. The ratios were based on the Region 13 Regional regression equations developed by the USGS (Thomas et al., 1997). An example for subbasin 100 is shown in Table 14.

Table 14. Spook Hill ADMP Update Q_T Estimates Based on Wood/Patel HEC-1 100-Year 24-Hour Peak Sub-Basin 100			
Discharge Event	Region 13 Regression Equation Q (cfs)	Q_T:Q100 Ratio	Q_T Estimate (cfs)
Q100	754	1.00	389[1]
Q50	578	0.767	299[2]
Q25	445	0.590	230[2]
Q10	284	0.377	147[2]
Q5	186	0.247	96[2]
Q2	79	0.105	41[2]

[1]Discharge provided by Wood/Patel HEC-1 model
[2]Calculated using Q_T:Q100 ratio

Soil Erodibility Factor (K)

The soil erodibility factor (K) for each soil can be found in the table of physical and chemical properties in the *Soil Survey of Aguila-Carefree Area, Parts of Maricopa and Pinal Counties, Arizona* (Camp, 1986). The erodibility factors for each soil series are summarized in Table XX. The soil survey described the composition of each map unit as a percentage of each soil series. The map unit K was based on a weighted average of the soil series percentages. Further, several map units covered each sub-basin. Thus the subbasin K is a weighted average of the weighted map unit Ks occurring in the basin. See Table 15 for an example of the weighting procedure for sub-basin 100. The remaining calculations can be found in the appendix.

Table 15. Spook Hill ADMP Update Soil Series Erosion Factor (K) Values	
Soil Series	Erosion Factor (K)
Antho	0.20
Carrizo	0.10
Cipriano	0.20
Ebon	0.10
Gachado	0.10
Gran	0.10
Gunsight	0.10
Lomitas	0.05
Maripo	0.20
Momoli	0.20
Pinamt	0.05
Rillito	0.32
Sun City	0.20
Tremant	0.32
Wickenberg	0.20

Table 16. Spook Hill ADMP Update Sub-basin 100 Weighted Erodibility Factor (K)				
Map Unit	**Soil**	**% Map Unit**	**Erosion Factor (K)**	**% Sub-basin**
3	Antho	35	0.20	
	Carrizo	30	0.10	
	Maripo	20	0.20	
Weighted Map Unit K:			**0.16**	2.4
44	Ebon	100	0.10	
Weighted Map Unit K:			**0.10**	2.6
48	Ebon	45	0.10	
	Pinamt	35	0.05	
Weighted Map Unit K:			**0.08**	25.8
98	Pinamt	45	0.05	
	Tremant	35	0.32	
Weighted Map Unit K:			**0.17**	69.2
Weighted Sub-basin K:				**0.22**

Slope Length and Gradient Factor (LS)

The topography of the basin is represented by the slope length and gradient factor. The equation relating length and gradient to determine the LS factor is

$$LS = (\lambda / 72.6)^n (0.065 + 0.0454 S + 0.0065 S^2) \qquad (9)$$

where LS = slope/length factor
λ = slope length
S = percent slope
n = exponent based on slope (0.3 for slope < 3%; 0.4 for slope = 4%; 0.5 for slope > 5%).

The slope length is defined in the MUSLE guidelines as the distance from the origination point of overland flow to the point where either slope decreases to the extent that deposition occurs or the runoff enters a channel. Slope lengths were estimated for each subbasin based on crenulations in the contours on USGS topographic maps and photo interpretation of the 1999 Kenney aerial photographs. The slope lengths ranged from approximately 50 feet to 300 feet. The adjusted slopes (converted to percent slopes) for each sub-basin provided in the Wood/Patel HEC-1 model were used to determine the LS factor.

Cover and Management Practice (C)

The cover and management practice factor is the product of three factors:

$$C = C_I \times C_{II} \times C_{III} \qquad (10)$$

where C_I = canopy cover
C_{II} = mulch cover
C_{III} = root cover.

Values for these three factors were estimated using the percent vegetation for varying land uses provided in the Wood/Patel HEC-1 model, field observation, and reasonable assumptions. The percent vegetation cover was divided into percent canopy and percent mulch. Canopy cover includes leaves and branches that do not directly touch the ground. Mulch cover includes plants that are low to the ground such as grasses, as well as litter and in some cases rock (i.e. xeriscaped lawns). For desert and open areas it was assumed that 80% of the vegetation cover was in the form of canopy and 20% in the form of mulch based on field observations. It was assumed that residential areas would have slightly higher proportions of mulch due to the increased probability of grass and rock lawns. Thus 66.7% and 33.3% percent of the vegetation cover was assigned to canopy and mulch respectively. For industrial, commercial, and park area it was assumed that mulch would be more prominent than canopy cover. Thus 33.3% and 66.7% percent of the vegetation cover was assigned to canopy and mulch respectively. For the root factor it was assumed that rooting percentages would equal vegetation cover percentages. Figures B.2., B.3., and B.4. in Appendix B (ADWR, 1985) were used to assign factor values. The results are presented in Table 17.

Table 17. Spook Hill ADMP Update
Land Use – Vegetation Cover and Associated MUSLE C Factors

Land Use	% Veg. Cover	% Canopy	Canopy Factor C_I	% Mulch	Mulch Factor C_{II}	% Rooting	Root Factor C_{III}	C Factor
Sonoran Desert	25	20	0.85	5	0.90	25	0.42	0.32
Open	10	8	0.95	2	1.00	10	0.44	0.42
Very Low Density Residential	30	20	0.85	10	0.76	30	0.40	0.26
Low Density Residential	50	33	0.78	17	0.63	50	0.37	0.18
Medium Density Residential	50	33	0.78	17	0.63	50	0.20	0.10
Multi-Family Residential	50	33	0.78	17	0.63	50	0.20	0.10
Industrial	60	20	0.85	40	0.39	60	0.17	0.06
Commercial	75	25	0.82	30	0.31	75	0.12	0.03
Park	90	30	0.78	60	0.25	90	0.10	0.02

Wood/Patel provided land use divisions for each subbasin used in the HEC-1 model. The divisions were presented as percentages of the total subbasin area. These percentages were used to develop a weighted average C factor. Table 18 presents an example of the weighting procedure for subbasin 100. The results for all subbasins are presented in the appendix.

Table 18. Spook Hill ADMP Update
Sub-basin 100 Weighted Cover Factor (C)

Land Use	C_I	C_{II}	C_{III}	C Factor	% Subbasin
Sonoran Desert	0.85	0.90	0.42	0.32	39.1
Very Low Density Residential	0.85	0.76	0.40	0.26	60.9
				Weighted Subbasin C:	**0.28**

Erosion Control Practice Factor (P)

This factor accounts for conservation practices such as contouring and terracing. In desert and open areas it can be reasonably assumed that no such activities have taken place, and the factor can be assigned a value of 1.0.

Results

Sediment yield results based on existing conditions can be divided into average annual results and event-based results.

Average Annual Results

The results of the five predictive methods used are summarized in Table 19.

Renard Equation Results

Calculations based on the Renard Equation resulted in a range of average annual sediment yields from 0.50 acre-feet/square mile/year to 0.95 acre-feet/square mile/year. The average was 0.64 acre-feet/square mile/year with a standard deviation of 0.12 acre-feet/square mile/year.

Dendy-Bolton Equation Results

Calculations based on the Dendy-Bolton Equation produced a range of average annual sediment yields from 0.47 acre-feet/square mile/year to 0.98 acre-feet/square mile/year. The average was 0.63 acre-feet/square mile/year with a standard deviation of 0.13 acre-feet/square mile/year.

Flaxman Equation Results

Calculations based on the 1974 Flaxman Equation produced a range of average annual sediment yields from 0.05 acre-feet/square mile/year to 1.38 acre-feet/square mile/year. The average was 0.22 acre-feet/square mile/year with a standard deviation of 0.26 acre-feet/square mile/year.

PSIAC Method Results

Estimations based on the PSIAC method resulted in a range of average annual sediment yields from 0.11 acre-feet/square mile/year to 0.37 acre-feet/square mile/year. The average was 0.20 acre-feet/square mile/year with a standard deviation of 0.06 acre-feet/square mile/year.

MUSLE Results

MUSLE calculations based on the data for the Spook Hill ADMP watersheds resulted in a range of average annual sediment yields from 0.005 acre-feet/square mile/year to 0.320 acre-feet/square mile/year. The average was 0.07 acre-feet/square mile/year with a standard deviation of 0.07 acre-feet/square mile/year.

Table 19. Spook Hill ADMP Update
Summary of Results of Sediment Yield Predictive Equations

Method	Minimum Sediment Yield (ac-ft/mi^2/yr)	Maximum Sediment Yield (ac-ft/mi^2/yr)	Average Sediment Yield (ac-ft/mi^2/yr)	Standard Deviation
Renard	0.50	0.95	0.64	0.12
Dendy-Bolton	0.47	0.98	0.63	0.13
Flaxman (1974)	0.05	0.31	0.13	0.06
PSIAC	0.11	0.37	0.20	0.06
MUSLE	0.005	0.32	0.07	0.07

Figure 9 compares the average annual sediment yield results of the five methods discussed above. The Renard and Dendy-Bolton results correspond almost exactly. Both use drainage basin area as the influencing variable when calculating the sediment yield. The results provided by the Flaxman, MUSLE, and PSIAC methods agree fairly well with each other but are much lower than the Renard and Dendy-Bolton results. Table 20 presents a detailed summary of the predicted sediment yields for each subbasin.

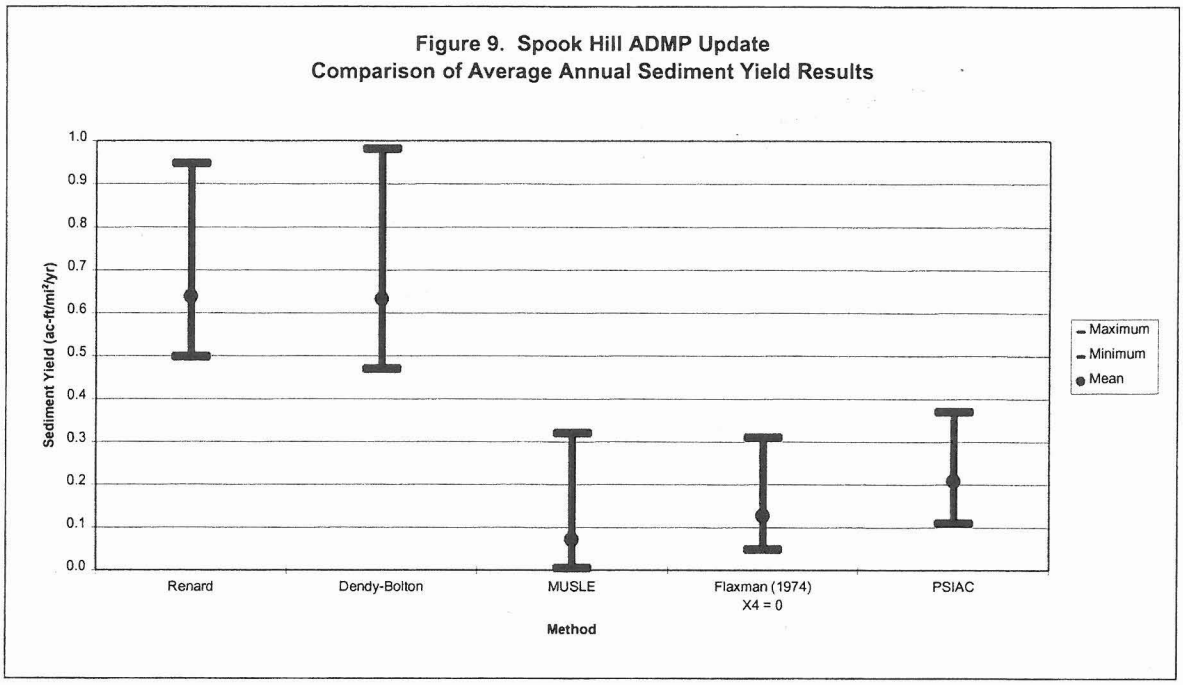
Figure 9. Spook Hill ADMP Update
Comparison of Average Annual Sediment Yield Results
Sediment Yield (ac-ft/mi²/yr)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Renard
Dendy-Bolton
MUSLE
Flaxman (1974)
X4 = 0
PSIAC
Method
Maximum
Minimum
Mean

Table 20. Spook Hill ADMP Update
Comparison of Average Annual Sediment Yield Calculations - Existing Conditions

	Subbasin ID	Basin Area (sq. mi.)	Length (miles)	Renard (ac-ft/mi^2/yr)	Dendy-Bolton (ac-ft/mi^2/yr)	Flaxman (1974) (ac-ft/mi^2/yr)	PSIAC (ac-ft/mi^2/yr)	MUSLE (ac-ft/mi^2/yr)	1% Concentration (ac-ft/mi^2/yr)	Period of Record 1% Concentration (ac-ft/mi^2/yr)	5% Concentration (ac-ft/mi^2/yr)	Period of Record 5% Concentration (ac-ft/mi^2/yr)
	20	1.82	4.58	0.511	0.485	0.049	0.170	0.023	0.206	0.129	3.516	0.565
	40	2.23	3.08	0.499	0.470	0.081	0.140	0.051	0.413	0.259	5.806	0.927
	60	1.75	4.19	0.513	0.487	0.071	0.160	0.046	0.256	0.161	4.547	0.731
Apache Jct. FRS	60C	5.80		0.445	0.406	0.067	0.157	0.040	0.790	0.493	4.334	0.681
	80	1.48	2.69	0.524	0.500	0.092	0.157	0.060	0.310	0.195	6.479	1.048
	100	0.48	1.94	0.599	0.588	0.062	0.150	0.005	0.076	0.049	4.590	0.787
	120	2.20	3.07	0.500	0.471	0.104	0.150	0.090	0.535	0.336	7.620	1.217
	140	0.60	1.61	0.583	0.570	0.080	0.200	0.028	0.115	0.073	5.645	0.954
	160	0.78	3.18	0.565	0.549	0.085	0.130	0.072	0.111	0.071	4.270	0.711
	180	1.00	2.42	0.549	0.529	0.059	0.180	0.024	0.129	0.082	3.931	0.646
	200	1.81	3.28	0.511	0.485	0.105	0.140	0.141	0.375	0.235	6.443	1.035
	220	1.25	3.14	0.534	0.512	0.111	0.200	0.102	0.263	0.166	6.466	1.053
	240	1.04	3.5	0.546	0.526	0.077	0.180	0.061	0.143	0.091	4.193	0.688
Signal Butte FRS	C180	10.64		0.414	0.368	0.086	0.165	0.065	1.869	1.165	5.597	0.878
	260	0.27	0.81	0.641	0.637	0.109	0.150	0.013	0.082	0.053	8.412	1.510
	280	0.30	0.77	0.633	0.628	0.106	0.164	0.016	0.091	0.059	8.533	1.518
	300	0.99	2.28	0.549	0.530	0.065	0.110	0.024	0.154	0.097	4.714	0.775
	320	1.53	4.67	0.522	0.497	0.070	0.110	0.048	0.163	0.102	3.291	0.532
	340	1.45	2.4	0.525	0.501	0.081	0.140	0.025	0.253	0.160	5.394	0.873
	350	0.97	2.22	0.551	0.532	0.129	0.180	0.167	0.206	0.130	6.434	1.059
	360	1.33	4.84	0.530	0.508	0.073	0.150	0.041	0.123	0.078	2.845	0.462
	380	1.64	5.05	0.517	0.492	0.075	0.230	0.041	0.150	0.094	2.835	0.457
	390	1.09	2.82	0.543	0.523	0.120	0.150	0.096	0.219	0.138	6.126	1.003
	400	0.62	1.64	0.581	0.567	0.056	0.160	0.016	0.064	0.041	3.042	0.513
	420	0.85	1.91	0.559	0.542	0.071	0.240	0.017	0.133	0.085	4.731	0.784
	440	0.08	0.4	0.740	0.752	0.256	0.150	0.320	0.042	0.028	12.673	2.608
	441	0.01	0.28	0.948	0.982	0.309	0.140	0.084	0.006	0.004	9.062	2.814
	442	0.10	0.83	0.721	0.730	0.108	0.330	0.042	0.022	0.015	5.607	1.120
	443	0.08	0.71	0.740	0.752	0.204	0.230	0.079	0.034	0.023	10.336	2.128
	444	0.04	0.33	0.804	0.823	0.275	0.260	0.244	0.021	0.015	11.469	2.631
	445	0.19	0.82	0.668	0.669	0.149	0.310	0.099	0.061	0.040	8.585	1.593
	446	0.04	0.46	0.804	0.823	0.203	0.370	0.041	0.017	0.012	9.062	2.079
	447	0.09	0.49	0.730	0.740	0.149	0.310	0.023	0.031	0.021	8.496	1.721
	448	0.05	0.36	0.783	0.799	0.206	0.200	0.180	0.022	0.015	9.855	2.177
	449	0.05	0.4	0.783	0.799	0.187	0.180	0.083	0.019	0.013	8.722	1.927
	450	0.07	0.85	0.752	0.765	0.094	0.270	0.033	0.014	0.009	4.693	0.984
	451	0.03	0.557	0.832	0.854	0.074	0.290	0.016	0.005	0.003	3.209	0.776
	452	0.04	0.43	0.804	0.823	0.194	0.280	0.061	0.016	0.011	8.637	1.982
	453	0.06	0.58	0.766	0.781	0.095	0.250	0.018	0.015	0.010	5.664	1.216
	454	0.18	1.23	0.673	0.674	0.092	0.270	0.026	0.032	0.021	4.783	0.892
	C119	1.10		0.543	0.522	0.137	0.216	0.071	0.141	0.089	3.908	0.640
	455	1.56	2.92	0.520	0.496	0.103	0.200	0.039	0.282	0.177	5.595	0.903
Spook Hill FRS	455C	13.68		0.402	0.353	0.135	0.216	0.070	1.401	0.874	3.260	0.512

Table 20. Spook Hill ADMP Update
Comparison of Average Annual Sediment Yield Calculations - Existing Conditions

	Subbasin ID	Basin Area (sq. mi.)	Length (miles)	Renard (ac-ft/mi^2/yr)	Dendy-Bolton (ac-ft/mi^2/yr)	Flaxman (1974) (ac-ft/mi^2/yr)	PSIAC (ac-ft/mi^2/yr)	MUSLE (ac-ft/mi^2/yr)	1% Concentration (ac-ft/mi^2/yr)	Period of Record 1% Concentration (ac-ft/mi^2/yr)	5% Concentration (ac-ft/mi^2/yr)	Period of Record 5% Concentration (ac-ft/mi^2/yr)
	456	0.26	0.94	0.644	0.641	0.172	0.150	0.226	0.093	0.061	9.977	1.797
	457	0.19	1.01	0.668	0.669	0.142	0.150	0.092	0.053	0.035	7.571	1.405
	458	0.19	0.76	0.668	0.669	0.206	0.215	0.140	0.073	0.048	10.344	1.919
	459	0.03	0.35	0.832	0.854	0.185	0.260	0.068	0.012	0.008	8.118	1.963
	460	0.14	0.62	0.693	0.697	0.180	0.240	0.026	0.045	0.030	8.293	1.591
	461	0.12	0.83	0.706	0.712	0.190	0.260	0.034	0.035	0.023	7.363	1.438
	462	0.30	0.97	0.633	0.628	0.178	0.240	0.101	0.105	0.068	9.874	1.756
	C56	1.35		0.529	0.507	0.179	0.216	0.098	0.228	0.144	5.194	0.843
	480	0.73	1.21	0.570	0.554	0.101	0.180	0.025	0.188	0.119	7.689	1.285
	500	0.93	2.77	0.553	0.535	0.108	0.230	0.108	0.185	0.117	6.017	0.993
Spook Hill FW				0.663	0.662	0.163	0.214	0.091	0.088	0.057	8.361	1.572
	MEAN			0.638	0.632	0.127	0.202	0.071	0.125	0.079	6.699	1.282
	STDEV			0.115	0.132	0.062	0.062	0.066	0.119	0.074	2.463	0.610
	MAX			0.948	0.982	0.309	0.370	0.320	0.535	0.336	12.673	2.814
	MIN			0.499	0.470	0.049	0.110	0.005	0.005	0.003	2.835	0.457
	MEDIAN			0.591	0.579	0.108	0.200	0.060	0.108	0.069	6.072	1.041

Event-Based Results

MUSLE Results. As part of the calculations for determining average annual sediment yield, the MUSLE first calculates event-based sediment yield for the 2-, 5-, 10-, 25-, 50-, and 100-year events. The results of the event-based calculations are presented in Table 21.

Table 21. Spook Hill ADMP Update
MUSLE Calculated Event-Based Sediment Yields

Event	Maximum Sed. Yield (ac-ft/mi^2)	Minimum Sed. Yield (ac-ft/mi^2)	Average Sed. Yield (ac-ft/mi^2)	Standard Deviation (ac-ft/mi^2)
2-year	0.194	0.003	0.040	0.040
5-year	0.470	0.007	0.101	0.097
10-year	0.705	0.011	0.158	0.146
25-year	1.106	0.018	0.254	0.231
50-year	1.393	0.024	0.355	0.324
100-year	1.763	0.032	0.437	0.384

The ratios of Q_S2:Q_S100, etc., are similar to the ratios developed from the Region 13 regression equations for discharge. Comparison of the MUSLE average annual sediment yield and the event-based sediment yields reveals that the 100-year event yields six times more sediment than the average annual sediment yield.

The results for all subbasins for the average annual and T-year sediment yields are given in Table 22.

Table 22. Modified Universal Soil Loss Equation (MUSLE)
Sediment Yield Calculations -- Existing Conditions

	Subbasin Name	Avg. Annual Sediment Yield ($AF/mi^2/yr$)	2-yr Sediment Yield (AF/mi^2)	5-yr Sediment Yield (AF/mi^2)	10-yr Sediment Yield (AF/mi^2)	25-yr Sediment Yield (AF/mi^2)	50-yr Sediment Yield (AF/mi^2)	100-yr Sediment Yield (AF/mi^2)
	20	0.023	0.012	0.031	0.051	0.087	0.119	0.163
	40	0.051	0.026	0.070	0.116	0.196	0.270	0.371
	60	0.046	0.024	0.064	0.105	0.177	0.243	0.334
Apache Jct FRS	average =	0.040	0.020	0.055	0.091	0.153	0.211	0.289
	80	0.060	0.031	0.083	0.136	0.228	0.313	0.429
	100	0.005	0.003	0.007	0.011	0.018	0.024	0.032
	120	0.090	0.046	0.124	0.204	0.346	0.476	0.655
	140	0.028	0.015	0.040	0.064	0.107	0.144	0.194
	160	0.072	0.038	0.100	0.162	0.271	0.368	0.499
	180	0.024	0.012	0.033	0.054	0.090	0.122	0.167
	200	0.141	0.072	0.194	0.319	0.538	0.740	1.016
	220	0.102	0.053	0.141	0.231	0.389	0.532	0.727
	240	0.061	0.032	0.084	0.138	0.231	0.315	0.429
Signal Butte	average =	0.065	0.033	0.089	0.147	0.246	0.337	0.461
	260	0.013	0.007	0.018	0.029	0.047	0.062	0.082
	280	0.016	0.009	0.022	0.035	0.058	0.076	0.102
	300	0.024	0.013	0.034	0.055	0.092	0.126	0.171
	320	0.048	0.025	0.066	0.109	0.183	0.251	0.344
	340	0.025	0.013	0.034	0.056	0.094	0.129	0.177
	350	0.167	0.087	0.231	0.377	0.631	0.858	1.170
	360	0.041	0.021	0.057	0.093	0.157	0.214	0.293
	380	0.041	0.021	0.056	0.092	0.155	0.213	0.292
	390	0.096	0.049	0.133	0.217	0.364	0.496	0.677
	400	0.016	0.008	0.022	0.036	0.060	0.081	0.109
	420	0.017	0.009	0.024	0.039	0.065	0.088	0.120
	440	0.320	0.194	0.470	0.705	1.106	1.393	1.763
	441	0.084	0.063	0.136	0.175	0.234	0.255	0.296
	442	0.042	0.025	0.061	0.094	0.147	0.186	0.240
	443	0.079	0.047	0.117	0.176	0.273	0.344	0.436
	444	0.244	0.156	0.367	0.533	0.815	0.976	1.208
	445	0.099	0.056	0.141	0.221	0.356	0.465	0.611
	446	0.041	0.027	0.060	0.088	0.133	0.160	0.197
	447	0.023	0.014	0.034	0.052	0.081	0.103	0.131
	448	0.180	0.118	0.266	0.392	0.600	0.736	0.910
	449	0.083	0.053	0.125	0.180	0.277	0.336	0.421
	450	0.033	0.019	0.048	0.073	0.115	0.142	0.179
	451	0.016	0.011	0.023	0.037	0.051	0.060	0.075
	452	0.061	0.039	0.090	0.135	0.202	0.244	0.298
	453	0.018	0.011	0.026	0.040	0.059	0.075	0.094
	454	0.026	0.015	0.038	0.058	0.093	0.121	0.159
	C119	0.071	0.043	0.104	0.158	0.248	0.315	0.406
	455	0.039	0.020	0.053	0.088	0.148	0.202	0.277
Spook Hill FRS	455C	0.070	0.042	0.102	0.155	0.244	0.311	0.401
	456	0.226	0.126	0.321	0.506	0.823	1.086	1.439
	457	0.092	0.052	0.131	0.206	0.330	0.431	0.566
	458	0.140	0.079	0.200	0.313	0.505	0.658	0.864
	459	0.068	0.047	0.103	0.147	0.215	0.255	0.311
	460	0.026	0.015	0.037	0.057	0.090	0.117	0.152
	461	0.034	0.004	0.019	0.040	0.088	1.270	0.199
	462	0.101	0.056	0.143	0.228	0.370	0.491	0.653
	C56	0.098	0.054	0.136	0.214	0.346	0.615	0.598
	480	0.025	0.013	0.034	0.056	0.093	0.126	0.170
	500	0.108	0.056	0.150	0.244	0.409	0.556	0.757
Spook Hill FW		0.077	0.041	0.107	0.171	0.282	0.432	0.508
Average for all =		0.071	0.040	0.101	0.158	0.254	0.355	0.437
Standard deviation=		0.066	0.040	0.097	0.146	0.231	0.324	0.384
Maximum =		0.320	0.194	0.470	0.705	1.106	1.393	1.763
Minimum =		0.005	0.003	0.007	0.011	0.018	0.024	0.032

Verification of Predicted Sediment Yield Values

Verification of predicted sediment yields is difficult without extensive sampling of actual events. The irregularity and infrequency of runoff events in the Spook Hill ADMP study area also makes direct sampling of sediment yield difficult. The best indirect method of sediment yield measurement is to measure the sediment that has been deposited behind the structures over time. An examination of the trapping efficiency of the structures is necessary to select the most appropriate sampling sites for comparison to predicted sediment yield values. An understanding of the trapping efficiency of the structures also provides context for the interpretation of the measured volumes as minimum sediment yields.

Sediment continuity and trapping efficiencies

Sediment does not move unhindered through the Spook Hill ADMP system of structures. The three Flood Retarding Structures and the Pass Mountain Diversion essentially act as sediment traps of varying efficiencies, preventing some portion of the sediment from moving into the next basin. Spook Hill Floodway is not as efficient as the other structures in trapping sediment since much of the flow escapes into the Salt River behind Granite Reef Dam due to the low three-foot spillway on the Spook Hill Floodway sediment basin. The five structures and their contributing watersheds are presented in Table 23.

Table 23. Spook Hill ADMP Update
Flood Control Structures and Contributing Subbasins

Structure	Contributing Subbasins	Area (mi^2)
Apache Junction FRS	20,40,60	5.80
Bulldog FW/Signal Butte FRS	80,100,120,140,160,180	6.54
Pass Mountain Diversion	200,220,240	4.10
Signal Butte FW/Spook Hill FRS	260,280,300,320,340,350,360,380,390,400,420,440,441,442, 443,444,445,446,447,448,449,450,451,452,453,454,455	13.68
Spook Hill FW	456,457,458,459,460,461,462,480,500	2.89

Apache Junction FRS

The Apache Junction FRS drains via an orifice two feet in diameter at a stage elevation of zero feet, thus water is released into Bulldog Floodway during each storage event. Flows are detained behind the FRS when inflow discharges exceed approximately 15 cfs. The spillway elevation is at 16.0 feet gage height. The maximum pool stage recorded behind Apache Junction FRS was 4.76 feet in 1999. The storage event lasted for only two days. The short storage time suggests that some fine sediments probably escape while larger bedload particles have a higher probability of being deposited behind the structure.

Signal Butte FRS

Since its construction, the Signal Butte FRS has operated as an essentially closed system, blocking the transmission of water and sediment to basins downstream. The highest recorded gage height behind Signal Butte is 13.3 feet. The west outlet into Signal Butte Floodway is at a gage height of 15.5 feet. The Signal Butte FRS emergency spillway is at a gage height of 27.1 feet. The pool elevation has never been high enough to flow out of the structure either at the west drain or the spillway. The only flow out of the FRS has been through the vegetative outlet (middle drain), which according to FCDMC personnel (Loy, 1999) is normally opened only very slightly when water pools behind the structure for extended periods of time. The result is that Signal Butte FRS acts as an essentially 100% efficient sediment trap.

Pass Mountain Diversion

Pass Mountain Diversion has also served as an efficient sediment trap over the period of record. The physical evidence indicates that all water has been stopped within the multiple grade control detention basins before reaching the Signal Butte FRS detention area, allowing sediment to deposit behind the grade control structures. FCDMC personnel also state that water has never flowed over the most downstream grade control structure (Loy, 1999).

Spook Hill FRS

Water entering Spook Hill FRS can readily flow out and into Spook Hill Floodway. The highest stage reached by water in the storage pool was 6.74 feet recorded in 1993. The emergency spillway level corresponds to a 16-foot gage height. However, below a gage height of 11.5 feet the only outflow is through a small one foot by one foot opening. This outlet is at a stage elevation of zero feet, so water flows out immediately. During large flows, water will back up behind the outlet, decreasing velocity and allowing for some deposition of large bedload particles. Thus, generally only the finest suspended load has escaped into Spook Hill Floodway.

Conclusions

The Signal Butte FRS is the most appropriate location to examine sediment deposits, since the trapping efficiency is nearly 100%. Apache Junction FRS and Spook Hill FRS are less efficient at trapping sediment than the Signal Butte FRS. Thus, the focus of field measurements was the area behind Signal Butte FRS.

Field Measurements

Field surveys and observations were used to confirm the predictive equations used to estimate sediment yield. The Signal Butte FRS provides a convenient and appropriate place to measure the actual sediment deposited.

Signal Butte FRS

Aerial photographs taken in 1999 by Kenney Aerial show an inundation area behind Signal Butte FRS of 10.7 acres. An average position was selected in the field and the depth of recently deposited sediment at this location was assumed to be the average depth. The depth of sediment measured was 0.2 feet, to the nearest tenth of a foot. Recent deposition was identified by the contrast in grain size: sorted fines overlaid mixed pebbles and cobbles. Based on these values, the volume of sediment stored behind Signal Butte FRS was determined to be 2.1 acre-feet. The sediment behind the FRS represents the suspended load from subbasins 80, 100, 120, 140, 160, and 180. Bedload from 160 and 180 may also reach the inundation area.

The 2.1 acre-feet of sediment accumulated over the approximately 14-year life of the Signal Butte FRS (Figure 10). The average annual volume is therefore 0.15 acre-feet/year. This time period includes several wet years (1993, 1995, & 1998) and some dry years (1989, 1996, 1997) indicating that the period of record is representative of long-term yields.

Figure 10. Sediment deposition behind Signal Butte FRS.

The 10.7-acre inundation area calculated from the aerial photograph corresponds to a stage of approximately four feet. FCDMC ALERT records indicate that the highest stage in Signal Butte was 13.3 feet in January 1993, which corresponds to an inundated area of approximately 61 acres. However, field inspections of the pool area behind the Signal Butte FRS indicated that the visible inundation area matched more closely to the 10.7-acre area. One explanation for this disparity is that as part of the maintenance schedule, the bottom of the pool area may have been regraded/bladed at some time between 1993 and the present. Between 1994 and 1999 the maximum stage of the pool behind Signal Butte FRS has been between 4.83 and 5.82 feet. These stage readings correspond more closely to the 4 foot stage associated with the 10.7-acre area measured from the aerial photograph. Alternately, sedimentation may have occurred only in the deeper parts of the pool and not over the entire inundation area; or the pool elevation may have been drawn down by several feet before the sediment had a chance to settle out of suspension. Therefore, field estimates may be lower than actual sediment yield.

Bulldog Floodway

JEF personnel examined the sediment accumulated in the catch basin at the end of Bulldog Floodway, leading into the Signal Butte FRS (Figure 11). The sediment in the basin represents the bedload sediment from subbasins 80, 100, 120, and 140. JEF calculated the volume of sediment in the basin by digging holes down to the basin floor, easily determined because it was made of large boulders similar to the basin sides. The depth of each hole was measured. The area of the basin was measured and, combined with the depth information, calculations were made to determine a volume of 17,226 cubic feet (0.40 acre-feet).

Figure 11. Sedimentation in Bulldog Floodway detention basin.

FCDMC personnel perform preventative maintenance at wash inlets to Bulldog Floodway that affects the input of sediment to the floodway and ultimately the detention basin at its terminus. Ed Loy (1999) estimates that FCDMC personnel remove roughly two cubic yards (162 ft^3) of sediment from each inlet structure annually (Figure 12). Fifteen washes draining into Bulldog Floodway were counted on aerial photographs (Kenny, 1999). Thus, the estimated total bed load removed annually at these inlets was 2,430 cubic feet (0.06 acre-feet).

Figure 12. Removed bedload collected in piles away from active channel bed.

Accounting for the three-year accumulation time and the removal of bedload from wash inlets (Loy, 1999), the resulting total average annual sediment yield estimated from field data is 0.19 acre-feet/year.

Combined Bulldog Floodway and Signal Butte FRS

The combined average annual volume of sediment from the Bulldog Floodway and the Signal Butte FRS is 0.34 acre-feet/year. The total area drained by subbasins 80, 100, 120, 140, 160, and 180 equals 6.54 square miles. Thus the average annual sediment yield for the total drainage area is 0.05 acre-feet/square mile/year.

However, the chance that some amount of sediment escapes with the draining of the storage pool must not be ignored. Trap efficiency calculations based on the SCS design specifications (1992) and subsequent FCDMC surveys (1993) of the pool area and volume suggest a trapping efficiency of approximately 93% (Moore et al., 1960). Such a high trapping efficiency has little impact on the final average annual sediment yield estimate from field data, and in fact the average annual sediment yield remains 0.05 acre-feet/square mile/year.

Precipitation was below average for the three-year period over which the measured sediment accumulated in the basin. Average annual precipitation for 1997-1999 was 6.68 inches. Average annual precipitation for the period of record (1986-1999) was 8.56 inches (Table 24). 1997 was the driest year on record, and 1999 was below average. The only year in which significant sedimentation my have occurred was 1998 when precipitation was above average. The below average precipitation may have resulted in below average annual sedimentation in the catch basin.

Table 24. Spook Hill ADMP Update Annual Average Precipitation (measured by ALERT gages)	
Year	Precipitation (inches)
1989	4.60
1990	7.74
1991	7.64
1992	15.98
1993	15.36
1994	7.85
1995	12.08
1996	4.60
1997	3.69
1998	10.59
1999	5.76
Average	8.56

Taking into account the low precipitation during the three years of accumulation, the possibility of losing portions of the sediment through drains in the FRS, and the estimated channel inlet maintenance volumes, the field survey value should be treated as a minimum sediment yield value. Results of the predictive equations compared to the survey results are presented in Table 25. The MUSLE, Flaxman 1974, and PSIAC results agree most closely with the minimum field measurements.

Table 25. Spook Hill ADMP Update Comparison of Signal Butte FRS Field Data to Predicted Sediment Yields						
Subbasin	Renard	Dendy-Bolton	Flaxman (1974)	PSIAC	MUSLE	Field Survey
80	0.52	0.50	0.09	0.15	0.06	
100	0.60	0.59	0.06	0.15	0.01	
120	0.50	0.47	0.10	0.20	0.09	
140	0.58	0.57	0.08	0.13	0.03	
Average	**0.55**	**0.53**	**0.08**	**0.16**	**0.05**	**0.05**

Pass Mountain Diversion

The Pass Mountain Diversion intercepts flow that would normally flow into Signal Butte FRS. Field observations of sedimentation in the downstream basins in the Pass Mountain Diversion suggest that flow has never escaped Pass Mountain Diversion. There is no sedimentation in the downstream basins except for small amounts from adjacent slopes (Figure 13). Discussions with FCDMC personnel also support this conclusion (Loy, 1999).

Figure 13. Example of sediment trapping basin at downstream end of Pass Mountain Diversion with little evidence of sedimentation.

Sediment yield to the upper grade control pool in Pass Mountain Diversion was empirically measured in the field at 0.03 acre-feet/square mile/year (Figure 14). The volume of sediment behind the grade control pool was determined by directly measuring the depth of sediment deposited on the channel bottom. The area of the channel was measured partially in the field and partially from aerial photographs. Subbasins 220 and 240 contribute sediment to the upper grade control pool of Pass Mountain Diversion, for a total basin area of 2.29 square miles. The Pass Mountain Diversion had not been cleared of sediment since its construction in 1986 (Loy, 1999). Thus the sediment had been accumulating for 13 years.

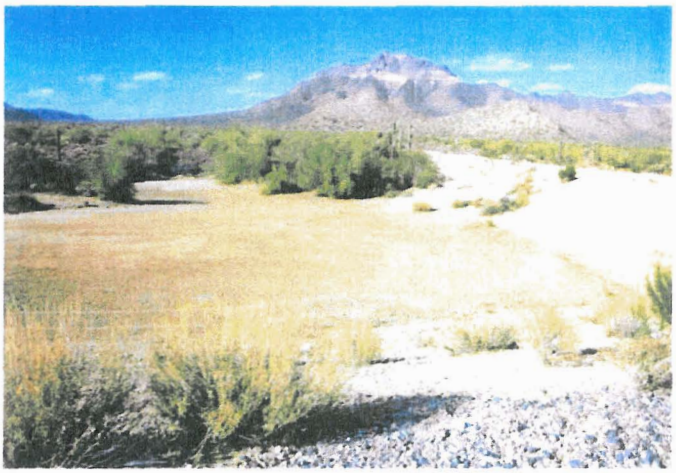

Figure 14. Upper sediment basin on the Pass Mountain Diversion

The sediment yield measured at the upper grade control pool is a minimum value. The grade control structure has apparently been overtopped in the past since there is sediment deposited below it on the apron at the toe of the drop. Results of the predictive equations are compared to the survey results presented in Table 26.

