Spook Hill ADMP Update

Flood Control District of Maricopa County

Appendix A
Volume 9

Red Mountain Freeway
Crude Cost Estimates

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Spook Hill Area Drainage Master Plan Update

Flood Control District of Maricopa County

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JANE DEE HULL
Governor

RITA PEARSON
MAGUIRE
Director

April 19, 2001

Mr. Thomas M. Monchak, P.E.
DMJM Arizona, Inc.
2777 East Camelback Road, Suite 200
Phoenix, AZ 85016-4302

Subject: Spook Hill FRS Dam (07.50)
Technical Report No. 1 (Draft) – Existing Condition Hydrology

Dear Mr. Monchack:

As requested in your letter dated February 7, 2001 the Arizona Department of Water Resources (Department) has completed a review of the Technical Report No. 1 (Draft) – Existing Condition Hydrology report dated January 2001 (draft report). The attached memo by Dr. Michael Johnson presents the Department's technical review comments. The final report should address the comments contained in the attached memo.

In addition to the technical review comments contained in Dr. Johnson's memo, the Department would like to also address the draft report's recommendation to set the design criteria as one-half the Probable Maximum Precipitation (PMF). This recommendation appears to be based on the fact that the full PMF condition overtops the dam. In evaluating this recommendation, the Department considered the following:

1. Spook Hill FRS Dam is currently classified as a high hazard and intermediate size dam. The high hazard classification was applied during original construction in 1980. The intermediate size classification is based on the capacity (1,217 acre-feet) as reported in the Flood Control District of Maricopa County's (FCDMC) Individual Structures Assessment Report prepared by Kimley-Horn and Associates, Inc. and the Department's current rules which became effective on June 12, 2000.

2. The design prepared by the Soil Conservation Service (SCS) and approved by the Department is presented in Section 2.0 on Page 12 of the draft report. The design of the emergency spillway capacity and embankment crest elevation was based on the PMF.

3. Arizona Administrative Code (A.A.C.) R12-15-1216(A)(2), Table 4, specifies that a high hazard potential dam be designed to withstand an inflow design flood (IDF) that varies from 0.5 PMF to the full PMF with the size increasing based on persons at risk and potential for downstream damage. Alternative design approaches to this requirement are contained in A.A.C. R12-15-1216(A)(2)(b) and A.A.C. R12-15-1216(A)(2)(c). It should

be noted that the IDF design criteria is a requirement specified in rule and not a guideline or recommendation as implied in the draft report.

4. The applicability of the Department's dam design requirements contained in A.A.C. R12-15-1216 are discussed in A.A.C. R12-15-1220. If the Director has determined that a dam is safe, A.A.C. R12-15-1220(B) specifies that the owner is not required to comply with A.A.C. R12-15-1216 unless the Director determines, based on several factors, that it is cost effective to upgrade the dam at the time of a major alteration or major repair.

Based on the above considerations, the Department does not agree with draft report's recommendation that the one-half PMF be utilized as the design criteria. Considering the large number of persons at risk and potential for significant downstream damage, it is the Department's position that full the PMF be utilized as the IDF design criteria. Utilization of the full PMF as the design criteria would also be consistent with the original design approved by the Department. The proposal to relocate several sections of the dam and the upstream low flow channel would constitute a major alteration to the dam. Therefore, pursuant to A.A.C. R12-15-1220 modifying the dam to meet the requirements of A.A.C. R12-15-1216 must be considered. Alternative design approaches contained in A.A.C. R12-15-1216(A)(2)(b) and A.A.C. R12-15-1216(A)(2)(c) may also be considered.

We look forward to discussing these comments at the meeting scheduled for May 2, 2001 at your offices. If you have any question concerning this letter or the attached review memo, please contact me at (602) 417-2400 extension 7189 or Dr. Johnson at extension 7204.

Sincerely,

William C. Jenkins, P.E.
Manager
Dam Safety Section

Enclosure

WCJ:mdg

Cc: Tom Renckly – FCDMC
Joe Warren – ADOT
Quan Quan - NRCS

ARIZONA DEPARTMENT OF WATER RESOURCES
SURFACE WATER MANAGEMENT DIVISION
Dam Safety Section

MEMORANDUM

To: **Michael Greenslade, P.E.**

From: **Michael Johnson, Ph.D.**

Subject: **Spook Hill Floodwater Retarding Structure (07.50)**
Technical Report No. 1 (DRAFT) – Existing Condition Hydrology
Technical Review

Memo Date: **April 19, 2001**

I have completed a review of "Spook Hill Floodwater Retarding Structure – Technical Report No. 1 (DRAFT) – Existing Condition Hydrology" prepared for the Arizona Department of Transportation by DMJM Inc.

I reviewed the assumptions made, methodologies employed, engineering parameters selected, and implementation of the methodologies. The model is well developed and adequately describes the existing hydrology. The calculation of time of concentration by the iterative empirical relation proposed by Papadakis and Kazan (1987) and recommended by FCDMC results in significantly larger predicted peak inflows to the reservoir than those predicted in previous reports (i.e. SCS Design Report and 1981 Inspection Report). This difference represents an advance in the state of the practice. Based on the results of this model, the one-half PMF leaves about 2.5 feet of residual freeboard while the full PMF causes the dam to overtop.

Two issues should be addressed regarding the flood routing through the reservoir. The first issue, discussed in General Comment No. 1, deals with the treatment of the FRS as a single reservoir versus four interrelated sub-reservoirs. The second issue is discussed in General Comment No. 2 and pertains to the principal and emergency spillway stage-discharge functions.

General Comments

1. The SCS Final Design Report routed the flood hydrograph through four sub-reservoirs delineated by the roadway crossings at Brown, McKellips, and McDowell Roads. The report confirmed that the roadway crossing profiles did not impact the dam crest elevation. The current DMJM study models the FRS as a single reservoir. Given that the predicted peak inflows are two-and-a-half times larger than the original analysis, the reservoir should be modeled as four interrelated reservoirs to assure that overtopping is not predicted at an intermediate section of the dam before the water can get to the emergency spillway. A preliminary calculation indicates that the McKellips Road crossing may not be able to pass the PMF peak flow.

2. The stage-discharge function employed in the current analysis (referenced to SCS and WPA) is significantly different from that shown on the as built drawings. The stage-discharge function for the emergency spillway shown on the as built drawings seems to be based on a discharge coefficient, C, equaling 2.85 (i.e. $Q = CLH^{1.5}$). The value of the coefficient used in the current analysis is not clear because the discharge through the principal and emergency spillways are lumped, however, it appears to be greater than 2.85. Considering the emergency spillway as a broad-crested weir, King and Brater's Handbook of Hydraulics, Seventh Edition indicates a value of 2.63 is appropriate. If a value other than 2.63 is used, then computations or documentation should be submitted supporting the validity of the chosen value. Additionally, calculations of the discharge through the principal spillway should be submitted, as the values used do not agree with the as built drawings.

3. As a point of clarification, the negative values of residual freeboard given in Table 27 on page 36 are not the same as overtopping depth. The absolute values of these numbers represent the increases in dam height necessary to prevent overtopping of the dam. Additional dam height, over and above this amount, would be necessary to conform to current ADWR Rules regarding residual freeboard. If the dam were to overtop in response to the PMF event in its current configuration, then the overtopping depth would be expected to be significantly less than these values due to the additional "weir" flow over the dam.

4. The flow volume greater than the 8,400 cfs capacity of the Spook Hill Floodway located downstream of the dam was diverted from the model prior to routing the inflow hydrograph from the dam through the floodway. However, the inflow to the floodway is through the principal spillway with a capacity of only about 1,100 cfs (reference: as built drawings). This issue is <u>not</u> of concern relating to the safety of the dam because the reservoir storage routing is governed by the elevation-storage function and elevation-discharge function (i.e. the combined rating curve for the principal and emergency spillways) which are applied correctly in HEC-1.

5. Section 4.7, Table 16; It should be specified that these values of T_c and R are for the local storm PMP and that for the general storm PMP the values are different (i.e. larger).

6. The elevations of the original SCS design and the information the Dam Safety office has on file for this dam are relative to NGVD 29 Datum. This report refers to the elevations relative to the NAVD 88 Datum. Care must be exercised to keep the elevation references consistent.

The following typographical errors were noticed during review.

Typographical Errors

1. Section 2.3, Page 13; The dimensionless time increment is referred to as "0.02 hour," it should read "0.02."

2. Section 2.10, Page 17; The SCS stage-storage and stage-discharge relationships are referenced as Figures "B.1" and "B.2," they are actually contained in Appendix C as Figures "C.1" and "C.2."

3. Section 4; All of the Appendix C tables and figures referenced in this section are mislabeled as "B.x" rather than "C.x."

4. Appendix C, Tables C.5 & C.6; Third columns show units of "in," should be dimensionless.

5. Appendix C, Precipitation Comparison; Regarding the DMJM study, the drainage area is listed as "14.02" sq. miles and the general storm 24 hour PMP is listed as "14.6" inches, the correct values appear to be "13.9" sq. miles and "15.4" inches.

6. Appendix C, Tables C.7 & C.8; The subheadings of the third columns are entitled "(sq. ft)," they should be entitled "(acres)."

7. Appendix C, Green-Ampt Parameters – Basin A1 Hand Calculations; In the computation of the composite XKSAT, the value for the area of map unit "3" is incorrectly written as "0.12" sq. miles instead of "0.012" sq. miles. However, the composite value shown, 0.349 in/hr, is correct.

8. Section 4.7, Table 16; The column heading for storage coefficient, R, should be labeled with units of "hours."

9. Section 4.7, Table 17; The contributing area corresponding to a time of 60 percent of T_c for urban watersheds should be 84 percent of the total area, not 87 percent as shown in the table. The values used in the HEC-1 runs are correct.

10. Appendix D, HEC-1 input file for general storm PMP; In the ID cards, the storm duration is incorrectly stated as 6 hours instead of 24 hours, the actual input parameters are correct.

11. Section 5, Page 32; The word hour is misspelled as "hourr."

12. Section 5, Page 34; The example computation of the SCS lag time for subbasin A1 is referenced to Appendix B, it is actually Table C.10 in Appendix C.

13. Section 6, Page 36; The residual freeboard for the one-half PMF is stated as "2.58" feet in the text and "2.57" feet in Table 27.

d. Hydraulic characteristics, engineering data, and calculations used in determining the capacities of the outlet works and emergency spillway. The design report shall include input and output listings on both hard copy and computer diskette.
e. Geotechnical investigation and testing of the dam site and reservoir basin. Results and analysis of subsurface investigations, including logs of test borings and geologic cross sections.
f. Guidelines and criteria for blasting to be used by the contractor in preparing the blasting plan.
g. Details of the plan for control or diversion of surface water during construction.
h. Details of the dewatering plan for subsurface water during construction.
i. Testing results of earth and rock materials, including the location of test pits and the logs of these pits.
j. Discussion and design of the foundation blanket grouting, grout curtain, and grout cap based on foundation stability and seepage considerations.
k. Calculations and basic assumptions on loads and limiting stresses for reinforced concrete design. The design report shall include input and output listings on both hard copy and computer diskette.
l. A discussion and stability analysis of the dam including appropriate seismic loading, safety factors, and embankment zone strength characteristics. Analyses shall include both short-term and long-term loading on upstream and downstream slopes. The design report shall include input and output listings on both hard copy and computer diskette.
m. A discussion of seismicity of the project area and activity of faults in the vicinity. The design report shall use both deterministic and statistical methods and identify the appropriate seismic coefficient for use in analyses.
n. Discussion and design of the cutoff trench based on seepage and other considerations.
o. Permeability characteristics of foundation and dam embankment materials, including calculations for seepage quantities through the dam, the foundation, and anticipated in the internal drain system. The design report shall include input and output listings on both hard copy and computer diskette. The design report shall include copies of any flow nets used.
p. Discussion and design of internal drainage based on seepage quantity calculations. The design report shall include instrumentation necessary to monitor the drainage system and filter design calculations for protection against piping of foundation and embankment.
q. Erosion protection against waves and rainfall runoff for both the upstream and downstream slopes, as appropriate.
r. Discussion and design of foundation treatment to compensate for geological weakness in the dam foundation and abutment areas and in the spillway foundation area.
s. Post-construction vertical and horizontal movement systems.
t. Discussion of foundation conditions including the potential for subsidence, fissures, dispersive soils, collapsible soils, and sink holes.