Table 26. Spook Hill ADMP Update Comparison of Pass Mountain Diversion Field Data to Predicted Sediment Yields						
Subbasin	Renard	Dendy-Bolton	Flaxman (1974)	PSIAC	MUSLE	Field Survey
220	0.53	0.51	0.11	0.18	0.10	
240	0.55	0.53	0.08	0.15	0.06	
Average	**0.54**	**0.52**	**0.10**	**0.17**	**0.08**	**0.03**

The field survey results were much lower than the predictive sediment yields, but was expected. Nevertheless, the field measurements are within an order of magnitude of the MUSLE, PSIAC, and Flaxman method predictions. The Renard and Dendy-Bolton results are approximately 18 times larger than the measured sediment deposition. This suggests that the MUSLE, PSIAC, and Flaxman results are more appropriate for the study area.

Spook Hill Floodway

Field measurements of sedimentation in the downstream end and settling basin of Spook Hill Floodway resulted in the following estimate of sediment yield. The sediment survey was divided into two parts. The first part was the settling basin, where the sediment consisted of mostly fine particles (Figure 15). Field measurements established the average depth of the sediment in the pool at approximately 0.08 feet. Length and width of the basin were 630 feet and 110 feet respectively, measured from aerial photographs. Thus the volume of sediment in the settling basin was 5,775 cubic feet.

Figure 15. Sediment basin at end of Spook Hill Floodway.

Sediment deposited in the downstream end of the Spook Hill Floodway was measured by taking regularly spaced depth measurements along transects across the floodway (Figure 16). The sediment in the floodway is coarser than that deposited in the settling basin. The final estimated volume of sediment in the floodway was 5,976 cubic feet. The total volume of sediment is thus 11,751 cubic feet, accumulated over four years according to FCDMC personnel (Loy, 1999). The contributing basin area was 2.89 square miles, resulting in an average annual sediment yield of 0.02 acre-feet/square mile/year.

Figure 16. View of downstream outlet of Spook Hill Floodway.

The spillway elevation at the Spook Hill Floodway sediment basin is only three feet high. It can be reasonably assumed that most flow events spilled out of the sediment basin, thus making the calculated sediment yield a minimum value. Table 27 compares the sediment yield calculated from deposition measurements in the Spook Hill Floodway to predicted sediment yields.

Table 27. Spook Hill ADMP Update
Comparison of Spook Hill Floodway Field Data to Predicted Sediment Yields

Subbasin	Renard	Dendy-Bolton	Flaxman (1974)	PSIAC	MUSLE	Field Survey
456	0.644	0.641	0.172	0.260	0.226	
457	0.668	0.669	0.142	0.240	0.092	
458	0.668	0.669	0.206	0.260	0.140	
459	0.832	0.854	0.185	0.240	0.068	
460	0.693	0.697	0.180	0.180	0.026	
461	0.706	0.712	0.190	0.180	0.034	
462	0.633	0.628	0.178	0.230	0.101	
480	0.570	0.554	0.101	0.240	0.025	
500	0.553	0.535	0.108	0.370	0.108	
Average	**0.663**	**0.662**	**0.162**	**0.244**	**0.091**	**0.023**

The field survey results are much lower than the predictive sediment yields. This was to be expected since the trapping efficiency of the Spook Hill Floodway is much lower than the other structures in the system. Nevertheless, the field measurements are approximately within an order of magnitude of the MUSLE, PSIAC, and Flaxman method predictions. The Renard and Dendy-Bolton results are approximately 28 times larger than the measured sediment deposition. This suggests that the MUSLE, PSIAC, and Flaxman results are more appropriate.

Assumed Sediment Yields

The depth of sediment deposited from an assumed sediment yield can be used to constrain reasonable limits on the range of actual sediment yield. For these calculations the contributing drainage area, time, and inundation area must be known. This section will focus on the Signal Butte FRS since sediment deposition and volume was measured in the field.

Measurements of aerial photographs suggest that the frequently inundated area behind Signal Butte FRS is approximately 10.7 acres in area. This corresponds to only 1% of spillway capacity and a stage height of 4.0 feet (FCDMC, 1993). FCDMC ALERT data record the maximum stage height as 13.3 feet in 1993, which corresponds to a pool surface area of approximately 60 acres. Besides the 13.3 feet maximum stage, the remaining large events ranged between 4.83 feet stage (approximately 14 acres surface area) and 5.82 feet stage (approximately 18 acres surface area). Since the photo evidence and field observations discount the 13.3 feet measurement, an average inundation area of 14 acres was used.

Field evidence and recollections by Ed Loy (1999) indicate that no event has ever produced flow that escaped the Pass Mountain Diversion and entered the storage area behind Signal Butte FRS. The contributing drainage area is thus 6.54 square miles. The sediment depths for various assumed sediment yields for Signal Butte FRS are presented in Table 28.

Table 28. Spook Hill ADMP Update Signal Butte Sediment Depths			
		Signal Butte FRS	
Contributing Drainage Area (miles^2)		6.54	
Time Since Completion (years)		14	
Inundation Area (acres)		14	
		Total Volume (ac-ft)	Average Depth (ft)
Index Sediment Yield (ac-ft/mi^2/yr)	1.0	91.6	6.5
	0.5	45.8	3.3
	0.2	18.3	1.3
	0.1	9.2	0.7
	0.05	4.6	0.3

JEF personnel estimated the average depth of sediment behind Signal Butte FRS at 0.2 feet. The value is slightly lower than the 0.3 feet depth predicted by a 0.05 acre-feet/square mile/year sediment yield. The average depths presented in Table 28 reflect the depth that would exist if all of the sediment was deposited directly behind the FRS. This is not the case, however, since a portion of the sediment is trapped in the basin at the end of the Bulldog Floodway. A better comparison may be the total volumes produced by the index sediment yields to the volume of sediment estimated through field investigations. Field estimates place the annual sediment volume stored behind Signal Butte FRS at 4.01 acre-feet. This compares favorably to the total volume produced by a sediment yield of 0.05 acre-feet/square mile/year.

Discussion and Recommendations

The range of predicted sediment yields in the Spook Hill ADMP are fairly large. The average sediment yield values range between a low of 0.07 acre-feet/square mile/year (MUSLE result) and 0.64 acre-feet/square mile/year (Renard result). The difference is nearly an order of magnitude. Table 23 shows the results for the various methods considered for computation of the average annual sediment yield for the Spook Hill ADMP study area.

Examination of the large variation in results in Table 23 prompts the question: are the sediment yield values produced by one of the methods more reasonable than the others, or is an average of all the sediment yield values from all the methods a better solution? Empirical field measurements were utilized to identify reasonable estimates of sediment yield. The field evidence provides a minimum value of sediment yield.

Verification

Based on empirical measurement of sediment deposits in the field, it was determined that the Renard and Dendy-Bolton equations overestimate the amount of sediment yield produced by the contributing basins in the Spook Hill ADMP study area. Other researchers made similar conclusions based on empirical work at the Walnut Gulch Experimental Watershed near Tombstone, Arizona (Renard and Stone, 1981). The results of the MUSLE, PSIAC, and Flaxman 1974 methods are closer to the empirical field evidence than the Renard and Dendy-Bolton results.

Recommendation

Average annual sediment yield

The MUSLE, PSIAC, and Flaxman method results reflect internal variation in the study area. The largest average annual sediment yields are predicted in the basins dominated by the steepest and longest slopes and little cover. In general the smallest yields are generated in developed basins (i.e. residential) with low slopes. Additionally, drainages closer to the mountain slopes deliver greater sediment quantities than the same drainages further downstream on the piedmont. The representation of internal variation and close agreement with empirically measured sediment deposits in the field suggest that some combination of the MUSLE, PSIAC, and Flaxman results should be considered for planning level average annual sediment yield estimates. Moreover, the parameterization of these methods allows for examination of future conditions impacts on sediment yield in the alternatives phase of the ADMP Update. Therefore, an average value of the MUSLE, PSIAC, and Flaxman estimates is recommended for consideration of average annual sediment yield in the Spook Hill ADMP Update (Table 29).

Table 29. Spook Hill ADMP Update
Flood Control Structures and Average Annual Sediment Yield

Structure	Flaxman Avg. Ann. Sed. Yield (ac-ft/mi^2/yr)	PSIAC Avg. Ann. Sed. Yield (ac-ft/mi^2/yr)	MUSLE Avg. Ann. Sed. Yield (ac-ft/mi^2/yr)	Recommended Planning Sed. Yield (ac-ft/mi^2/yr)
Apache Junction FRS	0.07	0.16	0.04	0.07
Signal Butte FRS*	0.09	0.17	0.07	0.11
Spook Hill FRS	0.14	0.22	0.07	0.14
Spook Hill FW	0.16	0.22	0.09	0.16
Average for Spook Hill ADMP	**0.13**	**0.20**	**0.07**	**0.13**

*Includes Pass Mountain Diversion sediment despite fact that none has entered Signal Butte FRS since construction.

When grouped into basins separated by the FRS structures, there is a slight variation in sediment yield. The sediment yield is greater in the east than in the west, which agrees with predictions of sediment yield variation based on the geomorphologic characteristics observed in the field.

Event-based sediment yield

The MUSLE method calculates sediment yield for specific events. The average annual sediment yield falls between the sediment yields calculated for the 2-year and 5-year events. The precipitation record from the FCDMC ALERT system indicates that the largest impoundments recorded since the installation of the stage gages occurred in January 1993. The rainfall which produced these impoundments varied between 2-year 24-hour and 5-year 24-hour events on a wet watershed. The field measurements support the idea that the deposits measured in the field have been produced by smaller, more frequent floods.

Comparisons of the 2- and 5-year event sediment yields to the empirically measured sediment yields for Signal Butte FRS are provided in Table 30. Table 31 presents similar data for Pass Mountain Diversion.

Table 30. Spook Hill ADMP Update
Comparison of Signal Butte Field Data to Predicted Sediment Yields

Subbasin	MUSLE 2-year 24-hour Q_S (ac-ft/mi^2)	MUSLE 5-year 24-hour Q_S (ac-ft/mi^2)	Field Survey
80	0.031	0.083	
100	0.003	0.007	
120	0.046	0.124	
140	0.015	0.040	
160	0.038	0.100	
180	0.012	0.033	
Average	**0.024**	**0.065**	**0.05**

Table 31. Spook Hill ADMP Update
Comparison of Pass Mountain Field Data to Predicted Sediment Yields

Subbasin	MUSLE 2-year 24-hour Q_S (ac-ft/mi^2)	MUSLE 5-year 24-hour Q_S (ac-ft/mi^2)	Field Survey
220	0.072	0.194	
240	0.053	0.141	
Average	**0.063**	**0.168**	**0.03**

These data suggest that the T-year MUSLE results may be reasonable for consideration of event specific sediment yields in the Spook Hill ADMP study area. However, since no empirical evidence for larger, less frequent events is available, the validity of the MUSLE results for those floods remains less certain. Table 32 presents the MUSLE results for each of the primary subwatersheds draining to the important flood control facilities in the study area.

Table 32. Spook Hill ADMP Update Flood Control Structures and the MUSLE T-year Sediment Yield Estimates, in ac-ft/ mi^2						
Structure	2-year	5-year	10-year	25-year	50-year	100-year
Apache Junction FRS	0.020	0.055	0.091	0.153	0.211	0.289
Signal Butte FRS	0.033	0.089	0.147	0.246	0.337	0.461
Spook Hill FRS	0.042	0.102	0.155	0.244	0.311	0.401
Spook Hill FW	0.041	0.107	0.171	0.282	0.432	0.508
Average for all subbasins in the Spook Hill ADMP	**0.04**	**0.10**	**0.16**	**0.25**	**0.36**	**0.44**

Given the recommendation for the average annual sediment yield to consider the average of the MUSLE, PSIAC, and Flaxman results, it is recommended that a similar adjustment to the MUSLE T-year sediment yields also be made. The 2-year sediment yield and average annual sediment yield can be considered to have a similar frequency of occurrence. Therefore, the ratio of the MUSLE average annual sediment yield to the recommended sediment yield was used as an adjustment factor to the 2-year MUSLE sediment yield to arrive at the recommended 2-year value. Once this value was computed, the remaining T-year recommended sediment yield values were computed by multiplying the ratio of the MUSLE 2-year to T-year values by the recommended 2-year value. Table 33 summaries the recommended T-year sediment yields for each of the primary subwatersheds.

Table 33. Spook Hill ADMP Update Flood Control Structures and the Recommended T-year Sediment Yield Estimates, in ac-ft/ mi^2						
Structure	2-year	5-year	10-year	25-year	50-year	100-year
Apache Junction FRS	0.04	0.10	0.17	0.28	0.39	0.54
Signal Butte FRS	0.06	0.17	0.27	0.46	0.63	0.86
Spook Hill FRS	0.08	0.19	0.29	0.45	0.58	0.74
Spook Hill FW	0.08	0.20	0.32	0.52	0.80	0.94
Average for all subbasins in the Spook Hill ADMP	**0.07**	**0.19**	**0.30**	**0.46**	**0.67**	**0.82**

Long Term Sediment Impacts and Effective Lifespan of Spook Hill ADMP Structures

The original SCS design storage volumes for the Buckhorn-Mesa structures were compared to the storage volumes computed from elevation models of the impoundment areas provided by more recent topography provided by the FCDMC (McLain Harbors FCD 93-51). The SCS design storage volumes represent the volume of storage allowed for only floodwater behind the structure. This volume does not account for the designed sediment pool volume, which is also shown in Table 34. The McLain Harbors data show a total volume of the impoundment area. This volume may be considered a more accurate measurement of the total volume available behind the dam for storage of both floodwater and sediment. A comparison of the difference between the FCD 93-51 volume and the SCS total volumes indicates that the three dams all have somewhat greater storage volume than designed.

Table 34. Spook Hill ADMP Update FRS Storage Volumes					
Structure Name	Design Storage Volume (acre-feet)*	Design Sediment Storage Pool (acre-feet)	Total SCS Volume (ac-ft)	FCD 93-51 Storage Volume (ac-ft)	Difference of Totals (93-51 – SCS)
Apache Junction FRS	484	95	579	676	97
Signal Butte FRS	1,365	247	1,612	1,665	53
Spook Hill FRS	902	271	1,173	1,391	218
* Storage volume at emergency spillway crest elevation					

Table 35. Spook Hill ADMP Update Effective Lifespan of Current Structures					
Structure	Total Storage Volume (ac-ft)	100-yr 24-hr Volume (ac-ft)	Volume less 100-yr 24 hr event (ac-ft)	Avg. Annual Sed. Yield (ac-ft/mi^2/yr)	Effective Years at Recom'd Sed. Yld.
Apache Junction FRS	676	375	301	0.07	741
Signal Butte FRS	1665	952	713	0.11	609
Spook Hill FRS	1391	1306	85	0.14	44

Table 35 shows the effective lifespan of the three Buckhorn-Mesa dams. Several theories may explain the order of magnitude difference between the projected lifespan of the Signal Butte and Apache Junction FRS compared to the Spook Hill FRS. First, there may have been a change in design philosophy between the time Spook Hill FRS was constructed and when Signal Butte and Apache Junction FRSs were built. Second, the differences in length of effectiveness may be a result in changes in the Spook Hill FRS watershed. Urbanization of the watershed may have increased the volume of water that reaches the structure as modeled by Wood/Patel using HEC-1. Typically in urbanized areas infiltration decreases and runoff consequently increases. Thus, a larger volume of water is produced.

Table 36 shows the performance of the FRS structures for a number of various time periods of sediment delivery. For each time period a certain number of 10-year and 100-year floods are assumed to have occurred. Additionally, the average annual sediment yield is shown for the given time period. For example, for a 100-year time period, ten 10-year events, one 100-year event, and 100 years of average annual volumes are added together. To this total volume, the 100-year 24-hour runoff volume is also added and then compared to the total storage volume in the structure.

The results indicate that a regular sediment removal program does not need to be considered for planning at either Apache Junction or Signal Butte FRS. The only maintenance (for sediment) to consider is to keep the principle outlet clear and to assure positive drainage to the outlet along the toe of the dam. These practices are already being performed by FCDMC personnel. The calculations also indicate that Spook Hill FRS

will require some type of sediment removal program. The results of this report suggest that a 15-year maintenance schedule would be appropriate to assure continued safe operation of the Spook Hill FRS. Again, regular maintenance of the low flow channel along the dam will continue to be required. Finally, the average annual and event-based results indicate that a 4-year cycle of sediment removal from the Spook Hill Floodway sediment basin be used. Discussions with FCD maintenance personnel indicate that a similar schedule is already in place.

Spook Hill ADMP Update

Table 36. Performance of Structures for Various Sediment Delivery Periods

Structure	#	Sediment Yield (ac-ft/sq.mi.) 10-year	#	100-year	Avg. Annual	Yrs	Drainage Area (sq.mi.)	Total Sediment Volume (ac-ft)	Total Storage* Volume (ac-ft)	100-yr 24-hr Runoff Volume (ac-ft)	Remaining Volume (ac-ft)	No. of Times**
One year cycle assuming 1 10-yr event and 1 100-yr event in addition to 1 average annual volume.												
Apache Junction FRS	1	0.17	1	0.54	0.07	1	5.8	4.5	676	375	296.5	65.5
Signal Butte FRS	1	0.27	1	0.86	0.11	1	10.64	13.2	1665	952	699.8	53.0
Spook Hill FRS	1	0.29	1	0.74	0.14	1	13.68	16.0	1391	1306	69.0	4.3
Spook Hill Floodway	1	0.32	1	0.94	0.16	1	2.89	4.1	4.8			
Five year cycle assuming 1 10-yr event and 1 100-yr event in addition to 5 average annual volumes.												
Apache Junction FRS	1	0.17	1	0.54	0.07	5	5.8	6.1	676	375	294.9	48.0
Signal Butte FRS	1	0.27	1	0.86	0.11	5	10.64	17.9	1665	952	695.1	38.9
Spook Hill FRS	1	0.29	1	0.74	0.14	5	13.68	23.7	1391	1306	61.3	2.6
Spook Hill Floodway	1	0.32	1	0.94	0.16	5	2.89	6.0	4.8			
Ten year cycle assuming 2 10-yr events and 2 100-yr events in addition to 10 average annual volumes.												
Apache Junction FRS	2	0.17	2	0.54	0.07	10	5.8	12.3	676	375	288.7	23.5
Signal Butte FRS	2	0.27	2	0.86	0.11	10	10.64	35.8	1665	952	677.2	18.9
Spook Hill FRS	2	0.29	2	0.74	0.14	10	13.68	47.3	1391	1306	37.7	0.8
Spook Hill Floodway	2	0.32	2	0.94	0.16	10	2.89	11.9	4.8			
15 year cycle assuming 2 10-yr events and 2 100-yr events in addition to 10 average annual volumes.												
Apache Junction FRS	3	0.17	2	0.54	0.07	15	5.8	18.4	676	375	282.6	15.3
Signal Butte FRS	3	0.27	2	0.86	0.11	15	10.64	53.6	1665	952	659.4	12.3
Spook Hill FRS	3	0.29	2	0.74	0.14	15	13.68	71.0	1391	1306	14.0	0.2
Spook Hill Floodway	3	0.32	2	0.94	0.16	15	2.89	17.9	4.8			
20 year cycle assuming 4 10-yr events and 2 100-yr events in addition to 10 average annual volumes.												
Apache Junction FRS	4	0.17	2	0.54	0.07	20	5.8	24.6	676	375	276.4	11.2
Signal Butte FRS	4	0.27	2	0.86	0.11	20	10.64	71.5	1665	952	641.5	9.0
Spook Hill FRS	4	0.29	2	0.74	0.14	20	13.68	94.7	1391	1306	-9.7	-0.1
Spook Hill Floodway	4	0.32	2	0.94	0.16	20	2.89	23.8	4.8			
100 year cycle assuming 10 10-yr events and 1 100-yr events in addition to 100 average annual volumes.												
Apache Junction FRS	10	0.17	1	0.54	0.07	100	5.8	53.6	676	375	247.4	4.6
Signal Butte FRS	10	0.27	1	0.86	0.11	100	10.64	154.9	1665	952	558.1	3.6
Spook Hill FRS	10	0.29	1	0.74	0.14	100	13.68	241.3	1391	1306	-156.3	-0.6
Spook Hill Floodway	10	0.32	1	0.94	0.16	100	2.89	58.2	4.8			

* Total storage volumes from McLain Harbors mapping done for FCD under FCD No. 93-51.
Spook Hill Sediment Basin storage does not account for any water storage.

** Number of times the scenario of sediment delivery can occur before the 100-yr 24-hr storm water runoff volume no longer fits within the dam without flowing over the emergency spillway.

Comparison with Regional Studies

SCS design calculations

The Soil Conservation Service based initial sediment yields used in the planning of the Buckhorn-Mesa watershed structures on sediment yield values determined by surveys of stock ponds in Maricopa County (SCS, 1974). The sediment yields determined by the stock pond survey ranged from 0.04 to 0.32 acre-feet/square mile/year. Final sediment yield values used in the original design of Apache Junction FRS, Signal Butte FRS, and Spook Hill FRS are presented in Table 37.

Table 37. Spook Hill ADMP Update Original Design Sediment Yields

Structure	Sediment Yield (ac-ft/ mi^2/yr)
Apache Junction FRS	0.25
Signal Butte FRS	0.20
Spook Hill FRS	0.20

Designs for the Pass Mountain Diversion used an average annual sediment yield of 0.36 acre-feet/square mile/year (SCS, 1983). The original design average annual sediment yield is three times the yield estimated and verified in this study. The designs for the Pass Mountain Diversion also incorporated a 100-year event sediment yield 9.7 times the average annual sediment yield. JEF estimated a 100-year event sediment yield six times greater than the average annual sediment yield for the Spook Hill ADMP study area.

Design updates for the Spook Hill Floodway used an average annual sediment yield of 0.25 acre-feet/square mile/year (SCS, 1992). The 100-year event sediment yield was determined to be 1.34 times the average annual sediment yield. The design calculations determined that a 2- to 4-year maintenance schedule would be required to maintain the effectiveness of the downstream sediment basin. Although sediment yield values estimated by JEF differ from those used in the Spook Hill Floodway design update, a similar maintenance schedule was determined to be appropriate.

Original Drainage Master Plan

Parsons Brinkerhoff (1987) predicted sediment yields for the Spook Hill area as part of the original drainage master plan. Parsons Brinkerhoff used the SEDIMOT II sediment modeling routine developed at the University of Kentucky (Wilson et al., cited in Parsons Brinkerhoff 1987). The input parameters used included runoff volume in acre-feet, peak discharge in cfs, the length and slope of the watershed, the soil erodibility factor, and control practices. The parameters were essentially the same as the input parameters for the MUSLE method.

Results of the event-based sediment yield results for the original study and the ADMP update are presented in Table 38. The subbasins used by Parsons Brinkerhoff did not match the Wood/Patel subbasins exactly. General groupings were similar, however, so

comparisons of large areas were possible. A few of the original subbasins were delineated on the higher slopes of the piedmont and fed into downslope subbasins. Thus one comparison uses only the most downslope basins in order to account for possible transmission losses. Averages of all the subbasins and only the most downslope subbasins are presented for comparison to the updated sediment yields. Parsons Brinkerhoff used the 2- and 100-year 2-hour events, while JEF used the 2- and 100-year 24-hour events, as per current FCDMC guidelines.

Table 38. Spook Hill ADMP Update
Origianl Drainage Master Plan Sediment Yield and Updated Sediment Yield

		Parsons-Brinkerhoff: Original Drainage Master Plan						JEF: Updated ADMP		
		All Subbasins			Most Downslope Subbasins Only			Adjusted MUSLE		
Structure	Area (mi^2)	2-year 2-hour (ac-ft mi^2)/	100-year 2-hour (ac-ft/ mi^2)	Q_s100: Q_s2	2-year 2-hour (ac-ft/ mi^2)	100-year 2-hour (ac-ft/ mi^2)	Q_s100: Q_s2	2-year 24-hour (ac-ft/ mi^2)	100-year 24-hour (ac-ft/ mi^2)	Q_s100: Q_s2
Signal Butte FW	4.06	0.13	3.4	26.1	0.09	1.8	20.0	0.09[1]	0.69[1]	7.7
Spook Hill FRS	6.98	0.16	4.6	28.8	0.14	3.5	25.0	0.04[2]	0.52[2]	13.0

1. Average of Wood/Patel subbasins 260, 280, 300, 320, and 350
2. Average of Wood/Patel subbasins 340, 360, 380, 390, 400, and 420

The updated sediment yields are lower than the original sediment yields. The Q_s100:Q_s2 ratios for the updated sediment yields are also smaller than the original Q_s100:Q_s2 ratios. However these smaller ratios are more consistent with other regional sediment yields than the larger original ratios (see below).

Other studies

Various agencies, academics, and engineering professionals have conducted many sediment yield studies in the arid southwest. The results produced by this study were placed in a regional context by comparing them to sediment yield values calculated by previous studies. This sediment yields presented are primarily the results of sedimentation studies conducted in the Phoenix area.

Table 39 presents the study site, drainage area, and the estimated average annual sediment yield. Sediment yield values estimated for the Spook Hill ADMP Update compare to sediment yields on the lower end of the regional range. Table 40 presents comparisons of the event-based sediment yields. The event-based sediment yields compare favorably with previous sediment yield studies conducted in the region.

Table 39. Spook Hill ADMP Update Summary of Regional Sites and Sediment Yield		
Site	Area (mi^2)	Average Annual Sediment Yield (ac-ft/ mi^2/yr)
Casandro Wash[1]	1.24	0.31*
Rawhide Wash[1]	13.64	0.39*
Phoenix Mountain Preserve (Tatum Wash)[2]	1.92	1.9*
Shea Boulevard (Tatum Wash)[2]	2.17	2.1*
Rillito Creek Recharge Dam[2]	NA	0.1*
Bunkerville Detention Basin[2]	NA	0.9
Town Wash Detention Basin[2]	NA	0.9
Western Tributary (Cherokee Wash)[3]	0.14	2.16*
Desert Park Tributary (Cherokee Wash)[3]	0.30	1.98*
Desert Greenbelt Project, AZ[4]	8.58	0.10
Cave Creek, AZ[4]	121.0	0.31
Spookhill Dam, AZ[4]	*16.40*	*0.15*
Saddleback Dam, AZ[4]	30.00	0.08
Davis Tank, AZ[5]	0.21	0.96
Kennedy Tank, AZ[5]	0.97	0.27
Juniper Wash, AZ[5]	2.00	0.29
Alhambra Tank, AZ[5]	6.61	0.03
Black Hills Tank, AZ[5]	1.14	0.68
Black Hills Tank, AZ[6]	1.56	0.58
Mesquite Tank, AZ[5]	9.00	0.03
Tank 76, AZ[5]	1.17	0.21
Spook Hill ADMP Update Apache Junction FRS	5.80	**0.07**
Spook Hill ADMP Update Signal Butte FRS	10.64	**0.11**
Spook Hill ADMP Update Spook Hill FRS	13.68	**0.14**
Spook Hill ADMP Update Spook Hill Floodway	2.89	**0.16**
*Based on average of several values determined by different methods.		
1. CH2M-Hill, 1994		
2. JE Fuller, 1997		
3. WEST Consulting, 1997		
4. Hjalmarson, 1996		
5. Peterson, 1962		
6. Langbien, Hains and Culler, 1951		

Table 40. Spook Hill ADMP Update Summary of Regional Sites and Event-Based Sediment Yield					
Event	**Casandro Wash (CH2M-Hill, 1994**	**Rawhide Wash (CH2M-Hill, 1994))**	**Cherokee Wash (WEST Consulting, 1997)**	**Desert Greenbelt (Sabol Consulting, 1996)**	**Spook Hill ADMP Update Recommended Values**
2-Year	0.32	0.13	0.07	0.001	**0.07**
5-Year	0.56	0.30	--	0.038	**0.19**
10-Year	0.76	0.46	0.33	0.086	**0.30**
25-Year	1.05	0.69	--	0.199	**0.46**
50-Year	1.25	0.88	0.63	0.332	**0.67**
100-Year	1.45	0.98	0.77	0.551	**0.82**

Summary

Sediment yield is a topic of much concern in an area like Phoenix where flood control structures may be prone to a reduction in effectiveness due to sedimentation. A review of several sedimentation studies reveals that estimated average annual sediment yield varies greatly, with reported values ranging from a low of 0.03 ac-ft/yr/mi^2/yr to 2.16 ac-ft/ /mi^2/yr. Additionally, sediment yield values can vary greatly depending on the method used to calculate the value, as can be seen in studies reviewed above. In the case of Tatum Wash the MUSLE and BUREC curves tended to give much higher sediment yield values than the other methods used. These higher values contribute to the high average values summarized in Table 40. A summary of the sites, drainage areas, and average annual sediment yields can be viewed in Table 40.

Conclusions

Sediment yield is an important design parameter for flood control structures, because sediment deposition in dams, reservoirs, or floodways reduces the storage or transport capacity. Reduced capacity of flood control structures increases the likelihood of a spillover during floods, increasing the chance of injuries, damage to the structure itself, downstream property damage, and even loss of human life.

Several methods appropriate to the prediction of sediment yield in the arid southwest were used to estimate sediment yield for the study area. Empirical methods of verification including field measurements were used to determine an appropriate sediment yield value.

Key findings from the sedimentation investigation included the following:

- Sediment yield for individual subbasins varies within the watershed. The MUSLE, PSIAC, and Flaxman method results reflect internal variation in the study area.
- The largest average annual sediment yields are predicted in the basins dominated by the steepest and longest slopes and little vegetative cover.
- The smallest sediment yields are predicted for the developed basins (i.e. residential) with low slopes.
- Watersheds located closer to the mountain slopes will deliver greater sediment quantities than similar sized watersheds or even the same watersheds at concentration points located further downstream on the piedmont.
- The representation of internal variation and close agreement with empirically measured sediment deposits in the field suggest that a combination of the MUSLE, PSIAC, and Flaxman results should be considered for planning level sediment yields.
- The parameterization of the MUSLE, PSIAC, and Flaxman methods also allows for examination of future conditions impacts on sediment yield in the alternatives phase of the ADMP Update. IS THIS PART OF THIS CONTRACT

Therefore, an average value of the MUSLE, PSIAC, and Flaxman estimates is recommended for consideration of average annual sediment yield in the Spook Hill ADMP Update. The resulting average annual sediment yield value for the entire study of 0.13 ac-ft/mi^2/yr compares reasonably with previous estimates for the area.

Event-based sediment yield estimates were also computed for the study area. The MUSLE method served as the method for computation of the T-year event sediment yield. The 100-year 24-hour flood sediment yield is about six times greater than the average annual sediment yield estimates.

It is recommended that for both the average annual and event-based sediment yields the mean sediment yield for the subbasins contributing to each FRS be used as the planning level sediment yield.

Consideration of the impact of estimated sediment yield on the effectiveness of the flood retarding structures led to the following conclusions:

- A regular sediment removal program does not need to be considered for planning at either Apache Junction or Signal Butte FRS. The current FCDMC maintenance practice of keeping the principle outlet clear and assuring positive drainage to the outlet is sufficient for successful FRS operation and should continue.
- Some type of sediment removal program for Spook Hill FRS is needed. This report suggest that a 15 year maintenance schedule would be appropriate to assure continued safe operation of the Spook Hill FRS. Again, regular maintenance of the low flow channel along the dam will continue to be required.

- Finally, the results indicate that a 4-year cycle of sediment removal from the Spook Hill Floodway sediment basin be used. Discussions with FCDMC maintenance personnel indicate that a similar schedule is already in place.

The geomorphic contrast between the eastern and western portions of the study area is an important consideration when evaluating sediment impacts on flood control alternatives in the Spook Hill ADMP. The western area is likely to deliver greater quantities of sediment than the eastern area. Moreover, the nature of the sediment delivered is also likely to differ. The western area is dominated by bedload sediments and, under natural conditions, is more widely distributed spatially in its location. The eastern area delivers a higher proportion of suspended sediments that will flow through the system more easily. Additionally, the location of sediment inflows in the eastern area will be limited primarily to readily identifiable washes with relatively low width to depth ratios. Internal storage is greater in the western half of the study area than in the eastern half due to the shallow, distributary nature of washes in the western half. Finally, the western half of the study area has greater potential for urban development than the eastern half. Therefore, future conditions in the western half are likely to differ more from current conditions than in the eastern half.