Historical Note
New Section adopted by final rulemaking at 6 A.A.R. 2558, effective June 12, 2000 (Supp. 00-2).

R12-15-1216. Design of a High, Significant, or Low Hazard Potential Dam

A. General Requirements.
1. Emergency Spillway Requirements. An applicant shall:
a. Construct each spillway in a manner that avoids flooding in excess of the flooding that would have occurred in the same location under the same conditions before construction. The owner of a dam shall demonstrate that a spillway discharge would not result in incremental adverse consequences. In determining whether a spillway discharge of a dam would result in incremental adverse consequences, the Director shall evaluate whether the owner has taken any or all of the following actions: issuing public notice to downstream property owners, complying with flood insurance requirements, adopting emergency action plans, conducting mock flood drills, acquiring flow easements or other acquisitions of real property, or other actions appropriate to safeguard the dam site and flood channel.
b. Include a control structure to avoid head cutting and lowering of the spillway crest for spillways excavated in soils or soft rock. In the alternative, the design may provide evidence acceptable to the Director that erosion during the inflow design flood will not result in a sudden release of the reservoir.
c. Provide each spillway and channel with a minimum width of 10 feet and suitable armor to prevent erosion during the discharge resulting from the inflow design flood.
d. Ensure that downstream spillway channel flows do not encroach on the dam unless suitable erosion protection is constructed.
e. Ensure that each spillway, in combination with outlets, is able to safely pass the peak discharge flow rate, as calculated on the basis of the inflow design flood.
f. Not construct bridges or fences across a spillway unless the construction is approved in writing by the Director. The Director's approval may include conditions regarding the design and operation of the spillway and fencing, based on safety concerns.
g. Not use a pipe or culvert as an emergency spillway unless the Director approves the use following review of the dam design and site characteristics.
2. Inflow Design Flood Requirements
a. Unless directed otherwise in writing by the Director, the inflow design flood requirements for determining the spillway minimum capacity are stated in Table 4.
b. As an alternative to the requirements prescribed in Table 4, the Director may accept an inflow design flood determined by an incremental damage assessment study, based on the relative safety of the alternatives.
c. The Director may accept site-specific probable maximum precipitation studies in determination of the inflow design flood.
d. An applicant shall ensure that the total freeboard is the largest of the following:
i. The sum of the inflow design flood maximum water depth above the spillway crest plus wave run up.

ii. The sum of the inflow design flood maximum water depth above the spillway crest plus 3 feet.

USED iii. A minimum of 5 feet.

3. Outlet Works Requirements. An applicant shall ensure that a dam has a low level outlet works that:
   a. Is capable of draining the reservoir to the sediment pool level. A low level outlet works for a high or significant hazard potential dam shall be a minimum of 36 inches in diameter. A low level outlet works for a low hazard potential dam shall be a minimum of 18 inches in diameter.
   b. For a high or significant hazard potential dam, has the capacity to evacuate 90% of the storage capacity of the reservoir within 30 days, excluding reservoir inflows.
   c. Has a filter diaphragm or other current practice measures to reduce the potential for piping along the conduit.
   d. Has accessible outlet controls when the spillway is in use.
   e. Has an emergency manual override system or can be operated manually.
   f. Is constructed of materials appropriate for loading condition, seismic forces, thermal expansion, cavitation, corrosion, and potential abrasion. The applicant shall not use corrugated metal pipes or other thin-walled pipes except as a form for a cast-in-place concrete conduit. The applicant shall construct outlet conduits of cast-in-place reinforced concrete. The applicant shall design each outlet to maintain water tightness. The applicant shall construct each outlet to prevent the occurrence of piping adjacent to the outlet.
   g. Has an operating or guard gate on the upstream end of any gated outlet.
   h. Has an outlet conduit near the base of 1 of the abutments on native bedrock or other competent material. The applicant shall support the entire length of the conduit on foundation materials of uniform density and consistency to prevent adverse differential settlement.
   i. Has an upstream valve or gate capable of controlling the discharge through all ranges of flow on any gated outlet conduit.
   j. Has a trashrack designed for a minimum of 25% of the reservoir head to which it would be subjected if completely clogged at the upstream end of the outlet.
   k. Has an air vent pipe just downstream of the control gate. The applicant shall include a blow-off valve at or near the downstream toe of the dam for an outlet conduit that is connected directly to a distribution system.
   l. Has an outlet conduit designed for internal pressure equal to the full reservoir head and for superimposed embankment loads, acting separately.
4. Dam Site And Reservoir Area Requirements
   a. An applicant shall demonstrate that reservoir storage during the inflow design flood will not result in incremental adverse consequences and that the design will not result in the inundation or wave damage of properties within the reservoir, except marina-type structures, during the inflow design flood. In determining whether a discharge will result in incremental adverse consequences, the Director shall evaluate whether the owner has taken any or all of the following actions: issuing public notice to upstream affected property owners, complying with flood insurance requirements, adopting emergency action plans, conducting mock flood drills, acquiring flood easements or other acquisitions of real property, or other actions appropriate to safeguard the dam site and reservoir. Permanent habitations are not allowed within the reservoir below the spillway elevation.
   b. The applicant shall clear the reservoir storage area of logs and debris.
   c. The applicant shall place borrow areas a safe distance from the upstream toe and the downstream toe of the dam to prevent a piping failure of the dam.
   d. The applicant shall keep the top of the dam and appurtenant structures accessible by equipment and vehicles for emergency operations and maintenance.
5. Geotechnical Requirements
   a. The applicant shall provide an evaluation of the static stability of the foundation, dam, and slopes of the reservoir rim and demonstrate that sufficient material is available to construct the dam as designed.
   b. The applicant shall not construct a dam on active faults, collapsible soils, dispersive soils, sink holes, or fissures, unless the applicant demonstrates that the dam can safely withstand the anticipated offset or other unsafe effects on the dam.
6. Seismic Requirements
   a. The applicant shall submit a review of the seismic or earthquake history of the area around the dam within a radius of 100 miles to establish the relationship of the site to known faults and epicenters. The review shall include any known earthquakes and the epicenter locations and magnitudes of the earthquakes.
   b. The applicant shall identify the location of active or potentially active faults that have experienced Holocene or Late Pleistocene displacement within a radius of 100 miles of the site.
   c. For a high or significant hazard potential dam, the applicant shall design the dam to withstand the maximum credible earthquake.
   d. For a low hazard potential dam, the applicant shall use probabilistic or deterministic methods to determine the design earthquake. The magnitude of the design earthquake shall vary with the size of the dam, site condition, and specific location.

B. Embankment Dam Requirements.
1. Geotechnical Requirements. Table 5 states minimum factors of safety for embankment stability under various loading conditions. For an embankment dam an applicant shall provide a written analysis of minimum factors of safety for stability.
   a. The analysis of minimum factors of safety shall include the effects of anisotropy on the phreatic surface position by using a ratio of horizontal permeability to vertical permeability of at least 10. The Director may require ratios of up to 100 if the material types and construction techniques will cause excessive stratification.
   b. The applicant shall use tests modeling the conditions being analyzed to determine the strengths used in the stability analysis. The stability analysis shall include total and effective stress strengths appropriate for the different material zones and conditions analyzed.

The stability analysis shall use undrained strengths or strength parameters for all saturated materials.

c. The applicant shall perform an analysis of the upstream slope stability for a partial pool with steady seepage considering the reservoir level that provides the lowest factor of safety.

d. A stability analysis is not required for low hazard potential dams if the owner or the owner's engineer demonstrates that conservative slopes and competent materials are included in the design.

2. Seismic Requirements

a. The applicant shall determine the seismic characteristics of the site as prescribed in subsection (A)(6).

b. The applicant shall determine the liquefaction susceptibility of the embankment, foundation, and abutments. The applicant shall use standard penetration testing, cone penetration testing, shear wave velocity measurements, or a combination of these methods to make this determination. The applicant shall compute the minimum factor of safety against liquefaction at specific points and make a determination of whether the overall site is subject to liquefaction.

c. The applicant shall determine the safety of the dam under seismic loading using a pseudo static stability analysis, computing the minimum factor of safety if the embankment, foundation or abutment is not subject to liquefaction and has a maximum peak acceleration of 0.2g or less, or a maximum peak acceleration of 0.35g or less, and consists of clay on a clay or bedrock foundation. The applicant shall use in the pseudo static stability analysis a pseudo static coefficient that is at least 60% of the maximum peak bedrock acceleration at the site.

d. The applicant shall compute a minimum factor of safety against overtopping due to deformation and settlement in each of the following cases. The minimum factor of safety against overtopping can be no less than 2.5, determined by dividing the total pre-earthquake freeboard by the estimated vertical settlement in feet. The applicant shall determine the total vertical settlement by adding the settlement values of the upstream and downstream slopes.

i. The minimum factor of safety in a pseudo static analysis is less than 1.0;

ii. An embankment, foundation, or abutment is not subject to liquefaction, has a maximum peak acceleration of more than 0.2g or a maximum peak acceleration of more than 0.35g and consists of clay on a clay or bedrock foundation; or

iii. The embankment, foundation or abutment is subject to liquefaction.

e. The applicant shall perform a liquefaction analysis to establish approximate boundaries of liquefiable zones and physical characteristics of the soil following liquefaction for an embankment, foundation, or abutment subject to liquefaction. The applicant shall perform an analysis of the potential for flow liquefaction.

f. Other, more sophisticated analytical procedures may be required by the Director for sites with high seismicity or low strength embankment or foundation soils.

3. Miscellaneous Design Requirements

a. The design of any significant or high hazard potential dam shall provide seepage collection and prevent internal erosion or piping due to embankment cracking or other causes.

b. The Director shall review the filter and permeability design for a chimney drain, drain blanket, toe drain, or outlet conduit filter diaphragms on the basis of unique site characteristics.

i. The minimum thickness of an internal drain is 3 feet.

ii. The minimum width of a chimney drain is 6 feet.

iii. The applicant shall filter match an internal drain to its adjacent material.

iv. The applicant shall design internal drains with sufficient capacity for the expected drainage without the use of drainpipes using only natural granular materials.

c. The use of a geosynthetic is not permitted in a design if it serves as the sole defense against dam failure. The use of geotextiles and geonets as a filter or drain material or a geomembrane liner is permitted only in a location that is easily accessible for repair or if its excavation cannot create an unsafe condition at the dam. A geosynthetic liner is allowed under special conditions and in specific situations if it is subject to monitoring and redundant safety controls. The Director may impose conditions, including monitoring appropriate to the hazard classification, inspection, and necessary repairs, each performed every 5 years.

d. The applicant shall use armoring on any upstream slope of an embankment dam that impounds water for more than 30 days at a time. If the applicant uses rock riprap, it shall be well-graded, durable, sized to withstand wave action, and placed on a well-graded pervious sand and gravel bedding or geotextile with filtering capacity appropriate for the site.

e. The applicant shall protect the downstream slopes and groins of an embankment dam from erosion.

f. The minimum width of the top of an embankment dam is equal to the structural height of the dam divided by 5 plus an additional 5 feet. The required minimum width for any embankment dam is 12 feet. The maximum width for any embankment dam is 25 feet.

Historical Note

New Section adopted by final rulemaking at 6 A.A.R. 2558, effective June 12, 2000 (Supp. 00-2).

Table 4. Inflow Design Flood

Dam Hazard Class	Dam Size Classification	IDF Magnitude
Very Low	All Sizes	100-year
Low	All Sizes	0.25 PMF
Significant	Small Intermediate Large	0.25 PMF 0.5 PMF 0.5 PMF
High*	All Sizes	*

* For a high hazard potential dam, the applicant shall design the dam to withstand an inflow design flood that varies from .5 PMF to the full PMF, with size increasing based on persons at risk and potential for downstream damage. The applicant shall consider foreseeable future conditions.

Historical Note
New Table adopted by final rulemaking at 6 A.A.R. 2558, effective June 12, 2000 (Supp. 00-2).

Table 5. Minimum Factors of Safety for Stability[1]

Embankment Loading Condition	Minimum Factor of Safety
End of construction case – upstream and downstream slopes	1.3
End of construction case for embankments greater than 50 feet in height on weak foundations	1.4
Steady state seepage - upstream (critical partial pool) and downstream slope (full pool)	1.5
Instantaneous drawdown - upstream slope	1.2

[1] Not applicable to an embankment on a clay shale foundation.

Historical Note
New Table adopted by final rulemaking at 6 A.A.R. 2558, effective June 12, 2000 (Supp. 00-2).

R12-15-1217. Maintenance and Repair; Emergency Actions

A. An owner shall perform general maintenance and ordinary repairs that do not impair the safety of the dam. General maintenance and ordinary repair activities listed under this subsection do not require prior approval of the Director. These repair activities include:
1. Removing brush or tall weeds.
2. Cutting trees and removing slash from the embankment or spillway. Small stumps may be removed provided no excavation into the embankment occurs.
3. Exterminating rodents by trapping or other methods. Rodent damage may be repaired provided it does not involve excavation that extends more than 2 feet into the embankment and replacement materials are compacted as they are placed.
4. Repairing erosion gullies less than 2 feet deep on the embankment or in the spillway.
5. Grading the surface on the top of the dam embankment or spillway to eliminate potholes and provide proper drainage, provided the freeboard is not reduced.
6. Placing additional riprap and bedding on the upstream slope, or in the spillway in areas that have sustained minor damage and restoring the original riprap protection where the damage has not yet resulted in erosion and weakening of the dam.
7. Painting, caulking, or lubricating metal structures.
8. Patching or caulking spalled or cracked concrete to prevent deterioration.
9. Removing debris, rock, or earth from outlet conduits or spillway channels and basins.
10. Patching to prevent deterioration within outlet works.
11. Replacing worn or damaged parts on outlet valves or controls to restore them to original condition or its equivalent.
12. Repairing or replacing fences intended to keep traffic or livestock off the dam or spillway.

B. General maintenance and ordinary repair that may impair or adversely effect safety, such as excavation into or near the toe of the dam, construction of new appurtenant structures for the dam, and repair of damage that has already significantly weakened the dam shall be performed in accordance with this Article. The Director may approve maintenance performed according to a standard detail or method of repair on file with the Department upon submittal of a letter. The Director shall determine whether general maintenance and ordinary repair activities not listed in subsection (A) will impair safety.

C. Emergency actions not impairing the safety of the dam may be taken before guidance can be provided by an engineer and do not require prior approval of the Director. Emergency actions do not excuse an owner's responsibility to promptly undertake a permanent solution. Emergency actions include:
1. Stockpiling materials such as riprap, earth fill, sand, sandbags, and plastic sheeting.
2. Lowering the reservoir level by making releases through the outlet or a gated spillway, by pumping, or by siphoning.
3. Armoring eroded areas by placing sandbags, riprap, plastic sheeting, or other available material.
4. Plugging leakage entrances on the upstream slope.
5. Increasing freeboard by placing sandbags or temporary earth fill on the dam.
6. Diverting flood waters to prevent them from entering the reservoir basin.

7. Constructing training berms to control flood waters.
8. Placing sandbag ring dikes or reverse filter materials around boils at the downstream toe to provide back pressure.
9. Removing obstructions from outlet or spillway flow areas.

D. Emergency actions impairing the safety of the dam require prior approval of the Director. An owner shall not lower the water level by excavating the spillway or embankment unless failure is imminent.

E. For all high and significant hazard potential dams, the emergency action plan shall be implemented with any emergency actions taken at the dam.

F. The owner shall notify the Director immediately of any emergency condition that exists and any emergency action taken.

Historical Note
New Section adopted by final rulemaking at 6 A.A.R. 2558, effective June 12, 2000 (Supp. 00-2).

R12-15-1218. Safe Storage Level

The Director has the authority to determine the safe storage level for the reservoir behind each dam, including the storage level of an existing dam while it is being repaired, enlarged, altered, breached, or removed. The elevation of the safe storage level is stated on the license. The owner shall not store water in excess of the level determined by the Director to be safe. The owner shall not place flashboards or other devices in the emergency spillway without approval of an alteration of the dam in accordance with this Article.

Historical Note
New Section adopted by final rulemaking at 6 A.A.R. 2558, effective June 12, 2000 (Supp. 00-2).

R12-15-1219. Safety Inspections

A. Except as provided in subsection (E), the Director shall conduct a dam safety inspection annually or more frequently for each high hazard potential dam, triennially for each significant hazard potential dam, and once every 5 years for each low and very low hazard potential dam.

B. An engineer is considered qualified to provide information to the Director regarding the safe storage level of a reservoir if the engineer:
1. Meets the criteria in R12-15-1202(11);
2. Has 3 years of experience in the field of dam safety; and
3. Has actual experience in conducting dam safety inspections.

C. A dam safety inspection includes:
1. Review of previous inspections, reports, and drawings;
2. Inspection of the dam, spillways, outlet facilities, seepage control, and measurement systems;
3. Inspection of any permanent monument or monitoring installations;
4. Assessment of all parts of the dam that are related to the dam's safety; and
5. A recommendation regarding the safe storage level of the reservoir.

D. The engineer shall submit a safety inspection report that describes the findings and lists actions that will improve the safety of the dam. The report shall include the engineer's recommendation of the safe storage level. The engineer shall use a report form approved by the Director.

E. Inspections by the Owner
1. An owner may provide to the Director, at the owner's expense, a safety inspection report that complies with the requirements of subsections (B), (C), and (D) in place of an inspection by the Department. The owner's engineer shall notify the Director and submit a written summary of the engineer's qualifications at least 14 days before the scheduled safety inspection.
2. The Director may refuse to accept an inspection that does not conform to this Article.

F. Inspections by the Department
1. The Director may enter at reasonable times upon private or public property and the owner shall permit such entry, where a dam is located, including a dam under construction, reconstruction, repair, enlargement, alteration, breach, or removal, for any of the following purposes:
   a. To enforce the conditions of approval of the construction drawings and specifications related to an application for construction, reconstruction, repair, enlargement, alteration, breach, or removal.
   b. To inspect a dam that is subject to this Article.
   c. To investigate or assemble data to aid review and study of the design and construction of dams, reservoirs, and appurtenances or make watershed investigations to facilitate decisions on public safety to fulfill the duties of A.R.S. § 45-1214.
   d. To ascertain compliance with this Article and A.R.S. Title 45, Chapter 6.
2. Upon receipt of a complaint that a dam is endangering people or property:
   a. The Director shall inspect the dam unless there is substantial cause to believe the complaint is without merit.
   b. If the complainant files a complaint in writing and deposits with the Director sufficient funds to cover the costs of the inspection, the Director shall make an inspection.
   c. The Director shall provide a written report of the inspection to the complainant and the dam owner.
   d. If an unsafe condition is found, the Director shall cause it to be corrected and return the deposit to the complainant. If the complaint was without merit the deposit shall be paid into the general fund.
3. The Director may employ qualified on-call consultants to conduct inspections.
4. Inspections under subsection (A) shall comply with the requirements of A.R.S. § 41-1009.

Historical Note
New Section adopted by final rulemaking at 6 A.A.R. 2558, effective June 12, 2000 (Supp. 00-2).

R12-15-1220. Existing Dams

A. The requirements of this Article apply to existing dams, except as provided in subsections (B) and (C).

B. If the Director has determined that an existing dam is in a safe condition, the owner is not required to comply with R12-15-1216 unless the Director determines that it is cost effective to upgrade the dam to comply with the requirements of R12-15-1216 at the time a major alteration or major repair is planned. In determining whether it is cost effective to upgrade a dam, the Director shall consider:
1. The hazard potential classification of the dam;
2. Whether the cost of the upgrade would exceed 25% of the total cost of the major alteration or major repair; and
3. Whether there is a more cost effective alternative that would provide an equivalent increase in safety.

C. If the Director has determined that a dam is in an unsafe condition, the owner shall comply with the requirements in R12-15-1216. The owner is not required to comply with a requirement in this Article if the Director finds that, considering the site characteristics and the proposed design, the requirement is unduly burdensome or expensive and is not necessary to pro-

tect human life or property. The Director shall consider the size, hazard potential classification, physical site conditions, and applicability of a requirement to the dam. The Director shall state in writing the reason or reasons the owner is not required to comply with a requirement.

D. The owner shall ensure that installation of utilities beneath or through an existing dam is accomplished by open cuts or jacking and boring methods.

Historical Note
New Section adopted by final rulemaking at 6 A.A.R. 2558, effective June 12, 2000 (Supp. 00-2).

R12-15-1221. Emergency Action Plans

A. Each owner of a high or significant hazard potential dam shall prepare, maintain, and exercise a written emergency action plan for immediate defensive action to prevent failure of the dam and minimize any threat to downstream development. The emergency action plan shall contain a:
   1. Notification chart showing the priority for notification in an emergency situation. The owner shall notify local emergency response agencies, affected downstream populations, county emergency management agencies, and affected flood control districts;
   2. Description of the demand reservoir and scope of the emergency action plan;
   3. Delineation of potentially unsafe conditions, evaluation procedures, and triggering events that require the initiation of partial or full emergency notification procedures, based on the urgency of the situation;
   4. Delineation of areas of responsibility of the owner and other parties. The emergency action plan shall clearly identify individuals responsible for notifications and declaring an emergency;
   5. Specific notification procedure for each emergency situation anticipated;
   6. Description of emergency supplies and resources, equipment access to the site, and alternative means of communication. The emergency action plan shall also identify specific preparedness activities required, such as annual full or partial mock exercises and updates of the emergency action plan; and
   7. Map showing the area that would be subject to flooding due to spillway flows and dam failures.

B. The owner shall use the Director's model emergency action plan, which is available at no cost, or an equivalent model, for guidance in preparing the emergency action plan.

C. The owner shall submit a copy of the proposed emergency action plan for review by the Arizona Division of Emergency Management and all local emergency coordinators involved in the plan. The owner shall incorporate appropriate recommendations generated by the reviews and submit the revised emergency action plan to the Department.

D. The owner shall review and update the emergency action plan annually or more frequently to incorporate changes such as new personnel, changing roles of emergency agencies, emergency response resources, conditions of the dam, and information learned from mock exercises. The owner shall send updated portions of the plan to persons and agencies holding copies of the plan within 15 days after preparation of an update.

Historical Note
New Section adopted by final rulemaking at 6 A.A.R. 2558, effective June 12, 2000 (Supp. 00-2).

R12-15-1222. Right of Review

A. An applicant or owner aggrieved by a decision of the Director regarding the determination of hazard classification, jurisdictional status, or the Director's application of this Article may seek review of an appealable agency action under A.R.S. Title 41, Chapter 6, Article 10.

B. An applicant or owner aggrieved by a decision of the Director that requires the exercise of professional engineering judgment or discretion or the assessment of risk to human life or property, such as the adequacy of an applicant's project documentation, dam design, safe storage level, requirements for existing dams, or maintenance, may seek review by a board of review under A.R.S. §§ 45-1210 and 45-1211.

C. The following actions are not subject to review:
   1. Emergency measures taken under A.R.S. §§ 45-1212 or 45-1221.
   2. Agency decisions made under A.R.S. §§ 41-1009(E) or (F).
   3. Agency actions made exempt from review by law.

Historical Note
New Section adopted by final rulemaking at 6 A.A.R. 2558, effective June 12, 2000 (Supp. 00-2).

R12-15-1223. Enforcement Authority

A. The Department may exercise its discretion to take action necessary to prevent danger to human life or property. The Director may take any legal action that is proper and necessary for the enforcement of this Chapter.