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APPENDIX

Section 1 – Comparison of Average Annual Sediment Yield Calculations

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Section 3 – Dendy-Bolton Average Annual Sediment Yield Calculations

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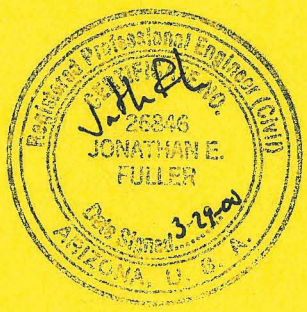
Section 5 – Pacific Southwest Interagency Committee (PSIAC) Average Annual Sediment Yield Calculations

Section 6 – Modified Universal Soil Loss Equation (MUSLE) Average Annual and Event-Based Sediment Yield Calculations

Section 7 – Existing Conditions 100-year 24-hour HEC-1 Results and Parameters Used in the Sediment Yield Calculations

Section 8 – Field Interview With Mr. Ed Loy, Maintenance Supervisor

Section 9 – Verification Surveys of Spook Hill and Bulldog Floodway Sediment Basins



Section 1

Comparison of Average Annual Sediment Yield Calculations

Spook Hill ADMP Update
Comparison of Average Annual Sediment Yield Calculations - Existing Conditions

	Subbasin ID	Basin Area (sq. mi.)	Length (miles)	Renard (ac-ft/mi^2/yr)	Dendy-Bolton (ac-ft/mi^2/yr)	Flaxman (1974) (ac-ft/mi^2/yr)	PSIAC (ac-ft/mi^2/yr)	MUSLE (ac-ft/mi^2/yr)	1% Concentration (ac-ft/mi^2/yr)	Period of Record 1% Concentration (ac-ft/mi^2/yr)	5% Concentration (ac-ft/mi^2/yr)	Period of Record 5% Concentration (ac-ft/mi^2/yr)
	20	1.82	4.58	0.511	0.485	0.049	0.170	0.023	0.206	0.129	3.516	0.565
	40	2.23	3.08	0.499	0.470	0.081	0.140	0.051	0.413	0.259	5.806	0.927
	60	1.75	4.19	0.513	0.487	0.071	0.160	0.046	0.256	0.161	4.547	0.731
Apache Jct. FRS	60C	5.80		0.445	0.406	0.067	0.157	0.040	0.790	0.493	4.334	0.681
	80	1.48	2.69	0.524	0.500	0.092	0.157	0.060	0.310	0.195	6.479	1.048
	100	0.48	1.94	0.599	0.588	0.062	0.150	0.005	0.076	0.049	4.590	0.787
	120	2.20	3.07	0.500	0.471	0.104	0.150	0.090	0.535	0.336	7.620	1.217
	140	0.60	1.61	0.583	0.570	0.080	0.200	0.028	0.115	0.073	5.645	0.954
	160	0.78	3.18	0.565	0.549	0.085	0.130	0.072	0.111	0.071	4.270	0.711
	180	1.00	2.42	0.549	0.529	0.059	0.180	0.024	0.129	0.082	3.931	0.646
	200	1.81	3.28	0.511	0.485	0.105	0.140	0.141	0.375	0.235	6.443	1.035
	220	1.25	3.14	0.534	0.512	0.111	0.200	0.102	0.263	0.166	6.466	1.053
	240	1.04	3.5	0.546	0.526	0.077	0.180	0.061	0.143	0.091	4.193	0.688
Signal Butte FRS	C180	10.64		0.414	0.368	0.086	0.165	0.065	1.869	1.165	5.597	0.878
	260	0.27	0.81	0.641	0.637	0.109	0.150	0.013	0.082	0.053	8.412	1.510
	280	0.30	0.77	0.633	0.628	0.106	0.164	0.016	0.091	0.059	8.533	1.518
	300	0.99	2.28	0.549	0.530	0.065	0.110	0.024	0.154	0.097	4.714	0.775
	320	1.53	4.67	0.522	0.497	0.070	0.110	0.048	0.163	0.102	3.291	0.532
	340	1.45	2.4	0.525	0.501	0.081	0.140	0.025	0.253	0.160	5.394	0.873
	350	0.97	2.22	0.551	0.532	0.129	0.180	0.167	0.206	0.130	6.434	1.059
	360	1.33	4.84	0.530	0.508	0.073	0.150	0.041	0.123	0.078	2.845	0.462
	380	1.64	5.05	0.517	0.492	0.075	0.230	0.041	0.150	0.094	2.835	0.457
	390	1.09	2.82	0.543	0.523	0.120	0.150	0.096	0.219	0.138	6.126	1.003
	400	0.62	1.64	0.581	0.567	0.056	0.160	0.016	0.064	0.041	3.042	0.513
	420	0.85	1.91	0.559	0.542	0.071	0.240	0.017	0.133	0.085	4.731	0.784
	440	0.08	0.4	0.740	0.752	0.256	0.150	0.320	0.042	0.028	12.673	2.608
	441	0.01	0.28	0.948	0.982	0.309	0.140	0.084	0.006	0.004	9.062	2.814
	442	0.10	0.83	0.721	0.730	0.108	0.330	0.042	0.022	0.015	5.607	1.120
	443	0.08	0.71	0.740	0.752	0.204	0.230	0.079	0.034	0.023	10.336	2.128
	444	0.04	0.33	0.804	0.823	0.275	0.260	0.244	0.021	0.015	11.469	2.631
	445	0.19	0.82	0.668	0.669	0.149	0.310	0.099	0.061	0.040	8.585	1.593
	446	0.04	0.46	0.804	0.823	0.203	0.370	0.041	0.017	0.012	9.062	2.079
	447	0.09	0.49	0.730	0.740	0.149	0.310	0.023	0.031	0.021	8.496	1.721
	448	0.05	0.36	0.783	0.799	0.206	0.200	0.180	0.022	0.015	9.855	2.177
	449	0.05	0.4	0.783	0.799	0.187	0.180	0.083	0.019	0.013	8.722	1.927
	450	0.07	0.85	0.752	0.765	0.094	0.270	0.033	0.014	0.009	4.693	0.984
	451	0.03	0.557	0.832	0.854	0.074	0.290	0.016	0.005	0.003	3.209	0.776
	452	0.04	0.43	0.804	0.823	0.194	0.280	0.061	0.016	0.011	8.637	1.982
	453	0.06	0.58	0.766	0.781	0.095	0.250	0.018	0.015	0.010	5.664	1.216
	454	0.18	1.23	0.673	0.674	0.092	0.270	0.026	0.032	0.021	4.783	0.892
	C119	1.10		0.543	0.522	0.137	0.216	0.071	0.141	0.089	3.908	0.640
	455	1.56	2.92	0.520	0.496	0.103	0.200	0.039	0.282	0.177	5.595	0.903
Spook Hill FRS	455C	13.68		0.402	0.353	0.135	0.216	0.070	1.401	0.874	3.260	0.512

Spook Hill ADMP Update
Comparison of Average Annual Sediment Yield Calculations - Existing Conditions

	Subbasin ID	Basin Area (sq. mi.)	Length (miles)	Renard (ac-ft/mi^2/yr)	Dendy-Bolton (ac-ft/mi^2/yr)	Flaxman (1974) (ac-ft/mi^2/yr)	PSIAC (ac-ft/mi^2/yr)	MUSLE (ac-ft/mi^2/yr)	1% Concentration (ac-ft/mi^2/yr)	Period of Record 1% Concentration (ac-ft/mi^2/yr)	5% Concentration (ac-ft/mi^2/yr)	Period of Record 5% Concentration (ac-ft/mi^2/yr)
	456	0.26	0.94	0.644	0.641	0.172	0.150	0.226	0.093	0.061	9.977	1.797
	457	0.19	1.01	0.668	0.669	0.142	0.150	0.092	0.053	0.035	7.571	1.405
	458	0.19	0.76	0.668	0.669	0.206	0.215	0.140	0.073	0.048	10.344	1.919
	459	0.03	0.35	0.832	0.854	0.185	0.260	0.068	0.012	0.008	8.118	1.963
	460	0.14	0.62	0.693	0.697	0.180	0.240	0.026	0.045	0.030	8.293	1.591
	461	0.12	0.83	0.706	0.712	0.190	0.260	0.034	0.035	0.023	7.363	1.438
	462	0.30	0.97	0.633	0.628	0.178	0.240	0.101	0.105	0.068	9.874	1.756
	C56	1.35		0.529	0.507	0.179	0.216	0.098	0.228	0.144	5.194	0.843
	480	0.73	1.21	0.570	0.554	0.101	0.180	0.025	0.188	0.119	7.689	1.285
	500	0.93	2.77	0.553	0.535	0.108	0.230	0.108	0.185	0.117	6.017	0.993
Spook Hill FW				0.663	0.662	0.163	0.214	0.091	0.088	0.057	8.361	1.572
	MEAN			0.638	0.632	0.127	0.202	0.071	0.125	0.079	6.699	1.282
	STDEV			0.115	0.132	0.062	0.062	0.066	0.119	0.074	2.463	0.610
	MAX			0.948	0.982	0.309	0.370	0.320	0.535	0.336	12.673	2.814
	MIN			0.499	0.470	0.049	0.110	0.005	0.005	0.003	2.835	0.457
	MEDIAN			0.591	0.579	0.108	0.200	0.060	0.108	0.069	6.072	1.041

Section 2

Renard Method Average Annual Sediment Yield Calculations

Spook Hill ADMP Update
Renard Method Average Annual Sediment Yield Calculations - Existing Conditions

	Subbasin ID	Basin Area (sq. mi.)	Basin Area (acres)	Renard (ac-ft/ac/yr)	Renard (ac-ft/mi^2/yr)
	20	1.82	1164.8	0.00080	0.511
	40	2.23	1427.2	0.00078	0.499
	60	1.75	1120	0.00080	0.513
Apache Junction FRS	60C	5.80	3712	0.00070	0.445
	80	1.48	947.2	0.00082	0.524
	100	0.48	307.2	0.00094	0.599
	120	2.20	1408	0.00078	0.500
	140	0.60	384	0.00091	0.583
	160	0.78	499.2	0.00088	0.565
	180	1.00	640	0.00086	0.549
	200	1.81	1158.4	0.00080	0.511
	220	1.25	800	0.00083	0.534
	240	1.04	665.6	0.00085	0.546
Signal Butte FRS	C180	10.64	6809.6	0.00065	0.414
	260	0.27	172.8	0.00100	0.641
	280	0.30	192	0.00099	0.633
	300	0.99	633.6	0.00086	0.549
	320	1.53	979.2	0.00082	0.522
	340	1.45	928	0.00082	0.525
	350	0.97	620.8	0.00086	0.551
	360	1.33	851.2	0.00083	0.530
	380	1.64	1049.6	0.00081	0.517
	390	1.09	697.6	0.00085	0.543
	400	0.62	396.8	0.00091	0.581
	420	0.85	544	0.00087	0.559
	440	0.08	51.2	0.00116	0.740
	441	0.01	6.4	0.00148	0.948
	442	0.10	64	0.00113	0.721
	443	0.08	51.2	0.00116	0.740
	444	0.04	25.6	0.00126	0.804
	445	0.19	121.6	0.00104	0.668
	446	0.04	25.6	0.00126	0.804
	447	0.09	57.6	0.00114	0.730
	448	0.05	32	0.00122	0.783
	449	0.05	32	0.00122	0.783
	450	0.07	44.8	0.00118	0.752
	451	0.03	19.2	0.00130	0.832
	452	0.04	25.6	0.00126	0.804
	453	0.06	38.4	0.00120	0.766
	454	0.18	115.2	0.00105	0.673
	C119	1.10	704	0.00085	0.543
	455	1.56	998.4	0.00081	0.520
Spook Hill FRS	455C	13.68	8755.2	0.00063	0.402

Renard Method Average Annual Sediment Yield Calculations - Existing Conditions

	Subbasin ID	Basin Area (sq. mi.)	Basin Area (acres)	Renard (ac-ft/ac/yr)	Renard (ac-ft/mi^2/yr)
	456	0.26	166.4	0.00101	0.644
	457	0.19	121.6	0.00104	0.668
	458	0.19	121.6	0.00104	0.668
	459	0.03	19.2	0.00130	0.832
	460	0.14	89.6	0.00108	0.693
	461	0.12	76.8	0.00110	0.706
	462	0.30	192	0.00099	0.633
	C56	1.35	864	0.00083	0.529
	480	0.73	467.2	0.00089	0.570
	500	0.93	595.2	0.00086	0.553
Spook Hill Floodway					0.551
	MEAN				0.638
	STDEV				0.115
	MAX				0.948
	MIN				0.499
	MEDIAN				0.591

Section 3

Dendy-Bolton Average Annual Sediment Yield Calculations

Spook Hill ADMP Update
Dendy-Bolton Average Annual Sediment Yield Calculations - Existing Conditions

	Subbasin ID	Basin Area (sq. mi.)	Dendy-Bolton (tons/mi^2/yr)	Dendy-Bolton (ac-ft/mi^2/yr)
	20	1.82	1161.1	0.485
	40	2.23	1126.2	0.470
	60	1.75	1167.9	0.487
Apache Junction FRS	60C	5.80	971.5	0.406
	80	1.48	1197.4	0.500
	100	0.48	1409.3	0.588
	120	2.20	1128.5	0.471
	140	0.60	1365.3	0.570
	160	0.78	1314.9	0.549
	180	1.00	1268.4	0.529
	200	1.81	1162.1	0.485
	220	1.25	1227.7	0.512
	240	1.04	1261.2	0.526
Signal Butte FRS	C180	10.64	881.1	0.368
	260	0.27	1527.3	0.637
	280	0.30	1505.1	0.628
	300	0.99	1270.3	0.530
	320	1.53	1191.5	0.497
	340	1.45	1201.1	0.501
	350	0.97	1274.0	0.532
	360	1.33	1216.5	0.508
	380	1.64	1179.3	0.492
	390	1.09	1252.6	0.523
	400	0.62	1358.9	0.567
	420	0.85	1298.7	0.542
	440	0.08	1800.5	0.752
	441	0.01	2351.6	0.982
	442	0.10	1747.9	0.730
	443	0.08	1800.5	0.752
	444	0.04	1971.8	0.823
	445	0.19	1602.8	0.669
	446	0.04	1971.8	0.823
	447	0.09	1772.6	0.740
	448	0.05	1915.4	0.799
	449	0.05	1915.4	0.799
	450	0.07	1832.6	0.765
	451	0.03	2046.4	0.854
	452	0.04	1971.8	0.823
	453	0.06	1870.2	0.781
	454	0.18	1614.7	0.674
	C119	1.10	1250.9	0.522
	455	1.56	1188.1	0.496
Spook Hill FRS	455C	13.68	845.3	0.353

Spook Hill ADMP Update
Dendy-Bolton Average Annual Sediment Yield Calculations - Existing Conditions

	Subbasin	Basin Area	Dendy-Bolton	Dendy-Bolton
	ID	(sq. mi.)	(tons/mi^2/yr)	(ac-ft/mi^2/yr)
	456	0.26	1535.3	0.641
	457	0.19	1602.8	0.669
	458	0.19	1602.8	0.669
	459	0.03	2046.4	0.854
	460	0.14	1670.7	0.697
	461	0.12	1705.7	0.712
	462	0.30	1505.1	0.628
	C56	1.35	1213.8	0.507
	480	0.73	1327.5	0.554
	500	0.93	1281.9	0.535
Spook Hill Floodway				0.532
	MEAN		1514.9	0.632
	STDEV		317.2	0.132
	MAX		2351.6	0.982
	MIN		1126.2	0.470
	MEDIAN		1387.3	0.579

Section 4

Flaxman (1974) Method Average Annual Sediment Yield Calculations

Spook Hill ADMP Update
Flaxman (1974) Method Average Annual Sediment Yield Calculations - Existing Conditions

	Subbasin	Basin Area	Basin Area	Average Annual Precip.	Average Annual Temp.	P/T Ratio (X_1)	Length	High Elev	Low Elev	Slope	Adj. Slope	Slope (X_2)	Particles > 1.0 mm (X_3)	Aggregation Index (X_4)	50 % Chance Peak Q	50% Chance Peak Q (X_5)	Flaxman (1974) $X_4 = 0$	Flaxman (1974) $X_4 = 0$
	ID	(sq. mi.)	(acres)	(inches)	(^{0}F)		(miles)	(ft)	(ft)	(ft/mi)	(ft/mile)	(%)	(%)	(%)	(cfs)	(cfs/mi^2)	(tons/mi^2/yr)	(ac-ft/mi^2/yr)
	20	1.82	1164.8	8.24	67	0.123	4.58	2350	1810	118	118	2.23	54.6	16.7	106	58	117.0	0.049
	40	2.23	1427.2	8.24	67	0.123	3.08	2373	1790	189	189	3.58	53.4	14.7	213	96	194.9	0.081
	60	1.75	1120	8.24	67	0.123	4.19	2685	1800	211	210	3.97	54.1	15.8	132	76	169.4	0.071
Apache Jct. FRS	60C	5.80	3712	8.24	67	0.123									404		160.4	0.067
	80	1.48	947.2	8.24	67	0.123	2.69	2400	1770	234	230	4.35	55.8	16.4	161	109	221.4	0.092
	100	0.48	307.2	8.24	67	0.123	1.94	1950	1740	108	108	2.05	55.4	15.7	41	85	147.8	0.062
	120	2.20	1408	8.24	67	0.123	3.07	2500	1740	248	239	4.53	55.9	15	276	125	250.2	0.104
	140	0.60	384	8.24	67	0.123	1.61	1970	1730	149	149	2.82	53.3	13.4	61	102	190.5	0.080
	160	0.78	499.2	8.24	67	0.123	3.18	3160	1700	459	299	5.67	52.1	12.4	59	75	204.7	0.085
	180	1.00	640	8.24	67	0.123	2.42	2030	1690	140	140	2.66	53	13.6	68	68	140.2	0.059
	200	1.81	1158.4	8.24	67	0.123	3.28	3312	1750	476	300	5.68	54	11.6	194	107	252.5	0.105
	220	1.25	800	8.24	67	0.123	3.14	3312	1750	497	302	5.72	52.3	17.1	137	110	264.9	0.111
	240	1.04	665.6	8.24	67	0.123	3.5	3312	1760	443	299	5.66	56.9	14.8	75	72	183.9	0.077
Signal Butte FRS	C180	10.64	6809.6	8.24	67	0.123									958		206.2	0.086
	260	0.27	172.8	8.24	67	0.123	0.81	1750	1695	68	68	1.29	50.3	20	45	167	260.1	0.109
	280	0.30	192	8.24	67	0.123	0.77	1760	1695	84	84	1.60	53.5	17	50	167	254.4	0.106
	300	0.99	633.6	8.24	67	0.123	2.28	1980	1690	127	127	2.41	53.3	13.6	81	81	154.6	0.065
	320	1.53	979.2	8.24	67	0.123	4.67	2840	1600	266	249	4.71	47.9	13.5	84	55	167.3	0.070
	340	1.45	928	8.24	67	0.123	2.4	1953	1570	160	160	3.02	48.4	13.6	132	91	193.9	0.081
	350	0.97	620.8	8.24	67	0.123	2.22	3270	1670	721	315	5.97	44.1	12.9	108	111	309.7	0.129
	360	1.33	851.2	8.24	67	0.123	4.84	2933	1570	282	258	4.88	42.7	13.8	64	48	174.1	0.073
	380	1.64	1049.6	8.24	67	0.123	5.05	2972	1570	278	256	4.84	40.7	13.5	78	47	178.8	0.075
	390	1.09	697.6	8.24	67	0.123	2.82	2959	1750	429	298	5.65	44.5	11.7	114	105	288.2	0.120
	400	0.62	396.8	8.24	67	0.123	1.64	1750	1570	110	110	2.08	44.7	13.6	34	55	134.9	0.056
	420	0.85	544	8.24	67	0.123	1.91	1800	1570	120	120	2.28	48	15.3	70	83	170.1	0.071
	440	0.08	51.2	8.24	67	0.123	0.4	2760	2080	1700	315	5.97	53.5	10.3	25	312	614.4	0.256
	441	0.01	6.4	8.24	67	0.123	0.28	2190	1965	804	315	5.97	58.1	20.7	4	411	741.4	0.309
	442	0.10	64	8.24	67	0.123	0.83	2070	1790	337	274	5.19	60.3	16	13	132	257.7	0.108
	443	0.08	51.2	8.24	67	0.123	0.71	2270	1820	634	315	5.97	57.4	21	20	255	489.6	0.204
	444	0.04	25.6	8.24	67	0.123	0.33	2650	2060	1788	315	5.97	52.5	13.5	13	334	659.8	0.275
	445	0.19	121.6	8.24	67	0.123	0.82	2645	1925	878	315	5.97	59.4	15.4	34	180	356.1	0.149
	446	0.04	25.6	8.24	67	0.123	0.46	2155	1920	511	304	5.76	59	18.8	11	264	486.6	0.203
	447	0.09	57.6	8.24	67	0.123	0.49	1910	1800	224	221	4.19	56.6	15.7	18	204	358.0	0.149
	448	0.05	32	8.24	67	0.123	0.36	2400	1920	1333	315	5.97	60.8	12.9	14	271	494.2	0.206
	449	0.05	32	8.24	67	0.123	0.4	2230	1860	925	315	5.97	60.4	15.2	12	240	447.0	0.187
	450	0.07	44.8	8.24	67	0.123	0.85	1920	1740	212	211	3.99	57.1	14.8	8	119	224.9	0.094
	451	0.03	19.2	8.24	67	0.123	0.557	1840	1740	180	175	3.31	60.3	16	3	101	176.6	0.074
	452	0.04	25.6	8.24	67	0.123	0.43	2230	1840	907	315	5.97	60.5	14.4	10	251	465.0	0.194
	453	0.06	38.4	8.24	67	0.123	0.58	1800	1720	138	138	2.61	60.3	16	9	149	227.2	0.095
	454	0.18	115.2	8.24	67	0.123	1.23	1880	1680	163	163	3.08	46	15	18	101	219.5	0.092
	C119	1.10	704	8.24	67	0.123									74		327.1	0.137
	455	1.56	998.4	8.24	67	0.123	2.92	2500	1570	318	269	5.10	46.5	14.3	146	94	246.7	0.103
Spook Hill FRS	455C	13.68	8755.2	8.24	67	0.123									720		324.1	0.135

Spook Hill ADMP Update
Flaxman (1974) Method Average Annual Sediment Yield Calculations - Existing Conditions

	Subbasin ID	Basin Area (sq. mi.)	Basin Area (acres)	Average Annual Precip. (inches)	Average Annual Temp. (°F)	P/T Ratio (X_1)	Length (miles)	High Elev (ft)	Low Elev (ft)	Slope (ft/mi)	Adj. Slope (ft/mile)	Slope (X_2) (%)	Particles > 1.0 mm (X_3) (%)	Aggregation Index (X_4) (%)	50 % Chance Peak Q (cfs)	50% Chance Peak Q (X_5) (cfs/mi^2)	Flaxman (1974) $X_4 = 0$ (tons/mi^2/yr)	Flaxman (1974) $X_4 = 0$ (ac-ft/mi^2/yr)
	456	0.26	166.4	8.24	67	0.123	0.94	2960	1980	1043	315	5.97	54.7	10.3	52	199	412.9	0.172
	457	0.19	121.6	8.24	67	0.123	1.01	2340	1785	550	309	5.85	54.8	14.2	30	159	340.1	0.142
	458	0.19	121.6	8.24	67	0.123	0.76	2070	1725	454	299	5.66	45.3	10.8	41	217	492.7	0.206
	459	0.03	19.2	8.24	67	0.123	0.35	1995	1900	271	252	4.77	58.3	15.8	8	256	444.3	0.185
	460	0.14	89.6	8.24	67	0.123	0.62	1920	1800	194	194	3.67	34.9	13.9	26	183	432.2	0.180
	461	0.12	76.8	8.24	67	0.123	0.83	1850	1700	181	181	3.42	26.1	12.6	20	167	455.3	0.190
	462	0.30	192	8.24	67	0.123	0.97	1970	1565	418	298	5.64	48.7	11.8	58	193	427.2	0.178
	C56	1.35	864	8.24	67	0.123									118		429.2	0.179
	480	0.73	467.2	8.24	67	0.123	1.21	1780	1580	165	165	3.13	54.2	14.7	99	136	242.7	0.101
	500	0.93	595.2	8.24	67	0.123	2.77	2500	1440	383	287	5.43	49.8	10.1	97	104	259.3	0.108
Spook Hill FW																	389.6	0.163
	MEAN																304.1	0.127
	STDEV																149.0	0.062
	MAX																741.4	0.309
	MIN																117.0	0.049
	MEDIAN																258.5	0.108

Spook Hill ADMP Update
Flaxman Soil Particle Size Index (X3) Calculations

				Percent passing #10 Sieve		% Particles	Soil Particle Size
Map Unit	Soil Name	% of Unit	%adj for RO	% Reported	Median %	> 1.1 mm	Index (X_3, Flaxman)
3	Antho	35		95-100	97.5	2.5	
	Carrizo	30		15-50	32.5	67.5	
	Maripo	20		95-100	97.5	2.5	
						25.4	**25.4**
44	Ebon	80		40-50	45.0	**55.0**	**55.0**
45	Ebon	80		40-50	45.0	**55.0**	**55.0**
47	Ebon	35		40-50	45.0	55.0	
	Gunsight	20		20-50	35.0	65.0	
	Cipriano	20		40-50	45.0	55.0	
						57.7	**57.7**
48	Ebon	45		40-50	45.0	55.0	
	Pinamt	35		20-25	22.5	77.5	
						64.8	**64.8**
49	Ebon	45		40-50	45.0	55.0	
	Pinamt	35		20-25	22.5	77.5	
						64.8	**64.8**
52	Gachado	45	56	25-50	37.5	62.5	
	Lomitas	20	25	35-45	40.0	60.0	
	Rock Outcrop	20		0	0.0	100.0	
						70.7	**70.7**
61	Gran	40		30-50	40.0	60.0	
	Wickenburg	35		50-100	75.0	25.0	
						43.7	**43.7**
63	Gran	30	40	30-50	40.0	60.0	
	Wickenburg	25	33	50-100	75.0	25.0	
	Rock Outcrop	25		0	0.0	100.0	
						61.6	**61.6**
68	Gunsight	45		20-50	35.0	65.0	
	Cipriano	40		40-50	45.0	55.0	
						60.3	**60.3**
90	Momoli	70		60-75	67.5	**32.5**	**32.5**
98	Pinamt	45		20-50	35.0	65.0	
	Tremant	35		50-75	62.5	37.5	
						53.0	**53.0**
101	Rillito	85		75-90	82.5	**17.5**	**17.5**
110	Sun City	55		60-75	67.5	32.5	
	Cipriano	30		40-50	45.0	55.0	
						40.4	**40.4**
112	Tremant	80		50-75	62.5	**37.5**	**37.5**
113	Tremant	80		50-75	62.5	**37.5**	**37.5**
115	Tremant	45		50-75	62.5	37.5	
	Antho	35		95-100	97.5	2.5	
						22.2	**22.2**
116	Tremant	30		50-75	62.5	37.5	
	Gunsight	20		20-50	35.0	65.0	
	Rillito	20		60-75	67.5	32.5	
						43.9	**43.9**
118	Tremant	45		50-75	62.5	37.5	
	Rillito	30		60-75	67.5	32.5	
						35.5	**35.5**

Spook Hill ADMP Update
Flaxman Soil Aggregation Index (X4) Calculations

			Aggregation Factors					Soil Aggregation
Map Unit	Soil Name	% of Unit	%adj for RO	%clay reported*	Median %clay	pH reported*	Median pH	Index (X_4, Flaxman)
3	Antho	35		5-15	10	7.9-8.4	8.2	
	Carrizo	30		0-10	5	7.9-8.4	8.2	
	Maripo	20		0-18	9	7.9-8.4	8.2	
					8.0		**8.2**	**8.0**
44	Ebon	80		20-35	**27.5**	6.6-8.4	**7.5**	**27.5**
45	Ebon	80		20-35	**27.5**	6.6-8.4	**7.5**	**27.5**
47	Ebon	35		20-35	28	6.6-8.4	7.5	
	Gunsight	20		10-15	13	7.9-8.4	8.2	
	Cipriano	20		15-25	20	7.9-8.4	8.2	
					21.5		**7.8**	**21.5**
48	Ebon	45		20-35	28	6.6-8.4	7.5	
	Pinamt	35		10-15	13	7.9-8.4	8.2	
					20.9		**7.8**	**20.9**
49	Ebon	45		20-35	28	6.6-8.4	7.5	
	Pinamt	35		10-15	13	7.9-8.4	8.2	
					20.9		**7.8**	**20.9**
52	Gachado	45	56	15-20	18	7.9-8.4	8.2	
	Lomitas	20	25	10-20	15	7.4-8.4	7.9	
	Rock Outcrop	20		0	0			
					12.8		**8.1**	**12.8**
61	Gran	40		5-15	10	7.4-8.4	7.9	
	Wickenburg	35		10-15	13	7.4-8.4	7.9	
					11.2		**7.9**	**11.2**
63	Gran	30	40	5-15	10	7.4-8.4	7.9	
	Wickenburg	25	33	10-15	13	7.4-8.4	7.9	
	Rock Outcrop	25		0	0			
					7.7		**7.9**	**7.7**
68	Gunsight	45		10-15	13	7.9-8.4	8.2	
	Cipriano	40		15-25	20	7.9-8.4	8.2	
					16.0		**8.2**	**16.0**
90	Momoli	70		10-20	**15.0**	7.9-8.4	**8.2**	**15.0**
98	Pinamt	45		10-15	13	7.9-8.4	8.2	
	Tremant	35		10-20	15	7.9-8.4	8.2	
					13.6		**8.2**	**13.6**
101	Rillito	85		10-18	**14**	7.9-8.4	**8.2**	**14.0**
110	Sun City	55		15-25	20	7.9-8.4	8.2	
	Cipriano	30		15-25	20	7.9-8.4	8.2	
					20.0		**8.2**	**20.0**
112	Tremant	80		10-20	**15.0**	7.9-8.4	**8.2**	**15.0**
113	Tremant	80		10-20	**15.0**	7.9-8.4	**8.2**	**15.0**
115	Tremant	45		10-20	15	7.9-8.4	8.2	
	Antho	35		5-15	10	7.9-8.4	8.2	
					12.8		**8.2**	**12.8**
116	Tremant	30		10-20	15	7.9-8.4	8.2	
	Gunsight	20		10-15	13	7.9-8.4	8.2	
	Rillito	20		10-18	14	7.9-8.4	8.2	
					14.0		**8.2**	**14.0**
118	Tremant	45		10-20	15	7.9-8.4	8.2	
	Rillito	30		10-18	14	7.9-8.4	8.2	
					14.6		**8.2**	**14.6**

Section 5

Pacific Southwest Interagency Committee (PSIAC) Average Annual Sediment Yield Calculations

Spook Hill ADMP Update
PSIAC Sediment Yield Calculations Summary

Subbasin	Surface Geology	Soils	Climate	Runoff	Topo-graphy	Effective Ground Cover	Land Type & Manage-ment Quality	Upland Erosion	Channel Erosion & Sediment Transport	PSIAC Total Rating	Sediment Yield (ac-ft/sq mi/yr)	Basin Area (sq. mi.)
20	1.00	5.61	2	5	6.97	3	-7	1.88	4	22	0.17	1.82
40	0.25	5.51	2	5	2.87	3	-6	0.76	4	17	0.14	2.23
60	0.72	5.58	2	5	6.70	2	-7	1.81	4	21	0.16	1.75
AJ FRS											0.16	
80	0.24	5.36	2	5	3.49	4	-6	0.97	4	19	0.15	1.48
100	0	5.32	2	5	1.77	4	-5	0.53	4	18	0.15	0.48
120	1.20	5.84	2	5	11.91	1	-7	3.17	4	27	0.20	2.2
140	0.04	5.43	2	5	0.49	3	-5	0.13	4	15	0.13	0.6
160	0.68	5.75	2	5	7.61	3	-7	2.04	4	23	0.18	0.78
180	0	5.40	2	5	0.14	5	-5	0.04	4	17	0.14	1
200	1.41	6.13	2	5	13.88	0	-10	3.63	4	26	0.20	1.81
220	0.53	5.75	2	5	9.50	5	-10	2.61	4	24	0.18	1.25
240	0.47	5.42	2	5	6.35	4	-10	1.82	4	19	0.15	1.04
Signal Butte											0.16	
260	0	5.42	2	5	0.00	-2	-5	0.00	2	7	0.11	0.27
280	0	5.30	2	5	0.00	-2	-5	0.00	2	7	0.11	0.3
300	0.29	5.56	2	5	1.83	1	-5	0.48	2	13	0.14	0.99
320	0.35	5.77	2	5	2.89	1	0	0.79	2	20	0.18	1.53
340	0.16	5.66	2	5	1.45	-2	0	0.39	2	15	0.15	1.45
350	1.03	6.08	2	5	8.18	4	-5	2.29	2	26	0.23	0.97
360	0.26	5.98	2	5	2.13	-1	-2	0.58	2	15	0.15	1.33
380	0.25	6.09	2	5	3.05	-1	-2	0.84	2	16	0.16	1.64
390	1.03	6.51	2	5	9.47	-1	0	2.61	2	28	0.24	1.09
400	0	5.68	2	5	0.00	-1	0	0.00	2	14	0.15	0.62
420	0	5.58	2	5	0.00	-2	0	0.00	2	13	0.14	0.85
440	2	6.42	2	5	20.00	5	-10	5.00	2	37	0.33	0.08
441	2	5.06	2	5	11.95	3	-7	3.39	2	27	0.23	0.01
442	1.89	5.10	2	5	9.58	2	0	2.88	2	30	0.26	0.1
443	2	5.39	2	5	13.45	3	-2	3.69	2	35	0.31	0.08
444	2	5.79	2	5	18.74	10	-10	4.70	2	40	0.37	0.04
445	2	5.23	2	5	14.31	8	-7	3.86	2	35	0.31	0.19
446	1.80	5.08	2	5	11.59	-1	-7	3.32	2	23	0.20	0.04
447	1.12	5.23	2	5	5.58	-3	0	1.67	2	20	0.18	0.09
448	2	5.62	2	5	16.47	4	-2	4.29	2	39	0.27	0.05

Spook Hill ADMP Update
PSIAC Sediment Yield Calculations Summary

Subbasin	Surface Geology	Soils	Climate	Runoff	Topo-graphy	Effective Ground Cover	Land Type & Manage-ment Quality	Upland Erosion	Channel Erosion & Sediment Transport	PSIAC Total Rating	Sediment Yield (ac-ft/sq mi/yr)	Basin Area (sq. mi.)
449	2	5.24	2	5	12.28	3	-2	3.46	2	33	0.29	0.05
450	1.01	5.52	2	5	11.92	3	-2	3.48	2	32	0.28	0.07
451	1.98	6.20	2	5	7.59	4	-2	2.28	2	29	0.25	0.03
452	1.59	5.36	2	5	11.70	2	-2	3.34	2	31	0.27	0.04
453	1.69	5.10	2	5	7.52	-1	-2	2.26	2	23	0.20	0.06
454	0.11	6.16	2	5	2.25	-1	-2	0.65	2	15	0.15	0.18
455	0.35	5.79	2	5	2.05	-2	-2	0.56	2	14	0.15	1.56
Spook Hill FRS											0.22	
456	2	6.29	2	5	17.65	1	-10	4.53	2	30	0.26	0.26
457	1.22	5.58	2	5	10.94	5	-7	3.07	2	28	0.24	0.19
458	1.74	6.47	2	5	11.59	5	-7	3.32	2	30	0.26	0.19
459	1.56	5.17	2	5	10.00	4	-5	3.00	2	28	0.24	0.03
460	0.40	5.97	2	5	5.08	-3	0	1.52	2	19	0.18	0.14
461	0.34	6.39	2	5	3.72	-1	0	1.08	2	20	0.18	0.12
462	1.72	6.28	2	5	11.12	3	-7	3.18	2	27	0.23	0.3
480	1.37	5.66	2	5	2.67	-3	0	0.73	2	16	0.16	0.73
500	2.00	6.49	2	5	14.53	2	-10	3.91	4	30	0.24	0.93
Spook Hill FW											0.22	
										MAX	0.37	
										AVG	0.20	
										MIN	0.11	
										STDEV	0.06	

PSIAC Sediment Yield Factor Rating Sheet 1991 Rev.

Watershed:_____ State:_____ Condition: Present, FWOP, FWP, Fire

Geomorphic Unit_____ Names:_____ Date:_____

Map_____ Location: T____R_____, S____, ____1/4____1/4____1/4

(a) Surface Geology Geologist	(b) Soils Soil Scientist	(c) Climate Local Knowledge	(d) Runoff Hydrologist	(e) Topography Map & Field
(5) a. Marine shales and related mudstones and siltstones	(10) a. Fine textured; easily dispersed; saline-alkaline; high shrink-swell characteristics b. Single grain silt and fine sands	(10) a. Storms of several days' duration with short periods of intense rainfall b. Frequent intense convective storms c. Freeze-thaw occurrences	(10) a. High peak flows per unit area b. Large volume of flow per unit area	(20) a. Steep upland slopes (in excess of 30%) b. High relief; little or no floodplain development
(3) a. Rocks of medium hardness b. Moderately weathered c. Moderately fractured	(5) a. Medium textured soil b. Occasional rock fragments c. Caliche layers	(5) a. Storms of moderate duration and intensity b. Infrequent convective storms	(5) a. Moderate peak flows per unit area b. Moderate volume of flow per unit area	(10) a. Moderate upland slopes (less than 20%) b. Moderate fan or floodplain development
(0) a. Massive, hard formations	(0) a. High percentage of rock fragments b. Aggregated clays c. High in organic matter	(0) a. Humid climate with rainfall of low intensity b. Precipitation in form of snow c. Arid climate, low intensity storms d. Arid climate; rare convective storms	(0) a. Low peak flows per unit area b. Low volume of runoff per unit area c. Rare runoff events	(0) a. Gentle upland slopes (less than 5%) b. Extensive alluvial plains % Slope %Area = _____ x _____ = _____ _____ x _____ = _____ _____ x _____ = _____ _____ x _____ = _____ _____ x _____ = _____ Weighted Slope %_____ Rating Chart (e) on back
Factor Value				

(f) Effective Ground Cover Land Use Planner Range Conservationist	(g) Land Type and Management Quality Land Planner	(h) Upland Erosion Geologist	(i) Channel Erosion and Sediment Transport Geologist
(10) Ground cover does not exceed 20% a. Vegetation sparse; little or no litter b. No rock in surface soil cover	(10) a. Almost all of area overgrazed or historic overgrazing impacts still active b. All of area recently burned c. Roads in need of O & M or improved design d. Almost all of area is badlands with minimal armor	(25) a. More than 50% of the area characterized by concentrated flow erosion with increasing gully development	(25) a. Eroding banks, continuously or at frequent intervals, with deep flows of long duration. b. Active headcuts and degradation in tributary channels
(0) Cover not exceeding 40% a. Noticeable litter b. If trees present, understory not well developed	(0) a. <50% of area overgrazed or with historic overgrazing impacts still active b. <50 % area recently logged c. Ordinary road and other construction d. Almost all of area is badlands with 50% of area covered with armor	(10) a. About 25 % of the area characterized by concentrated flow erosion with increasing gully development	(10) a. Moderate flow depths, medium flow duration with occasionally eroding banks or bed
(-10) a. Area completely protected by vegetation, rock fragments, litter b. Little opportunity for rainfall to reach erodible material	(-10) a. No recent logging b. Good grazing management or historic overgrazing impact under control c. Badland are totally armored	(0) a. No apparent signs of erosion	(0) a. Wide shallow channels with flat gradients and short flow duration b. Channels in massive rock, large boulders, or well vegetated c. Artificially controlled channels
Rating Chart (f) on back Veg.____% Litter____% Rock___% Total Cover_____%		Rating Chart (h) on back	
Factor Value			

	Subtotal (a) - (g)	Subtotal (h) - (i)	Total Rating____ = _____ ac.ft./sq.mi./yr.

(instructions on reverse side)

(AcFt/mi ^{2}) X (3) Conversion Factor = ____Tons/acre

Sheet _____of _____

Instructions: Interpolation between sediment yield levels in each factor may be made. High values for columns (a) through (g) should correspond to high values for (h) and (i). If the difference between the total (a) through (g) and the total of (h) and (i) is greater than 10 points, then either a field related justification is necessary or the factor ratings should be revaluated. The total rating should be reviewed from a field perspective with this question: "Does this rating reflect field observations of erosion and sediment yield for the geomorphic unit?"