B. If the Director has cause to believe that a dam is unsafe or a person is violating or has violated a provision of this Article or A.R.S. Title 45, Chapter 6, Article 1, the Director may issue a notice directing the owner to remedy the safety deficiency or correct the violation. The owner may appeal a notice issued under this subsection as an appealable agency action in accordance with A.R.S. Title 41, Chapter 6, Article 10. If the owner does not appeal within 30 days after the date on the notice, the notice becomes final and may be incorporated as a condition of any license based on the duration of the requirement.

C. If the Director has cause to believe that a dam is unsafe or a person is violating or has violated a provision of this Article or A.R.S. Title 45, Chapter 6, Article 1, the Director may proceed under A.R.S. § 45-1221 to initiate a contested case under A.R.S. Title 41, Chapter 6, Article 10 by requesting an administrative hearing.

D. Following a written decision by an administrative law judge, the Director shall issue a decision and order accepting, rejecting, or modifying the administrative law judge's decision. Upon expiration of time to appeal, the decision and order becomes final and may be incorporated as a condition of any license based on the duration of the requirement.

E. If the Director has cause to believe that a dam is unsafe or a person is violating or has violated a provision of this Article or A.R.S. Title 45, Chapter 6, Article 1 the Director may commence an action in a court of appropriate jurisdiction if:
   1. The violation is an emergency requiring appropriate steps to be taken without delay; or
   2. The Director has cause to believe that use of the administrative procedure would be ineffective or that delay would ensue and a deterioration in the safety of the dam would occur.

F. If the Director commences an action it shall be brought in a court of appropriate jurisdiction in which:
   1. The cause or some part of the cause arose; or
   2. The owner or person complained of has his or her place of business; or
   3. The owner or person complained of resides.

G. A person determined to be in violation of this Article; A.R.S. Title 45, Chapter 6; a license; or order may be assessed a civil penalty not exceeding $1,000 per day of violation. The Director may offer evidence relating to the amount of the penalty in accordance with A.R.S. § 45-1222.

H. A violation of A.R.S. Title 45, Chapter 6, Article 1 regarding Supervision of Dams, Reservoirs, and Projects is a class 2 misdemeanor, in accordance with A.R.S. § 45-1216.

Historical Note
New Section adopted by final rulemaking at 6 A.A.R. 2558, effective June 12, 2000 (Supp. 00-2).

R12-15-1224. Emergency Procedures

A. The owner of a dam shall immediately notify the Department and responsible authorities in adjacent and downstream communities, including emergency management authorities, of a condition that may threaten the safety of the dam. The owner shall take necessary actions to protect human life and property, including action required under an emergency action plan or order issued under this Article.
   1. A condition that may threaten the safety of a dam includes:
      a. Sliding of upstream or downstream slopes or abutments contiguous to the dam;
      b. Sudden subsidence of the top of the dam;
      c. Longitudinal or transverse cracking of the top of the dam;
      d. Unusual release of water from the downstream slope or face of the dam;
      e. Other unusual conditions at the downstream slope of the dam;
      f. Significant landslides in the reservoir area;
      g. Increasing volume of seepage;
      h. Cloudy seepage or recent deposits of soil at seepage exit points;
      i. Sudden cracking or displacement of concrete in a concrete or masonry dam spillway or outlet works;
      j. Loss of freeboard or dam cross section due to storm wave erosion;
      k. Flood waters overtopping an embankment dam; or
      l. Spillway backcutting that threatens evacuation of the reservoir.
   2. In case of an emergency, the owner shall telephone the Arizona Department of Public Safety's emergency numbers at (800) 411-2336 or (602) 223-2000.

B. The Director shall issue an emergency approval to repair, alter, or remove an existing dam if the Director finds that immediate remedial action is necessary to alleviate an imminent threat to human life or property.
   1. The emergency approval shall be provided in writing on a form developed for this purpose.
   2. The emergency approval may contain conditions the Director determines are appropriate to protect human life or property.
   3. The emergency approval is effective immediately for 30 days after notice is issued unless extended in writing by the Director. The Director shall also send notice to the county flood control district of the county in which the dam is located, all municipalities within 5 miles downstream of the dam, and any additional persons identified in the emergency action plan.
   4. The Director may institute legal or administrative proceedings that the Director deems appropriate for violations of the emergency approval or conditions of the emergency approval.

Historical Note
New Section adopted by final rulemaking at 6 A.A.R. 2558, effective June 12, 2000 (Supp. 00-2).

R12-15-1225. Emergency Repairs

A. The Director shall use monies from the dam repair fund, established under A.R.S. § 45-1212.01 to employ any remedial measure necessary to protect human life and property resulting from a condition that threatens the safety of a dam if the dam owner is unable or unwilling to take action and there is not sufficient time to issue and enforce an order.

B. The deputy director may authorize an expenditure not to exceed $10,000 from the dam repair fund for remedial measures under A.R.S. § 45-1212. The expenditure of any additional funds shall be approved by the Director.

C. The Director shall hold a lien against all property of the owner in accordance with A.R.S. § 45-1212.

Historical Note
New Section adopted by final rulemaking at 6 A.A.R. 2558, effective June 12, 2000 (Supp. 00-2).

R12-15-1226. Non-Emergency Repairs; Loans and Grants

A. If the Director determines that a dam represents a threat to human life and property but is not in an emergency condition, the Director may use the dam repair fund, established under A.R.S. § 45-1212.01, as prescribed in this Article to defray the costs of repair.

B. Monies from the dam repair fund may be used for loans and grants to owners as provided in A.R.S. §§ 45-1218 and 45-1219.

C. To qualify for a loan or grant from the dam repair fund, a dam shall be classified as unsafe by the Director.

D. The Director may authorize grant funds for all or part of the cost of engineering studies or construction needed to mitigate the threat to human life and property created by a dam.
   1. The Director and the grantee shall execute a financial assistance agreement that includes terms of financial assistance, the work progress, and payment schedule.
   2. The Director shall disburse grant funds in accordance with the financial assistance agreement.
   3. The Director shall establish a priority ranking for grants based on factors including the potential for failure of a dam, the number of lives at risk, and the capability of the owner to pay a portion of the costs.

E. The Director may loan funds for engineering studies or for all or part of construction as prescribed in A.R.S. § 45-1218.
   1. The Director and the dam owner shall execute a loan repayment agreement. The loan repayment agreement shall be delivered to and held by the Department.
   2. The Director shall establish a priority ranking for loans based on factors including the potential for failure of a dam, the number of human lives at risk, and the capability of the owner to pay a portion of the costs.

Historical Note
New Section adopted by final rulemaking at 6 A.A.R. 2558, effective June 12, 2000 (Supp. 00-2).

Wood/Patel

Spook Hill ADMP
Flood Control District of Maricopa County
FCD 99-43

May 8, 2001
W/P # 99989

Crude Cost Estimate for Drainage Facilities required for the Red Mountain Freeway
Option 1
Reconstruct the Spook Hill FRS to accommodate the full Probable Maximum Flood Option

MAJOR ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Excavation	$2.50	CY	2,550,000	$6,375,000
2	Backfill - onsite source	$2.50	CY	2,550,000	$6,375,000
3	Backfill - offsite source	$6.50	CY	250,000	$1,625,000
4	6' Concrete lined Interceptor channel	$124	LF	19,200	$2,380,800
5	16' Service road (ABC)	$5	LF	19,200	$96,000
6	Drop inlet & slope drain @ 500' O.C.	$12,550	EA	38	$476,900
7	Low flow/maintenance access road	$84	LF	19,200	$1,612,800
8	1120' Bridge at McDowell Road	$75	SF	105,280	$7,896,000
9	1710' Bridge at McKellips Road	$75	SF	160,740	$12,055,500
10	1850' Bridge at Brown Road	$75	SF	173,900	$13,042,500
11	1056' NB Bridge over the Emergency Spillway	$75	SF	57,024	$4,276,800
12	1176' SB Bridge over the Emergency Spillway	$75	SF	63,504	$4,762,800
13	Common element - Bridge at South end of FRS	$0	SF	0	$0
			SUBTOTAL MAJOR ELEMENTS		$60,975,100
	CONTINGENCIES:				
	Construction			20%	$12,195,020
	Engineering			3.5%	$2,134,129
	Construction Admin			3.5%	$2,134,129
			TOTAL MAJOR ELEMENTS		**$77,438,377**
				TOTAL	***$77,438,377***

Wood/Patel

Crude Concept: Red Mountain Freeway cut/fill quantity estimate for drainage design

End Area

Section			FRS fill		Roadway fill	Roadway berm		Storage lost to roadway	Replacement storage		Additional Cut		Total fill required for roadway	Fill available for roadway	
			above 100 yr flood	below 100 yr flood		above 100 yr flood	below 100 yr flood		above ground elev	above low flow elev	above 100 yr flood	for concrete channel		above ground	above low flow
No.	(Station) ft	Length ft	(A1) ft²	(A2) ft²	(A3) ft²	(A4) ft²	(A5) ft²	A2+A3+A5 ft²	(A6) ft²	(A7) ft²	(A8) ft²	(A9) ft²	sum(A1:A5) ft²	(A6+A8+A9) ft²	sum(A6:A9) ft²
1	778	1500	645.47	485.59	2536.30	162.00	321.59	3343.48	3760.90	1564.20	1008.27	45.10	4150.95	4814.27	6378.47
2	821	6250	645.47	461.38	2500.98	162.00	285.01	3247.37	4243.26	1267.02	1274.86	44.81	4054.84	5562.93	6829.95
3	887	7900	645.47	345.05	2606.64	162.00	298.05	3249.74	4199.47	1293.93	889.22	48.28	4057.21	5136.97	6430.90
4	943	3550	645.47	352.17	2102.78	162.00	148.73	2603.68	1844.57	217.74	759.59	42.46	3411.15	2646.62	2864.36

Volumetric

Section			FRS fill		Roadway fill	Roadway berm		Storage lost to roadway	Replacement storage		Additional Cut		Total fill required for roadway	Fill available for roadway	
			above 100 yr flood	below 100 yr flood		above 100 yr flood	below 100 yr flood		above ground elev	above low flow elev	above 100 yr flood	for concrete channel		above ground*	above low flow*
No.	(Station) ft	Length ft	(A1) yd³	(A2) yd³	(A3) yd³	(A4) yd³	(A5) yd³	A2+A3+A5 yd³	(A6) yd³	(A7) yd³	(A8) yd³	(A9) yd³	sum(A1:A5) yd³	(A6+A8+A9) yd³	sum(A6:A9) yd³
1	778	1500	35,859	26,977	140,906	9,000	17,866	185,749	208,939	86,900	56,015	2,506	230,608	200,595	265,770
2	821	6250	149,414	106,801	578,931	37,500	65,975	751,706	982,236	293,292	295,106	10,373	938,620	965,786	1,185,755
3	887	7900	188,860	100,959	762,684	47,400	87,207	950,850	1,228,734	378,594	260,179	14,126	1,187,110	1,127,280	1,411,225
4	943	3550	84,867	46,304	276,477	21,300	19,555	342,336	242,527	28,629	99,872	5,583	448,503	260,986	282,458
Totals:		19,200	459,001	281,041	1,758,996	115,200	190,603	2,230,640	2,662,436	787,415	711,173	32,587	2,804,841	2,554,647	3,145,208

Notes:
1. * A shrinkage factor of 25% has been applied to material excavated on site to determine the compacted volume.
2. The Section stations correspond to the sections defined in the Red Mountain Freeway Design Concept Report by Parsons Brinckerhoff.

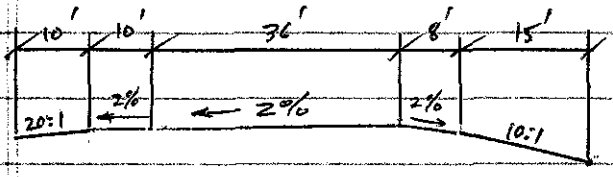
Shrinkage: 25.00%

JDS 5/1/01

— Calculate the fill quantity required for the proposed Red Mountain Freeway along the Spook Hill FRS.