Factor (e) Chart
Topography

%	Pts	%	Pts
>30	20	18 - 20	- 10
29	19	17 - 18	- 9
28	18	15 - 17	- 8
27	17	14 - 15	- 7
26	16	12 - 14	- 6
25	15	11 - 12	- 5
24	14	9 - 11	- 4
23	13	8 - 9	- 3
22	12	6 - 8	- 2
21	11	5 - 6	- 1
		<5	- 0

Factor (f) Chart
Effective Ground Cover

%	Pts
<20--	10
25--	8
30--	5
35--	3
40--	0
45--	-1
50--	-2
55--	-2
60--	-3
65--	-4
70--	-5
75--	-6
80--	-7
85--	-7
90--	-8
95--	-9
100--	-10

Factor (h) Chart
Upland Erosion

%	Pts
50--	25
45--	22
40--	19
35--	16
30--	13
25--	10
20--	8
15--	6
10--	4
5--	2
0--	0

Total Rating vs Annual Sediment Yield Chart

Pts	ac-ft/sq mi	Pts	ac-ft/sq mi	Pts	ac-ft/sq mi	Pts	ac-ft/sq mi
1	<0.10	41	0.36	81	1.52	121	6.44
2	<0.10	42	0.37	82	1.58	122	6.67
3	<0.10	43	0.39	83	1.64	123	6.92
4	<0.10	44	0.40	84	1.70	124	7.17
5	0.10	45	0.42	85	1.76	125	7.44
6	0.10	46	0.43	86	1.82	126	7.71
7	0.11	47	0.45	87	1.89	127	8.00
8	0.11	48	0.45	88	1.96	128	8.29
9	0.11	49	0.48	89	2.03	129	8.59
10	0.12	50	0.50	90	2.11	130	8.90
11	0.12	51	0.52	91	2.18	131	9.23
12	0.13	52	0.54	92	2.26	132	9.57
13	0.13	53	0.56	93	2.35	133	9.92
14	0.14	54	0.58	94	2.43	134	10.29
15	0.14	55	0.60	95	2.52	135	10.66
16	0.15	56	0.62	96	2.61		
17	0.15	57	0.64	97	2.71		
18	0.16	58	0.66	98	2.81		
19	0.16	59	0.69	99	2.91		
20	0.17	60	0.72	100	3.02		
21	0.18	61	0.74	101	3.13		
22	0.18	62	0.77	102	3.25		
23	0.19	63	0.80	103	3.36		
24	0.20	64	0.82	104	3.49		
25	0.20	65	0.86	105	3.62		
26	0.21	66	0.89	106	3.75		
27	0.22	67	0.92	107	3.89		
28	0.23	68	0.95	108	4.03		
29	0.23	69	0.99	109	4.18		
30	0.24	70	1.02	110	4.33		
31	0.25	71	1.06	111	4.49		
32	0.26	72	1.10	112	4.65		
33	0.27	73	1.14	113	4.82		
34	0.28	74	1.18	114	5.00		
35	0.29	75	1.23	115	5.19		
36	0.30	76	1.27	116	5.38		
37	0.31	77	1.32	117	5.57		
38	0.32	78	1.37	118	5.78		
39	0.33	79	1.42	119	6.00		
40	0.34	80	1.47	120	6.21		

Notes:

Spook Hill ADMP Update
PSIAC Geology Factor Computations

Subbasin ID	Map Unit	AREA (sq. ft)	PSIAC Geology Rating	Weighted Score	Subbasin Weighted Score
20	Ql	22145	0	0.00000	1.00
20	Qm	18694946	0	0.00000	
20	Qs	920843	0	0.00000	
20	Qyc	7381	0	0.00000	
20	Qyc	6172987	0	0.00000	
20	Tdm	3412006	2	0.13176	
20	Tdm	682341	2	0.02635	
20	Tdm	1146489	2	0.04427	
20	Tdm	341621	2	0.01319	
20	Tdm	322495	2	0.01245	
20	Tdm	728258	2	0.02812	
20	Tdm	521273	2	0.02013	
20	Tdt	760923	2	0.02939	
20	Tdt	86790	2	0.00335	
20	Tdt	1632831	2	0.06306	
20	Tdt	867358	2	0.03350	
20	Tsl	153104	2	0.00591	
20	Tsl	856115	2	0.03306	
20	Tsl	488062	2	0.01885	
20	Tsl	5031009	2	0.19429	
20	Tsl	244778	2	0.00945	
20	Tsl	158899	2	0.00614	
20	YXgg	910290	2	0.03515	
20	YXgg	6409660	2	0.24753	
20	YXgg	1217220	2	0.04701	
40	Ql	10919283	0	0.00000	0.25
40	Qm	35505372	0	0.00000	
40	Qyc	4155393	0	0.00000	
40	Qyc	1150400	0	0.00000	
40	Qyc	1959796	0	0.00000	
40	Qyc	944083	0	0.00000	
40	Tdm	686882	2	0.02200	
40	Tdm	617830	2	0.01979	
40	Tdm	866435	2	0.02775	
40	Tdm	189247	2	0.00606	
40	Tdt	748244	2	0.02397	
40	Tdt	1260625	2	0.04038	
40	Tdt	817221	2	0.02618	
40	YXgg	676853	2	0.02168	
40	YXgg	532660	2	0.01706	
40	YXgg	936029	2	0.02998	
40	YXgg	305432	2	0.00978	
40	YXgg	164991	2	0.00529	

60	Ql	345405	0	0.00000	0.72
60	Ql	667160	0	0.00000	
60	Qm	31636936	0	0.00000	
60	Qyc	90051	0	0.00000	
60	Tdm	386372	2	0.01578	
60	Tdm	336493	2	0.01375	
60	Tdt	1029163	2	0.04204	
60	Tfb	175187	2	0.00716	
60	Tsl	1120200	2	0.04576	
60	Tsl	412169	2	0.01684	
60	Xgf	2717568	3	0.16652	
60	Xgf	17592	3	0.00108	
60	YXgg	9953262	2	0.40660	
60	YXgg	57532	2	0.00235	
60	YXgg	13032	2	0.00053	
80	Ql	10269161	0	0.00000	0.24
80	Ql	38721	0	0.00000	
80	Qm	17343810	0	0.00000	
80	Qm	2548795	0	0.00000	
80	Qyc	5691641	0	0.00000	
80	Qyc	644198	0	0.00000	
80	Qyc	387591	0	0.00000	
80	Tfb	86373	2	0.00413	
80	Tsl	489321	2	0.02340	
80	Xgf	43551	3	0.00312	
80	YXgg	4273888	2	0.20441	
100	Ql	117269	0	0.00000	0
100	Ql	321198	0	0.00000	
100	Qm	4717634	0	0.00000	
100	Qm	4974112	0	0.00000	
100	Qyc	3336221	0	0.00000	
100	Qyc	135657	0	0.00000	

120	Ql	468680	0	0.00000	1.20
120	Qm	19555603	0	0.00000	
120	Qm	797284	0	0.00000	
120	Qm	1727845	0	0.00000	
120	Qm	705967	0	0.00000	
120	Qyc	5054698	0	0.00000	
120	Tab	576974	2	0.01884	
120	Td	1530065	2	0.04996	
120	Td	642496	2	0.02098	
120	Tfb	1904472	2	0.06219	
120	Trlt	356763	2	0.01165	
120	Trp	3035578	2	0.09912	
120	Tsl	99914	2	0.00326	
120	Tsl	334430	2	0.01092	
120	Tsl	2046967	2	0.06684	
120	Tsl	217420	2	0.00710	
120	Tsl	944159	2	0.03083	
120	Xge	5089844	3	0.24930	
120	Xgf	1052681	3	0.05156	
120	Xgf	925725	3	0.04534	
120	Xgf	7745	3	0.00038	
120	Xgf	580963	3	0.02845	
120	YXgg	100869	2	0.00329	
120	YXgg	3966250	2	0.12951	
120	YXgg	3908215	2	0.12761	
120	YXgg	5619244	2	0.18348	
140	Qm	16359392	0	0.00000	0.04
140	Qyc	104294	0	0.00000	
140	Xge	196545	3	0.03539	
160	Qm	14587756	0	0.00000	0.68
160	Qyc	1744989	0	0.00000	
160	Qyc	29263	0	0.00000	
160	Trp	106554	2	0.00985	
160	Trp	1002834	2	0.09270	
160	Xge	707072	3	0.09804	
160	Xge	253015	3	0.03508	
160	Xgf	3181338	3	0.44109	
160	Xgf	24293	3	0.00337	
180	Qm	26898782	0	0.00000	0
180	Qyc	63124	0	0.00000	
180	Qyc	582179	0	0.00000	
180	Qyc	655952	0	0.00000	

200	Qm	11315040	0	0.00000	1.41
200	Qm	9361480	0	0.00000	
200	Qyc	2686840	0	0.00000	
200	Trlt	1562589	2	0.06151	
200	Trlt	333724	2	0.01314	
200	Trp	2988255	2	0.11763	
200	Trp	773199	2	0.03044	
200	Trp	121920	2	0.00480	
200	Tsl	628392	2	0.02474	
200	Xge	4946077	3	0.29205	
200	Xge	937751	3	0.05537	
200	Xgf	9843	3	0.00058	
200	Xgf	2053500	3	0.12125	
200	Xgf	1064358	3	0.06285	
200	Xgf	1002917	3	0.05922	
200	Xgf	6513232	3	0.38459	
200	Xgf	128055	3	0.00756	
200	YXgu	188071	2	0.00740	
200	YXgu	1530142	2	0.06023	
200	YXgu	143785	2	0.00566	
200	YXgu	2517260	2	0.09909	
220	Qm	25540700	0	0.00000	0.53
220	Qyc	358448	0	0.00000	
220	Trlt	1010415	2	0.05780	
220	Trp	967049	2	0.05532	
220	Xgf	510372	3	0.04379	
220	YXgu	4856902	2	0.27785	
220	YXgu	189499	2	0.01084	
220	YXgu	1527818	2	0.08740	
240	Ql	7546015	0	0.00000	0.47
240	Qm	14398458	0	0.00000	
240	Qyc	134798	0	0.00000	
240	Trlt	145077	2	0.01002	
240	Trp	141374	2	0.00977	
240	YXgu	1947223	2	0.13454	
240	YXgu	601316	2	0.04155	
240	YXgu	369283	2	0.02552	
240	YXgu	1562688	2	0.10797	
240	YXgu	67651	2	0.00467	
240	YXgu	2031720	2	0.14038	
260	Qm	3325672	0	0.00000	0
260	Qm	1873485	0	0.00000	
260	Qyc	2285755	0	0.00000	
280	Ql	4061260	0	0.00000	0
280	Qm	2626705	0	0.00000	
280	Qyc	2277743	0	0.00000	
300	Ql	23273098	0	0.00000	0.29
300	Qm	480646	0	0.00000	
300	Qyc	8899	0	0.00000	
300	Qyc	9346	0	0.00000	
300	YXgu	3754899	2	0.27010	
300	YXgu	277030	2	0.01993	

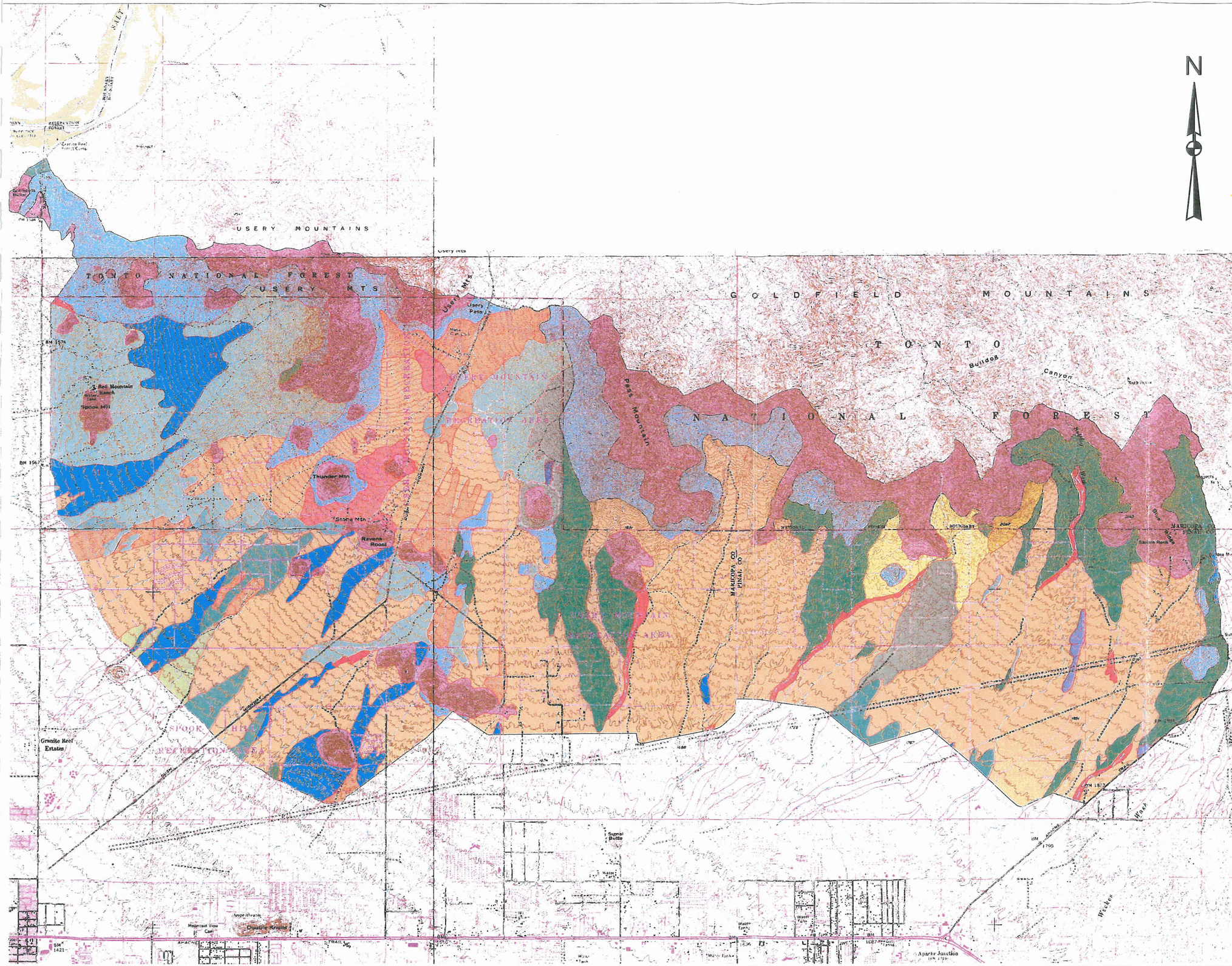
Wood/Patel
in association with:
JE Fuller / Hydrology and Geomorphology, Inc.

320	Ql	30158595	0	0.00000	0.35
320	Qm	2911345	0	0.00000	
320	Qyc	1023182	0	0.00000	
320	YXgu	226090	2	0.01093	
320	YXgu	1492528	2	0.07215	
320	YXgu	62457	2	0.00302	
320	YXgu	1675305	2	0.08098	
320	YXgu	108447	2	0.00524	
320	YXgu	3115002	2	0.15057	
320	YXgu	601905	2	0.02910	
340	Ql	31260243	0	0.00000	0.16
340	Qm	8685228	0	0.00000	
340	YXgu	1140940	2	0.05266	
340	YXgu	840146	2	0.03878	
340	YXgu	1402949	2	0.06476	
350	Ql	3755905	0	0.00000	1.03
350	Qm	7487901	0	0.00000	
350	Qyc	2180303	0	0.00000	
350	Trlt	152359	2	0.01096	
350	Trp	29245	2	0.00210	
350	Trp	8440	2	0.00061	
350	YXgu	7611292	2	0.54745	
350	YXgu	4801570	2	0.34536	
350	YXgu	32908	2	0.00237	
350	YXgu	1141289	2	0.08209	
350	YXgu	605265	2	0.04353	
360	Ql	27868540	0	0.00000	0.26
360	Qm	3290351	0	0.00000	
360	Qm	56728	0	0.00000	
360	Qy	350396	0	0.00000	
360	Qyc	1566850	0	0.00000	
360	YXgu	3224020	2	0.16964	
360	YXgu	1004659	2	0.05286	
360	YXgu	649099	2	0.03415	
380	Ql	14801715	0	0.00000	0.25
380	Qm	3597179	0	0.00000	
380	Qm	314147	0	0.00000	
380	Qy	21366559	0	0.00000	
380	YXgu	3311209	2	0.14420	
380	YXgu	833362	2	0.03629	
380	YXgu	856324	2	0.03729	
380	YXgu	182747	2	0.00796	
380	YXgu	520377	2	0.02266	
380	YXgu	141044	2	0.00614	
390	Qm	4660222	0	0.00000	1.03
390	Qy	10176672	0	0.00000	
390	YXgu	13282479	2	0.86594	
390	YXgu	157971	2	0.01030	
390	YXgu	100638	2	0.00656	
390	YXgu	158001	2	0.01030	
390	YXgu	2141448	2	0.13961	

400	Ql	98362	0	0.00000	0
400	Ql	8842212	0	0.00000	
400	Qy	9399022	0	0.00000	
420	Ql	11818903	0	0.00000	0
420	Qm	7724619	0	0.00000	
420	Qm	10260	0	0.00000	
420	Qy	4529257	0	0.00000	
440	YXgu	1780056	2	2.00000	2
441	YXgu	195379	2	2.00000	2
442	Qly	181515	0	0.00000	1.89
442	Qm	145	0	0.00000	
442	YXgu	3040689	2	1.88725	
443	YXgu	1507174	2	2.00000	2
444	YXgu	1022537	2	2.00000	2
445	YXgu	4748742	2	2.00000	2
446	Qly	85454	0	0.00000	1.80
446	YXgu	759924	2	1.79783	
447	Qly	1239044	0	0.00000	1.12
447	YXgu	1566374	2	1.11668	
448	YXgu	1158415	2	2.00000	2
449	YXgu	1038706	2	2.00000	2
450	Qy	893894	0	0.00000	1.01
450	YXgu	918640	2	1.01365	
451	Qy	7462	0	0.00000	1.98
451	YXgu	755137	2	1.98043	
452	Qy	156831	0	0.00000	1.59
452	YXgu	612791	2	1.59245	
453	Qly	16832	0	0.00000	1.69
453	Qm	283185	0	0.00000	
453	Qy	2965	0	0.00000	
453	YXgu	1665927	2	1.69223	
454	Qly	691629	0	0.00000	0.11
454	Qm	1000951	0	0.00000	
454	Qy	3671880	0	0.00000	
454	YXgu	300449	2	0.10607	
455	Qly	5668108	0	0.00000	0.35
455	Qly	7077990	0	0.00000	
455	Qm	16809398	0	0.00000	
455	Qm	290650	0	0.00000	
455	Qy	6735036	0	0.00000	
455	YXgu	4213575	2	0.19006	
455	YXgu	3545822	2	0.15994	
456	YXgu	6326156	2	2.00000	2
457	Qly	2074556	0	0.00000	1.22
457	YXgu	3248371	2	1.22052	
458	Qly	741833	0	0.00000	1.74
458	YXgu	5025837	2	1.74276	
459	Qly	230335	0	0.00000	1.56
459	YXgu	815457	2	1.55950	
460	Qly	3027280	0	0.00000	0.40
460	YXgu	760918	2	0.40173	

461	Qly	3192992	0	0.00000	0.34
461	YXgu	457382	2	0.23837	
461	YXgu	187141	2	0.09753	
462	Qly	1119457	0	0.00000	1.72
462	YXgu	5711483	2	1.45395	
462	YXgu	1025554	2	0.26107	
480	Qly	4928954	0	0.00000	1.37
480	Qly	153900	0	0.00000	
480	Qm	137670	0	0.00000	
480	Qm	132613	0	0.00000	
480	Qm	1199329	0	0.00000	
480	YXgu	14339572	2	1.37273	
500	Qy	11995	0	0.00000	2.00
500	YXgu	10475037	2	1.99771	

Map Unit	Soil Name	% of Unit	%adj for RO	Shrink-Swell Potential	Texture	Fragments > 3 inches (%)	Depth to Cemented Pan	Final Rating
3	Antho	35		low	sandy loam	0	none	7
	Carrizo	30		low	very gravelly sand	5 (0-10)	none	7
	Maripo	20		low	sandy loam	0	none	7
								7
44	Ebon	80		low-moderate	very gravelly loam	0	none	**5**
45	Ebon	80		low-moderate	very gravelly loam	0	none	**5**
47	Ebon	35		low-moderate	very gravelly loam	0	none	5
	Gunsight	20		low	very gravelly sandy loam	5 (0-10)	none	6
	Cipriano	20		low	very gravelly loam	7.5 (5-10)	4-20	4
								5
48	Ebon	45		low-moderate	very gravelly loam	0	none	5
	Pinamt	35		low	extremely gravelly sandy loam	7.5 (0-15)	none	5
								5
49	Ebon	45		low-moderate	very gravelly loam	0	none	5
	Pinamt	35		low	extremely gravelly sandy loam	7.5 (0-15)	none	5
								5
52	Gachado	45	56	low	very gravelly loam	7.5 (5-10)	none	4
	Lomitas	20	25	low	very gravelly sandy loam	15 (5-25)	none	5
	Rock Outcrop	20						0
								4.3
61	Gran	40		low-moderate	very gravelly sandy loam	0	none	6
	Wickenburg	35		low	gravelly sandy loam	0	none	7
								6.5
63	Gran	30	40	low-moderate	very gravelly sandy loam	0	none	6
	Wickenburg	25	33	low	gravelly sandy loam	0	none	7
	Rock Outcrop	25						0
								6.5
68	Gunsight	45		low	very gravelly sandy loam	5 (0-10)	none	6
	Cipriano	40		low	very gravelly loam	7.5 (5-10)	4-20	4
								5.1
90	Momoli	70		low	gravelly sandy loam	2.5 (0-5)	none	**7**
98	Pinamt	45		low	extremely gravelly sandy loam	7.5 (0-15)	none	5
	Tremant	35		low	gravelly loam	2.5 (0-5)	none	6
								5.4
101	Rillito	85		low	loam	0	none	**6**
110	Sun City	55		low-moderate	gravelly loam	2.5 (0-5)	5-20	6
	Cipriano	30		low	very gravelly loam	7.5 (5-10)	4-20	4
								5.3
112	Tremant	80		low	gravelly loam	2.5 (0-5)	none	**6**
113	Tremant	80		low	gravelly loam	2.5 (0-5)	none	**6**
115	Tremant	45		low	gravelly loam	2.5 (0-5)	none	6
	Antho	35		low	sandy loam	0	none	7
								6.4
116	Tremant	30		low	gravelly loam	2.5 (0-5)	none	6
	Gunsight	20		low	very gravelly sandy loam	5 (0-10)	none	6
	Rillito	20		low	loam	0	none	6
								6
118	Tremant	45		low	gravelly loam	2.5 (0-5)	none	6
	Rillito	30		low	loam	0	none	6
								6



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Flood Control District of Maricopa County

Spook Hill
Area Drainage Master Plan
Update

March 2000

LEGEND

Soil Map Unit

	101		45
	110		47
	112		48
	113		49
	115		52
	116		61
	118		63
	13		68
	3		90
	44		98

Units with red border are from Camp, 1986.
Units with black borders from Wood/Patel, 1999.

SCALE

2000 0 2000 4000 6000 Feet

Soils Map

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC

Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	Soil Rating
20	63	274.43	23.5	25	6.50
	98	401.36	34.4	0	5.40
	61	49.01	4.2	0	6.50
	44	398.72	34.2	0	5.00
	3	26.35	2.3	0	7.00
	116	15.81	1.4	0	6.00
	---	---	---	---	
	TOTAL =	1165.6			**5.61**
40	63	156.84	11	25	6.50
	44	185.29	13	0	5.00
	98	1005.86	70.4	0	5.40
	3	9.88	0.7	0	7.00
	116	46.24	3.2	0	6.00
	113	24.93	1.7	0	6.00
	---	---	---	---	
	TOTAL =	1429			**5.51**
60	63	219.74	19.7	25	6.50
	44	285.7	25.6	0	5.00
	98	547.99	49	0	5.40
	3	40.27	3.6	0	7.00
	116	15.47	1.4	0	6.00
	68	8.37	0.7	0	5.10
	---	---	---	---	
	TOTAL =	1117.5			**5.58**
80	63	49.93	5.3	25	6.50
	52	10.68	1.1	20	4.30
	45	57.06	6	0	5.00
	49	80.62	8.5	0	5.00
	68	12.88	1.4	0	5.10
	48	196.95	20.9	0	5.00
	113	95.71	10.1	0	6.00
	98	439.92	46.6	0	5.40
	---	---	---	---	
	TOTAL =	943.8			**5.36**
100	98	214.47	69.2	0	5.40
	44	7.98	2.6	0	5.00
	48	79.8	25.8	0	5.00
	3	7.5	2.4	0	7.00
	---	---	---	---	
	TOTAL =	309.8			**5.32**

Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	Soil Rating
120	98	201.48	14.3	0	5.40
	63	501.81	35.6	25	6.50
	61	171.4	12.2	0	6.50
	49	175.31	12.4	0	5.00
	44	313.15	22.2	0	5.00
	3	45.95	3.3	0	7.00
	---	---	---	---	
	TOTAL =	1409.1			**5.84**
140	98	371.24	97.1	0	5.40
	63	11.27	2.9	25	6.50
	---	---	---	---	
	TOTAL =	382.5			**5.43**
160	63	71.22	14.3	25	6.50
	61	73.19	14.7	0	6.50
	115	12.73	2.6	0	6.40
	98	340.4	68.4	0	5.40
	---	---	---	---	
	TOTAL =	497.5			**5.75**
180	98	639.98	100	0	5.40
	---	---	---	---	
	TOTAL =	640			**5.40**
200	63	496.25	42.8	25	6.50
	61	268.55	23.2	0	6.50
	98	261.51	22.6	0	5.40
	44	102.36	8.8	0	5.00
	3	30.64	2.6	0	7.00
	---	---	---	---	
	TOTAL =	1159.3			**6.13**
220	63	92.67	11.6	25	6.50
	61	280.68	35	0	6.50
	44	248.58	31	0	5.00
	68	3.55	0.4	0	5.10
	48	60.11	7.5	0	5.00
	47	11.21	1.4	0	5.00
	98	104.34	13	0	5.40
	---	---	---	---	
	TOTAL =	801.1			**5.75**

Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	Soil Rating
240	48	105.63	15.9	0	5.00
	68	202.13	30.4	0	5.10
	98	242.49	36.4	0	5.40
	61	63.02	9.5	0	6.50
	63	49.76	7.5	25	6.50
	---	---	---	---	
	TOTAL =	663			**5.42**
260	44	88.11	51.6	0	5.00
	98	59.73	35	0	5.40
	3	23.03	13.5	0	7.00
	---	---	---	---	
	TOTAL =	170.9			**5.42**
280	98	147.08	75.5	0	5.40
	44	47.63	24.5	0	5.00
	---	---	---	---	
	TOTAL =	194.7			**5.30**
300	63	67.84	10.7	25	6.50
	61	33.73	5.3	0	6.50
	68	44.1	7	0	5.10
	98	422.17	66.7	0	5.40
	44	17.86	2.8	0	5.00
	118	28.77	4.5	0	6.00
	115	2.98	0.5	0	6.00
	48	15.17	2.4	0	5.00
	---	---	---	---	
	TOTAL =	632.6			**5.56**
320	98	356.76	36.5	0	5.40
	118	179.59	18.4	0	6.00
	63	117.54	12	25	6.50
	61	64.8	6.6	0	6.50
	110	6.14	0.6	0	5.30
	68	127.88	13.1	0	5.10
	115	102.72	10.5	0	6.40
	44	21.72	2.2	0	5.00
	---	---	---	---	
	TOTAL =	977.2			**5.77**

Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	Soil Rating
340	61	26.29	2.8	0	6.50
	63	69.72	7.5	25	6.50
	68	165.11	17.8	0	5.10
	98	438.66	47.3	0	5.40
	3	13.1	1.4	0	7.00
	115	145.06	15.6	0	6.40
	113	29.05	3.1	0	6.00
	44	7.57	0.8	0	5.00
	118	24.86	2.7	0	6.00
	110	8.02	0.9	0	5.30
	---	---	---	---	
	TOTAL =	927.4			**5.66**
350	63	102.57	16.5	25	6.50
	61	124	20	0	6.50
	118	311.74	50.2	0	6.00
	68	57.67	9.3	0	5.10
	98	17.95	2.9	0	5.40
	101	6.68	1.1	0	6.00
	---	---	---	---	
	TOTAL =	620.6			**6.08**
360	63	47.99	5.6	25	6.50
	61	13.41	1.6	0	6.50
	118	86.57	10.2	0	6.00
	90	165.09	19.4	0	7.00
	110	14.45	1.7	0	5.30
	101	37.61	4.4	0	6.00
	98	335.83	39.5	0	5.40
	115	69.56	8.2	0	6.40
	68	31.45	3.7	0	5.10
	113	48.59	5.7	0	6.00
	---	---	---	---	
	TOTAL =	850.6			**5.98**
380	63	109.44	10.4	25	6.50
	61	43.59	4.2	0	6.50
	90	177.04	16.9	0	7.00
	101	94.87	9	0	6.00
	110	10.47	1	0	5.30
	115	67.03	6.4	0	6.40
	98	280.1	26.7	0	5.40
	113	142.95	13.6	0	6.00
	118	45.56	4.3	0	6.00
	112	77.51	7.4	0	6.00
	---	---	---	---	
	TOTAL =	1048.6			**6.09**

Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	Soil Rating
390	63	250.02	35.9	25	6.50
	61	142.77	20.5	0	6.50
	68	12.1	1.7	0	5.10
	90	189.53	27.2	0	7.00
	101	73.56	10.6	0	6.00
	110	28.72	4.1	0	5.30
	---	---	---	---	
	TOTAL =	696.7			**6.51**
400	98	265.05	67.2	0	5.40
	112	24.02	6.1	0	6.00
	113	23.19	5.9	0	6.00
	115	82.28	20.8	0	6.40
	---	---	---	---	
	TOTAL =	394.5			**5.68**
420	90	57.73	10.6	0	7.00
	68	97.52	17.9	0	5.10
	110	82.38	15.2	0	5.30
	118	70.36	13	0	6.00
	98	235.15	43.3	0	5.40
	---	---	---	---	
	TOTAL =	543.1			**5.58**
440	63	26.3	51.4	25	6.50
	61	22.1	43.2	0	6.50
	44	2.8	5.5	0	5.00
	---	---	---	---	
	TOTAL =	51.2			**6.42**
441	68	3.8	59.4	0	5.10
	44	2.6	40.6	0	5.00
	---	---	---	---	
	TOTAL =	6.4			**5.06**
442	68	64	100	0	5.10
	---	---	---	---	
	TOTAL =	64			**5.10**
443	63	12.9	25.2	25	6.50
	68	6.9	13.5	0	5.10
	44	31.4	61.3	0	5.00
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	TOTAL =	51.2			**5.39**

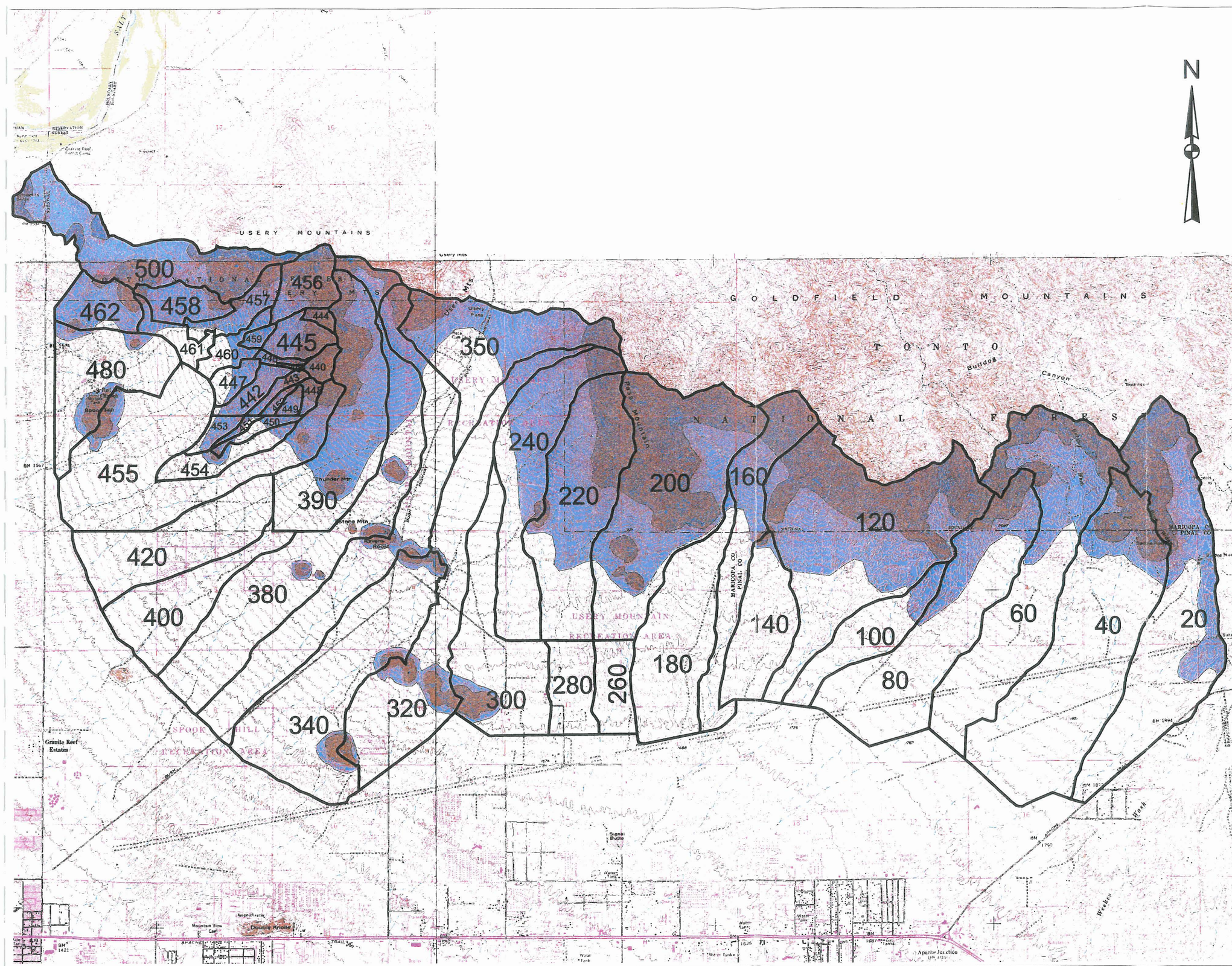
Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	Soil Rating
444	63	0.6	2.3	25	6.50
	61	12.1	47.3	0	6.50
	68	12.9	50.4	0	5.10
	TOTAL =	25.6			**5.79**
445	63	4.5	3.7	25	6.50
	61	6.7	5.5	0	6.50
	68	110.4	90.8	0	5.10
	TOTAL =	121.6			**5.23**
446	68	19.4	75.8	0	5.10
	44	6.2	24.2	0	5.00
	TOTAL =	25.6			**5.08**
447	68	52	90.3	0	5.10
	115	5.6	9.7	0	6.40
	TOTAL =	57.6			**5.23**
448	63	10.6	36.8	25	6.50
	68	18.2	63.2	0	5.10
	TOTAL =	28.8			**5.62**
449	63	3.1	9.7	25	6.50
	68	28.9	90.3	0	5.10
	TOTAL =	32			**5.24**
450	63	5.9	13.2	25	6.50
	68	33.4	74.6	0	5.10
	90	5.5	12.3	0	7.00
	TOTAL =	44.8			**5.52**
451	68	16	100	0	6.20
	TOTAL =	16			**6.20**
452	63	4.8	18.8	25	6.50
	68	20.8	81.2	0	5.10
	TOTAL =	25.6			**5.36**

Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	Soil Rating
453	68	38.4	100	0	5.10
	---	---	---	---	
	TOTAL =	38.4			**5.10**
454	63	6.8	5.9	25	6.50
	68	48.9	42.4	0	5.10
	90	59.5	51.6	0	7.00
	---	---	---	---	
	TOTAL =	115.2			**6.16**
455	61	47.41	4.8	0	6.50
	63	70.94	7.1	25	6.50
	68	492.91	49.4	0	5.10
	90	88.09	8.8	0	7.00
	115	263.61	26.4	0	6.40
	110	17.72	1.8	0	5.30
	98	8.88	0.9	0	5.40
	118	8.34	0.8	0	6.00
	---	---	---	---	
	TOTAL =	997.9			**5.79**
456	63	78.8	47.4	25	6.50
	61	62	37.3	0	6.50
	68	25.6	15.4	0	5.10
	---	---	---	---	
	TOTAL =	166.4			**6.29**
457	63	9.5	7.8	25	6.50
	61	26.1	21.5	0	6.50
	68	79.5	65.4	0	5.10
	115	6.5	5.3	0	6.40
	---	---	---	---	
	TOTAL =	121.6			**5.58**
458	63	21.4	17.6	25	6.50
	61	87.9	72.3	0	6.50
	68	2.1	1.7	0	5.10
	115	10.2	8.4	0	6.40
	---	---	---	---	
	TOTAL =	121.6			**6.47**
459	68	18.2	94.8	0	5.10
	115	1	5.2	0	6.40
	---	---	---	---	
	TOTAL =	19.2			**5.17**

Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	Soil Rating
460	68	29.8	33.2	0	5.10
	115	59.9	66.8	0	6.40
	---	---	---	---	
	TOTAL =	89.7			**5.97**
461	63	1.6	2.1	25	6.50
	68	1.6	2.1	0	5.10
	61	8.3	10.8	0	6.50
	115	65.3	85	0	6.40
	---	---	---	---	
	TOTAL =	76.8			**6.39**
462	63	20	10.4	25	6.50
	61	131.1	68.1	0	6.50
	68	39.4	20.5	0	5.40
	115	2.1	1.1	0	6.40
	---	---	---	---	
	TOTAL =	192.6			**6.28**
480	63	43.11	9.2	25	6.50
	68	348.53	74.5	0	5.40
	115	76.19	16.3	0	6.40
	---	---	---	---	
	TOTAL =	467.8			**5.66**
500	63	208.27	35	25	6.50
	61	368.91	62	0	6.50
	113	17.75	3	0	6.00
	---	---	---	---	
	TOTAL =	594.9			**6.49**

Spook Hill ADMP Update
PSIAC Topography Factor
Summary Sheet

Subbasin ID	Topography Rating
20	7
40	3
60	7
80	3
100	2
120	12
140	0
160	8
180	0
200	14
220	10
240	6
260	0
280	0
300	2
320	3
340	1
350	8
360	2
380	3
390	9
400	0
420	0
440	20
441	12
442	10
443	13
444	19
445	14
446	12
447	6
448	16
449	12
450	12
451	8
452	12
453	8
454	2
455	2
456	18
457	11
458	12
459	10
460	5
461	4
462	11
480	3
500	15



Flood Control District of Maricopa County

Spook Hill
Area Drainage Master Plan
Update

March 2000

LEGEND

280 Subbasin

PSIAC Topographic Class

- > 30 percent
- 5 to 30 percent
- < 5 percent

SCALE

2000 0 2000 4000 6000 Feet

PSIAC Topographic Factor

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC

Spook Hill ADMP Update
PSIAC Topography Factor Calculations

Subbasin ID	Slope category	Area (acres)	Percent 0f Subbasin	PSIAC Topo. Rating	PSIAC Topo. Rating Weight	Subbasin Topography Rating
20	< 5 percent	610.3	51.3	0	0.0	
20	> 30 percent	250.3	21.1	20	4.2	
20	5 to 30 percent	328.3	27.6	10	2.8	7.0
40	< 5 percent	1173.7	81.9	0	0.0	
40	> 30 percent	151.7	10.6	20	2.1	
40	5 to 30 percent	108.0	7.5	10	0.8	2.9
60	< 5 percent	597.5	53.2	0	0.0	
60	> 30 percent	226.8	20.2	20	4.0	
60	5 to 30 percent	299.6	26.7	10	2.7	6.7
80	< 5 percent	697.6	72.7	0	0.0	
80	> 30 percent	72.8	7.6	20	1.5	
80	5 to 30 percent	189.5	19.7	10	2.0	3.5
100	< 5 percent	256.9	82.3	0	0.0	
100	5 to 30 percent	55.4	17.7	10	1.8	1.8
120	< 5 percent	301.7	21.5	0	0.0	
120	> 30 percent	568.1	40.4	20	8.1	
120	> 30 percent	1.9	0.1	20	0.0	
120	5 to 30 percent	534.3	38.0	10	3.8	11.9
140	< 5 percent	368.6	96.4	0	0.0	
140	> 30 percent	4.8	1.3	20	0.3	
140	5 to 30 percent	9.1	2.4	10	0.2	0.5
160	< 5 percent	238.5	48.0	0	0.0	
160	> 30 percent	117.0	23.5	20	4.7	
160	> 30 percent	3.0	0.6	20	0.1	
160	5 to 30 percent	138.2	27.8	10	2.8	7.6
180	< 5 percent	638.2	98.6	0	0.0	
180	5 to 30 percent	9.2	1.4	10	0.1	0.1
200	< 5 percent	168.8	14.5	0	0.0	
200	> 30 percent	25.6	2.2	20	0.4	
200	> 30 percent	16.2	1.4	20	0.3	
200	> 30 percent	579.3	49.7	20	9.9	
200	5 to 30 percent	376.5	32.3	10	3.2	13.9
220	< 5 percent	233.1	29.0	0	0.0	
220	> 30 percent	183.6	22.9	20	4.6	
220	> 30 percent	9.5	1.2	20	0.2	
220	5 to 30 percent	376.5	46.9	10	4.7	9.5
240	< 5 percent	295.9	44.5	0	0.0	
240	> 30 percent	45.2	6.8	20	1.4	
240	> 30 percent	8.3	1.2	20	0.2	
240	5 to 30 percent	315.1	47.4	10	4.7	6.4
260	< 5 percent	171.8	100.0	0	0.0	0.0
280	< 5 percent	205.8	100.0	0	0.0	0.0
300	< 5 percent	565.0	88.5	0	0.0	
300	> 30 percent	43.6	6.8	20	1.4	
300	5 to 30 percent	29.7	4.7	10	0.5	1.8