Design Criteria:

- The roadway pavement must be at or above the 100 yr flood elevation of 1583.86.
- The required fill will be excavated from the area uphill of the roadway alignment.
- The dam will be raised 2.25' plus required residual freeboard of 5.0' to comply with ADWR regulations.
- The 100 yr flood elevation is assumed to be the same as the ~~F~~ emergency spillway crest.
- The top of the Spook Hill FRS is at a constant elevation of 1592.86'
- A constant roadway elevation of 1583.98 is used to simplify calculations. This value is the average elevation needed to ensure that all pavement is above 1583.86 for the section shown.



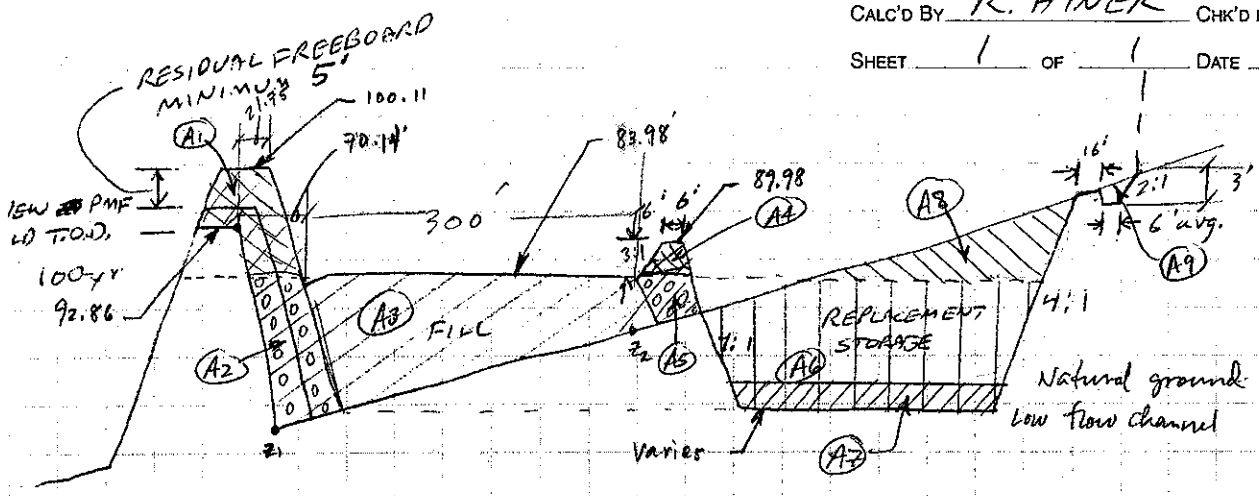
WOOD/PATEL

CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS • CONSTRUCTION MANAGERS

PROJECT SPOOK HILL No. 99989

CALC'D BY R. HINER CHK'D BY

SHEET 1 OF 1 DATE



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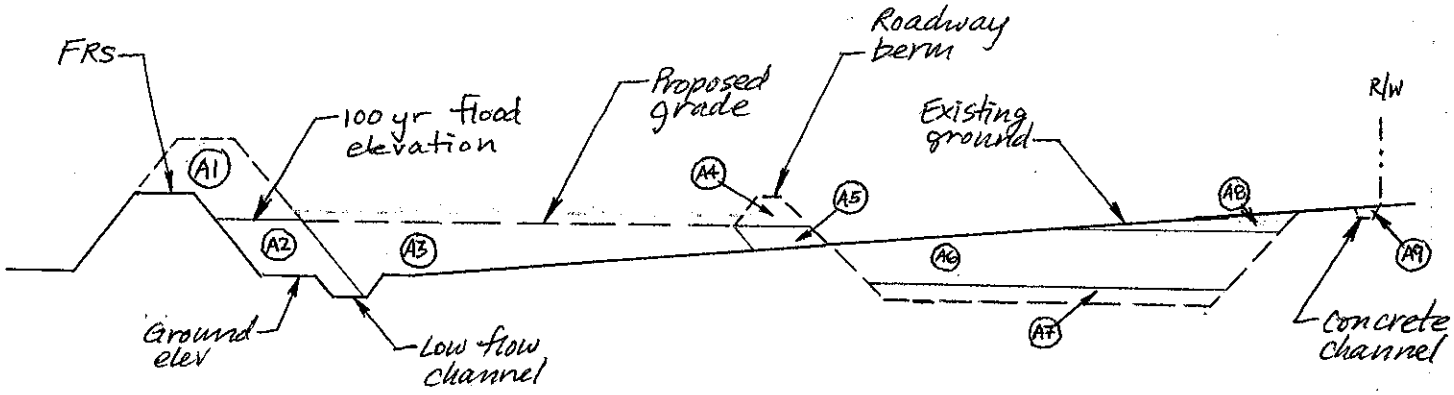
PROJECT Spook Hill NO. 99989

CALC'D BY JDS CHK'D BY

SHEET 1 OF DATE 5/2/01

— Calculate area for typical sections

Section	Location
1	Between beginning and McDowell Rd.
2	Between McDowell and McKellips.
3	Between McKellips and Brown.
4	Between Brown and the end.



PROJECT Spook Hill NO. 99989

CALC'D BY JDS CHK'D BY

SHEET 2 OF DATE 3/2/01

Section 1 (778)

973' to R/W line

Dist	Elev	Note
0	92.86	Top berm
50.58	76	Toe
80 ~~66.58~~	74	Ditch
92 ~~81.58~~	70	Ditch
104	70	Ditch
116	74	Ditch
441.1	78	
973	93	

Area

fill = 4150.97 ft²

cut = 6333.32 ft²

cut below roadway elev = 5325 ft²

A1 = 645.47 ft²

A2 = 485.59 ft²

A3 = 2536.3 ft²

A4 = 162 ft²

A5 = 321.59 ft²

A6 = ~~5325~~ 3760.9 ft²

A7 = 1564.2 ft²

A8 = 1008.27 ft²

A9 = 45.10 ft²

PROJECT Spook Hill NO. 99989

CALC'D BY JDS CHK'D BY 3

SHEET 3 OF DATE 5/2/01

Section 2 (821) 995' to R/W Line

Dist	Elev	Note
0	92.86	Top berm
50.58	76	
81	74	
93.2	~~78~~ 71	
104.8	~~78~~ 71	
~~117~~ 131.3	74	
519	80	
553.1	84	
1039.2	92	

$A_1 = 645.47$ ft²
$A_2 = 461.38$ ft²
$A_3 = 2500.98$ ft²
$A_4 = 162.00$ ft²
$A_5 = 285.01$ ft²
$A_6 = 4243.26$ ft²
$A_7 = 1267.02$ ft²
$A_8 = 1274.86$ ft²
$A_9 = 44.81$ ft²

Section 3 (887) 1002' to R/W Line

Dist	Elev	Note
0	92.86	Top
47.58	77	
125.1	74	
132.7	71	
148.8	71	
160	74	
530	80	
542.1	82	
1070.2	92	

$A_1 = 645.47$ ft²
$A_2 = 345.05$ ft²
$A_3 = 2606.64$ ft²
$A_4 = 162$ ft²
$A_5 = 298.05$ ft²
$A_6 = 4199.47$ ft²
$A_7 = 1293.93$ ft²
$A_8 = 889.22$ ft²
$A_9 = 48.28$ ft²

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PROJECT Spook Hill NO. 99989

CALC'D BY JDS CHK'D BY

SHEET 4 OF DATE 3/2/01

710' ~~[illegible]~~' to R/W Line

Section 4 (943)

Dist	Elev	Notes
0	92.86	
44.58	78	
83.1	76	
94.1	72.5	
109.8	72.5	
116.6	74	
446.8	82	
464.7	86	
681.2	90	

$A_1 = 645.47$ ft²

$A_2 = 357.17$ ft²

$A_3 = 2102.78$ ft²

$A_4 = 602$ ft²

$A_5 = 148.73$ ft²

$A_6 = 1844.57$ ft²

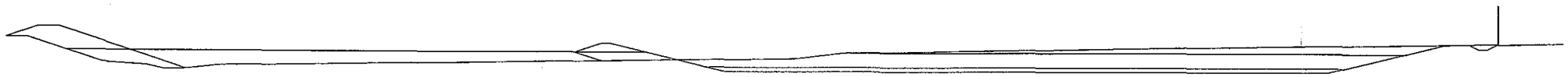
$A_7 = 217.74$ ft²

$A_8 = 759.59$ ft²

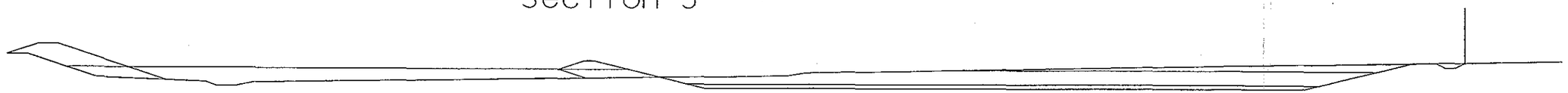
$A_9 = 42.46$ ft²

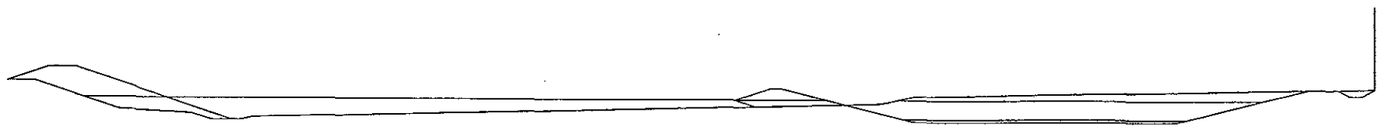
Section 1

Section 2



Section 3





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PROJECT Spook Hill NO. 99989

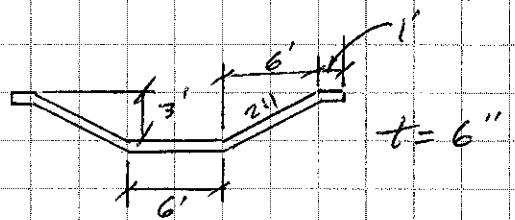
CALC'D BY JDS CHK'D BY

SHEET 1 OF DATE 5/3/01

Crude Cost Estimate —
Red Mountain Freeway Drainage

- Calculate quantities for the 6' concrete lined channel

  — calculate a volume of concrete per linear foot of channel.

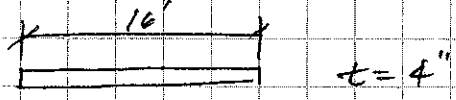


$$V = \left[6 + z\left(1 + \sqrt{6^2+3^2}\right)\right] 0.5$$
$$= 10.7 \text{ ft}^3/\text{ft}$$
$$= \underline{0.4 \text{ yd}^3/\text{ft}}$$

Assume ~~$250~~ $310/yd³ for concrete

Cost per lin ft = $0.4 \text{ yd}^3/\text{ft} (\$310/\text{yd}^3) = \underline{\$124/\text{lin ft}}$

- Calculate quantities for the 16' service road



Volume of gravel = $16' (4/12)/27$
$= \underline{0.20 \text{ yd}^3/\text{ft}}$

Assume $25/yd³ for gravel

cost = $\$25/\text{yd}^3 (0.20 \text{ yd}^3/\text{ft}) = \underline{\$5/\text{ft}}$

PROJECT Spook Hill NO. 99989

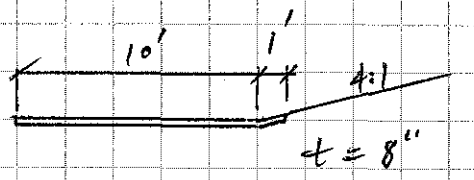
CALC'D. BY JDS CHK'D BY

SHEET 2 OF DATE 5/3/01

Crude Cost Estimate (cont.) –

- Calculate quantities for the maintenance access pad

Volume of concrete
= (10+1)(8/12)/27
= 0.27 yd³/ft



Assume ~~$250~~ 310/yd³ concrete

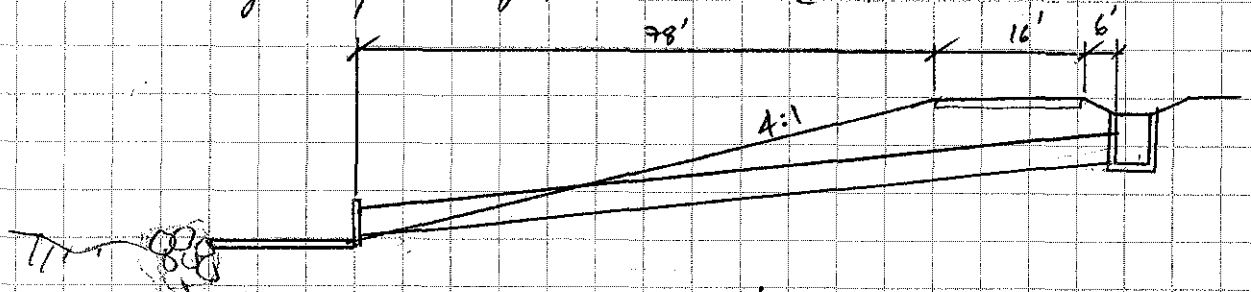
Cost = (0.27)(~~$250~~ 310) = ~~$68~~ 84/lin ft.