Spook Hill ADMP Update
PSIAC Topography Factor Calculations

Subbasin ID	Slope category	Area (acres)	Percent 0f Subbasin	PSIAC Topo. Rating	PSIAC Topo. Rating Weight	Subbasin Topography Rating
320	< 5 percent	314.6	33.1	0	0.0	
320	< 5 percent	431.6	45.4	0	0.0	
320	> 30 percent	3.0	0.3	20	0.1	
320	> 30 percent	1.6	0.2	20	0.0	
320	> 30 percent	19.5	2.1	20	0.4	
320	> 30 percent	34.9	3.7	20	0.7	
320	> 30 percent	12.0	1.3	20	0.3	
320	5 to 30 percent	0.0	0.0	10	0.0	
320	5 to 30 percent	66.1	7.0	10	0.7	
320	5 to 30 percent	6.5	0.7	10	0.1	
320	5 to 30 percent	54.9	5.8	10	0.6	
320	5 to 30 percent	5.0	0.5	10	0.1	2.9
340	< 5 percent	895.8	90.1	0	0.0	
340	> 30 percent	7.1	0.7	20	0.1	
340	> 30 percent	9.5	1.0	20	0.2	
340	> 30 percent	8.1	0.8	20	0.2	
340	> 30 percent	20.6	2.1	20	0.4	
340	5 to 30 percent	23.5	2.4	10	0.2	
340	5 to 30 percent	13.7	1.4	10	0.1	
340	5 to 30 percent	16.4	1.7	10	0.2	1.4
350	< 5 percent	220.5	34.5	0	0.0	
350	> 30 percent	43.5	6.8	20	1.4	
350	> 30 percent	61.0	9.6	20	1.9	
350	5 to 30 percent	313.3	49.1	10	4.9	
350	5 to 30 percent	0.0	0.0	10	0.0	8.2
360	< 5 percent	462.0	52.9	0	0.0	
360	< 5 percent	275.0	31.5	0	0.0	
360	> 30 percent	34.9	4.0	20	0.8	
360	> 30 percent	10.3	1.2	20	0.2	
360	> 30 percent	5.4	0.6	20	0.1	
360	5 to 30 percent	57.5	6.6	10	0.7	
360	5 to 30 percent	27.5	3.1	10	0.3	2.1
380	< 5 percent	811.5	76.8	0	0.0	
380	> 30 percent	12.2	1.2	20	0.2	
380	> 30 percent	7.4	0.7	20	0.1	
380	> 30 percent	1.1	0.1	20	0.0	
380	> 30 percent	1.4	0.1	20	0.0	
380	> 30 percent	42.1	4.0	20	0.8	
380	> 30 percent	12.3	1.2	20	0.2	
380	5 to 30 percent	13.9	1.3	10	0.1	
380	5 to 30 percent	2.0	0.2	10	0.0	
380	5 to 30 percent	2.4	0.2	10	0.0	
380	5 to 30 percent	8.7	0.8	10	0.1	
380	5 to 30 percent	135.5	12.8	10	1.3	
380	5 to 30 percent	6.6	0.6	10	0.1	3.0

Spook Hill ADMP Update
PSIAC Topography Factor Calculations

Subbasin ID	Slope category	Area (acres)	Percent 0f Subbasin	PSIAC Topo. Rating	PSIAC Topo. Rating Weight	Subbasin Topography Rating
390	< 5 percent	203.3	28.9	0	0.0	
390	> 30 percent	4.1	0.6	20	0.1	
390	> 30 percent	19.8	2.8	20	0.6	
390	> 30 percent	142.2	20.2	20	4.0	
390	5 to 30 percent	334.9	47.5	10	4.8	9.5
400	< 5 percent	421.0	100.0	0	0.0	0.0
420	< 5 percent	552.9	100.0	0	0.0	0.0
440	> 30 percent	40.9	100.0	20	20.0	20.0
441	> 30 percent	0.9	19.5	20	3.9	
441	5 to 30 percent	3.6	80.5	10	8.0	12.0
442	< 5 percent	3.1	4.2	0	0.0	
442	5 to 30 percent	70.9	95.8	10	9.6	9.6
443	> 30 percent	11.9	34.5	20	6.9	
443	5 to 30 percent	22.7	65.5	10	6.6	13.4
444	> 30 percent	21.5	91.7	20	18.3	
444	5 to 30 percent	2.0	4.0	10	0.4	18.7
445	> 30 percent	47.0	43.1	20	8.6	
445	5 to 30 percent	62.0	56.9	10	5.7	14.3
446	> 30 percent	3.1	15.9	20	3.2	
446	5 to 30 percent	16.3	84.1	10	8.4	11.6
447	< 5 percent	28.5	44.2	0	0.0	
447	5 to 30 percent	35.9	55.8	10	5.6	5.6
448	> 30 percent	17.2	64.7	20	12.9	
448	5 to 30 percent	9.4	35.3	10	3.5	16.5
449	> 30 percent	5.4	22.8	20	4.6	
449	5 to 30 percent	18.4	77.2	10	7.7	12.3
450	< 5 percent	16.1	90.4	0	0.0	
450	> 30 percent	1.7	9.6	20	1.9	
450	5 to 30 percent	6.6	27.7	10	2.8	
450	5 to 30 percent	17.3	72.3	10	7.2	11.9
451	< 5 percent	4.2	24.1	0	0.0	
451	5 to 30 percent	13.3	75.9	10	7.6	7.6
452	> 30 percent	3.0	17.0	20	3.4	
452	5 to 30 percent	14.7	83.0	10	8.3	11.7
453	< 5 percent	11.2	24.8	0	0.0	
453	5 to 30 percent	34.0	75.2	10	7.5	7.5
454	< 5 percent	103.4	79.5	0	0.0	
454	> 30 percent	2.6	2.0	20	0.4	
454	5 to 30 percent	11.5	8.9	10	0.9	
454	5 to 30 percent	12.5	9.6	10	1.0	2.2
455	< 5 percent	862.1	84.7	0	0.0	
455	> 30 percent	5.0	0.5	20	0.1	
455	> 30 percent	24.2	2.4	20	0.5	
455	> 30 percent	24.0	2.4	20	0.5	
455	5 to 30 percent	30.8	3.0	10	0.3	
455	5 to 30 percent	71.7	7.0	10	0.7	2.1
456	> 30 percent	124.2	76.5	20	15.3	
456	5 to 30 percent	38.2	23.5	10	2.4	17.6

Spook Hill ADMP Update
PSIAC Topography Factor Calculations

Subbasin ID	Slope category	Area (acres)	Percent 0f Subbasin	PSIAC Topo. Rating	PSIAC Topo. Rating Weight	Subbasin Topography Rating
457	< 5 percent	14.3	11.7	0	0.0	
457	> 30 percent	20.1	16.4	20	3.3	
457	> 30 percent	5.8	4.7	20	0.9	
457	5 to 30 percent	82.1	67.2	10	6.7	10.9
458	> 30 percent	14.1	10.7	20	2.1	
458	> 30 percent	6.9	5.2	20	1.0	
458	5 to 30 percent	111.3	84.1	10	8.4	11.6
459	5 to 30 percent	24.0	100.0	10	10.0	10.0
460	< 5 percent	42.8	49.2	0	0.0	
460	5 to 30 percent	44.2	50.8	10	5.1	5.1
461	< 5 percent	58.9	66.8	0	0.0	
461	> 30 percent	3.5	4.0	20	0.8	
461	5 to 30 percent	0.0	0.0	10	0.0	
461	5 to 30 percent	25.7	29.1	10	2.9	3.7
462	< 5 percent	8.2	4.5	0	0.0	
462	> 30 percent	24.5	13.6	20	2.7	
462	> 30 percent	3.8	2.1	20	0.4	
462	5 to 30 percent	0.0	0.0	10	0.0	
462	5 to 30 percent	143.9	79.8	10	8.0	11.1
480	< 5 percent	387.2	80.7	0	0.0	
480	> 30 percent	3.0	0.6	20	0.1	
480	> 30 percent	2.2	0.4	20	0.1	
480	> 30 percent	30.5	6.4	20	1.3	
480	5 to 30 percent	24.7	5.1	10	0.5	
480	5 to 30 percent	17.3	3.6	10	0.4	
480	5 to 30 percent	14.9	3.1	10	0.3	2.7
500	> 30 percent	148.8	25.5	20	5.1	
500	> 30 percent	61.2	10.5	20	2.1	
500	> 30 percent	24.0	4.1	20	0.8	
500	> 30 percent	16.0	2.7	20	0.5	
500	> 30 percent	14.2	2.4	20	0.5	
500	5 to 30 percent	317.2	54.4	10	5.4	
500	5 to 30 percent	1.6	0.3	10	0.0	14.5

Spook Hill ADMP Update
PSIAC Effective Ground Cover Factor Calculations

Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	% Rock		LAND USE Type	% Area	%Veg. cover	% Effective Cover	PSIAC Rating
20	63	274.43	23.5	25	31.3		Desert	96.4	25		
	98	401.36	34.4	0	5.3		V.L.D.R	1.1	30		
	61	49.01	4.2	0	0		M.D.R.	0.9	50		
	44	398.72	34.2	0	0		Ind	1.6	60		
	3	26.35	2.3	0	1.8		---------	---------	------		
	116	15.81	1.4	0	2.5						
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	TOTAL =	1165.6		%Rock = 6	**9.2551**				**25.8**	**35**	**3**
40	63	156.84	11	25	31.3		Desert	90.8	25		
	44	185.29	13	0	0		V.L.D.R	6.6	30		
	98	1005.86	70.4	0	5.3		Comm	2.6	75		
	3	9.88	0.7	0	1.8		---------	---------	------		
	116	46.24	3.2	0	2.5						
	113	24.93	1.7	0	2.5						
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	TOTAL =	1429		%Rock = 3	**7.3093**				**26.6**	**34**	**3**
60	63	219.74	19.7	25	31.3		Desert	68.4	25		
	44	285.7	25.6	0	0		V.L.D.R	28.5	30		
	98	547.99	49	0	5.3		Comm	3.1	75		
	3	40.27	3.6	0	1.8		---------	---------	------		
	116	15.47	1.4	0	2.5						
	68	8.37	0.7	0	6.2						
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	TOTAL =	1117.5		%Rock = 5	**8.9063**				**28.0**	**37**	**2**

Spook Hill ADMP Update
PSIAC Effective Ground Cover Factor Calculations

Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	% Rock		LAND USE Type	% Area	%Veg. cover	% Effective Cover	PSIAC Rating
80	63	49.93	5.3	25	31.3		Desert	61.4	25		
	52	10.68	1.1	20	31		V.L.D.R	38.6	30		
	45	57.06	6	0	0		---------	---------	------		
	49	80.62	8.5	0	3.3						
	68	12.88	1.4	0	6.2						
	48	196.95	20.9	0	3.3						
	113	95.71	10.1	0	2.5						
	98	439.92	46.6	0	5.3						
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	TOTAL =	943.8		%Rock = 2	**5.7792**				**26.9**	**33**	**4**
100	98	214.47	69.2	0	5.3		Desert	39.1	25		
	44	7.98	2.6	0	0		V.L.D.R	60.9	30		
	48	79.8	25.8	0	3.3		---------	---------	------		
	3	7.5	2.4	0	1.8						
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	TOTAL =	309.8		%Rock = 0	**4.5622**				**28.0**	**33**	**4**
120	98	201.48	14.3	0	5.3		Desert	59.6	25		
	63	501.81	35.6	25	31.3		V.L.D.R	40.4	30		
	61	171.4	12.2	0	0		---------	---------	------		
	49	175.31	12.4	0	3.3						
	44	313.15	22.2	0	0						
	3	45.95	3.3	0	1.8						
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	TOTAL =	1409.1		%Rock = 9	**12.3693**				**27.0**	**39**	**1**
140	98	371.24	97.1	0	5.3		Desert	28.5	25		
	63	11.27	2.9	25	31.3		V.L.D.R	71.5	30		
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	TOTAL =	382.5		%Rock = 1	**6.054**				**28.6**	**35**	**3**

Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	% Rock		LAND USE Type	% Area	%Veg. cover	% Effective Cover	PSIAC Rating
160	63	71.22	14.3	25	31.3		Desert	89.6	25		
	61	73.19	14.7	0	0		V.L.D.R	10.4	30		
	115	12.73	2.6	0	1.4		---------	---------	------		
	98	340.4	68.4	0	5.3						
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	TOTAL =	497.5		%Rock = 4	**8.1375**				**25.5**	**34**	**3**
180	98	639.98	100	0	5.3		Desert	100	25		
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	TOTAL =	640		%Rock = 0	**5.3**				**25**	**30**	**5**
200	63	496.25	42.8	25	31.3		Desert	100	25		
	61	268.55	23.2	0	0		---------	---------	------		
	98	261.51	22.6	0	5.3						
	44	102.36	8.8	0	0						
	3	30.64	2.6	0	1.8						
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	TOTAL =	1159.3		%Rock = 11	**14.641**				**25.0**	**40**	**0**
220	63	92.67	11.6	25	31.3		Desert	100	25		
	61	280.68	35	0	0		---------	---------	------		
	44	248.58	31	0	0						
	68	3.55	0.4	0	6.2						
	48	60.11	7.5	0	3.3						
	47	11.21	1.4	0	3.3						
	98	104.34	13	0	5.3						
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	TOTAL =	801.1		%Rock = 3	**4.6383**				**25.0**	**30**	**5**

Spook Hill ADMP Update
PSIAC Effective Ground Cover Factor Calculations

Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	% Rock		LAND USE Type	% Area	%Veg. cover	% Effective Cover	PSIAC Rating
240	48	105.63	15.9	0	3.3		Desert	100	25		
	68	202.13	30.4	0	6.2		---------	---------	------		
	98	242.49	36.4	0	5.3						
	61	63.02	9.5	0	0						
	63	49.76	7.5	25	31.3						
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	TOTAL =	663		%Rock = 2	**6.6862**				**25.0**	**32**	**4**
260	44	88.11	51.6	0	0		L.D.R.	100	50		
	98	59.73	35	0	5.3		---------	---------	------		
	3	23.03	13.5	0	1.8						
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	TOTAL =	170.9		%Rock = 0	**2.098**				**50.0**	**52**	**-2**
280	98	147.08	75.5	0	5.3		L.D.R.	100	50		
	44	47.63	24.5	0	0		---------	---------	------		
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	TOTAL =	194.7		%Rock = 0	**4.0015**				**50.0**	**54**	**-2**
300	63	67.84	10.7	25	31.3		Desert	73.4	25		
	61	33.73	5.3	0	0		L.D.R.	26.6	50		
	68	44.1	7	0	6.2		---------	---------	------		
	98	422.17	66.7	0	5.3						
	44	17.86	2.8	0	0						
	118	28.77	4.5	0	1.5						
	115	2.98	0.5	0	1.4						
	48	15.17	2.4	0	3.3						
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	TOTAL =	632.6		%Rock = 3	**7.4719**				**31.7**	**39**	**1**

Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	% Rock		LAND USE Type	% Area	%Veg. cover	% Effective Cover	PSIAC Rating
320	98	356.76	36.5	0	5.3		Desert	66.4	25		
	118	179.59	18.4	0	1.5		V.L.D.R	11.6	30		
	63	117.54	12	25	31.3		L.D.R.	8.9	50		
	61	64.8	6.6	0	0		M.D.R.	12.8	50		
	110	6.14	0.6	0	4.3		Comm	0.3	75		
	68	127.88	13.1	0	6.2		---------	---------	------		
	115	102.72	10.5	0	1.4						
	44	21.72	2.2	0	0						
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	TOTAL =	977.2		%Rock = 3	**6.9515**				**31.2**	**38**	**1**
340	61	26.29	2.8	0	0		Desert	27.4	25		
	63	69.72	7.5	25	31.3		V.L.D.R	1.6	30		
	68	165.11	17.8	0	6.2		L.D.R.	17.7	50		
	98	438.66	47.3	0	5.3		M.D.R.	35.2	50		
	3	13.1	1.4	0	1.8		M.F.R.	4.1	50		
	115	145.06	15.6	0	1.4		Comm	4.3	75		
	113	29.05	3.1	0	2.5		Park	9.7	90		
	44	7.57	0.8	0	0		---------	---------	------		
	118	24.86	2.7	0	1.5						
	110	8.02	0.9	0	4.3						
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	TOTAL =	927.4		%Rock = 2	**6.3583**				**47.8**	**54**	**-2**
350	63	102.57	16.5	25	31.3		Desert	100	25		
	61	124	20	0	0		---------	---------	------		
	118	311.74	50.2	0	1.5						
	68	57.67	9.3	0	6.2						
	98	17.95	2.9	0	5.3						
	101	6.68	1.1	0	4.3						
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	TOTAL =	620.6		%Rock = 4	**6.6951**				**25.0**	**32**	**4**

Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	% Rock		LAND USE Type	% Area	%Veg. cover	% Effective Cover	PSIAC Rating
360	63	47.99	5.6	25	31.3		Desert	53.8	25		
	61	13.41	1.6	0	0		V.L.D.R	2.7	30		
	118	86.57	10.2	0	1.5		L.D.R.	17.7	50		
	90	165.09	19.4	0	2.5		M.D.R.	7.3	50		
	110	14.45	1.7	0	4.3		M.F.R.	5.3	50		
	101	37.61	4.4	0	0		Comm	4.5	75		
	98	335.83	39.5	0	5.3		Park	8.7	90		
	115	69.56	8.2	0	1.4		---------	---------	------		
	68	31.45	3.7	0	6.2						
	113	48.59	5.7	0	2.5						
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	TOTAL =	850.6		%Rock = 1	**5.0441**				**40.6**	**46**	**-1**
380	63	109.44	10.4	25	31.3		Desert	67.1	25		
	61	43.59	4.2	0	0		L.D.R.	19.4	50		
	90	177.04	16.9	0	2.5		Comm	2.8	75		
	101	94.87	9	0	0		Park	10.7	90		
	110	10.47	1	0	4.3		---------	---------	------		
	115	67.03	6.4	0	1.4						
	98	280.1	26.7	0	5.3						
	113	142.95	13.6	0	2.5						
	118	45.56	4.3	0	1.5						
	112	77.51	7.4	0	2.5						
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	TOTAL =	1048.6		%Rock = 3	**5.8149**				**38.2**	**44**	**-1**
390	63	250.02	35.9	25	31.3		Desert	65.8	25		
	61	142.77	20.5	0	0		L.D.R.	34.2	50		
	68	12.1	1.7	0	6.2		---------	---------	------		
	90	189.53	27.2	0	2.5						
	101	73.56	10.6	0	0						
	110	28.72	4.1	0	4.3						
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	TOTAL =	696.7		%Rock = 9	**12.1984**				**33.6**	**46**	**-1**

Spook Hill ADMP Update
PSIAC Effective Ground Cover Factor Calculations

Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	% Rock		LAND USE Type	% Area	%Veg. cover	% Effective Cover	PSIAC Rating
400	98	265.05	67.2	0	5.3		Desert	52.5	25		
	112	24.02	6.1	0	2.5		L.D.R.	42.6	50		
	113	23.19	5.9	0	2.5		Park	4.9	90		
	115	82.28	20.8	0	1.4		---------	---------	------		
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	TOTAL =	394.5		%Rock = 0	**4.1528**				**38.8**	**43**	**-1**
420	90	57.73	10.6	0	2.5		Desert	21.3	25		
	68	97.52	17.9	0	6.2		L.D.R.	78.7	50		
	110	82.38	15.2	0	4.3		---------	---------	------		
	118	70.36	13	0	1.5						
	98	235.15	43.3	0	5.3						
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	TOTAL =	543.1		%Rock = 0	**4.5183**				**44.7**	**49**	**-2**
440	63	26.3	51.4	25	31.3		Desert	34	25		
	61	22.1	43.2	0	0		OPEN	66	10		
	44	2.8	5.5	0	0		---------	---------	------		
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	TOTAL =	51.2		%Rock = 13	**16.0882**				**15.1**	**31**	**5**
441	68	3.8	59.4	0	6.2		V.L.D.R	100	30		
	44	2.6	40.6	0	0		---------	---------	------		
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	TOTAL =	6.4		%Rock = 0	**3.6828**				**30.0**	**34**	**3**
442	68	64	100	0	6.2		V.L.D.R	100	30		
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	TOTAL =	64		%Rock = 0	**6.2**				**30.0**	**36**	**2**

Spook Hill ADMP Update
PSIAC Effective Ground Cover Factor Calculations

Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	% Rock		LAND USE Type	% Area	%Veg. cover	% Effective Cover	PSIAC Rating
443	63	12.9	25.2	25	31.3		OPEN	26	10		
	'68	6.9	13.5	0	6.2		V.L.D.R	74	30		
	44	31.4	61.3	0	0		---------	---------	------		
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	TOTAL =	51.2		%Rock = 6	**8.7246**				**24.8**	**34**	**3**
444	63	0.6	2.3	25	31.3		Desert	10.9	25		
	61	12.1	47.3	0	0		OPEN	89.1	10		
	68	12.9	50.4	0	6.2		---------	---------	------		
	--------	---------	----------	----------							
	TOTAL =	25.6		%Rock = 1	**3.8447**				**11.6**	**15**	**10**
445	63	4.5	3.7	25	31.3		OPEN	62.9	10		
	61	6.7	5.5	0	0		V.L.D.R	37.1	30		
	68	110.4	90.8	0	6.2		---------	---------	------		
	--------	---------	----------	----------							
	TOTAL =	121.6		%Rock = 1	**6.7877**				**17.4**	**24**	**8**
446	68	19.4	75.8	0	6.2		V.L.D.R	44.1	30		
	44	6.2	24.2	0	0		M.D.R.	55.9	50		
	--------	---------	----------	----------			---------	---------	------		
	TOTAL =	25.6		%Rock = 0	**4.6996**				**41.2**	**46**	**-1**
447	68	52	90.3	0	6.2		M.D.R.	100	50		
	115	5.6	9.7	0	1.4		---------	---------	------		
	--------	---------	----------	----------							
	TOTAL =	57.6		%Rock = 0	**5.7344**				**50.0**	**56**	**-3**
448	63	10.6	36.8	25	31.3		OPEN	63.5	10		
	68	18.2	63.2	0	6.2		V.L.D.R	36.5	30		
	--------	---------	----------	----------			---------	---------	------		
	TOTAL =	28.8		%Rock = 9	**15.4368**				**17.3**	**33**	**4**

Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	% Rock		LAND USE Type	% Area	%Veg. cover	% Effective Cover	PSIAC Rating
449	63	3.1	9.7	25	31.3		OPEN	20.6	10		
	68	28.9	90.3	0	6.2		V.L.D.R	79.4	30		
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	TOTAL =	32		%Rock = 2	**8.6347**				**25.9**	**35**	**3**
450	63	5.9	13.2	25	31.3		Desert	93.8	25		
	68	33.4	74.6	0	6.2		OPEN	3.3	10		
	90	5.5	12.3	0	2.5		M.D.R.	2.9	50		
	---	---	---	---			---	---	---		
	TOTAL =	44.8		%Rock = 3	**9.0643**				**25.2**	**34**	**3**
451	68	16	100	0	6.2		Desert	91.2	25		
	---	---	---	---			M.D.R.	8.8	50		
							---	---	---		
	TOTAL =	16		%Rock = 0	**6.2**				**27.2**	**33**	**4**
452	63	4.8	18.8	25	31.3		OPEN	19.1	10		
	68	20.8	81.2	0	6.2		V.L.D.R	80.9	30		
	---	---	---	---			---	---	---		
	TOTAL =	25.6		%Rock = 5	**10.9188**				**26.2**	**37**	**2**
453	68	38.4	100	0	6.2		Desert	41.4	25		
	---	---	---	---			M.D.R.	58.6	50		
							---	---	---		
	TOTAL =	38.4		%Rock = 0	**6.2**				**39.7**	**46**	**-1**
454	63	6.8	5.9	25	31.3		Desert	54.3	25		
	68	48.9	42.4	0	6.2		OPEN	2.7	10		
	90	59.5	51.6	0	2.5		M.D.R.	43.1	50		
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	TOTAL =	115.2		%Rock = 1	**5.7655**				**35.4**	**41**	**-1**

Spook Hill ADMP Update
PSIAC Effective Ground Cover Factor Calculations

Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	% Rock		LAND USE Type	% Area	%Veg. cover	% Effective Cover	PSIAC Rating
455	61	47.41	4.8	0	0		Desert	24.1	25		
	63	70.94	7.1	25	31.3		L.D.R.	22.7	50		
	68	492.91	49.4	0	6.2		M.D.R.	52.4	50		
	90	88.09	8.8	0	2.5		M.F.R.	0.4	50		
	115	263.61	26.4	0	1.4		Comm	0.5	75		
	110	17.72	1.8	0	4.3		---------	---------	------		
	98	8.88	0.9	0	5.3						
	118	8.34	0.8	0	1.5						
	--------	---------	----------	----------							
	TOTAL =	997.9		%Rock = 2	**6.0118**				**44.2**	**50**	**-2**
456	63	78.8	47.4	25	31.3		Desert	81.9	25		
	61	62	37.3	0	0		OPEN	18.1	10		
	68	25.6	15.4	0	6.2		---------	---------	------		
	--------	---------	----------	----------							
	TOTAL =	166.4		%Rock = 12	**15.791**				**22.3**	**38**	**1**
457	63	9.5	7.8	25	31.3		Desert	52.9	25		
	61	26.1	21.5	0	0		OPEN	25.1	10		
	68	79.5	65.4	0	6.2		V.L.D.R	10.9	30		
	115	6.5	5.3	0	1.4		M.D.R.	11.1	50		
	--------	---------	----------	----------			---------	---------	------		
	TOTAL =	121.6		%Rock = 2	**6.5704**				**24.6**	**31**	**5**
458	63	21.4	17.6	25	31.3		Desert	41.4	25		
	61	87.9	72.3	0	0		OPEN	14.1	10		
	68	2.1	1.7	0	6.2		V.L.D.R	44.6	30		
	115	10.2	8.4	0	1.4		---------	---------	------		
	--------	---------	----------	----------							
	TOTAL =	121.6		%Rock = 4	**5.7318**				**25.1**	**31**	**5**

Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	% Rock		LAND USE Type	% Area	%Veg. cover	% Effective Cover	PSIAC Rating
459	68	18.2	94.8	0	6.2		Desert	3.6	25		
	115	1	5.2	0	1.4		OPEN	35.4	10		
	--------	---------	----------	----------			V.L.D.R	40.6	30		
							M.D.R.	20.3	50		
							---------	---------	------		
	TOTAL =	19.2		%Rock = 0	**5.9504**				**26.8**	**33**	**4**
460	68	29.8	33.2	0	6.2		M.D.R.	90.5	50		
	115	59.9	66.8	0	1.4		Park	9.5	90		
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	TOTAL =	89.7		%Rock = 0	**2.9936**				**53.8**	**57**	**-3**
461	63	1.6	2.1	25	31.3		V.L.D.R	57.2	30		
	68	1.6	2.1	0	6.2		M.D.R.	34.4	50		
	61	8.3	10.8	0	0		Comm	8.5	75		
	115	65.3	85	0	1.4		---------	---------	------		
	--------	---------	----------	----------							
	TOTAL =	76.8		%Rock = 1	**1.9775**				**40.7**	**43**	**-1**
462	63	20	10.4	25	31.3		Desert	56.8	25		
	61	131.1	68.1	0	0		OPEN	5.8	10		
	68	39.4	20.5	0	6.2		V.L.D.R	27.1	30		
	115	2.1	1.1	0	1.4		M.D.R.	0.4	50		
	--------	---------	----------	----------			Comm	10	75		
							---------	---------	------		
	TOTAL =	192.6		%Rock = 3	**4.5416**				**30.6**	**35**	**3**
480	63	43.11	9.2	25	31.3		Desert	5.5	25		
	68	348.53	74.5	0	6.2		L.D.R.	46.3	50		
	115	76.19	16.3	0	1.4		M.D.R.	36.6	50		
	--------	---------	----------	----------			M.F.R.	5	50		
							Comm	6.7	75		
							---------	---------	------		
	TOTAL =	467.8		%Rock = 2	**7.7268**				**50.4**	**58**	**-3**

Spook Hill ADMP Update
PSIAC Effective Ground Cover Factor Calculations

Subbasin	Map Unit	AREA Acres	% Area	% Rock Outcrop	% Rock		LAND USE Type	% Area	%Veg. cover	% Effective Cover	PSIAC Rating
500	63	208.27	35	25	31.3		Desert	100	25		
	61	368.91	62	0	0		---------	---------	------		
	113	17.75	3	0	2.5						
	--------	---------	----------	----------							
	TOTAL =	594.9		%Rock = 9	**11.03**				**25.0**	**36**	**2**

Spook Hill ADMP Update
PSIAC Effective Ground Cover Factor
Percent Rock Fragments Computations for Soil Units

Map Unit	Soil Name	% of Unit	Fragments > 3 inches (%)
3	Antho	35	0
	Carrizo	30	5
	Maripo	20	0
			1.8
44	Ebon	80	**0**
45	Ebon	80	**0**
47	Ebon	35	0
	Gunsight	20	5
	Cipriano	20	7.5
			3.3
48	Ebon	45	0
	Pinamt	35	7.5
			3.3
49	Ebon	45	0
	Pinamt	35	7.5
			3.3
52	Gachado	45	7.5
	Lomitas	20	15
	Rock Outcrop	20	100
			31.0
61	Gran	40	0
	Wickenburg	35	0
			0
63	Gran	30	0
	Wickenburg	25	0
	Rock Outcrop	25	100
			31.3
68	Gunsight	45	5
	Cipriano	40	7.5
			6.2
90	Momoli	70	**2.5**
98	Pinamt	45	7.5
	Tremant	35	2.5
			5.3
101	Rillito	85	**0**
110	Sun City	55	2.5
	Cipriano	30	7.5
			4.3
112	Tremant	80	**2.5**
113	Tremant	80	**2.5**
115	Tremant	45	2.5
	Antho	35	0
			1.4
116	Tremant	30	2.5
	Gunsight	20	5
	Rillito	20	0
			2.5
118	Tremant	45	2.5
	Rillito	30	0
			1.5

Spook Hill ADMP Update
PSIAC Upland Erosion Factor
Summary Sheet

	Subbasin	
ID	PSIAC Rating	
20	1.88	
40	0.76	
60	1.81	
80	0.97	
100	0.53	
120	3.17	
140	0.13	
160	2.04	
180	0.04	
200	3.63	
220	2.61	
240	1.82	
260	0.00	
280	0.00	
300	0.48	
320	0.79	
340	0.39	
350	2.29	
360	0.58	
380	0.84	
390	2.61	
400	0.00	
420	0.00	
440	5.00	
441	3.39	
442	2.88	
443	3.69	
444	4.70	
445	3.86	
446	3.32	
447	1.67	
448	4.29	
449	3.46	
450	3.48	
451	2.28	
452	3.34	
453	2.26	
454	0.65	
455	0.56	
456	4.53	
457	3.07	
458	3.32	
459	3.00	
460	1.52	
461	1.08	
462	3.18	
480	0.73	
500	3.91	

Spook Hill ADMP Update
PSIAC Upland Erosion Factor Computations

Subbasin ID	Slope category	Area (acres)	Percent 0f Subbasin	PSIAC Upland Erosion Rating	Rating Weight	Subbasin PSIAC Upland Erosion Rating
20	< 5 percent	610.3	51.3	0	0.0	
20	> 30 percent	250.3	21.1	5	1.1	
20	5 to 30 percent	328.3	27.6	3	0.8	1.9
40	< 5 percent	1173.7	81.9	0	0.0	
40	> 30 percent	151.7	10.6	5	0.5	
40	5 to 30 percent	108.0	7.5	3	0.2	0.8
60	< 5 percent	597.5	53.2	0	0.0	
60	> 30 percent	226.8	20.2	5	1.0	
60	5 to 30 percent	299.6	26.7	3	0.8	1.8
80	< 5 percent	697.6	72.7	0	0.0	
80	> 30 percent	72.8	7.6	5	0.4	
80	5 to 30 percent	189.5	19.7	3	0.6	1.0
100	< 5 percent	256.9	82.3	0	0.0	
100	5 to 30 percent	55.4	17.7	3	0.5	0.5
120	< 5 percent	301.7	21.5	0	0.0	
120	> 30 percent	568.1	40.4	5	2.0	
120	> 30 percent	1.9	0.1	5	0.0	
120	5 to 30 percent	534.3	38.0	3	1.1	3.2
140	< 5 percent	368.6	96.4	0	0.0	
140	> 30 percent	4.8	1.3	5	0.1	
140	5 to 30 percent	9.1	2.4	3	0.1	0.1
160	< 5 percent	238.5	48.0	0	0.0	
160	> 30 percent	117.0	23.5	5	1.2	
160	> 30 percent	3.0	0.6	5	0.0	
160	5 to 30 percent	138.2	27.8	3	0.8	2.0
180	< 5 percent	638.2	98.6	0	0.0	
180	5 to 30 percent	9.2	1.4	3	0.0	0.0
200	< 5 percent	168.8	14.5	0	0.0	
200	> 30 percent	25.6	2.2	5	0.1	
200	> 30 percent	16.2	1.4	5	0.1	
200	> 30 percent	579.3	49.7	5	2.5	
200	5 to 30 percent	376.5	32.3	3	1.0	3.6
220	< 5 percent	233.1	29.0	0	0.0	
220	> 30 percent	183.6	22.9	5	1.1	
220	> 30 percent	9.5	1.2	5	0.1	
220	5 to 30 percent	376.5	46.9	3	1.4	2.6
240	< 5 percent	295.9	44.5	0	0.0	
240	> 30 percent	45.2	6.8	5	0.3	
240	> 30 percent	8.3	1.2	5	0.1	
240	5 to 30 percent	315.1	47.4	3	1.4	1.8
260	< 5 percent	171.8	100.0	0	0.0	0.0
280	< 5 percent	205.8	100.0	0	0.0	0.0
300	< 5 percent	565.0	88.5	0	0.0	
300	> 30 percent	43.6	6.8	5	0.3	
300	5 to 30 percent	29.7	4.7	3	0.1	0.5

Spook Hill ADMP Update
PSIAC Upland Erosion Factor Computations

Subbasin ID	Slope category	Area (acres)	Percent 0f Subbasin	PSIAC Upland Erosion Rating	Rating Weight	Subbasin PSIAC Upland Erosion Rating
320	< 5 percent	314.6	33.1	0	0.0	
320	< 5 percent	431.6	45.4	0	0.0	
320	> 30 percent	3.0	0.3	5	0.0	
320	> 30 percent	1.6	0.2	5	0.0	
320	> 30 percent	19.5	2.1	5	0.1	
320	> 30 percent	34.9	3.7	5	0.2	
320	> 30 percent	12.0	1.3	5	0.1	
320	5 to 30 percent	0.0	0.0	3	0.0	
320	5 to 30 percent	66.1	7.0	3	0.2	
320	5 to 30 percent	6.5	0.7	3	0.0	
320	5 to 30 percent	54.9	5.8	3	0.2	
320	5 to 30 percent	5.0	0.5	3	0.0	0.8
340	< 5 percent	895.8	90.1	0	0.0	
340	> 30 percent	7.1	0.7	5	0.0	
340	> 30 percent	9.5	1.0	5	0.0	
340	> 30 percent	8.1	0.8	5	0.0	
340	> 30 percent	20.6	2.1	5	0.1	
340	5 to 30 percent	23.5	2.4	3	0.1	
340	5 to 30 percent	13.7	1.4	3	0.0	
340	5 to 30 percent	16.4	1.7	3	0.0	0.4
350	< 5 percent	220.5	34.5	0	0.0	
350	> 30 percent	43.5	6.8	5	0.3	
350	> 30 percent	61.0	9.6	5	0.5	
350	5 to 30 percent	313.3	49.1	3	1.5	
350	5 to 30 percent	0.0	0.0	3	0.0	2.3
360	< 5 percent	462.0	52.9	0	0.0	
360	< 5 percent	275.0	31.5	0	0.0	
360	> 30 percent	34.9	4.0	5	0.2	
360	> 30 percent	10.3	1.2	5	0.1	
360	> 30 percent	5.4	0.6	5	0.0	
360	5 to 30 percent	57.5	6.6	3	0.2	
360	5 to 30 percent	27.5	3.1	3	0.1	0.6
380	< 5 percent	811.5	76.8	0	0.0	
380	> 30 percent	12.2	1.2	5	0.1	
380	> 30 percent	7.4	0.7	5	0.0	
380	> 30 percent	1.1	0.1	5	0.0	
380	> 30 percent	1.4	0.1	5	0.0	
380	> 30 percent	42.1	4.0	5	0.2	
380	> 30 percent	12.3	1.2	5	0.1	
380	5 to 30 percent	13.9	1.3	3	0.0	
380	5 to 30 percent	2.0	0.2	3	0.0	
380	5 to 30 percent	2.4	0.2	3	0.0	
380	5 to 30 percent	8.7	0.8	3	0.0	
380	5 to 30 percent	135.5	12.8	3	0.4	
380	5 to 30 percent	6.6	0.6	3	0.0	0.8

Spook Hill ADMP Update
PSIAC Upland Erosion Factor Computations

Subbasin ID	Slope category	Area (acres)	Percent 0f Subbasin	PSIAC Upland Erosion Rating	Rating Weight	Subbasin PSIAC Upland Erosion Rating
390	< 5 percent	203.3	28.9	0	0.0	
390	> 30 percent	4.1	0.6	5	0.0	
390	> 30 percent	19.8	2.8	5	0.1	
390	> 30 percent	142.2	20.2	5	1.0	
390	5 to 30 percent	334.9	47.5	3	1.4	2.6
400	< 5 percent	421.0	100.0	0	0.0	0.0
420	< 5 percent	552.9	100.0	0	0.0	0.0
440	> 30 percent	40.9	100.0	5	5.0	5.0
441	> 30 percent	0.9	19.5	5	1.0	
441	5 to 30 percent	3.6	80.5	3	2.4	3.4
442	< 5 percent	3.1	4.2	0	0.0	
442	5 to 30 percent	70.9	95.8	3	2.9	2.9
443	> 30 percent	11.9	34.5	5	1.7	
443	5 to 30 percent	22.7	65.5	3	2.0	3.7
444	> 30 percent	21.5	91.7	5	4.6	
444	5 to 30 percent	2.0	4.0	3	0.1	4.7
445	> 30 percent	47.0	43.1	5	2.2	
445	5 to 30 percent	62.0	56.9	3	1.7	3.9
446	> 30 percent	3.1	15.9	5	0.8	
446	5 to 30 percent	16.3	84.1	3	2.5	3.3
447	< 5 percent	28.5	44.2	0	0.0	
447	5 to 30 percent	35.9	55.8	3	1.7	1.7
448	> 30 percent	17.2	64.7	5	3.2	
448	5 to 30 percent	9.4	35.3	3	1.1	4.3
449	> 30 percent	5.4	22.8	5	1.1	
449	5 to 30 percent	18.4	77.2	3	2.3	3.5
450	< 5 percent	16.1	90.4	0	0.0	
450	> 30 percent	1.7	9.6	5	0.5	
450	5 to 30 percent	6.6	27.7	3	0.8	
450	5 to 30 percent	17.3	72.3	3	2.2	3.5
451	< 5 percent	4.2	24.1	0	0.0	
451	5 to 30 percent	13.3	75.9	3	2.3	2.3
452	> 30 percent	3.0	17.0	5	0.9	
452	5 to 30 percent	14.7	83.0	3	2.5	3.3
453	< 5 percent	11.2	24.8	0	0.0	
453	5 to 30 percent	34.0	75.2	3	2.3	2.3
454	< 5 percent	103.4	79.5	0	0.0	
454	> 30 percent	2.6	2.0	5	0.1	
454	5 to 30 percent	11.5	8.9	3	0.3	
454	5 to 30 percent	12.5	9.6	3	0.3	0.7
455	< 5 percent	862.1	84.7	0	0.0	
455	> 30 percent	5.0	0.5	5	0.0	
455	> 30 percent	24.2	2.4	5	0.1	
455	> 30 percent	24.0	2.4	5	0.1	
455	5 to 30 percent	30.8	3.0	3	0.1	
455	5 to 30 percent	71.7	7.0	3	0.2	0.6
456	> 30 percent	124.2	76.5	5	3.8	
456	5 to 30 percent	38.2	23.5	3	0.7	4.5

Spook Hill ADMP Update
PSIAC Upland Erosion Factor Computations

Subbasin ID	Slope category	Area (acres)	Percent 0f Subbasin	PSIAC Upland Erosion Rating	Rating Weight	Subbasin PSIAC Upland Erosion Rating
457	< 5 percent	14.3	11.7	0	0.0	
457	> 30 percent	20.1	16.4	5	0.8	
457	> 30 percent	5.8	4.7	5	0.2	
457	5 to 30 percent	82.1	67.2	3	2.0	3.1
458	> 30 percent	14.1	10.7	5	0.5	
458	> 30 percent	6.9	5.2	5	0.3	
458	5 to 30 percent	111.3	84.1	3	2.5	3.3
459	5 to 30 percent	24.0	100.0	3	3.0	3.0
460	< 5 percent	42.8	49.2	0	0.0	
460	5 to 30 percent	44.2	50.8	3	1.5	1.5
461	< 5 percent	58.9	66.8	0	0.0	
461	> 30 percent	3.5	4.0	5	0.2	
461	5 to 30 percent	0.0	0.0	3	0.0	
461	5 to 30 percent	25.7	29.1	3	0.9	1.1
462	< 5 percent	8.2	4.5	0	0.0	
462	> 30 percent	24.5	13.6	5	0.7	
462	> 30 percent	3.8	2.1	5	0.1	
462	5 to 30 percent	0.0	0.0	3	0.0	
462	5 to 30 percent	143.9	79.8	3	2.4	3.2
480	< 5 percent	387.2	80.7	0	0.0	
480	> 30 percent	3.0	0.6	5	0.0	
480	> 30 percent	2.2	0.4	5	0.0	
480	> 30 percent	30.5	6.4	5	0.3	
480	5 to 30 percent	24.7	5.1	3	0.2	
480	5 to 30 percent	17.3	3.6	3	0.1	
480	5 to 30 percent	14.9	3.1	3	0.1	0.7
500	> 30 percent	148.8	25.5	5	1.3	
500	> 30 percent	61.2	10.5	5	0.5	
500	> 30 percent	24.0	4.1	5	0.2	
500	> 30 percent	16.0	2.7	5	0.1	
500	> 30 percent	14.2	2.4	5	0.1	
500	5 to 30 percent	317.2	54.4	3	1.6	
500	5 to 30 percent	1.6	0.3	3	0.0	3.9

Section 6

Modified Universal Soil Loss Equation (MUSLE)
Average Annual and Event-Based Sediment Yield Calculations

Spook Hill ADMP Update
Modified Universal Soil Loss Equation (MUSLE)
Sediment Yield Calculations -- Existing Conditions

	Subbasin Name	Avg. Annual Sediment Yield ($AF/mi^2/yr$)	2-yr Sediment Yield (AF/mi^2)	5-yr Sediment Yield (AF/mi^2)	10-yr Sediment Yield (AF/mi^2)	25-yr Sediment Yield (AF/mi^2)	50-yr Sediment Yield (AF/mi^2)	100-yr Sediment Yield (AF/mi^2)
	20	0.023	0.012	0.031	0.051	0.087	0.119	0.163
	40	0.051	0.026	0.070	0.116	0.196	0.270	0.371
	60	0.046	0.024	0.064	0.105	0.177	0.243	0.334
Apache Jct FRS	average =	0.040	0.020	0.055	0.091	0.153	0.211	0.289
	80	0.060	0.031	0.083	0.136	0.228	0.313	0.429
	100	0.005	0.003	0.007	0.011	0.018	0.024	0.032
	120	0.090	0.046	0.124	0.204	0.346	0.476	0.655
	140	0.028	0.015	0.040	0.064	0.107	0.144	0.194
	160	0.072	0.038	0.100	0.162	0.271	0.368	0.499
	180	0.024	0.012	0.033	0.054	0.090	0.122	0.167
	200	0.141	0.072	0.194	0.319	0.538	0.740	1.016
	220	0.102	0.053	0.141	0.231	0.389	0.532	0.727
	240	0.061	0.032	0.084	0.138	0.231	0.315	0.429
Signal Butte	average =	0.065	0.033	0.089	0.147	0.246	0.337	0.461
	260	0.013	0.007	0.018	0.029	0.047	0.062	0.082
	280	0.016	0.009	0.022	0.035	0.058	0.076	0.102
	300	0.024	0.013	0.034	0.055	0.092	0.126	0.171
	320	0.048	0.025	0.066	0.109	0.183	0.251	0.344
	340	0.025	0.013	0.034	0.056	0.094	0.129	0.177
	350	0.167	0.087	0.231	0.377	0.631	0.858	1.170
	360	0.041	0.021	0.057	0.093	0.157	0.214	0.293
	380	0.041	0.021	0.056	0.092	0.155	0.213	0.292
	390	0.096	0.049	0.133	0.217	0.364	0.496	0.677
	400	0.016	0.008	0.022	0.036	0.060	0.081	0.109
	420	0.017	0.009	0.024	0.039	0.065	0.088	0.120
	440	0.320	0.194	0.470	0.705	1.106	1.393	1.763
	441	0.084	0.063	0.136	0.175	0.234	0.255	0.296
	442	0.042	0.025	0.061	0.094	0.147	0.186	0.240
	443	0.079	0.047	0.117	0.176	0.273	0.344	0.436
	444	0.244	0.156	0.367	0.533	0.815	0.976	1.208
	445	0.099	0.056	0.141	0.221	0.356	0.465	0.611
	446	0.041	0.027	0.060	0.088	0.133	0.160	0.197
	447	0.023	0.014	0.034	0.052	0.081	0.103	0.131
	448	0.180	0.118	0.266	0.392	0.600	0.736	0.910
	449	0.083	0.053	0.125	0.180	0.277	0.336	0.421
	450	0.033	0.019	0.048	0.073	0.115	0.142	0.179
	451	0.016	0.011	0.023	0.037	0.051	0.060	0.075
	452	0.061	0.039	0.090	0.135	0.202	0.244	0.298
	453	0.018	0.011	0.026	0.040	0.059	0.075	0.094
	454	0.026	0.015	0.038	0.058	0.093	0.121	0.159
	C119	0.071	0.043	0.104	0.158	0.248	0.315	0.406
	455	0.039	0.020	0.053	0.088	0.148	0.202	0.277
Spook Hill FRS	455C	0.070	0.042	0.102	0.155	0.244	0.311	0.401
	456	0.226	0.126	0.321	0.506	0.823	1.086	1.439
	457	0.092	0.052	0.131	0.206	0.330	0.431	0.566
	458	0.140	0.079	0.200	0.313	0.505	0.658	0.864
	459	0.068	0.047	0.103	0.147	0.215	0.255	0.311
	460	0.026	0.015	0.037	0.057	0.090	0.117	0.152
	461	0.034	0.004	0.019	0.040	0.088	1.270	0.199
	462	0.101	0.056	0.143	0.228	0.370	0.491	0.653
	C56	0.098	0.054	0.136	0.214	0.346	0.615	0.598
	480	0.025	0.013	0.034	0.056	0.093	0.126	0.170
	500	0.108	0.056	0.150	0.244	0.409	0.556	0.757
Spook Hill FW		0.077	0.041	0.107	0.171	0.282	0.432	0.508
Average for all =		0.071	0.040	0.101	0.158	0.254	0.355	0.437
Standard deviation=		0.066	0.040	0.097	0.146	0.231	0.324	0.384
Maximum =		0.320	0.194	0.470	0.705	1.106	1.393	1.763
Minimum =		0.005	0.003	0.007	0.011	0.018	0.024	0.032

Sub-Basin 20 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	1.82	sq. mi.
Area Contributing Sediment =	1.82	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	12	106	95	0.56	5205
Q-5	29	257	95	0.56	14033
Q-10	46	402	95	0.56	23162
Q-25	73	641	95	0.56	39059
Q-50	97	852	95	0.56	53719
Q-100	128	1130	95	0.56	73703

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
3						0.16	2.3
44						0.10	34.2
61						0.15	4.2
63						0.15	23.5
98						0.17	34.4
116						0.26	1.4
					Weighted K Factor:		0.14

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran desert	96.4	0.85	0.90	0.42	0.32	0.31
VLDR	1.1	0.85	0.76	0.40	0.26	0.00
MDR	0.9	0.78	0.63	0.20	0.10	0.00
Industrial	1.6	0.85	0.39	0.17	0.06	0.00
			Composite Weighted C Factor=			0.313

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	100	ft	(Basin Average)
Slope Angles:	2.23	%	(Basin Average)
n =	0.3		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.22

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	5205	0.14	0.22	0.31	1.00	50	0.01
Q-5	14033	0.14	0.22	0.31	1.00	136	0.03
Q-10	23162	0.14	0.22	0.31	1.00	224	0.05
Q-25	39059	0.14	0.22	0.31	1.00	378	0.09
Q-50	53719	0.14	0.22	0.31	1.00	520	0.12
Q-100	73703	0.14	0.22	0.31	1.00	713	0.16
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						99	0.02

Sub-Basin 40 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	2.23	sq. mi.
Area Contributing Sediment =	2.23	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	12	213	95	0.56	7764
Q-5	30	516	95	0.56	20916
Q-10	46	808	95	0.56	34563
Q-25	74	1292	95	0.56	58469
Q-50	99	1721	95	0.56	80610
Q-100	131	2286	95	0.56	110784

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
3						0.16	0.7
44						0.10	13
63						0.15	11
98						0.17	70.4
113						0.32	1.7
116						0.26	3.2
					Weighted K Factor:		0.16

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran desert	90.8	0.85	0.90	0.42	0.32	0.29
VLDR	6.6	0.85	0.76	0.40	0.26	0.02
Commercial	2.6	0.82	0.31	0.12	0.03	0.00
			Composite Weighted C Factor=			0.309

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	100	ft	(Basin Average)
Slope Angles:	3.58	%	(Basin Average)
n =	0.4		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.35

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	7764	0.16	0.35	0.31	1.00	139	0.03
Q-5	20916	0.16	0.35	0.31	1.00	374	0.07
Q-10	34563	0.16	0.35	0.31	1.00	619	0.12
Q-25	58469	0.16	0.35	0.31	1.00	1047	0.20
Q-50	80610	0.16	0.35	0.31	1.00	1443	0.27
Q-100	110784	0.16	0.35	0.31	1.00	1983	0.37
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**273**	**0.05**

Sub-Basin 60 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area = 1.75 sq. mi.

Area Contributing Sediment = 1.75 sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	11	132	95	0.56	5734
Q-5	28	320	95	0.56	15458
Q-10	43	500	95	0.56	25482
Q-25	69	798	95	0.56	43016
Q-50	92	1060	95	0.56	59119
Q-100	122	1405	95	0.56	81056

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
3						0.16	3.6
44						0.10	25.6
63						0.15	19.7
68						0.15	0.7
98						0.17	49
116						0.26	1.4
					Weighted K Factor:		0.15

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran desert	68.4	0.85	0.90	0.42	0.32	0.22
VLDR	28.5	0.85	0.76	0.40	0.26	0.07
Commercial	3.1	0.82	0.31	0.12	0.03	0.00
			Composite Weighted C Factor=			0.293

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths: 100 ft (Basin Average)

Slope Angles: 3.97 % (Basin Average)

n = 0.4

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.40

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	5734	0.15	0.40	0.29	1.00	99	0.02
Q-5	15458	0.15	0.40	0.29	1.00	267	0.06
Q-10	25482	0.15	0.40	0.29	1.00	440	0.10
Q-25	43016	0.15	0.40	0.29	1.00	743	0.18
Q-50	59119	0.15	0.40	0.29	1.00	1021	0.24
Q-100	81056	0.15	0.40	0.29	1.00	1399	0.33
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**194**	**0.05**

Sub-Basin 80 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	1.48	sq. mi.
Area Contributing Sediment =	1.48	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	8.7	161	95	0.56	5509
Q-5	21	389	95	0.56	14796
Q-10	33	606	95	0.56	24309
Q-25	52	965	95	0.56	40932
Q-50	70	1279	95	0.56	56117
Q-100	92	1693	95	0.56	76823

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
45						0.10	6
48						0.08	20.9
49						0.08	8.5
52						0.08	1.1
63						0.15	5.3
68						0.15	1.4
98						0.17	46.6
113						0.32	10.1
					Weighted K Factor:		0.15

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran desert	61.4	0.85	0.90	0.42	0.32	0.20
VLDR	38.6	0.85	0.76	0.40	0.26	0.10
			Composite Weighted C Factor=			0.297

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	100	ft	(Basin Average)
Slope Angles:	4.35	%	(Basin Average)
n =	0.4		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.44

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	5509	0.15	0.44	0.30	1.00	109	0.03
Q-5	14796	0.15	0.44	0.30	1.00	293	0.08
Q-10	24309	0.15	0.44	0.30	1.00	481	0.14
Q-25	40932	0.15	0.44	0.30	1.00	810	0.23
Q-50	56117	0.15	0.44	0.30	1.00	1110	0.31
Q-100	76823	0.15	0.44	0.30	1.00	1520	0.43
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**212**	**0.06**

Sub-Basin 100 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.48	sq. mi.
Area Contributing Sediment =	0.48	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	3.1	41	95	0.56	1421
Q-5	7.2	96	95	0.56	3685
Q-10	11	147	95	0.56	5939
Q-25	17	230	95	0.56	9805
Q-50	22	299	95	0.56	13154
Q-100	29	389	95	0.56	17662

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
3						0.16	6
44						0.10	20.9
48						0.08	8.5
98						0.17	1.1
					Weighted K Factor:		0.04

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran desert	39.1	0.85	0.90	0.42	0.32	0.13
VLDR	60.9	0.85	0.76	0.40	0.26	0.16
			Composite Weighted C Factor=			0.283

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	75	ft	(Basin Average)
Slope Angles:	2.05	%	(Basin Average)
n =	0.3		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.19

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	1421	0.04	0.19	0.28	1.00	3	0.003
Q-5	3685	0.04	0.19	0.28	1.00	8	0.01
Q-10	5939	0.04	0.19	0.28	1.00	12	0.01
Q-25	9805	0.04	0.19	0.28	1.00	20	0.02
Q-50	13154	0.04	0.19	0.28	1.00	27	0.02
Q-100	17662	0.04	0.19	0.28	1.00	37	0.03
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**5**	**0.0048**

Sub-Basin 120 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area = 2.2 sq. mi.

Area Contributing Sediment = 2.2 sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	16	276	95	0.56	10561
Q-5	40	669	95	0.56	28469
Q-10	62	1046	95	0.56	46965
Q-25	99	1673	95	0.56	79473
Q-50	132	2228	95	0.56	109538
Q-100	175	2960	95	0.56	150573

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
3						0.16	3.3
44						0.10	22.2
49						0.08	12.4
61						0.15	12.2
63						0.15	35.6
98						0.17	14.3
					Weighted K Factor:		0.13

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran desert	59.6	0.85	0.90	0.42	0.32	0.19
VLDR	40.4	0.85	0.76	0.40	0.26	0.10
			Composite Weighted C Factor=			0.296

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths: 150 ft (Basin Average)

Slope Angles: 4.53 % (Basin Average)

n = 0.5

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.58

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	10561	0.13	0.58	0.30	1.00	242	0.05
Q-5	28469	0.13	0.58	0.30	1.00	653	0.12
Q-10	46965	0.13	0.58	0.30	1.00	1077	0.20
Q-25	79473	0.13	0.58	0.30	1.00	1822	0.35
Q-50	109538	0.13	0.58	0.30	1.00	2511	0.48
Q-100	150573	0.13	0.58	0.30	1.00	3452	0.65
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**476**	**0.09**

Sub-Basin 140 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.6	sq. mi.
Area Contributing Sediment =	0.6	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	3.4	61	95	0.56	1874
Q-5	8.0	145	95	0.56	4942
Q-10	12	223	95	0.56	8003
Q-25	19	350	95	0.56	13259
Q-50	25	457	95	0.56	17875
Q-100	33	598	95	0.56	24157

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
63						0.15	2.9
98						0.17	97.1
					Weighted K Factor:		0.17

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran desert	28.5	0.85	0.90	0.42	0.32	0.09
VLDR	71.5	0.85	0.76	0.40	0.26	0.18
			Composite Weighted C Factor=			0.276

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	75	ft	(Basin Average)
Slope Angles:	2.82	%	(Basin Average)
n =	0.3		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.25

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	1874	0.17	0.25	0.28	1.00	22	0.02
Q-5	4942	0.17	0.25	0.28	1.00	57	0.04
Q-10	8003	0.17	0.25	0.28	1.00	93	0.06
Q-25	13259	0.17	0.25	0.28	1.00	153	0.11
Q-50	17875	0.17	0.25	0.28	1.00	207	0.14
Q-100	24157	0.17	0.25	0.28	1.00	279	0.19
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**41**	**0.03**

Sub-Basin 160 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.78	sq. mi.
Area Contributing Sediment =	0.78	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	4.5	59	95	0.56	2168
Q-5	11	140	95	0.56	5706
Q-10	17	216	95	0.56	9274
Q-25	26	341	95	0.56	15465
Q-50	34	448	95	0.56	20994
Q-100	45	588	95	0.56	28469

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
61						0.15	14.7
63						0.15	14.3
98						0.17	68.4
115						0.27	2.6
					Weighted K Factor:		0.17

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran desert	89.6	0.85	0.90	0.42	0.32	0.29
VLDR	10.4	0.85	0.76	0.40	0.26	0.03
			Composite Weighted C Factor=			0.315

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	100	ft	(Basin Average)
Slope Angles:	5.67	%	(Basin Average)
n =	0.5		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.62

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	2168	0.17	0.62	0.31	1.00	71	0.04
Q-5	5706	0.17	0.62	0.31	1.00	187	0.10
Q-10	9274	0.17	0.62	0.31	1.00	304	0.16
Q-25	15465	0.17	0.62	0.31	1.00	506	0.27
Q-50	20994	0.17	0.62	0.31	1.00	687	0.37
Q-100	28469	0.17	0.62	0.31	1.00	932	0.50
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**135**	**0.07**

Sub-Basin 180 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area = 1 sq. mi.

Area Contributing Sediment = 1 sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	4.4	68	95	0.56	2316
Q-5	11	163	95	0.56	6166
Q-10	16	252	95	0.56	10045
Q-25	26	399	95	0.56	16805
Q-50	34	526	95	0.56	22902
Q-100	45	694	95	0.56	31238

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
98						0.17	100
					Weighted K Factor:		0.17

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. *Also see the project file for more details.*

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran desert	100	0.85	0.90	0.42	0.32	0.32
			Composite Weighted C Factor=			0.321

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths: 75 ft (Basin Average)

Slope Angles: 2.66 % (Basin Average)

n = 0.3

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.23

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	2316	0.17	0.23	0.32	1.00	30	0.01
Q-5	6166	0.17	0.23	0.32	1.00	79	0.03
Q-10	10045	0.17	0.23	0.32	1.00	128	0.05
Q-25	16805	0.17	0.23	0.32	1.00	215	0.09
Q-50	22902	0.17	0.23	0.32	1.00	293	0.12
Q-100	31238	0.17	0.23	0.32	1.00	399	0.17
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**57**	**0.02**

Sub-Basin 200 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	1.81	sq. mi.
Area Contributing Sediment =	1.81	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	12	194	95	0.56	7319
Q-5	29	469	95	0.56	19671
Q-10	46	732	95	0.56	32387
Q-25	73	1168	95	0.56	54657
Q-50	96	1552	95	0.56	75147
Q-100	128	2059	95	0.56	103136

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
3						0.16	2.6
44						0.10	8.8
61						0.15	23.2
63						0.15	42.8
98						0.17	22.6
					Weighted K Factor:		0.15

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran desert	100	0.85	0.90	0.42	0.32	0.32
			Composite Weighted C Factor=			0.321

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	200	ft	(Basin Average)
Slope Angles:	5.68	%	(Basin Average)
n =	0.5		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.88

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	7319	0.15	0.88	0.32	1.00	313	0.07
Q-5	19671	0.15	0.88	0.32	1.00	840	0.19
Q-10	32387	0.15	0.88	0.32	1.00	1383	0.32
Q-25	54657	0.15	0.88	0.32	1.00	2334	0.54
Q-50	75147	0.15	0.88	0.32	1.00	3210	0.74
Q-100	103136	0.15	0.88	0.32	1.00	4405	1.02
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**611**	**0.14**

Sub-Basin 220 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	1.25	sq. mi.
Area Contributing Sediment =	1.25	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	8.2	137	95	0.56	4840
Q-5	20	330	95	0.56	12956
Q-10	31	513	95	0.56	21235
Q-25	49	816	95	0.56	35712
Q-50	64	1080	95	0.56	48883
Q-100	85	1427	95	0.56	66784

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permeability	K	% of Basin
44						0.10	31
47						0.13	1.4
48						0.08	7.5
61						0.15	35
63						0.15	11.6
68						0.15	0.4
98						0.17	13
					Weighted K Factor:		0.13

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran desert	100	0.85	0.90	0.42	0.32	0.32
			Composite Weighted C Factor=			0.321

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	150	ft	(Basin Average)
Slope Angles:	5.72	%	(Basin Average)
n =	0.5		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.77

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	4840	0.13	0.77	0.32	1.00	158	0.05
Q-5	12956	0.13	0.77	0.32	1.00	423	0.14
Q-10	21235	0.13	0.77	0.32	1.00	693	0.23
Q-25	35712	0.13	0.77	0.32	1.00	1165	0.39
Q-50	48883	0.13	0.77	0.32	1.00	1594	0.53
Q-100	66784	0.13	0.77	0.32	1.00	2178	0.73
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**306**	**0.10**

Sub-Basin 240 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	1.04	sq. mi.
Area Contributing Sediment =	1.04	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	5.3	75	95	0.56	2701
Q-5	13	180	95	0.56	7200
Q-10	20	279	95	0.56	11763
Q-25	31	443	95	0.56	19742
Q-50	41	584	95	0.56	26904
Q-100	54	770	95	0.56	36669

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
48						0.08	15.9
61						0.15	9.5
63						0.15	7.5
68						0.15	30.4
98						0.17	36.4
					Weighted K Factor:		0.15

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran desert	100	0.85	0.90	0.42	0.32	0.32
			Composite Weighted C Factor=			0.321

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	100	ft	(Basin Average)
Slope Angles:	5.66	%	(Basin Average)
n =	0.5		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.62

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	2701	0.15	0.62	0.32	1.00	79	0.03
Q-5	7200	0.15	0.62	0.32	1.00	210	0.08
Q-10	11763	0.15	0.62	0.32	1.00	343	0.14
Q-25	19742	0.15	0.62	0.32	1.00	575	0.23
Q-50	26904	0.15	0.62	0.32	1.00	784	0.31
Q-100	36669	0.15	0.62	0.32	1.00	1068	0.43
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**152**	**0.06**

Sub-Basin 260 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.27	sq. mi.
Area Contributing Sediment =	0.27	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	2.7	45	95	0.56	1395
Q-5	6.3	105	95	0.56	3603
Q-10	9.4	157	95	0.56	5653
Q-25	15	243	95	0.56	9221
Q-50	19	312	95	0.56	12199
Q-100	24	401	95	0.56	16159

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
3						0.16	13.5
44						0.10	51.6
98						0.17	35
					Weighted K Factor:		0.13

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
LDR	100	0.78	0.63	0.37	0.18	0.18
			Composite Weighted C Factor=			0.182

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	75	ft	(Basin Average)
Slope Angles:	1.29	%	(Basin Average)
n =	0.3		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.14

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	1395	0.13	0.14	0.18	1.00	5	0.01
Q-5	3603	0.13	0.14	0.18	1.00	12	0.02
Q-10	5653	0.13	0.14	0.18	1.00	19	0.03
Q-25	9221	0.13	0.14	0.18	1.00	30	0.05
Q-50	12199	0.13	0.14	0.18	1.00	40	0.06
Q-100	16159	0.13	0.14	0.18	1.00	53	0.08
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**8**	**0.01**

Sub-Basin 280 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.3	sq. mi.
Area Contributing Sediment =	0.3	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	2.5	50	95	0.56	1433
Q-5	6.0	117	95	0.56	3713
Q-10	9.0	176	95	0.56	5867
Q-25	14	273	95	0.56	9592
Q-50	18	350	95	0.56	12670
Q-100	23	452	95	0.56	16872

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
44						0.10	24.5
98						0.17	75.5
					Weighted K Factor:		0.15

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

	Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
LDR		100	0.78	0.63	0.37	0.18	0.18
				Composite Weighted C Factor=			0.182

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	75	ft	(Basin Average)
Slope Angles:	1.6	%	(Basin Average)
n =	0.3		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.16

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	1433	0.15	0.16	0.18	1.00	6	0.01
Q-5	3713	0.15	0.16	0.18	1.00	16	0.02
Q-10	5867	0.15	0.16	0.18	1.00	25	0.04
Q-25	9592	0.15	0.16	0.18	1.00	42	0.06
Q-50	12670	0.15	0.16	0.18	1.00	55	0.08
Q-100	16872	0.15	0.16	0.18	1.00	73	0.10
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**11**	**0.02**

Sub-Basin 300 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area = 0.99 sq. mi.

Area Contributing Sediment = 0.99 sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	5.7	81	95	0.56	2950
Q-5	14	193	95	0.56	7801
Q-10	21	299	95	0.56	12737
Q-25	33	474	95	0.56	21340
Q-50	44	625	95	0.56	29088
Q-100	58	824	95	0.56	39643

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
44						0.10	2.8
48						0.08	2.4
61						0.15	5.3
63						0.15	10.7
68						0.15	7
98						0.17	66.7
115						0.27	0.5
118						0.32	4.5
					Weighted K Factor:		0.17

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	73.4	0.85	0.90	0.42	0.32	0.24
LDR	26.6	0.78	0.63	0.37	0.18	0.05
			Composite Weighted C Factor=			0.284

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths: 75 ft (Basin Average)

Slope Angles: 2.41 % (Basin Average)

n = 0.3

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.21

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	2950	0.17	0.21	0.28	1.00	30	0.01
Q-5	7801	0.17	0.21	0.28	1.00	80	0.03
Q-10	12737	0.17	0.21	0.28	1.00	131	0.06
Q-25	21340	0.17	0.21	0.28	1.00	219	0.09
Q-50	29088	0.17	0.21	0.28	1.00	298	0.13
Q-100	39643	0.17	0.21	0.28	1.00	406	0.17
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**58**	**0.02**

Sub-Basin 320 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area = 1.53 sq. mi.

Area Contributing Sediment = 1.53 sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	8.8	84	95	0.56	3836
Q-5	21	204	95	0.56	10363
Q-10	33	318	95	0.56	17038
Q-25	53	506	95	0.56	28664
Q-50	70	671	95	0.56	39320
Q-100	93	889	95	0.56	53884

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
44						0.10	2.2
61						0.15	6.6
63						0.15	12
68						0.15	13.1
98						0.17	36.5
110						0.20	0.6
115						0.27	10.5
118						0.32	18.4
					Weighted K Factor:		0.20

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	66.4	0.85	0.90	0.42	0.32	0.21
VLDR	11.6	0.85	0.76	0.40	0.26	0.03
LDR	8.9	0.78	0.63	0.37	0.18	0.02
MDR	12.8	0.78	0.63	0.20	0.10	0.01
Commercial	0.3	0.82	0.31	0.12	0.03	0.00
			Composite Weighted C Factor=			0.272

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths: 75 ft (Basin Average)

Slope Angles: 4.71 % (Basin Average)

n = 0.5

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.43

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	3836	0.20	0.43	0.27	1.00	90	0.02
Q-5	10363	0.20	0.43	0.27	1.00	243	0.07
Q-10	17038	0.20	0.43	0.27	1.00	399	0.11
Q-25	28664	0.20	0.43	0.27	1.00	672	0.18
Q-50	39320	0.20	0.43	0.27	1.00	921	0.25
Q-100	53884	0.20	0.43	0.27	1.00	1263	0.34
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**176**	**0.05**

Sub-Basin 340 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area = 1.45 sq. mi.

Area Contributing Sediment = 1.45 sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	10	132	95	0.56	5435
Q-5	25	317	95	0.56	14500
Q-10	39	494	95	0.56	23831
Q-25	62	787	95	0.56	40148
Q-50	82	1043	95	0.56	55037
Q-100	109	1381	95	0.56	75369

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
3						0.16	1.4
44						0.10	0.8
61						0.15	2.8
63						0.15	7.5
68						0.15	17.8
98						0.17	47.3
110						0.20	0.9
113						0.32	3.1
115						0.27	15.6
118						0.32	2.7
					Weighted K Factor:		0.19

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, *Parts of Maricopa and Pinal Counties, Arizona*, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	27.4	0.85	0.90	0.42	0.32	0.09
VLDR	1.6	0.85	0.76	0.40	0.26	0.00
LDR	17.7	0.78	0.63	0.37	0.18	0.03
MDR	35.2	0.78	0.63	0.20	0.10	0.03
MFR	4.1	0.78	0.63	0.20	0.10	0.00
Commercial	4.3	0.82	0.31	0.12	0.03	0.00
Park	9.7	0.85	0.25	0.10	0.02	0.00
			Composite Weighted C Factor=			0.164

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths: 75 ft (Basin Average)

Slope Angles: 3.02 % (Basin Average)

n = 0.3

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.26

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	5435	0.19	0.26	0.16	1.00	44	0.01
Q-5	14500	0.19	0.26	0.16	1.00	118	0.03
Q-10	23831	0.19	0.26	0.16	1.00	194	0.06
Q-25	40148	0.19	0.26	0.16	1.00	327	0.09
Q-50	55037	0.19	0.26	0.16	1.00	449	0.13
Q-100	75369	0.19	0.26	0.16	1.00	615	0.18
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**86**	**0.02**

Sub-Basin 350 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area = 0.97 sq. mi.

Area Contributing Sediment = 0.97 sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	5.2	108	95	0.56	3290
Q-5	12	259	95	0.56	8762
Q-10	19	401	95	0.56	14296
Q-25	31	635	95	0.56	23922
Q-50	40	836	95	0.56	32551
Q-100	53	1102	95	0.56	44355

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
61						0.15	20
63						0.15	16.5
68						0.15	9.3
98						0.17	2.9
101						0.28	1.1
118						0.32	50.2
					Weighted K Factor:		0.24

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	100	0.85	0.90	0.42	0.32	0.32
			Composite Weighted C Factor=			0.321

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths: 150 ft (Basin Average)

Slope Angles: 5.9 % (Basin Average)

n = 0.5

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.80

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	3290	0.24	0.80	0.32	1.00	202	0.09
Q-5	8762	0.24	0.80	0.32	1.00	537	0.23
Q-10	14296	0.24	0.80	0.32	1.00	876	0.38
Q-25	23922	0.24	0.80	0.32	1.00	1466	0.63
Q-50	32551	0.24	0.80	0.32	1.00	1995	0.86
Q-100	44355	0.24	0.80	0.32	1.00	2718	1.17
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**387**	**0.17**

Sub-Basin 360 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area = 1.33 sq. mi.

Area Contributing Sediment = 1.33 sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	8.0	64	95	0.56	3136
Q-5	19	154	95	0.56	8384
Q-10	30	240	95	0.56	13781
Q-25	48	382	95	0.56	23193
Q-50	64	505	95	0.56	31705
Q-100	84	668	95	0.56	43371

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permeability	K	% of Basin
61						0.15	1.6
63						0.15	5.6
68						0.15	3.7
90						0.20	19.4
98						0.17	39.5
101						0.28	4.4
110						0.20	1.7
113						0.32	5.7
115						0.27	8.2
118						0.32	10.2
					Weighted K Factor:		0.21

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	53.8	0.85	0.90	0.42	0.32	0.17
VLDR	2.7	0.85	0.76	0.40	0.26	0.01
LDR	17.7	0.78	0.63	0.37	0.18	0.03
MDR	7.3	0.78	0.63	0.20	0.10	0.01
MFR	5.3	0.78	0.63	0.20	0.10	0.01
Commercial	4.5	0.82	0.31	0.12	0.03	0.00
Park	8.7	0.85	0.25	0.10	0.02	0.00
			Composite Weighted C Factor=			0.228

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths: 75 ft (Basin Average)

Slope Angles: 4.88 % (Basin Average)

n = 0.5

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.45

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	3136	0.21	0.45	0.23	1.00	68	0.02
Q-5	8384	0.21	0.45	0.23	1.00	181	0.06
Q-10	13781	0.21	0.45	0.23	1.00	297	0.09
Q-25	23193	0.21	0.45	0.23	1.00	500	0.16
Q-50	31705	0.21	0.45	0.23	1.00	683	0.21
Q-100	43371	0.21	0.45	0.23	1.00	935	0.29
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**131**	**0.04**

Sub-Basin 380 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

*MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P*

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area = 1.64 sq. mi.

Area Contributing Sediment = 1.64 sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	9.0	78	95	0.56	3736
Q-5	22	188	95	0.56	10006
Q-10	34	293	95	0.56	16448
Q-25	54	467	95	0.56	27724
Q-50	72	619	95	0.56	38011
Q-100	95	821	95	0.56	52153

B. K, SOIL ERODIBILITY FACTOR: *Figure 3, SCS Ag. Handbook #537*

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
61						0.15	4.2
63						0.15	10.4
90						0.20	16.9
98						0.17	26.7
101						0.28	9
110						0.20	1
112						0.32	7.4
113						0.32	13.6
115						0.27	6.4
118						0.32	4.3
					Weighted K Factor:		0.23

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of *Fluvial Systems*", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	67.1	0.85	0.90	0.42	0.32	0.22
Commercial	2.8	0.82	0.31	0.12	0.03	0.00
Park	10.7	0.85	0.25	0.10	0.02	0.00
			Composite Weighted C Factor=			0.219

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths: 75 ft (Basin Average)

Slope Angles: 4.84 % (Basin Average)

n = 0.5

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.44

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	3736	0.23	0.44	0.22	1.00	82	0.02
Q-5	10006	0.23	0.44	0.22	1.00	220	0.06
Q-10	16448	0.23	0.44	0.22	1.00	362	0.09
Q-25	27724	0.23	0.44	0.22	1.00	610	0.16
Q-50	38011	0.23	0.44	0.22	1.00	837	0.21
Q-100	52153	0.23	0.44	0.22	1.00	1148	0.29
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**160**	**0.04**

Sub-Basin 390 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	1.09	sq. mi.
Area Contributing Sediment =	1.09	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	7.7	114	95	0.56	4238
Q-5	19	275	95	0.56	11362
Q-10	29	427	95	0.56	18599
Q-25	46	677	95	0.56	31165
Q-50	61	893	95	0.56	42497
Q-100	80	1179	95	0.56	58010

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
61						0.15	20.5
63						0.15	35.9
68						0.15	1.7
90						0.20	27.2
101						0.28	10.6
110						0.20	4.1
					Weighted K Factor:		0.18

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	65.8	0.85	0.90	0.42	0.32	0.21
LDR	34.2	0.78	0.63	0.37	0.18	0.06
			Composite Weighted C Factor=			0.274

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	100	ft	(Basin Average)
Slope Angles:	5.65	%	(Basin Average)
n =	0.5		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.62

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	4238	0.18	0.62	0.27	1.00	129	0.05
Q-5	11362	0.18	0.62	0.27	1.00	346	0.13
Q-10	18599	0.18	0.62	0.27	1.00	567	0.22
Q-25	31165	0.18	0.62	0.27	1.00	950	0.36
Q-50	42497	0.18	0.62	0.27	1.00	1295	0.50
Q-100	58010	0.18	0.62	0.27	1.00	1768	0.68
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**250**	**0.10**

Sub-Basin 400 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.62	sq. mi.
Area Contributing Sediment =	0.62	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	2.7	34	95	0.56	1182
Q-5	6.3	81	95	0.56	3126
Q-10	10	124	95	0.56	5037
Q-25	15	195	95	0.56	8363
Q-50	20	254	95	0.56	11245
Q-100	26	333	95	0.56	15229

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
98						0.17	20.5
112						0.32	35.9
113						0.32	1.7
115						0.27	27.2
					Weighted K Factor:		0.23

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	52.5	0.85	0.90	0.42	0.32	0.17
LDR	42.6	0.78	0.63	0.37	0.18	0.08
Park	4.9	0.85	0.25	0.10	0.02	0.00
			Composite Weighted C Factor=			0.246

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	75	ft	(Basin Average)
Slope Angles:	2.08	%	(Basin Average)
n =	0.3		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.19

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	1182	0.23	0.19	0.25	1.00	13	0.01
Q-5	3126	0.23	0.19	0.25	1.00	33	0.02
Q-10	5037	0.23	0.19	0.25	1.00	54	0.04
Q-25	8363	0.23	0.19	0.25	1.00	89	0.06
Q-50	11245	0.23	0.19	0.25	1.00	120	0.08
Q-100	15229	0.23	0.19	0.25	1.00	162	0.11
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**24**	**0.02**

Sub-Basin 420 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.85	sq. mi.	
Area Contributing Sediment =	0.85	sq. mi.	