- Calculate quantities for the drop inlet and slope drains

Assume these will be located at 500' intervals

Number = 19,200 / 500 = 38.4 use 38

The average slope height = 19.5' @ 4:1



Length of pipe = 78+16+6 = 100'

Assume the drop inlet will be 6'x6'x8' interior dimensions with 8" sidewalls

Concrete V = $\left[\left(6+\frac{16}{12}\right)\left(6+\frac{16}{12}\right)\left(8+\frac{8}{12}\right)-(6)(6)(8)\right]/27$
= 6.60 yd³

PROJECT Spook Hill NO. 99989

CALC'D BY JDS CHK'D BY

SHEET 3 OF DATE 5/3/01

Crude Cost Estimate (cont.) –

• Drop inlet & slope drain (cont.)

Cost of concrete = ~~$250~~ 310/yd³ (6.6 yd³)
= ~~$1650~~ 2046

Grating – assume $1000/ea.

Headwall – assume $1000/ea.

Assume pipe is 48" CMP @ $85/ft

Cost = (100')($85/ft) = $8500

Total cost for drop inlet & slope drain
= $2046 + $1000 + $1000 + $8500
= $12,546 use $12,550

Crude cost estimate (cont.) —

- Calculate cost to provide bridge structures that don't affect backwater during the PMF

Assumptions: $75/ft² for bridge structure
Bridge must span from west of the canal to the R/W line.

Calculate width —

5 – 12' lanes with 10' shoulders = 80'
use 94' from CAD measurement of McDowell

Three crossings at McDowell, McKellips & Brown

Lengths: McDowell – 1120'
McKellips – 1710'
Brown – 1850'

Total area: McDowell = 1120 (94'/~~80~~) = ~~89,600 ft²~~ 105,280
McKellips = 1710 (94'/~~80~~) = ~~136,800 ft²~~ 160,740
Brown = 1850 (94'/~~80~~) = ~~148,000 ft²~~ 173,900
~~374,400 ft²~~ 439,920

Cost = 439,920 ~~374,000 ft²~~ ($75/ft²)
= ~~$28,080,000~~ $32,994,000

PROJECT Spook Hill NO. 999890

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SHEET 5 OF DATE 5/4/01

Crude Cost Estimate (cont.) —

— Determine the cost of the structure (bridge) needed for the Red Mountain Freeway which crosses the Spook Hill FRS near the emergency spillway.

Given: The FRS will be raised in order to contain the PMF.

Assume: The widths of the NB + SB segments of bridge are assumed to be $10' + 3(12') + 8' = 54'$

The cost for the higher structure is $\$75/ft^2$

The NB Bridge length in the Design Concept Plans is 1000'. The SB Bridge is 1120'.

The sideslope of the abutment is 2:1.

The bridges would need to be raised approximately 16' on the north end and 12' on the south end.

This would require an additional bridge length of $2(16+12) = 56'$

Adjusted lengths:

NB = $1000 + 56 = 1056'$

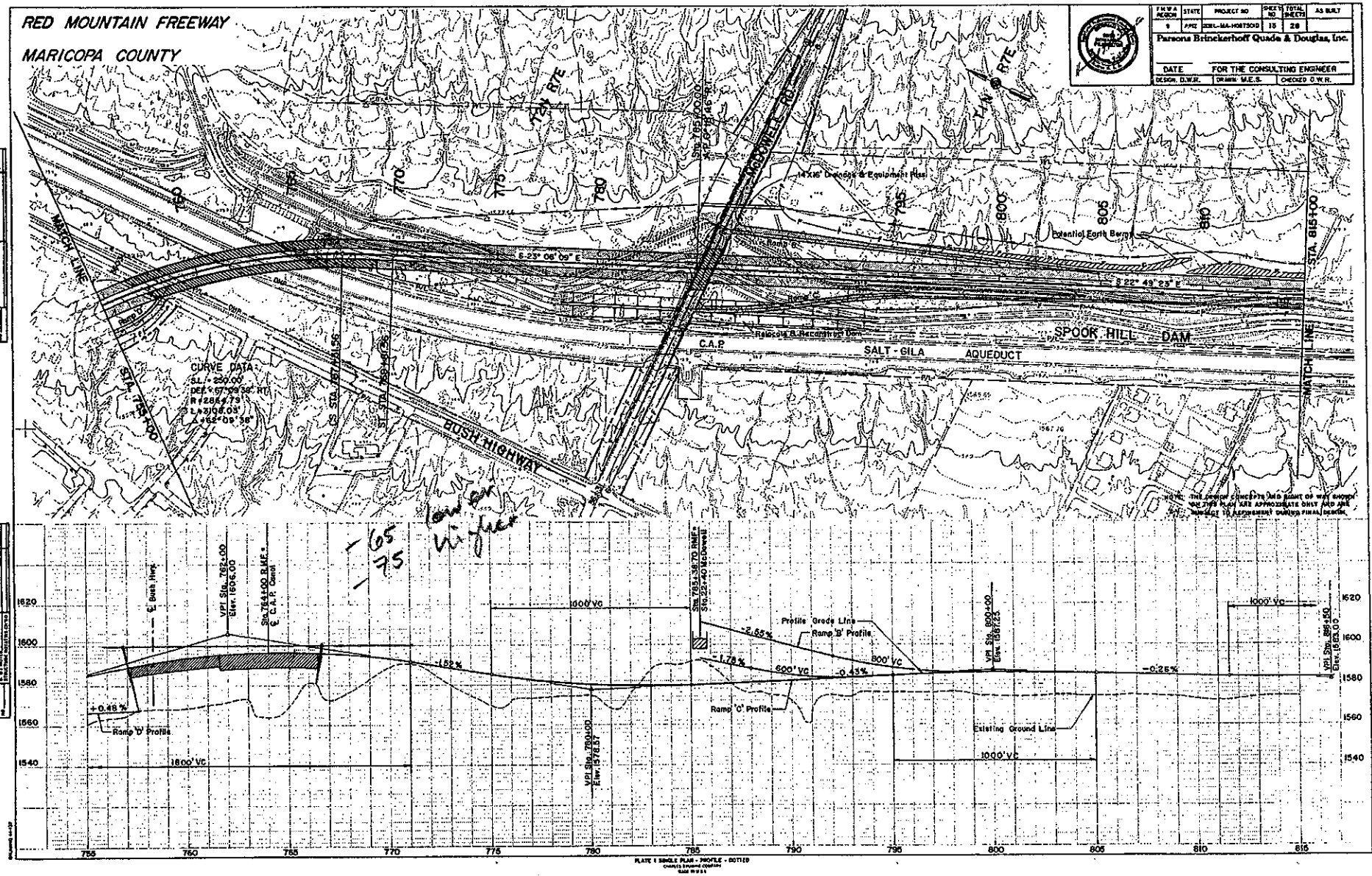
SB = $1120 + 56 = 1176'$

Structure Area:

NB = $54 (1056) = 57{,}024$

SB = $54 (1176) = 63{,}504$

TOTAL: $120{,}528\ ft^2$



DESIGN CONCEPT PLANS

Arizona Department of Transportation

RED MOUNTAIN FREEWAY

PARSONS BRINCKERHOFF

DATE: OCT 1988

PAGE 60

Spook Hill ADMP May 10, 2001
Flood Control District of Maricopa County W/P # 99989
FCD 99-43

Crude Cost Estimate for Drainage Facilities required for the Red Mountain Freeway
Option 2
Non-jurisdictional Option 4

Freeway or Freeway/Drainage Alternative

MAJOR ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Excavation	$2.50	CY	1,754,383	$4,385,958
2	Compacted fill - onsite source	$2.50	CY	1,578,383	$3,945,958
3	Compacted fill - offsite source	$6.50	CY	80,515	$523,348
4	6' Concrete lined channel	$124	LF	19,200	$2,380,800
5	16' Service road (ABC)	$5	LF	19,200	$96,000
6	Drop inlet & slope drain @ 500' O.C.	$8,500	EA	38	$323,000
7	Low flow/maintenance access road	$84	LF	0	$0
8	457' Bridge at McDowell Road	$75	SF	42,958	$3,221,850
9	521' Bridge at McKellips Road	$75	SF	48,974	$3,673,050
10	746' Bridge at Brown Road	$75	SF	70,124	$5,259,300
11	734' NB Bridge over the Emergency Spillway	$65	SF	39,636	$2,576,340
12	734' SB Bridge over the Emergency Spillway	$65	SF	39,636	$2,576,340
13	Common element - Bridge at South end of FRS	$0	SF	0	$0
14	Signal Butte Principal Spillway Modifications	$177,675	LUMP	1	$177,675
15	Signal Butte Outfall Channel	$490,700	LUMP	1	$490,700
16	Spook Hill Floodway	$6,284,000	LUMP	1	$6,284,000
17	Off line Detention Facility Appurtenances	$100,000	LUMP	1	$100,000
				SUBTOTAL MAJOR ELEMENTS	$36,014,318
		CONTINGENCIES:			
		Construction		20%	$7,202,864
		Engineering		3.5%	$1,260,501
		Construction Admin		3.5%	$1,260,501
				TOTAL MAJOR ELEMENTS	**$45,738,183**

ADDITIONAL ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	McDowell - Option 2E	$8,170,777	LUMP	1	$8,170,777
2	McKellips - Option 2E	$3,297,247	LUMP	1	$3,297,247
				SUBTOTAL ADDITIONAL ELEMENTS	$11,468,024
		CONTINGENCIES:			
		Construction		35%	$4,013,808
		Engineering		7%	$802,762
		Construction Admin		6%	$688,081
				TOTAL ADDITIONAL ELEMENTS	**$16,972,676**
				TOTAL	***$62,710,859***

Spook Hill ADMS Update
Flood Control District of Maricopa County
FCD 99-43

August 9, 2001
W/P # 99989

Spook Hill Floodway Channel Design
File: New_Geo
Revised Incised Concrete Channel with Gabion Outlet

MAJOR ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Concrete Channel	$310	CY	14,300	$4,433,000
2	Channel Excavation	$4	CY	68,000	$272,000
3	Gabion Channel Lining	$75	CY	14,600	$1,095,000
4	Concrete Bridge	$60	SF	6,400	$384,000
			SUBTOTAL MAJOR ELEMENTS		$6,184,000
		CONTINGENCIES:			
		Construction		35%	$2,164,400
		Engineering		7%	$432,880
		Construction Admin		6%	$371,040
			TOTAL MAJOR ELEMENTS		**$9,152,320**

ADDITIONAL ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Box Culvert Removal (Thomas Rd)	$100,000	Job	1	$100,000
2	Utility Relocations (W & S)	$8,000	EA	0	$0
			SUBTOTAL ADDITIONAL ELEMENTS		$100,000
		CONTINGENCIES:			
		Construction		35%	$35,000
		Engineering		7%	$7,000
		Construction Admin		6%	$6,000
			TOTAL ADDITIONAL ELEMENTS		**$148,000**