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	5.1	70	95	0.56	2561
Q-5	12	168	95	0.56	6829
Q-10	19	260	95	0.56	11137
Q-25	30	411	95	0.56	18599
Q-50	40	540	95	0.56	25250
Q-100	52	710	95	0.56	34308

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
68						0.15	15.2
90						0.20	9
98						0.17	36.7
110						0.20	12.9
118						0.32	11
					Weighted K Factor:		0.16

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	21.3	0.85	0.90	0.42	0.32	0.07
LDR	78.7	0.78	0.63	0.37	0.18	0.14
			Composite Weighted C Factor=			0.212

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	75	ft	(Basin Average)
Slope Angles:	2.28	%	(Basin Average)
n =	0.3		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.20

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	2561	0.16	0.20	0.21	1.00	18	0.01
Q-5	6829	0.16	0.20	0.21	1.00	48	0.02
Q-10	11137	0.16	0.20	0.21	1.00	79	0.04
Q-25	18599	0.16	0.20	0.21	1.00	132	0.06
Q-50	25250	0.16	0.20	0.21	1.00	179	0.09
Q-100	34308	0.16	0.20	0.21	1.00	243	0.12
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						35	0.02

Sub-Basin 440 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.08	sq. mi.
Area Contributing Sediment =	0.08	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	1.0	25	95	0.56	569
Q-5	2.2	55	95	0.56	1376
Q-10	3.1	79	95	0.56	2064
Q-25	4.6	118	95	0.56	3235
Q-50	5.7	145	95	0.56	4075
Q-100	7.0	179	95	0.56	5159

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
44						0.10	5.5
61						0.15	43.2
63						0.15	51.4
					Weighted K Factor:		0.15

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	34	0.85	0.90	0.42	0.32	0.11
Open	66	0.95	1.00	0.44	0.42	0.28
			Composite Weighted C Factor=			0.385

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	300	ft	(Basin Average)
Slope Angles:	5.97	%	(Basin Average)
n =	0.5		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 1.15

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	569	0.15	1.15	0.39	1.00	37	0.19
Q-5	1376	0.15	1.15	0.39	1.00	90	0.47
Q-10	2064	0.15	1.15	0.39	1.00	135	0.71
Q-25	3235	0.15	1.15	0.39	1.00	212	1.11
Q-50	4075	0.15	1.15	0.39	1.00	267	1.39
Q-100	5159	0.15	1.15	0.39	1.00	338	1.76
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**61**	**0.32**

Sub-Basin 441 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area = 0.01 sq. mi.

Area Contributing Sediment = 0.01 sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.25	4	95	0.56	95
Q-5	0.50	8	95	0.56	206
Q-10	0.63	10	95	0.56	265
Q-25	0.81	13	95	0.56	356
Q-50	0.88	14	95	0.56	386
Q-100	1.0	16	95	0.56	449

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
44						0.10	40.6
68						0.15	59.4
					Weighted K Factor:		0.13

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
VLDR	100	0.85	0.76	0.40	0.26	0.26
			Composite Weighted C Factor=			0.258

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths: 50 ft (Basin Average)

Slope Angles: 5.97 % (Basin Average)

n = 0.5

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.47

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	95	0.13	0.47	0.26	1.00	2	0.06
Q-5	206	0.13	0.47	0.26	1.00	3	0.14
Q-10	265	0.13	0.47	0.26	1.00	4	0.17
Q-25	356	0.13	0.47	0.26	1.00	6	0.23
Q-50	386	0.13	0.47	0.26	1.00	6	0.25
Q-100	449	0.13	0.47	0.26	1.00	7	0.30
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**2**	**0.08**

Sub-Basin 442 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.1	sq. mi.
Area Contributing Sediment =	0.1	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.66	13	95	0.56	316
Q-5	1.5	29	95	0.56	775
Q-10	2.2	43	95	0.56	1205
Q-25	3.2	64	95	0.56	1882
Q-50	4.0	79	95	0.56	2382
Q-100	5.0	99	95	0.56	3067

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
68						0.15	100
					Weighted K Factor:		0.15

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

	Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
VLDR		100	0.85	0.76	0.40	0.26	0.26
				Composite Weighted C Factor=			0.258

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	75	ft	(Basin Average)
Slope Angles:	5.19	%	(Basin Average)
n =	0.5		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.48

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	316	0.15	0.48	0.26	1.00	6	0.02
Q-5	775	0.15	0.48	0.26	1.00	15	0.06
Q-10	1205	0.15	0.48	0.26	1.00	23	0.09
Q-25	1882	0.15	0.48	0.26	1.00	35	0.15
Q-50	2382	0.15	0.48	0.26	1.00	45	0.19
Q-100	3067	0.15	0.48	0.26	1.00	57	0.24
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**10**	**0.04**

Sub-Basin 443 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area = 0.08 sq. mi.

Area Contributing Sediment = 0.08 sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	1.1	20	95	0.56	535
Q-5	2.5	45	95	0.56	1327
Q-10	3.6	65	95	0.56	2004
Q-25	5.3	96	95	0.56	3101
Q-50	6.5	118	95	0.56	3908
Q-100	8.0	146	95	0.56	4960

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
44						0.1	61.3
63						0.15	25.2
68						0.15	13.5
					Weighted K Factor:		0.12

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Open	26	0.95	1.00	0.44	0.42	0.11
VLDR	74	0.85	0.76	0.40	0.26	0.19
			Composite Weighted C Factor=			0.300

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths: 50 ft (Basin Average)

Slope Angles: 5.97 % (Basin Average)

n = 0.5

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.47

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	535	0.12	0.47	0.30	1.00	9	0.05
Q-5	1327	0.12	0.47	0.30	1.00	22	0.12
Q-10	2004	0.12	0.47	0.30	1.00	34	0.18
Q-25	3101	0.12	0.47	0.30	1.00	52	0.27
Q-50	3908	0.12	0.47	0.30	1.00	66	0.34
Q-100	4960	0.12	0.47	0.30	1.00	84	0.44
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**15**	**0.08**

Sub-Basin 444 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area = 0.04 sq. mi.

Area Contributing Sediment = 0.04 sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.32	13	95	0.56	211
Q-5	0.69	28	95	0.56	499
Q-10	1.0	39	95	0.56	724
Q-25	1.4	57	95	0.56	1107
Q-50	1.7	67	95	0.56	1327
Q-100	2.0	81	95	0.56	1641

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
61						0.15	47.3
63						0.15	2.3
68						0.15	50.4
					Weighted K Factor:		0.15

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	10.9	0.85	0.90	0.42	0.32	0.04
Open	89.1	0.95	1.00	0.44	0.42	0.37
			Composite Weighted C Factor=			0.407

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths: 300 ft (Basin Average)

Slope Angles: 5.97 % (Basin Average)

n = 0.5

Eq'n 8.4 ADWR Manual, Appendix B

LS = 1.15

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	211	0.15	1.15	0.41	1.00	15	0.16
Q-5	499	0.15	1.15	0.41	1.00	35	0.37
Q-10	724	0.15	1.15	0.41	1.00	51	0.53
Q-25	1107	0.15	1.15	0.41	1.00	78	0.81
Q-50	1327	0.15	1.15	0.41	1.00	94	0.98
Q-100	1641	0.15	1.15	0.41	1.00	116	1.21
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**23**	**0.24**

Sub-Basin 445 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.19	sq. mi.
Area Contributing Sediment =	0.19	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	1.1	34	95	0.56	708
Q-5	2.4	78	95	0.56	1795
Q-10	3.6	116	95	0.56	2799
Q-25	5.6	178	95	0.56	4522
Q-50	7.1	226	95	0.56	5908
Q-100	9.0	288	95	0.56	7751

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permeability	K	% of Basin
61						0.15	5.5
63						0.15	3.7
68						0.15	90.8
					Weighted K Factor:		0.15

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Open	62.9	0.95	1.00	0.44	0.42	0.26
VLDR	37.1	0.85	0.76	0.40	0.26	0.10
			Composite Weighted C Factor=			0.359

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	100	ft	(Basin Average)
Slope Angles:	5.97	%	(Basin Average)
n =	0.5		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.67

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	708	0.15	0.67	0.36	1.00	25	0.06
Q-5	1795	0.15	0.67	0.36	1.00	64	0.14
Q-10	2799	0.15	0.67	0.36	1.00	100	0.22
Q-25	4522	0.15	0.67	0.36	1.00	162	0.36
Q-50	5908	0.15	0.67	0.36	1.00	212	0.47
Q-100	7751	0.15	0.67	0.36	1.00	278	0.61
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**45**	**0.10**

Sub-Basin 446 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.04	sq. mi.
Area Contributing Sediment =	0.04	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.52	11	95	0.56	251
Q-5	1.0	22	95	0.56	546
Q-10	1.5	31	95	0.56	801
Q-25	2.1	45	95	0.56	1216
Q-50	2.5	53	95	0.56	1461
Q-100	3.0	64	95	0.56	1805

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
44						0.1	24.2
68						0.15	75.8
					Weighted K Factor:		0.14

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
VLDR	44.1	0.85	0.76	0.40	0.26	0.11
MDR	55.9	0.78	0.63	0.20	0.10	0.05
			Composite Weighted C Factor=			0.169

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	50	ft	(Basin Average)
Slope Angles:	5.76	%	(Basin Average)
n =	0.5		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.45

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	251	0.14	0.45	0.17	1.00	3	0.03
Q-5	546	0.14	0.45	0.17	1.00	6	0.06
Q-10	801	0.14	0.45	0.17	1.00	8	0.09
Q-25	1216	0.14	0.45	0.17	1.00	13	0.13
Q-50	1461	0.14	0.45	0.17	1.00	15	0.16
Q-100	1805	0.14	0.45	0.17	1.00	19	0.20
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**4**	**0.04**

Sub-Basin 447 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.09	sq. mi.
Area Contributing Sediment =	0.09	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	1.1	18	95	0.56	497
Q-5	2.4	41	95	0.56	1250
Q-10	3.5	59	95	0.56	1879
Q-25	5.2	88	95	0.56	2940
Q-50	6.5	109	95	0.56	3736
Q-100	8.0	135	95	0.56	4747

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
68						0.15	90.3
115						0.27	9.7
					Weighted K Factor:		0.16

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

	Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
MDR		100	0.78	0.63	0.20	0.10	0.10
				Composite Weighted C Factor=			0.098

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	75	ft	(Basin Average)
Slope Angles:	4.19	%	(Basin Average)
n =	0.4		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.37

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	497	0.16	0.37	0.10	1.00	3	0.01
Q-5	1250	0.16	0.37	0.10	1.00	7	0.03
Q-10	1879	0.16	0.37	0.10	1.00	11	0.05
Q-25	2940	0.16	0.37	0.10	1.00	17	0.08
Q-50	3736	0.16	0.37	0.10	1.00	22	0.10
Q-100	4747	0.16	0.37	0.10	1.00	28	0.13
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**5**	**0.02**

Sub-Basin 448 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.05	sq. mi.
Area Contributing Sediment =	0.05	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.48	14	95	0.56	277
Q-5	1.0	29	95	0.56	626
Q-10	1.4	41	95	0.56	923
Q-25	2.1	60	95	0.56	1414
Q-50	2.5	72	95	0.56	1734
Q-100	3.0	87	95	0.56	2143

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
63						0.15	36.8
68						0.15	63.2
					Weighted K Factor:		0.15

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Open	63.5	0.95	1.00	0.44	0.42	0.27
VLDR	36.5	0.85	0.76	0.40	0.26	0.09
			Composite Weighted C Factor=			0.360

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	200	ft	(Basin Average)
Slope Angles:	5.97	%	(Basin Average)
n =	0.5		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.94

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	277	0.15	0.94	0.36	1.00	14	0.12
Q-5	626	0.15	0.94	0.36	1.00	32	0.27
Q-10	923	0.15	0.94	0.36	1.00	47	0.39
Q-25	1414	0.15	0.94	0.36	1.00	72	0.60
Q-50	1734	0.15	0.94	0.36	1.00	88	0.74
Q-100	2143	0.15	0.94	0.36	1.00	109	0.91
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**22**	**0.18**

Sub-Basin 449 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area = 0.05 sq. mi.

Area Contributing Sediment = 0.05 sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.47	12	95	0.56	250
Q-5	1.0	26	95	0.56	593
Q-10	1.4	36	95	0.56	854
Q-25	2.1	53	95	0.56	1317
Q-50	2.5	63	95	0.56	1599
Q-100	3.0	77	95	0.56	2001

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
63						0.15	9.7
68						0.15	90.3
					Weighted K Factor:		0.15

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Open	20.6	0.95	1.00	0.44	0.42	0.09
VLDR	79.4	0.85	0.76	0.40	0.26	0.21
			Composite Weighted C Factor=			0.291

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths: 75 ft (Basin Average)

Slope Angles: 5.97 % (Basin Average)

n = 0.5

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.58

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	250	0.15	0.58	0.29	1.00	6	0.05
Q-5	593	0.15	0.58	0.29	1.00	15	0.12
Q-10	854	0.15	0.58	0.29	1.00	22	0.18
Q-25	1317	0.15	0.58	0.29	1.00	33	0.28
Q-50	1599	0.15	0.58	0.29	1.00	40	0.34
Q-100	2001	0.15	0.58	0.29	1.00	50	0.42
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**10**	**0.08**

Sub-Basin 450 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.07	sq. mi.
Area Contributing Sediment =	0.07	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.41	8	95	0.56	186
Q-5	0.93	18	95	0.56	461
Q-10	1.3	26	95	0.56	695
Q-25	2.0	39	95	0.56	1095
Q-50	2.4	47	95	0.56	1349
Q-100	3.0	58	95	0.56	1708

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
63						0.15	13.2
68						0.15	74.6
90						0.20	12.3
					Weighted K Factor:		0.16

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	93.8	0.85	0.90	0.42	0.32	0.30
Open	3.3	0.95	1.00	0.44	0.42	0.01
MDR	2.9	0.78	0.63	0.20	0.10	0.00
			Composite Weighted C Factor=			0.318

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	75	ft	(Basin Average)
Slope Angles:	3.99	%	(Basin Average)
n =	0.4		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.35

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	186	0.16	0.35	0.32	1.00	3	0.02
Q-5	461	0.16	0.35	0.32	1.00	8	0.05
Q-10	695	0.16	0.35	0.32	1.00	12	0.07
Q-25	1095	0.16	0.35	0.32	1.00	19	0.11
Q-50	1349	0.16	0.35	0.32	1.00	24	0.14
Q-100	1708	0.16	0.35	0.32	1.00	30	0.18
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						5	0.03

Sub-Basin 451 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area = 0.03 sq. mi.

Area Contributing Sediment = 0.03 sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.18	3	95	0.56	67
Q-5	0.35	6	95	0.56	145
Q-10	0.53	9	95	0.56	228
Q-25	0.71	12	95	0.56	314
Q-50	0.82	14	95	0.56	374
Q-100	1.0	17	95	0.56	464

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
68						0.15	100
					Weighted K Factor:		0.15

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	91.2	0.85	0.90	0.42	0.32	0.29
MDR	8.8	0.78	0.63	0.20	0.10	0.01
			Composite Weighted C Factor=			0.302

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths: 50 ft (Basin Average)

Slope Angles: 3.31 % (Basin Average)

n = 0.3

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.26

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	67	0.15	0.26	0.30	1.00	1	0.01
Q-5	145	0.15	0.26	0.30	1.00	2	0.02
Q-10	228	0.15	0.26	0.30	1.00	3	0.04
Q-25	314	0.15	0.26	0.30	1.00	4	0.05
Q-50	374	0.15	0.26	0.30	1.00	4	0.06
Q-100	464	0.15	0.26	0.30	1.00	5	0.07
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						1	0.02

Sub-Basin 452 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.04	sq. mi.
Area Contributing Sediment =	0.04	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.33	10	95	0.56	185
Q-5	0.69	21	95	0.56	424
Q-10	1.0	30	95	0.56	632
Q-25	1.4	43	95	0.56	946
Q-50	1.7	51	95	0.56	1145
Q-100	2.0	61	95	0.56	1400

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
63						0.15	18.8
68						0.15	81.2
					Weighted K Factor:		0.15

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Open	19.1	0.95	1.00	0.44	0.42	0.08
VLDR	80.9	0.85	0.76	0.40	0.26	0.21
			Composite Weighted C Factor=			0.289

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	50	ft	(Basin Average)
Slope Angles:	5.97	%	(Basin Average)
n =	0.5		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.47

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	185	0.15	0.47	0.29	1.00	4	0.04
Q-5	424	0.15	0.47	0.29	1.00	9	0.09
Q-10	632	0.15	0.47	0.29	1.00	13	0.13
Q-25	946	0.15	0.47	0.29	1.00	19	0.20
Q-50	1145	0.15	0.47	0.29	1.00	23	0.24
Q-100	1400	0.15	0.47	0.29	1.00	29	0.30
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**6**	**0.06**

Sub-Basin 453 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.06	sq. mi.
Area Contributing Sediment =	0.06	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.6	9	95	0.56	244
Q-5	1.3	19	95	0.56	564
Q-10	1.9	28	95	0.56	871
Q-25	2.7	40	95	0.56	1298
Q-50	3.3	49	95	0.56	1630
Q-100	4.0	60	95	0.56	2045

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
68						0.15	100
					Weighted K Factor:		0.15

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	41.4	0.85	0.90	0.42	0.32	0.13
MDR	58.6	0.78	0.63	0.20	0.10	0.06
			Composite Weighted C Factor=			0.191

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	75	ft	(Basin Average)
Slope Angles:	2.61	%	(Basin Average)
n =	0.3		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.23

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	244	0.15	0.23	0.19	1.00	2	0.01
Q-5	564	0.15	0.23	0.19	1.00	4	0.03
Q-10	871	0.15	0.23	0.19	1.00	6	0.04
Q-25	1298	0.15	0.23	0.19	1.00	9	0.06
Q-50	1630	0.15	0.23	0.19	1.00	11	0.07
Q-100	2045	0.15	0.23	0.19	1.00	13	0.09
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						3	0.02

Sub-Basin 454 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.18	sq. mi.
Area Contributing Sediment =	0.18	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	1.4	18	95	0.56	584
Q-5	3.3	42	95	0.56	1508
Q-10	4.9	62	95	0.56	2332
Q-25	7.4	94	95	0.56	3717
Q-50	9.4	119	95	0.56	4840
Q-100	12	152	95	0.56	6366

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
63						0.15	5.9
68						0.15	42.4
90						0.20	51.6
					Weighted K Factor:		0.18

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	54.3	0.85	0.90	0.42	0.32	0.17
Open	2.7	0.95	1.00	0.44	0.42	0.01
MDR	43.1	0.78	0.63	0.20	0.10	0.04
			Composite Weighted C Factor=			0.228

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	75	ft	(Basin Average)
Slope Angles:	3.08	%	(Basin Average)
n =	0.3		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.27

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	584	0.18	0.27	0.23	1.00	6	0.01
Q-5	1508	0.18	0.27	0.23	1.00	16	0.04
Q-10	2332	0.18	0.27	0.23	1.00	25	0.06
Q-25	3717	0.18	0.27	0.23	1.00	40	0.09
Q-50	4840	0.18	0.27	0.23	1.00	52	0.12
Q-100	6366	0.18	0.27	0.23	1.00	69	0.16
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**11**	**0.03**

Sub-Basin 455 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area = 1.56 sq. mi.

Area Contributing Sediment = 1.56 sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	11	146	95	0.56	5954
Q-5	27	353	95	0.56	16005
Q-10	42	550	95	0.56	26299
Q-25	67	877	95	0.56	44350
Q-50	88	1163	95	0.56	60840
Q-100	117	1541	95	0.56	83383

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
61						0.15	4.8
63						0.15	7.1
68						0.15	49.4
90						0.2	8.8
98						0.17	0.9
110						0.2	1.8
115						0.27	26.4
118						0.32	0.8
					Weighted K Factor:		0.19

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	24.1	0.85	0.90	0.42	0.32	0.08
LDR	22.7	0.78	0.63	0.37	0.18	0.04
MDR	52.4	0.78	0.63	0.20	0.10	0.05
MFR	0.4	0.78	0.63	0.20	0.10	0.00
Commercial	0.5	0.82	0.31	0.12	0.03	0.00
			Composite Weighted C Factor=			0.171

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths: 50 ft (Basin Average)

Slope Angles: 5.1 % (Basin Average)

n = 0.5

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.39

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	5954	0.19	0.39	0.17	1.00	74	0.02
Q-5	16005	0.19	0.39	0.17	1.00	199	0.05
Q-10	26299	0.19	0.39	0.17	1.00	327	0.09
Q-25	44350	0.19	0.39	0.17	1.00	552	0.15
Q-50	60840	0.19	0.39	0.17	1.00	757	0.20
Q-100	83383	0.19	0.39	0.17	1.00	1037	0.28
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**145**	**0.04**

Sub-Basin 456 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area = 0.26 sq. mi.

Area Contributing Sediment = 0.26 sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	2.2	52	95	0.56	1336
Q-5	5.0	120	95	0.56	3407
Q-10	7.5	180	95	0.56	5366
Q-25	12	278	95	0.56	8731
Q-50	15	356	95	0.56	11518
Q-100	19	458	95	0.56	15273

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
61						0.15	37.3
63						0.15	47.4
68						0.15	15.4
					Weighted K Factor:		0.15

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	81.9	0.85	0.90	0.42	0.32	0.26
Open	18.1	0.95	1.00	0.44	0.42	0.08
			Composite Weighted C Factor=			0.339

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths: 300 ft (Basin Average)

Slope Angles: 5.97 % (Basin Average)

n = 0.5

Eq'n 8.4 ADWR Manual, Appendix B

LS = 1.15

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	1336	0.15	1.15	0.34	1.00	78	0.13
Q-5	3407	0.15	1.15	0.34	1.00	200	0.32
Q-10	5366	0.15	1.15	0.34	1.00	315	0.51
Q-25	8731	0.15	1.15	0.34	1.00	513	0.82
Q-50	11518	0.15	1.15	0.34	1.00	676	1.09
Q-100	15273	0.15	1.15	0.34	1.00	897	1.44
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**141**	**0.23**

Sub-Basin 457 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.19	sq. mi.
Area Contributing Sediment =	0.19	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	1.3	30	95	0.56	739
Q-5	3.0	69	95	0.56	1878
Q-10	4.5	103	95	0.56	2942
Q-25	6.8	157	95	0.56	4716
Q-50	8.6	199	95	0.56	6151
Q-100	11	254	95	0.56	8084

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
61						0.15	21.5
63						0.15	7.8
68						0.15	65.4
115						0.27	5.3
					Weighted K Factor:		0.16

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	52.9	0.85	0.90	0.42	0.32	0.17
Open	25.1	0.95	1.00	0.44	0.42	0.10
VLDR	10.9	0.85	0.76	0.40	0.26	0.03
MDR	11.1	0.78	0.63	0.20	0.10	0.01
			Composite Weighted C Factor=			0.314

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	100	ft	(Basin Average)
Slope Angles:	5.85	%	(Basin Average)
n =	0.5		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.65

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	739	0.16	0.65	0.31	1.00	24	0.05
Q-5	1878	0.16	0.65	0.31	1.00	60	0.13
Q-10	2942	0.16	0.65	0.31	1.00	94	0.21
Q-25	4716	0.16	0.65	0.31	1.00	150	0.33
Q-50	6151	0.16	0.65	0.31	1.00	196	0.43
Q-100	8084	0.16	0.65	0.31	1.00	258	0.57
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**42**	**0.09**

Sub-Basin 458 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.19	sq. mi.
Area Contributing Sediment =	0.19	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	1.5	41	95	0.56	967
Q-5	3.5	94	95	0.56	2448
Q-10	5.2	140	95	0.56	3825
Q-25	8.1	215	95	0.56	6184
Q-50	10	272	95	0.56	8048
Q-100	13	347	95	0.56	10571

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
61						0.15	87.9
63						0.15	21.4
68						0.15	2.1
115						0.27	10.2
					Weighted K Factor:		0.19

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	41.4	0.85	0.90	0.42	0.32	0.13
Open	14.1	0.95	1.00	0.44	0.42	0.06
VLDR	44.6	0.85	0.76	0.40	0.26	0.12
			Composite Weighted C Factor=			0.307

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	100	ft	(Basin Average)
Slope Angles:	5.66	%	(Basin Average)
n =	0.5		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.62

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	967	0.19	0.62	0.31	1.00	36	0.08
Q-5	2448	0.19	0.62	0.31	1.00	91	0.20
Q-10	3825	0.19	0.62	0.31	1.00	142	0.31
Q-25	6184	0.19	0.62	0.31	1.00	230	0.51
Q-50	8048	0.19	0.62	0.31	1.00	299	0.66
Q-100	10571	0.19	0.62	0.31	1.00	393	0.86
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**64**	**0.14**

Sub-Basin 459 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.03	sq. mi.
Area Contributing Sediment =	0.03	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.37	8	95	0.56	175
Q-5	0.74	16	95	0.56	380
Q-10	1.0	22	95	0.56	543
Q-25	1.4	31	95	0.56	798
Q-50	1.7	36	95	0.56	943
Q-100	2	43	95	0.56	1151

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
68						0.15	94.8
115						0.27	5.2
					Weighted K Factor:		0.16

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	3.6	0.85	0.90	0.42	0.32	0.01
Open	35.4	0.95	1.00	0.44	0.42	0.15
VLDR	40.6	0.85	0.76	0.40	0.26	0.10
MDR	20.3	0.78	0.63	0.20	0.10	0.02
			Composite Weighted C Factor=			0.284

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	75	ft	(Basin Average)
Slope Angles:	4.77	%	(Basin Average)
n =	0.5		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.44

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	175	0.16	0.44	0.28	1.00	3	0.05
Q-5	380	0.16	0.44	0.28	1.00	7	0.10
Q-10	543	0.16	0.44	0.28	1.00	11	0.15
Q-25	798	0.16	0.44	0.28	1.00	15	0.22
Q-50	943	0.16	0.44	0.28	1.00	18	0.25
Q-100	1151	0.16	0.44	0.28	1.00	22	0.31
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						5	0.07

Sub-Basin 460 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.14	sq. mi.
Area Contributing Sediment =	0.14	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	1.5	26	95	0.56	745
Q-5	3.4	58	95	0.56	1830
Q-10	5.0	85	95	0.56	2808
Q-25	7.6	129	95	0.56	4481
Q-50	9.5	162	95	0.56	5783
Q-100	12	205	95	0.56	7527

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
68						0.15	33.2
115						0.27	66.8
					Weighted K Factor:		0.23

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
MDR	90.5	0.78	0.63	0.20	0.10	0.09
Park	9.5	0.85	0.25	0.10	0.02	0.00
			Composite Weighted C Factor=			0.091

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	75	ft	(Basin Average)
Slope Angles:	3.67	%	(Basin Average)
n =	0.4		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.32

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	745	0.23	0.32	0.09	1.00	5	0.02
Q-5	1830	0.23	0.32	0.09	1.00	12	0.04
Q-10	2808	0.23	0.32	0.09	1.00	19	0.06
Q-25	4481	0.23	0.32	0.09	1.00	30	0.09
Q-50	5783	0.23	0.32	0.09	1.00	39	0.12
Q-100	7527	0.23	0.32	0.09	1.00	51	0.15
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**9**	**0.03**

Sub-Basin 461 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.12	sq. mi.
Area Contributing Sediment =	0.12	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	1.9	8	20	0.56	91
Q-5	3.7	16	45	0.56	444
Q-10	5.1	22	66	0.56	930
Q-25	7.2	31	99	0.56	2047
Q-50	8.4	36	1214	0.56	29685
Q-100	10	43	156	0.56	4654

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
61						0.15	10.8
63						0.15	2.1
68						0.15	2.1
115						0.27	85
					Weighted K Factor:		0.25

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
VLDR	57.2	0.85	0.76	0.40	0.26	0.15
MDR	34.4	0.78	0.63	0.20	0.10	0.03
Commercial	8.5	0.82	0.31	0.12	0.03	0.00
			Composite Weighted C Factor=			0.184

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	50	ft	(Basin Average)
Slope Angles:	3.42	%	(Basin Average)
n =	0.3		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.26

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	91	0.25	0.26	0.18	1.00	1	0.00
Q-5	444	0.25	0.26	0.18	1.00	5	0.02
Q-10	930	0.25	0.26	0.18	1.00	11	0.04
Q-25	2047	0.25	0.26	0.18	1.00	25	0.09
Q-50	29685	0.25	0.26	0.18	1.00	365	1.27
Q-100	4654	0.25	0.26	0.18	1.00	57	0.20
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**10**	**0.03**

Sub-Basin 462 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.3	sq. mi.
Area Contributing Sediment =	0.3	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	2.4	58	95	0.56	1521
Q-5	5.7	135	95	0.56	3918
Q-10	8.6	204	95	0.56	6222
Q-25	13	315	95	0.56	10121
Q-50	17	405	95	0.56	13411
Q-100	22	523	95	0.56	17858

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
61						0.15	68.1
63						0.15	10.4
68						0.15	20.5
115						0.27	1.1
					Weighted K Factor:		0.15

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	56.8	0.85	0.90	0.42	0.32	0.18
Open	5.8	0.95	1.00	0.44	0.42	0.02
VLDR	27.1	0.85	0.76	0.40	0.26	0.07
MDR	0.4	0.78	0.63	0.20	0.10	0.00
Commercial	10	0.82	0.31	0.12	0.03	0.00
			Composite Weighted C Factor=			0.280

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	100	ft	(Basin Average)
Slope Angles:	5.64	%	(Basin Average)
n =	0.5		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.62

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	1521	0.15	0.62	0.28	1.00	40	0.06
Q-5	3918	0.15	0.62	0.28	1.00	103	0.14
Q-10	6222	0.15	0.62	0.28	1.00	164	0.23
Q-25	10121	0.15	0.62	0.28	1.00	266	0.37
Q-50	13411	0.15	0.62	0.28	1.00	353	0.49
Q-100	17858	0.15	0.62	0.28	1.00	470	0.65
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						73	0.10

Sub-Basin 480 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area =	0.73	sq. mi.
Area Contributing Sediment =	0.73	sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	5.9	99	95	0.56	3363
Q-5	14	237	95	0.56	8940
Q-10	22	365	95	0.56	14500
Q-25	34	576	95	0.56	24170
Q-50	45	755	95	0.56	32727
Q-100	59	991	95	0.56	44382

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
63						0.15	9.2
68						0.15	74.5
115						0.27	16.3
					Weighted K Factor:		0.17

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	5.5	0.85	0.90	0.42	0.32	0.02
LDR	46.3	0.78	0.63	0.37	0.18	0.08
MDR	36.6	0.78	0.63	0.20	0.10	0.04
MFR	5	0.78	0.63	0.20	0.10	0.00
Commercial	6.7	0.82	0.31	0.12	0.03	0.00
			Composite Weighted C Factor=			0.145

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths:	75	ft	(Basin Average)
Slope Angles:	3.13	%	(Basin Average)
n =	0.3		

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.27

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	3363	0.17	0.27	0.14	1.00	23	0.01
Q-5	8940	0.17	0.27	0.14	1.00	60	0.03
Q-10	14500	0.17	0.27	0.14	1.00	97	0.06
Q-25	24170	0.17	0.27	0.14	1.00	162	0.09
Q-50	32727	0.17	0.27	0.14	1.00	220	0.13
Q-100	44382	0.17	0.27	0.14	1.00	298	0.17
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**43**	**0.02**

Sub-Basin 500 (Spook Hill) - Sedimentation Analysis

Sediment Yield Computation

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b

Hydrographs for Spook Hill, based on WPA HEC-1 & Region 13 Q Eq'ns (USGS WSP 2433)

Drainage Area = 0.93 sq. mi.

Area Contributing Sediment = 0.93 sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	6.4	97	95	0.56	3476
Q-5	15	233	95	0.56	9275
Q-10	24	360	95	0.56	15099
Q-25	38	570	95	0.56	25262
Q-50	49	750	95	0.56	34353
Q-100	65	988	95	0.56	46776

B. K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
61						0.15	62
63						0.15	35
113						0.32	3
					Weighted K Factor:		0.16

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran Desert	100	0.85	0.90	0.42	0.32	0.32
			Composite Weighted C Factor=			0.321

D. LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)

Slope Lengths: 150 ft (Basin Average)

Slope Angles: 5.43 % (Basin Average)

n = 0.5

Eq'n 8.4 ADWR Manual, Appendix B

LS = 0.72

E. P, EROSION CONTROL FACTOR

No Practice, Natural or Regulated

Weighted P for Contributing Watershed = 1

F. RESULTS:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	3476	0.16	0.72	0.32	1.00	125	0.06
Q-5	9275	0.16	0.72	0.32	1.00	334	0.15
Q-10	15099	0.16	0.72	0.32	1.00	544	0.24
Q-25	25262	0.16	0.72	0.32	1.00	911	0.41
Q-50	34353	0.16	0.72	0.32	1.00	1238	0.56
Q-100	46776	0.16	0.72	0.32	1.00	1686	0.76
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**241**	**0.11**

Section 7

Existing Conditions 100-year 24-hour HEC-1 Results and Parameters Used in the Sediment Yield Calculations

Spook Hill ADMP Update
Existing Conditions 100-year 24-hour HEC-1 Results

KK ID	Peak Flow (cfs)	Time to Peak(hrs)	Volume (ac-ft)	Area (sq.mi.)
20	1130	12.57	128	1.82
40	2286	12.27	131	2.23
60	1405	12.37	122	1.75
60C	4438	12.3	375	5.8
SR60	92	14.77	292	5.8
R60	92	14.83	292	5.8
RR60	92	14.93	291	5.8
80	1693	12.2	92	1.48
80C	1767	12.2	384	1.48
R80	1767	12.23	384	1.48
100	389	12.33	29	0.48
100C	2119	12.23	412	1.96
R100	2113	12.27	411	1.96
120	2960	12.2	175	2.2
120C	4983	12.23	583	4.16
R120	4943	12.27	582	4.16
140	598	12.23	33	0.6
160	588	12.3	45	0.78
180	694	12.33	45	1
180C	6685	12.27	698	6.54
240	770	12.3	54	1.04
R240	760	12.37	54	1.04
220	1427	12.23	85	1.25
220C	2088	12.27	138	2.29
R220	2057	12.3	138	2.29
200	2059	12.23	128	1.81
200C	3995	12.27	263	4.1
R200	3967	12.3	263	4.1
C180	10514	12.27	952	10.64
SR180	141	15.2	481	10.64
R180	141	15.3	479	10.64
260	401	12.17	24	0.27
260C	515	12.17	509	0.27
R260	500	12.23	507	0.27
280	452	12.13	23	0.3
280C	908	12.17	529	0.57
R280	889	12.27	527	0.57
300	824	12.3	58	0.99
300C	1686	12.27	582	1.56
R300	1664	12.33	580	1.56
RR300	1641	12.4	579	1.56
320	889	12.43	93	1.53
D320	889	12.43	80	1.53
RT320	390	12.07	12	1.53
C320	2503	12.4	668	3.09
340	1381	12.27	109	1.45
D340	1219	12.4	53	1.45
RT340	1381	12.27	56	1.45
C340	3709	12.4	774	4.53

Spook Hill ADMP Update
Existing Conditions 100-year 24-hour HEC-1 Results

KK ID	Peak Flow (cfs)	Time to Peak(hrs)	Volume (ac-ft)	Area (sq.mi.)
350	1102	12.17	53	0.97
RR350	941	12.57	53	0.97
360	668	12.5	84	1.33
D360	657	12.57	56	1.33
RT360	655	12.43	29	1.33
SR360	10	9.47	29	1.33
360C	4557	12.53	906	6.83
380	821	12.5	95	1.64
D380	821	12.5	66	1.64
RT380	779	12.4	29	1.64
SR380	10	10.3	29	1.64
380C	5348	12.53	996	8.47
390	1179	12.2	80	1.09
D390	1179	12.2	76	1.09
RT390	7	8.13	3	1.09
SR390	1	0.5	3	1.09
390C	1180	12.2	80	1.09
RR390	1102	12.4	80	1.09
400	333	12.37	26	0.62
400C	6543	12.53	1096	10.18
420	710	12.3	52	0.85
D420	710	12.3	43	0.85
RT420	259	12	9	0.85
SR420	13	11.1	9	0.85
420C	6931	12.53	1141	11.03
440	179	12	7	0.08
R60	174	12.03	7	0.08
441	16	12.07	1	0.01
C108	189	12.03	7	0.09
DIV4	95	12.03	4	0.09
R108	84	12.1	4	0.09
442	99	12.13	5	0.1
C67	180	12.1	8	0.19
DIV6	68	12.1	5	0.19
RTDIV6	112	12.1	3	0.19
CDIV6	69	12.1	8	0.19
443	146	12.07	8	0.08
DIV66	68	12.07	1	0.08
R113	66	12.1	1	0.08
C114	133	12.1	9	0.27
444	81	12	2	0.04
R58	74	12.07	2	0.04
445	288	12.07	9	0.19
C107	360	12.07	11	0.23
R107	359	12.07	11	0.23
RTB2	95	12.03	4	0.09
RSPLIT	94	12.07	4	0.09
446	64	12.07	3	0.04
C109	513	12.07	18	0.27

Spook Hill ADMP Update
Existing Conditions 100-year 24-hour HEC-1 Results

KK ID	Peak Flow (cfs)	Time to Peak(hrs)	Volume (ac-ft)	Area (sq.mi.)
DIV5	478	12.07	14	0.27
R109	465	12.1	14	0.27
447	135	12.07	8	0.09
RT404	35	11.73	5	0.27
R404	35	11.9	5	0.27
C110	628	12.1	26	0.36
R110	629	12.1	26	0.36
C115	756	12.1	35	0.63
R115	755	12.1	35	0.63
448	87	12.03	3	0.05
449	77	12.03	3	0.05
C6364	163	12.03	6	0.09
R6364	140	12.2	6	0.09
450	58	12.17	3	0.07
451	17	12.17	1	0.03
RT66	78	11.9	6	0.08
452	61	12.07	2	0.04
C6566	139	12.07	9	0.04
R6566	131	12.13	9	0.04
C116	336	12.17	19	0.23
BASIN5	152	12.47	19	0.23
R116	151	12.53	19	0.23
453	60	12.13	4	0.06
C117	172	12.5	22	0.29
C118	835	12.1	57	0.92
R118	830	12.13	57	0.92
DIV7	624	12.13	50	0.92
RTDIV7	206	12.13	6	0.92
RFDIV7	1	11.93	4	0.92
CDIV7	625	12.13	54	0.92
454	152	12.23	12	0.18
R454	674	12.4	65	1.1
455	1541	12.23	117	1.56
D455	893	12.5	43	1.56
RT455	1541	12.23	74	1.56
SR455	25	9.73	74	1.56
C455	918	12.5	117	1.56
455C	7873	12.53	1306	13.68
SR440	806	14.07	1306	13.68
RR455	806	14.37	1297	13.68
456	458	12.07	19	0.26
DIV1	259	12.07	16	0.26
DIV2	195	12.07	11	0.26
R456	191	12.17	11	0.26
457	254	12.1	11	0.19
C101	438	12.1	22	0.45
DIV3	302	12.1	18	0.45
RTDIV3	136	12.1	4	0.45
RFDIV3	2	11.9	4	0.45

Spook Hill ADMP Update
Existing Conditions 100-year 24-hour HEC-1 Results

KK ID	Peak Flow (cfs)	Time to Peak(hrs)	Volume (ac-ft)	Area (sq.mi.)
CDIV3	304	12.1	22	0.45
R101	301	12.13	22	0.45
458	347	12.07	13	0.19
C103	625	12.07	34	0.64
R103	624	12.1	34	0.64
RT30	65	12.07	5	0.26
R30	64	12.1	5	0.26
RTB1	198	12.07	4	0.26
B1	36	12.23	4	0.26
RB1	36	12.3	4	0.26
CDIV	94	12.23	8	0.12
459	43	12.07	2	0.03
C52	118	12.17	10	0.15
R52	116	12.2	10	0.15
460	205	12.1	12	0.14
C102	310	12.1	21	0.29
BASIN3	75	12.6	21	0.29
R3	75	12.73	21	0.29
461	156	12.13	10	0.12
C104	216	12.13	31	0.41
C106	833	12.1	65	1.05
R106	799	12.17	65	1.05
462	523	12.07	22	0.3
480	991	12.13	59	0.73
D480	991	12.13	42	0.73
RT480	458	11.93	17	0.73
SR480	6	3.9	17	0.73
C480	997	12.13	59	0.73
480C	2497	12.13	1480	2.09
RR480	2439	12.2	1478	2.09
500	988	12.23	65	0.93
500C	3396	12.2	1537	2.84

Spook Hill ADMP Update
Existing Conditions HEC-1 Results and Parameters for Sediment Yield Calculations

	KK	Peak Flow	Time to	Volume	Area	Q/A	Length	High Elev	Low Elev	Slope	Slope	Adj. Slope	Adj Slope	Kb
	ID	(cfs)	Peak (hrs)	(ac-ft)	(sq.mi.)	(cfs/sq.mi.)	(miles)	(ft)	(ft)	(ft/mi)	(ft/ft)	(ft/mile)	(ft/ft)	
	20	1,130	12.57	128	1.82	621	4.58	2350	1810	118	0.0223	118	0.0223	0.037
	40	2,286	12.27	131	2.23	1,025	3.08	2373	1790	189	0.0358	189	0.0358	0.036
	60	1,405	12.37	122	1.75	803	4.19	2685	1800	211	0.0400	210	0.0397	0.038
AJ FRS	60C	4,438	12.30	375	5.80	765								
	80	1,693	12.20	92	1.48	1,144	2.69	2400	1770	234	0.0444	230	0.0435	0.039
	100	389	12.33	29	0.48	810	1.94	1950	1740	108	0.0205	108	0.0205	0.046
	120	2,960	12.20	175	2.20	1,345	3.07	2500	1740	248	0.0469	239	0.0453	0.037
	140	598	12.23	33	0.60	997	1.61	1970	1730	149	0.0282	149	0.0282	0.044
	160	588	12.30	45	0.78	754	3.18	3160	1700	459	0.0870	299	0.0567	0.043
	180	694	12.33	45	1.00	694	2.42	2030	1690	140	0.0266	140	0.0266	0.041
	200	2,059	12.23	128	1.81	1,138	3.28	3312	1750	476	0.0902	300	0.0568	0.038
	220	1,427	12.23	85	1.25	1,142	3.14	3312	1750	497	0.0942	302	0.0572	0.040
	240	770	12.30	54	1.04	740	3.50	3312	1760	443	0.0840	299	0.0566	0.041
SB + PM	C180	10,514	12.27	952	10.64	988								
	260	401	12.17	24	0.27	1,485	0.81	1750	1695	68	0.0129	68	0.0129	0.049
	280	452	12.13	23	0.30	1,507	0.77	1760	1695	84	0.0160	84	0.0160	0.049
	300	824	12.30	58	0.99	832	2.28	1980	1690	127	0.0241	127	0.0241	0.041
	320	889	12.43	93	1.53	581	4.67	2840	1600	266	0.0503	249	0.0471	0.039
	340	1,381	12.27	109	1.45	952	2.40	1953	1570	160	0.0302	160	0.0302	0.042
	350	1,102	12.17	53	0.97	1,136	2.22	3270	1670	721	0.1365	315	0.0597	0.042
	360	668	12.50	84	1.33	502	4.84	2933	1570	282	0.0533	258	0.0488	0.042
	380	821	12.50	95	1.64	501	5.05	2972	1570	278	0.0526	256	0.0484	0.041
	390	1,179	12.20	80	1.09	1,082	2.82	2959	1750	429	0.0812	298	0.0565	0.041
	400	333	12.37	26	0.62	537	1.64	1750	1570	110	0.0208	110	0.0208	0.046
	420	710	12.30	52	0.85	835	1.91	1800	1570	120	0.0228	120	0.0228	0.042
	440	179	12.00	7	0.08	2,238	0.40	2760	2080	1700	0.3220	315	0.0597	0.039
	441	16	12.07	1	0.01	1,600	0.28	2190	1965	804	0.1522	315	0.0597	0.069
	442	99	12.13	5	0.10	990	0.83	2070	1790	337	0.0639	274	0.0519	0.055
	443	146	12.07	8	0.08	1,825	0.71	2270	1820	634	0.1200	315	0.0597	0.050
	444	81	12.00	2	0.04	2,025	0.33	2650	2060	1788	0.3386	315	0.0597	0.034
	445	288	12.07	9	0.19	1,516	0.82	2645	1925	878	0.1663	315	0.0597	0.036

Spook Hill ADMP Update
Existing Conditions HEC-1 Results and Parameters for Sediment Yield Calculations

	446	64	12.07	3	0.04	1,600	0.46	2155	1920	511	0.0968	304	0.0576	0.061
	447	135	12.07	8	0.09	1,500	0.49	1910	1800	224	0.0425	221	0.0419	0.056
	448	87	12.03	3	0.05	1,740	0.36	2400	1920	1333	0.2525	315	0.0597	0.042
	449	77	12.03	3	0.05	1,540	0.40	2230	1860	925	0.1752	315	0.0597	0.054
	450	58	12.17	3	0.07	829	0.85	1920	1740	212	0.0401	211	0.0399	0.057
	451	17	12.17	1	0.03	567	0.56	1840	1740	180	0.0340	175	0.0331	0.063
	452	61	12.07	2	0.04	1,525	0.43	2230	1840	907	0.1718	315	0.0597	0.055
	453	60	12.13	4	0.06	1,000	0.58	1800	1720	138	0.0261	138	0.0261	0.058
	454	152	12.23	12	0.18	844	1.23	1880	1680	163	0.0308	163	0.0308	0.051
	C119	759	12.13	65	1.10	690								
	455	1,541	12.23	117	1.56	988	2.92	2500	1570	318	0.0603	269	0.0510	0.039
Spook Hill	455C	7,873	12.53	1306	13.68	576								
	456	458	12.07	19	0.26	1,762	0.94	2960	1980	1043	0.1975	315	0.0597	0.045
	457	254	12.10	11	0.19	1,337	1.01	2340	1785	550	0.1041	309	0.0585	0.045
	458	347	12.07	13	0.19	1,826	0.76	2070	1725	454	0.0860	299	0.0566	0.048
	459	43	12.07	2	0.03	1,433	0.35	1995	1900	271	0.0514	252	0.0477	0.052
	460	205	12.10	12	0.14	1,464	0.62	1920	1800	194	0.0367	194	0.0367	0.058
	461	156	12.13	10	0.12	1,300	0.83	1850	1700	181	0.0342	181	0.0342	0.052
	462	523	12.07	22	0.30	1,743	0.97	1970	1565	418	0.0791	298	0.0564	0.045
	C56	1,238	12.13	86	1.35									
	480	991	12.13	59	0.73	1,358	1.21	1780	1580	165	0.0313	165	0.0313	0.042
	500	988	12.23	65	0.93	1,062	2.77	2500	1440	383	0.0725	287	0.0543	0.042

Section 8

Field Interview With Mr. Ed Loy, Maintenance Supervisor

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: December 1, 1999

TO: Spook Hill ADMP File

FROM: Michael Henze

RE: **Spook Hill ADMP Field Trip, December 1, 1999**

CC: Ash Patel, Rick Hiner

Ted Lehman and Michael Henze, both of JE Fuller/ Hydrology & Geomorphology, Inc. met with Mr. Ed Loy, Flood Control District of Maricopa County (FCDMC), on December 1, 1999. The purpose of the meeting was to conduct a field reconnaissance of the Buckhorn-Mesa Flood Control Structures and gather insights on sediment production from the watersheds based on Mr. Loy's field experience and observation. The three participants drove the entire length of the project, from the beginning of the Apache Junction Floodway at the east end to the end of the Spook Hill Floodway on the west, stopping at many locations to photograph and discuss the sedimentation situation. Mr. Loy was very knowledgeable about the maintenance requirements to keep the floodways and low flow channels free of sediment. Mr. Loy has worked for FCDMC for 15 years, and the majority of his time has been on the Buckhorn-Mesa structures. He is currently the FCDMC maintenance supervisor for the east Mesa maintenance yard which is responsible for the operation and maintenance of the Buckhorn-Mesa structures.

Inquiries into the maintenance schedule of the Buckhorn-Mesa structures led Mr. Loy to explain that FCDMC does regular maintenance as part of the preparation for the annual inspection. The basic procedure is for the crews to inspect the structure, and if the sediment build-up does not significantly impact the conveyance of floodwater the crew leaves the sediment in place. Using this procedure, the Apache Junction Floodway and sediment basin had not been cleaned out in three years. However, just prior to the field trip, maintenance crews had been working on clearing out the Apache Junction Floodway and Flood Retarding Structure. As of December 1, 1999, there were crews on the Apache Junction, Bulldog, and Spook Hill Floodways as thunderstorms from the previous monsoon season had caused some sedimentation problems especially in the unlined channels.

Mr. Loy also made some general observations on trends in sediment yield from the watersheds behind the structures and gave some explanations as to why the trends were occurring. Mr. Loy has observed that sediment production is generally decreasing each year. Mr. Loy gave three possible explanations. First, the washes have finally adjusted to the structure elevation, so in effect the washes are reaching some sort of equilibrium with their new base levels. Second, FCDMC maintenance has become more proactive in their cleaning of the inlets into the floodways and retarding structures. The crews move excess sediment out of the washes before it reaches the structures. Third, urban development upstream of the structures reduces sediment yield after brief increases during and immediately following construction periods.

Apache Junction Floodway

The recent work mentioned by Mr. Loy on this structure resulted in the removal of approximately 5 cubic yards of material. Mr. Loy believes that this is probably the average annual removal from this structure. The removed sediment is placed in the District right-of-way on the downstream side of the floodway. At the end of Apache Junction Floodway there is a catch basin (Figure 1). Mr. Loy states that the basin had not been cleaned out in three years and the sediment is probably 6 feet deep at maximum. Additionally there is very little sediment deposited in the channel leading to the FRS pool area; most sediment (at least bed load) is deposited in the basin. The estimated volume of sediment in the basin, according to Mr. Loy, is 50 cubic yards.

Figure 1. Basin at end of Apache Junction Floodway (concrete channel of floodway visible right of center). Three years' worth of sediment is covered in area around standing water. Looking east toward Superstition Mountains. Photo by T. Lehman, 12/1/1999.

Some rough calculations can be done to get a general idea of sediment yield from watersheds upstream of the Apache Junction Floodway, as per Mr. Loy's comments.

Apache Junction Floodway:	5 cubic yards annually x 3 years =	15 cubic yards
Apache Junction Floodway Basin:	50 cubic yards in 3 years =	50 cubic yards
Total:		65 cubic yards

21.67 cubic yards annually = 585.09 cubic feet/year = 0.0134 acre-feet/year

Apache Junction FRS

FCDMC maintenance crews rarely remove sediment from behind the FRS; rather they rework it. Crews take the sediment from the wash mouths that empty into the low flow channel and place it in piles on either side of the wash. Recently crews removed duff (organic debris) veneer from the pool area along with approximately 1' of sand in the approach channel near the principle outlet.

Bulldog Floodway

The concrete lined Bulldog Floodway is cleaned out annually. Generally, the sediment removed equals "a couple of wheel barrows full" (Mr. Ed Loy). The small amount of sediment removed from the floodway is due to two reasons: 1. The floodway transports sediment down to the catch basin at the end of the floodway very efficiently, and 2. The maintenance crews have taken a more proactive stance and remove sediment from the ends of the washes before it is moved into the floodway and its inlets (Figure 2). Mr. Loy estimates that 1-2 cubic yards of sediment are removed from several of the washes each year. Not every wash undergoes annual maintenance as can be evidenced by vegetation growth in some of them (Figure 3). Mr. Loy further states that sedimentation problems are very localized and depend on where storms occur. A wash that contributes a large volume of sediment one year may not contribute much sediment other years.

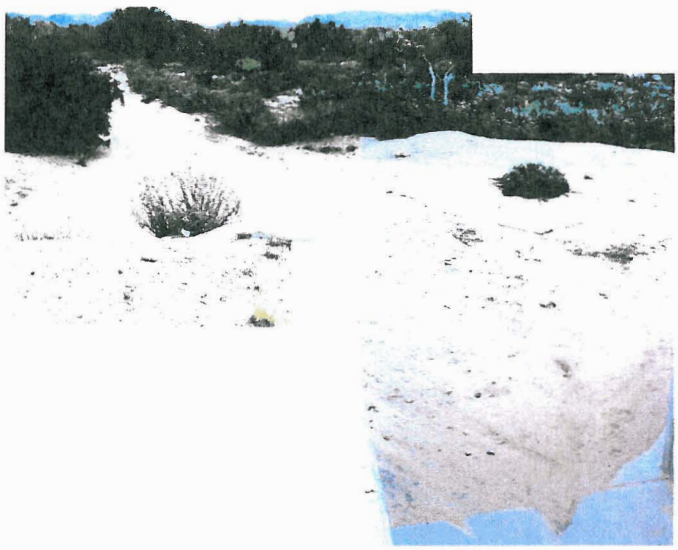

Figure 2. Wash entering Bulldog Floodway. Mound at right in photo is sediment removed from wash by maintenance crews. Looking northeast and upstream. Photo by T. Lehman, 12/1/1999

Figure 3. Wash entering Bulldog Floodway. Vegetation growth suggests lack of maintenance for some time. Looking south and downstream towards floodway. Photo by T. Lehman, 12/1/1999.

The catch basin at the end of Bulldog Floodway is similar to the one at the end of Apache Junction Floodway in that it hasn't been cleaned out in three years. The basin has filled with sediment over the years, visible as darker material (Figure 4). The lighter material between the floodway and basin is recently deposited material, probably from the last monsoon season (Figure 5). Mr. Loy estimates that the amount of material in the basin is comparable to the amount in the Apache Junction Floodway catch basin, or approximately 50 cubic yards. Most bedload is likely deposited in the basin since scour (evidence of clear water) has apparently occurred downstream of the catch basin.

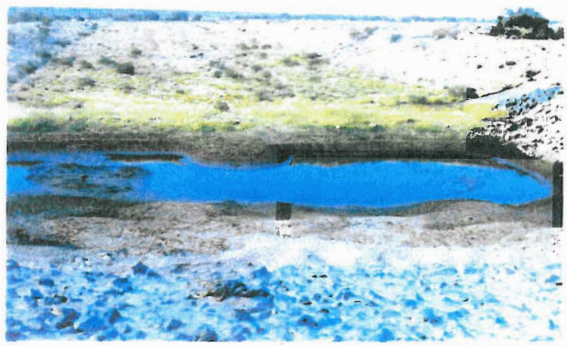

Figure 4. Bulldog Wash Floodway Basin. Sediment accumulation covered by standing water. Darker sediment is three years' worth of accumulation. Light sediment in foreground is probably from 1999 monsoon season. Looking west and downstream toward Signal Butte FRS. Photo by T. Lehman, 12/1/1999.

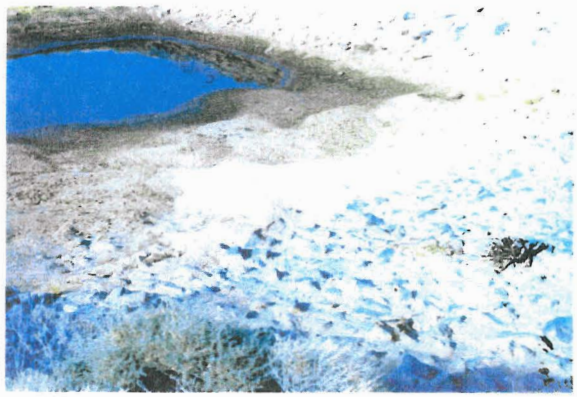

Figure 5. Bulldog Floodway Basin. Close-up of recent sediment deposition. Looking into basin. Photo by T. Lehman, 12/1/1999.

Signal Butte FRS

Most maintenance behind Signal Butte Dam is concerned with keeping the low flow channel along the upstream side of the structure clear of deposits so that storm water may flow efficiently to the pool area and down to the Signal Butte Floodway if necessary. Within the pool area fine sediment approximately 4" deep is near the outlet gate for the pool area (Figure 6). Elsewhere in the pool area it is approximately 1" deep. The gate is opened only slightly when the pool fills behind the dam, allowing the pool to drain very slowly. The "lake" stands long enough for most suspended sediment to settle on the floor

of the basin. During conversations, Ted Lehman stated that, to his knowledge, no water has ever moved from behind the Signal Butte FRS into the Signal Butte Floodway.

Figure 6. Mud cracks at Signal Butte FRS gate. Sediment deposits consist of very fine-grained particles at depths of 1" to 4". Looking away from FRS and into pool area. Photo by T. Lehman, 12/1/1999.

Signal Butte Floodway

Signal Butte Floodway is an unlined channel between Signal Butte FRS and station 96+75. Downstream of 96+75 the channel is a concrete-lined, box culvert. There is a barditch on the upstream side of the unlined portion of the floodway that might trap a lot of the bedload sediment during low flows.

Ed Loy suspects that half the material found deposited in the floodway comes from erosion of the unlined side slopes. The construction of the floodway is such that the upstream side traps some of the larger sediment. The inlets are sloped upward toward the opening to the floodway. In addition there are vegetation outlets, pipes that allow water to pass from the upstream to the downstream side of the floodway for the purpose of supplying water to the downstream portions of the natural washes and the vegetation in them (Figure 7). Apparently a lot of sediment especially from low flows gets trapped upstream of the floodway, either on the service road or on the slopes leading to the vegetative outlets. Mr. Loy stated that the grates are cleaned at least annually, and the amount of sediment seen in the photos is typical of a yearly build-up (Figure 8). Mr. Loy made no estimates of the amount of sediment along the upper unlined portion of the Signal Butte Floodway, although each photographed site could be revisited and measurements taken to estimate the volume of sediment shown in the photographs.

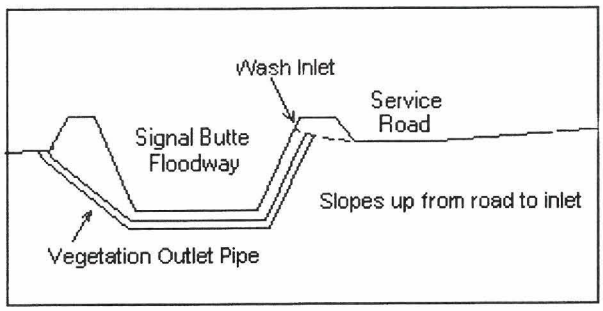

Figure 7. Diagrammatic sketch of unlined Signal Butte Floodway profile. Not to scale. Note slope of inlet to floodway.

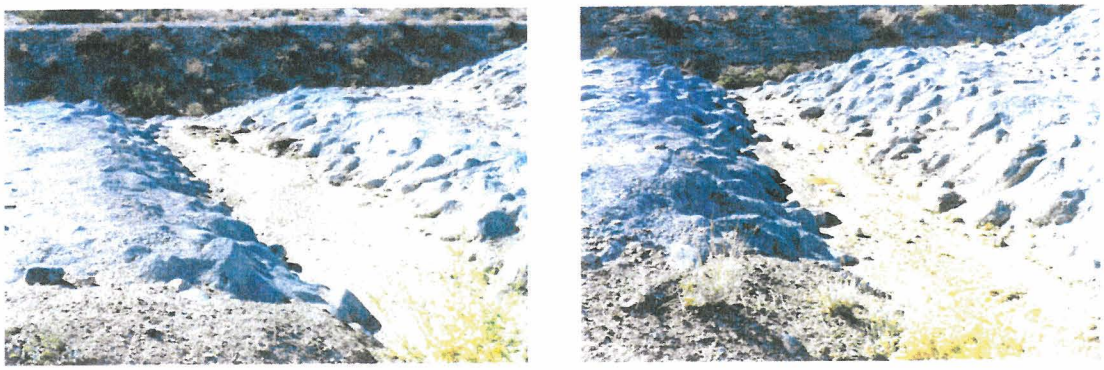

Figure 8. Examples of sedimentation on inlets to Signal Butte Floodway. Note vegetation outlet grate covered by organic debris in left photo. Both views looking generally south from upstream side of floodway. Photos by T. Lehman, 12/1/99.

The transition between unlined and lined channel is abrupt, with a significant change in width. There is a sediment veneer covering the riprap near the lined channel inlet (see Figure 9). Mr. Loy believes the sediment is mostly from the sides of the channel, and has probably been bladed at some point in time. But he cannot recall maintenance crews ever removing sediment from the channel at this location, so the sediment at station 96+75 may be the total accumulation of sediment since the completion of the floodway in the mid-1980s.

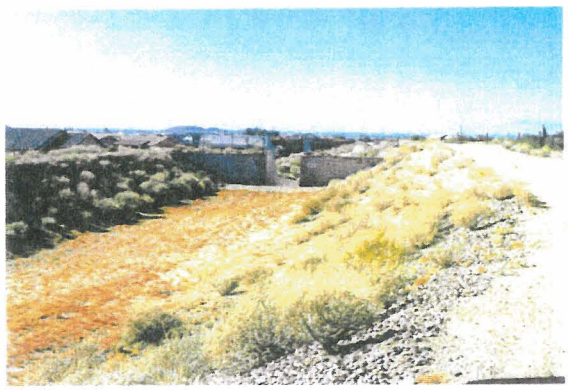

Figure 9. Looking downstream within Signal Butte Floodway at station 96+75. Note abrupt change from unlined trapezoid to lined box culvert. Photo by T. Lehman, 12/1/1999.

The lined reach of Signal Butte Floodway has apparently received more sediment from its watersheds than the unlined reach. At some locations maintenance crews were removing three cubic yards of sediment annually until 1993. These larger sediment amounts have been reduced in several of the washes due to residential development upstream of the floodway. Several washes were diverted from their original courses (stations 144+23, and the other just to east, station not recorded) rendering the inlets at those stations useless. The washes mentioned above were diverted to the inlet at station 150+00. The newly constructed lined channel leading to the inlet has been covered with sediment (Figure 10). Mr. Loy stated that the lined channel was several months old.

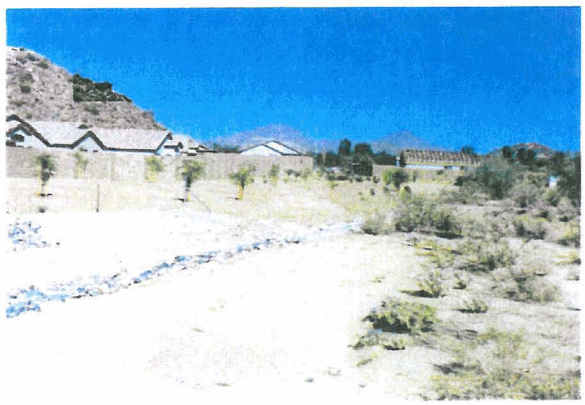

Figure 10. View of upstream development and newly constructed lined channels. Note sediment accumulation on the concrete liner. Looking upstream of Signal Butte Floodway, generally north, from station 150+00. Photo by T. Lehman, 12/1/1999.

Signal Butte Floodway ends in a catch basin similar to Apache Junction and Bulldog Floodways. It has been at least three years since the basin was last cleaned. Due to the standing water in the basin, visual estimation of sediment volume trapped in the basin was not possible (Figure 11).

Figure 11. Catch basin at end of Signal Butte Floodway. Sediment has not been removed for at least three years. Water line visible at lower left and upper left is approximately 3' above water surface. Photo by T. Lehman, 12/1/1999.

Spook Hill FRS

The Spook Hill FRS does not receive much sediment from Signal Butte Floodway. Most sediment comes from the washes that flow directly into either the low flow channel or the pool area. Mr. Loy estimates that the washes contribute approximately one cubic yard each of sediment on an average annual basis. There are some years, however, when maintenance crews spend up to a week clearing the low flow channel between Brown and McDowell Roads. The crews do not remove the sediment from the basin behind the structure, but place the material in piles on the wash overbanks or use the material to reinforce existing berms elsewhere in the basin. There are few defined washes between McKellips and McDowell Roads.

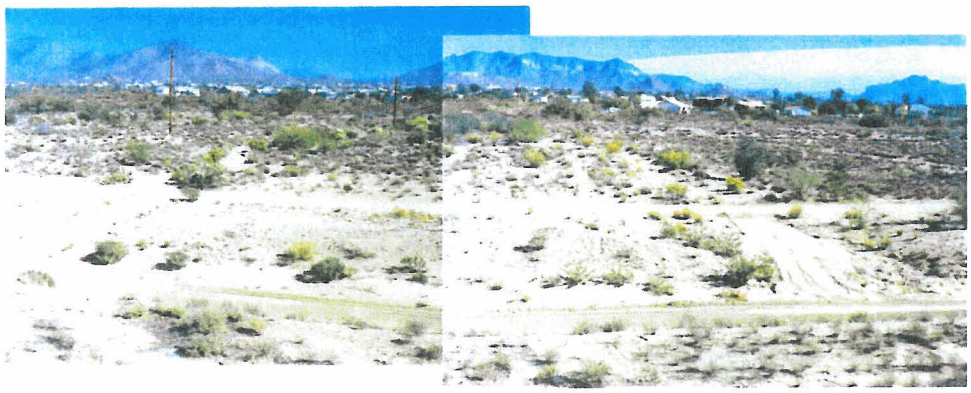

Figure 12. Photomosaic showing typical upstream view from crest of Spook Hill FRS between McKellips and McDowell Roads. Reworked areas at right and left are forks of a wash entering the low flow channel. Photos by T. Lehman, 12/1/1999.

North of McDowell Road, sedimentation has historically been caused by local sheeting action. A relatively new addition to the flow regime north of McDowell Road is the drainage channel paralleling McDowell Road built in conjunction with residential development upstream. The new channel terminated at an elevation higher than the low flow channel which caused some problems with headcutting, and according to Mr. Loy, has resulted in more sediment deposited in this portion of the low flow channel than previously experienced.

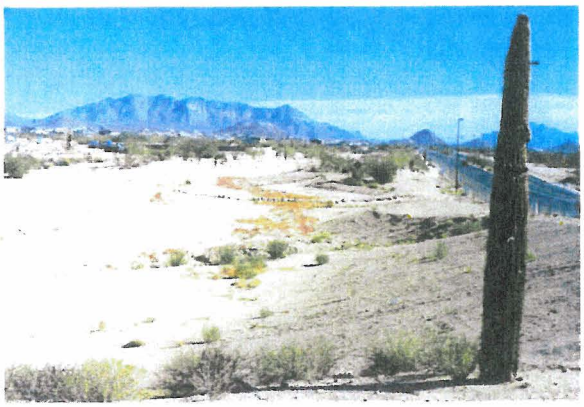

Figure 13. Looking east along McDowell Road. Drainage channel causing increased sedimentation is to the left of the road in the photo. Photo by T. Lehman, 12/1/1999.

Spook Hill Floodway

Substantial residential development has occurred just upstream of Spook Hill Floodway since it was built. The wash at station 110+00 contributes approximately 10 to 20 cubic yards of sediment to the Floodway, according to Mr. Ed Loy (Figure 14). This same site was the location of a high sediment yield event within the last year, based on Mr. Loy's memories as of December 1,1999. According to Mr. Loy's explanation, suburban development upstream produced a large volume of sediment that moved down the wash and clogged the service road between the wash mouth and the floodway. The runoff water subsequently pooled behind the plug and eventually overtopped its confines south of the plug. The spillover created a new wash whose flow blew out the road and eroded down to caliche, depositing approximately 30 cubic yards of material in the floodway. FCDMC maintenance crews reopened the plugged wash and repaired the damaged road.

Figure 14. Wash at station 110+00 along Spook Hill Floodway. This wash contributes large amounts of sediment to the floodway, according to Mr. Ed Loy. Photo by T. Lehman, 12/1/1999.

Most washes have been cut off by the Las Sendas development just upstream of Spook Hill Floodway. Sediment delivery to the floodway is now generally only produced by local sheeting action and street runoff across the FCDMC right-of-way (Figure 15).

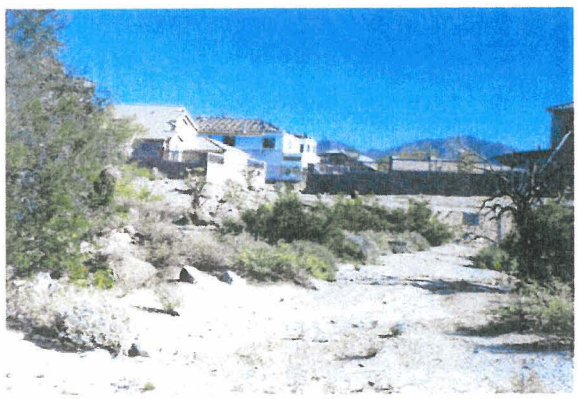

Figure 15. Residential development and resulting wash truncation upstream of Spook Hill Floodway. Looking generally east from station 152+30. Photo by T. Lehman, 12/1/1999.

For example Mr. Loy recalls that the first wash north of Eagle Crest Drive (Thomas Road alignment) used to produce approximately 5 cubic yards of sediment annually before residential development. Sediment yield has decreased since construction of the residential development was completed. Mr. Loy also recalls that at the second wash north of the Thomas alignment, maintenance crews used to clear the bar ditch of sediment. Cleaning is no longer required since the wash was diverted north and now only local runoff from the FCD ROW contributes to sediment deposition.

A major wash enters Spook Hill Floodway at station 182+00 (Figure 16). Mr. Loy explained that a lot of water always came through the wash but that maintenance crews never had much problem with sedimentation at the location. Mr. Loy believes that the Las Sendas development reroutes most of its runoff through this wash. Inspection of the riprap placed at the floodway inlet showed that there was no deposition between the boulders, nor were there large amounts of sediment within the floodway at this location.

Figure 16. Looking north across spillway of major wash feeding into Spook Hill Floodway at station 182+00. There is a lack of fine sediment between the large protective boulders. Photo by T. Lehman, 12/1/1999.

Significant amounts of sediment occur downstream of the major wash, near station 189+40. The sedimentation is often severe enough to pond water behind the deposits. Maintenance crews remove some of the sediment and grade the remainder to level. Large amounts of sand-sized material were evident in the floodway channel, and Mr. Loy estimated the volume of that sediment to be upwards of 50 cubic yards (Figure 17).

Figure 17. Looking southwest into Spook Hill Floodway from station189+40. Bottom of channel is covered with sand-sized deposits that have been graded by FCDMC maintenance personnel. Photo by T. Lehman, 12/1/1999.

FCDMC maintenance personnel place removed sediment at the end of Spook Hill Floodway, at some distance from the floodway outlet but in the path of the outflow discharge (Figure 18). The purpose of this procedure is to place the sediment in a position that does not obstruct the operation of the floodway but allows discharge to carry excess sediment away to the Salt River. According to Mr. Loy, this procedure has been in place since the District took over maintenance of the floodway. Volume calculations based on these spoil deposits could be one way to estimate total sediment yield from the Spook Hill Floodway.

Figure 18. Sediment piles dumped by FCDMC personnel at end of Spook Hill Floodway. Some of the sediment dumped here is periodically washed away as can be seen by erosive cuts in photo on right. Photos by T. Lehman, 12/1/1999.

Closing Remarks

Mr. Ed Loy provided a very useful view of sedimentation problems along the structures of the Spook Hill ADMP. His recollections of annual work and observations over a period of 15 years provide an excellent data source to corroborate sediment yield calculations based on more formal methods. Mr. Loy's insight, and that of other FCDMC maintenance personnel, could also prove valuable when considering alternatives for the Spook Hill ADMP.

Section 9

Verification Surveys of Spook Hill and Bulldog Floodway Sediment Basins

Spook Hill ADMP
Field Data Verification of Sediment Yield Equation Results

Location	Sub-basin	Flaxman 1974 (ac-ft/mi^2/yr)	MUSLE (ac-ft/mi^2/yr)	Period of Record 1% Concentration (ac-ft/mi^2/yr)	Field Data (ac-ft/mi^2/yr)
Bulldog Floodway Storage Basin	80	0.092	0.060	0.132	
	100	0.062	0.005	0.101	
	120	0.104	0.090	0.153	
	140	0.080	0.028	0.122	
	Average:	**0.085**	**0.046**	**0.127**	**0.03**
Pass Mountain Diversion Structure	220	0.111	0.102	0.133	
	240	0.077	0.061	0.087	
	Average:	**0.094**	**0.082**	**0.110**	**0.03**
Spook Hill Floodway	500	**0.108**	**0.108**	**0.126**	**0.02**

Spook Hill ADMP Update
Sediment Survey of Spook Hill Floodway Sediment Basin and Channel

Data from survey of Feb. 29, 2000

Bed-material load
Cross sections taken of sediments deposited at mouth and within concrete floodway channel

Transect Station	Sample Depth Left	Center	Right	Transect Width	Dist. To U/S XS	Remarks	Volume (cu. Ft)	Volume (ac-ft)
1294	0.2	0.1	0	64	27	edge of outlet sill	70	
1267	0	0.2	0.1	40	43	12+67	140	
1224	0.6	0	0.1	40	40		387	
1184	0.4	0.1	0	40	42		273	
1142	0.6	0.3	0.3	40	42		672	
1100	0.1	0.1	0.1	40	42		168	
1058	0	0	0.2	40	42		112	
1016	0.1	0	0.1	40	83		167	
933	0.2	0.4	0.3	40	83		996	
850	0.6	0.2	0.1	40	83		996	
767	0	0.2	0.4	40	83		664	
684	0	0.1	0.1	40	83		221	
601	0	0	0.1	40	83		111	
518	0.2	0.1	0.4	40	83		775	
435	0	0	0	40	42		0	
393	0.4	0.2	0.2	40		3+93, at D/S of Bush Hwy bridge	224	
Total							5976	0.137195

Wash Load
estimate from "pits" dug at various locations in pond area

Length	Width	Depth	Volume	
630	110	0.083333	5775	L and W from aerial photos
685.61	106	0.083333	6056.222	L and W from SCS design notes

			2.93	sq. mi.
Total Sediment Volume =	11751	in cubic feet	Total "unregulated" drainage area = 2.89	sq. mi.
	0.270	in acre-feet	1849.6	acres

Unit Sed.Yield	0.09	ac-ft/sq.mi
Time period of accumulation	4	years
Avg. Annual Sed. Yield	0.023	ac-ft/sq.mi/yr

Wood/Patel
in association with:
JE Fuller / Hydrology and Geomorphology, Inc.

Verification Surveys
Spook Hill ADMP Update
March 2000

Spook Hill ADMP Update
Sediment Survey of Bulldog Floodway Sediment Basin

Estimate of Sediment Volume from field measurements in the sediment basin at the end of Bulldog Floodway
Data collected on Feb. 25, 2000 by T.W. Lehman and M.W. Henze, JEF, Inc.

Subsection	Width (ft)	Length (ft)	Depth (ft)	Volume (cu.ft)	Volume (ac-ft)
1	110	45	1.2	5940	
2	110	17	1.8	3366	
3	110	24	3	7920	
Total				17226	0.40

Drainage Area to Floodway (not considering any contribution from AJ FRS)
4.76 sq.mi.

Unit Sediment Yield = 0.08 ac-ft/sq.mi.
Assume 3 years (Loy, 1999)

Avg. Annual Sed. Yield = 0.03 ac-ft/sq.mi./yr