LAND ACQUISITION:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Land Acquisition	$0	AC	0.00	$0
2	Basin Land Acquisition	$0	AC	0.00	$0
			SUBTOTAL LAND ACQUISITION		$0
		CONTINGENCIES :		25%	$0
			TOTAL LAND ACQUISITION		**$0**
			TOTAL		***$9,300,320***

Spook Hill ADMS Update
Flood Control District of Maricopa County
FCD 99-43

August 9, 2001
W/P # 99989

Signal Butte Principal Spillway Modification

MAJOR ELEMENTS:

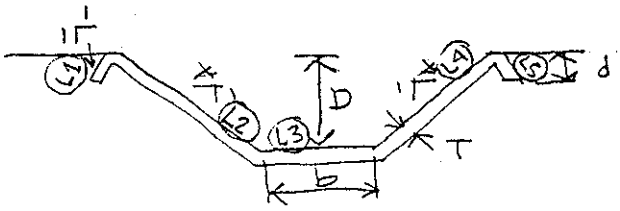
ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Concrete Spillway (Inlet, box ,outlet, etc.)	$450	CY	201	$90,585
2	Grouted Riprap	$45	SY	645	$29,025
3	Handrail	$50	LF	64	$3,200
4	Fence	$11	LF	215	$2,365
5	Walkway	$100	LF	25	$2,500
6	Removals (Spillway, Riprap, Headwalls, etc.)	$50,000	EA	1	$50,000
			SUBTOTAL MAJOR ELEMENTS		$177,675
		CONTINGENCIES:			
		Construction		35%	$62,186
		Engineering		7%	$12,437
		Construction Admin		6%	$10,661
			TOTAL MAJOR ELEMENTS		**$262,959**

PROJECT Spook Hill NO.

CALC'D BY JST CHK'D BY

SHEET OF DATE 5/2/01

Signal Butte Outfall Channel
for Quadrupled Spillway Design
Channel lining costs



Overall Length = (L1+L2+L3+L4+L5)

L1 = L5 & L2 = L4

L = 2(L1) + 2(L2) + L3

$L_1 = \sqrt{2 \cdot d^2}$

$L_2 = \sqrt{D^2 + (dx)^2}$

$L_3 = b$

V = (L · T)/27 = cy/lf

d = 2, b = 10, D = 9.3, T = 0.5

@ d = 9.3', b = 10', x = 2, T = 0.5, d = 2', Conc = 1.06 cy/LF

STA 12+50 to sta 23+00

1050 LF × 1.06 = 1113 cy

@ d = 9.3', b = 16, x = 2, T = 0.5 d = 2, conc = 1.17 cy/lf

sta 23+00 to sta 30+00

700 lf × 1.17 = 819 cy

Total Concrete Volume = 1932 cy

Earthwork = 1,932 cy

Conc	1932 cy @	$250/cy =	$ 483,000
	1932 cy @	$4/cy =	$ 7,700
			$ 490,700

Signal Butte Culvert

No upgrade Required

Spook Hill ADMP May 10, 2001
Flood Control District of Maricopa County W/P # 99989
FCD 99-43

Crude Cost Estimate for Drainage Facilities required for the Red Mountain Freeway
Option 2
Non-jurisdictional Option 6

MAJOR ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Excavation	$2.50	CY	1,300,383	$3,250,958
2	Compacted fill - onsite source	$2.50	CY	1,237,883	$3,094,708
3	Compacted fill - offsite source	$6.50	CY	421,015	$2,736,598
4	6' Concrete lined channel	$124	LF	19,200	$2,380,800
5	16' Service road (ABC)	$5	LF	19,200	$96,000
6	Drop inlet & slope drain @ 500' O.C.	$8,500	EA	38	$323,000
7	Low flow/maintenance access road	$84	LF	0	$0
8	457' Bridge at McDowell Road	$75	SF	42,958	$3,221,850
9	521' Bridge at McKellips Road	$75	SF	48,974	$3,673,050
10	746' Bridge at Brown Road	$75	SF	70,124	$5,259,300
11	734' NB Bridge over the Emergency Spillway	$65	SF	39,636	$2,576,340
12	734' SB Bridge over the Emergency Spillway	$65	SF	39,636	$2,576,340
13	Common element - Bridge at South end of FRS	$0	SF	0	$0
14	Signal Butte Principal Spillway Modifications	$177,675	LUMP	1	$177,675
15	Signal Butte Outfall Channel	$490,700	LUMP	1	$490,700
16	Spook Hill Floodway	$6,284,000	LUMP	1	$6,284,000
17	Pass Mountain Alternative	$3,035,989	LUMP	1	$3,035,989
18	Off line Detention Facility Appurtenances	$50,000	LUMP	1	$50,000
				SUBTOTAL MAJOR ELEMENTS	$39,227,307
		CONTINGENCIES:			
		Construction		20%	$7,845,461
		Engineering		3.5%	$1,372,956
		Construction Admin		3.5%	$1,372,956
				TOTAL MAJOR ELEMENTS	**$49,818,679**

ADDITIONAL ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	McDowell - Option 2E	$8,170,777	LUMP	1	$8,170,777
2	McKellips - Option 2E	$3,297,247	LUMP	1	$3,297,247
				SUBTOTAL ADDITIONAL ELEMENTS	$11,468,024
		CONTINGENCIES:			
		Construction		35%	$4,013,808
		Engineering		7%	$802,762
		Construction Admin		6%	$688,081
				TOTAL ADDITIONAL ELEMENTS	**$16,972,676**
				TOTAL	***$66,791,355***

PROJECT _____ NO. _____

CALC'D BY _____ CHK'D BY _____

SHEET _____ OF _____ DATE _____

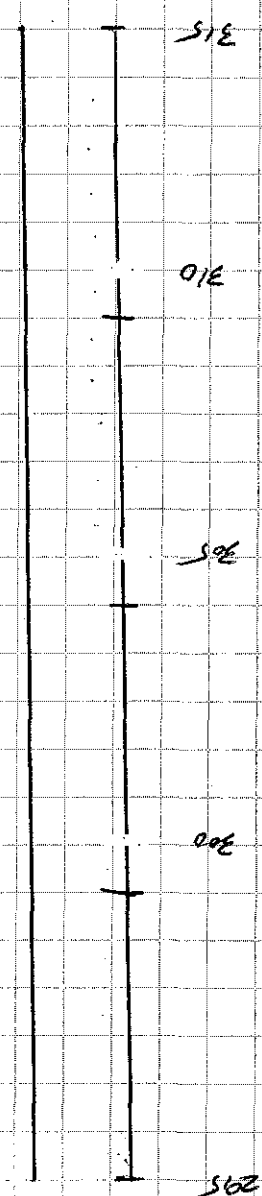
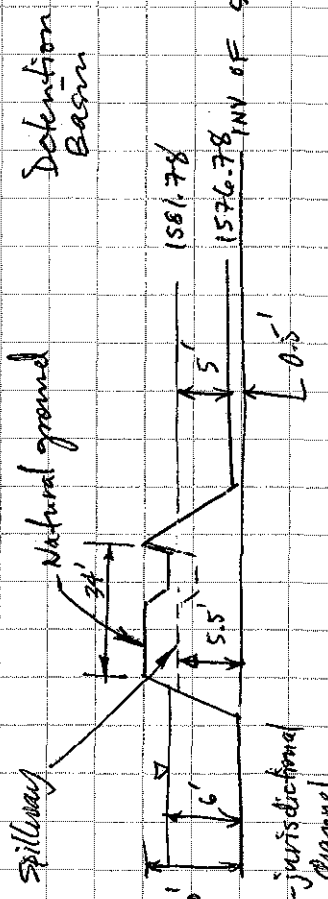


Diagram of Detention Basin



WOOD/PATEL

CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS • CONSTRUCTION MANAGERS

PROJECT Spook Hill NO. 99989

CALC'D BY JDS CHK'D BY

SHEET 1 OF DATE 5/10/01

- Determine V for off-line basin
  Option 4 Non jurisdictional channel

Section ~~295~~ 300

Total offset	Inc Offset	Elev
0	0	
		1590
		1592
		94
		96
		98
		1600

Section 305

Total offset	Inc offset	Elev
0	0	1589.2
	55.9	1590
	111.5	92
	~~55.7~~ 111.3	94
	~~86.0~~ 82.7	96
	167.4	98
	~~74.4~~	1600
	132.8	1602

372.9

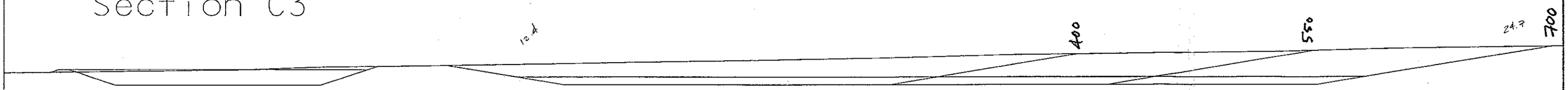
Area for Option 4 Non-jurisdictional off-line basin

Top Width (ft)	Cross Section Area		Length (ft)	Volume			Length (ft)	Volume		
	Storage (ft^2)	Total Cut (ft^2)		Storage (yd^3)	(ac-ft)	Total Cut (yd^3)		Storage (yd^3)	(ac-ft)	Total Cut (yd^3)
400	1187	5341.3	5504.6	242,000	150	1,088,959	3669.8	161,333	100	725,973
550	1873.7	8168.8	3487.2	242,000	150	1,055,051	2324.8	161,333	100	703,368
700	2537.1	11281.8	2575.4	242,000	150	1,076,109	1716.9	161,333	100	717,406

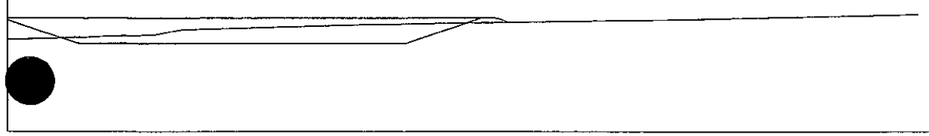
Section C1

Section C2

Section C3



Section C4



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Crude Concept: Non-jurisdictional channel cut/fill quantity estimate

End Area

Section (Station) ft	Section Length ft	Channel Area: Below Ground (A1) ft²	Channel Area: Above Ground (A2) ft²	Additional Cut above Channel Area (A3) ft²	Total Cut (A1+A3) ft²	Channel Berm: Down Slope (A4) ft²	Channel Berm: Up Slope (A5) ft²	Fill Required (A4+A5) ft²	Fill Available (-25%) ft²
21500	2200	1300.00	0.00	460.48	1760.48	0.00	0.00	0.00	1320.36
24000	7000	1291.50	8.50	189.40	1480.90	5.46	0.00	5.46	1110.68
30500	7500	1505.41	94.59	102.14	1607.55	16.79	0.00	16.79	1205.66
37500	2500	825.74	774.26	0.00	825.74	272.94	20.47	293.41	619.31

Volumetric

Section (Station) ft	Section Length ft	FRS fill: above 100 yr flood (A1) yd³	FRS fill: below 100 yr flood (A2) yd³	Additional Cut above Channel Area (A3) yd³	Total Cut (A1+A3) yd³	Channel Berm: Down Slope (A4) yd³	Channel Berm: Up Slope (A5) yd³	Fill Required (A4+A5) yd³	Fill Available (A4+A5) yd³
21500	2200	105,926	0	37,521	143,447	0	0	0	107,585
24000	7000	334,833	2,204	49,104	383,937	1,416	0	1,416	287,953
30500	7500	418,169	26,275	28,372	446,542	4,664	0	4,664	334,906
37500	2500	76,457	71,691	0	76,457	25,272	1,895	27,168	57,343
Totals:	19,200	935,386	100,169	114,997	1,050,383	31,352	1,895	33,247	787,787

Notes: 1. * A shrinkage factor of 25% has been applied to material excavated on site to determine the compacted volume.

2. The Section stations correspond to the sections defined by the Wood/Patel initial Spook Hill FRS Channel Design.

Shrinkage: 25.00%

PROJECT Spook Hill NO. 99989

CALC'D BY JDS CHK'D BY

SHEET 1 OF DATE 5/7/01

- Develop Cost Estimate for the non-jurisdictional channel option along the Spook Hill FRS for comparitive purposes with the Red Mountain Freeway / Full PMF option. This is a very crude estimate.

Earthwork estimate

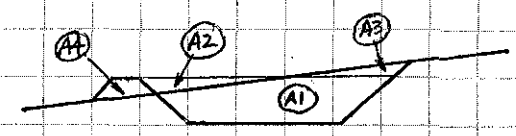
- Estimate the earthwork for the non-jurisdictional channel

  • Use typical sections at sections identified in the Spook Hill FRS Channel Design calculations & spreadsheet.

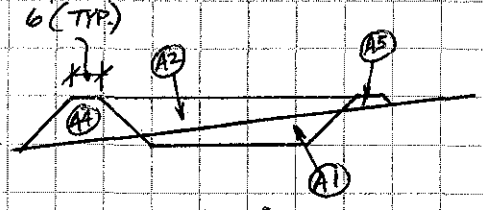
#	Section	Representative Reach		
C1	21500	20300	TO	22500
C2	24000	22500	TO	29500
C3	30500	29500	TO	37000
C4	37500	37000	TO	39500

- Refer to the spreadsheet and section figure for additional info on calculations

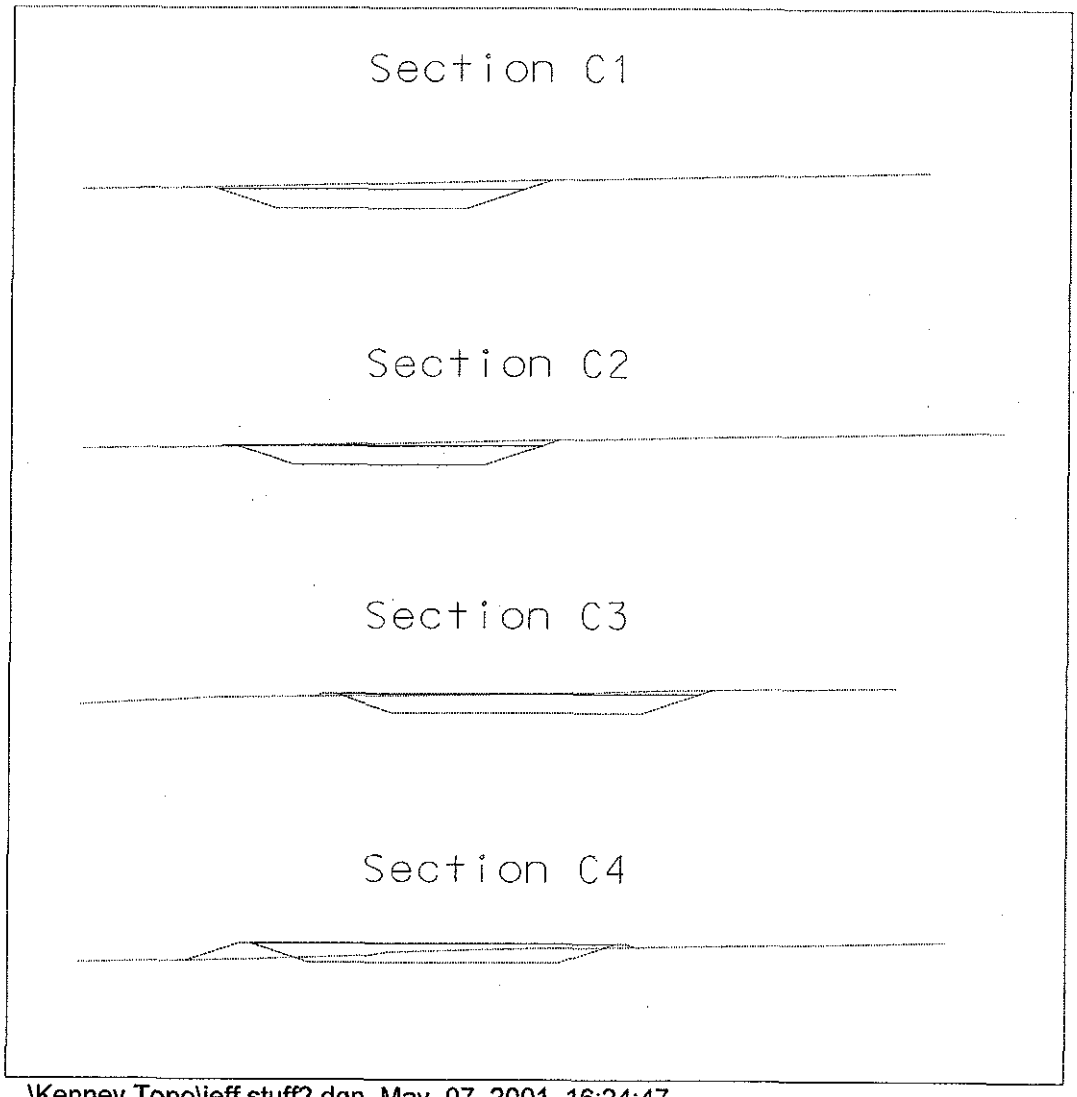
The areas are shown below:
- The channel bottom width varies and sideslopes are 3:1



Situation 1



Situation 2



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PROJECT Spook Hill NO. 99987

CALC'D BY JDS CHK'D BY

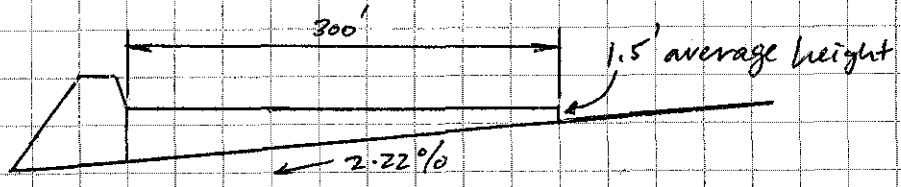
SHEET 2 OF DATE 5/9/01

— Crude Non-Jurisdictional cost est. (cont.)

— Estimate Earthwork for Freeway

Assume that the Freeway will be flat with a 3' undulation to provide longitudinal drainage.

Assume a cross slope for the natural ground of 10'/450' = 2.22 %



The Area = 300 (1.5 + 300 (.02222))/2

= 1225 ft²

Volume over 19,200' = 1225 (19200)/27 = 871,111 yd³

— Use as much from local source with the remainder coming from offsite.

Structure Estimate

see page 4

~~The bridges for NB and SB freeway lanes at the emergency spillway will be the lengths assumed in the Red Mountain Freeway Design Concept Report.~~

The cost will be $65/ft² due to the reduction of structure height.

PROJECT Spook Hill NO. 99989

CALC'D BY JDS CHK'D BY

SHEET 3 OF DATE 5/7/01

— Crude Non-Jurisdictional Cost Est. (cont.)

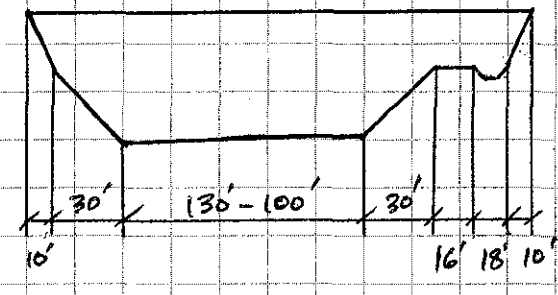
~~The bridge areas required =~~

~~NB : 1000 (54) = 54,000 ft²~~

~~SB : 1120 (54) = 60,480 ft²~~

For the structures at McDowell, McKellips & Brown, an overall length of assumed structure will be used. The bridge widths will remain the same as the FMF option. Assume the bridges over canals will not be affected.

Location	Length
McDowell	225' + 214 / cos 23° = 457'
McKellips	237' + 214 / cos 41° = 521'
Brown	310' + 244 / cos 56° = 746'



Assumed x-section of bridge crossings for the non-jurisdictional channel, Access/maintenance road and concrete lined channel.

Bridge Areas

McDowell = 94 (457) = 42,958 ft²

McKellips = 94 (521) = 48,974 ft²

Brown = 94 (746) = 70,124 ft²

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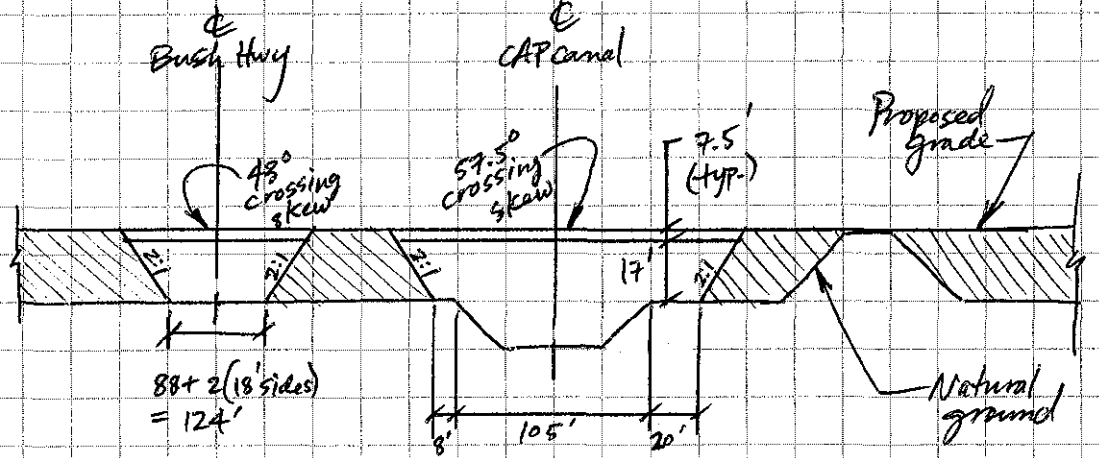
SHEET 4 OF DATE 5/7/01

– Crude Non-Jurisdictional Cost Est. (cont.)

The bridges near the emergency spillway can be several spans for this option.

A perpendicular crossing diagram follows:



Length of bridge over highway –

$$L = [124 + 2(17+7.5)2] / \cos 43^\circ$$
$$= \underline{304'}$$

Length of bridge over canal –

$$L = [8+105+20 + 2(17+7.5)2] / \cos 57.5^\circ$$
$$= \underline{430'}$$

Area = $(304+430)(54) = \underline{39,636\ ft^2}$ for both NB + SB

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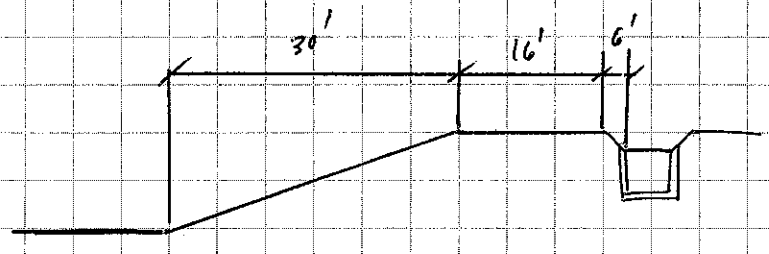
SHEET 5 OF DATE 5/8/01

– Crude Non-Jurisdictional Cost Est. (cont.)

• Calculate new cost for drop inlets + storm drains

use same number = 38



Length of pipe = 30+16+6 = 52'

same drop inlet, grate, outlet protection

pipe cost = (52')($85/ft) = $4420

Total cost =	$2046	Drop inlet
	$1000	Grating
	$1000	Outlet
	$4420	Pipe
Total	$8466	
USE	$8500	

PROJECT Spook Hill NO. 99989

CALC'D BY JDS CHK'D BY

SHEET 6 OF DATE 5/10/01

— Crude Non-Jurisdictional Cost Est. (cont.)

- Estimate the volume required for a 35 ac-ft detention pond which is required for the Base Mountain Diversion

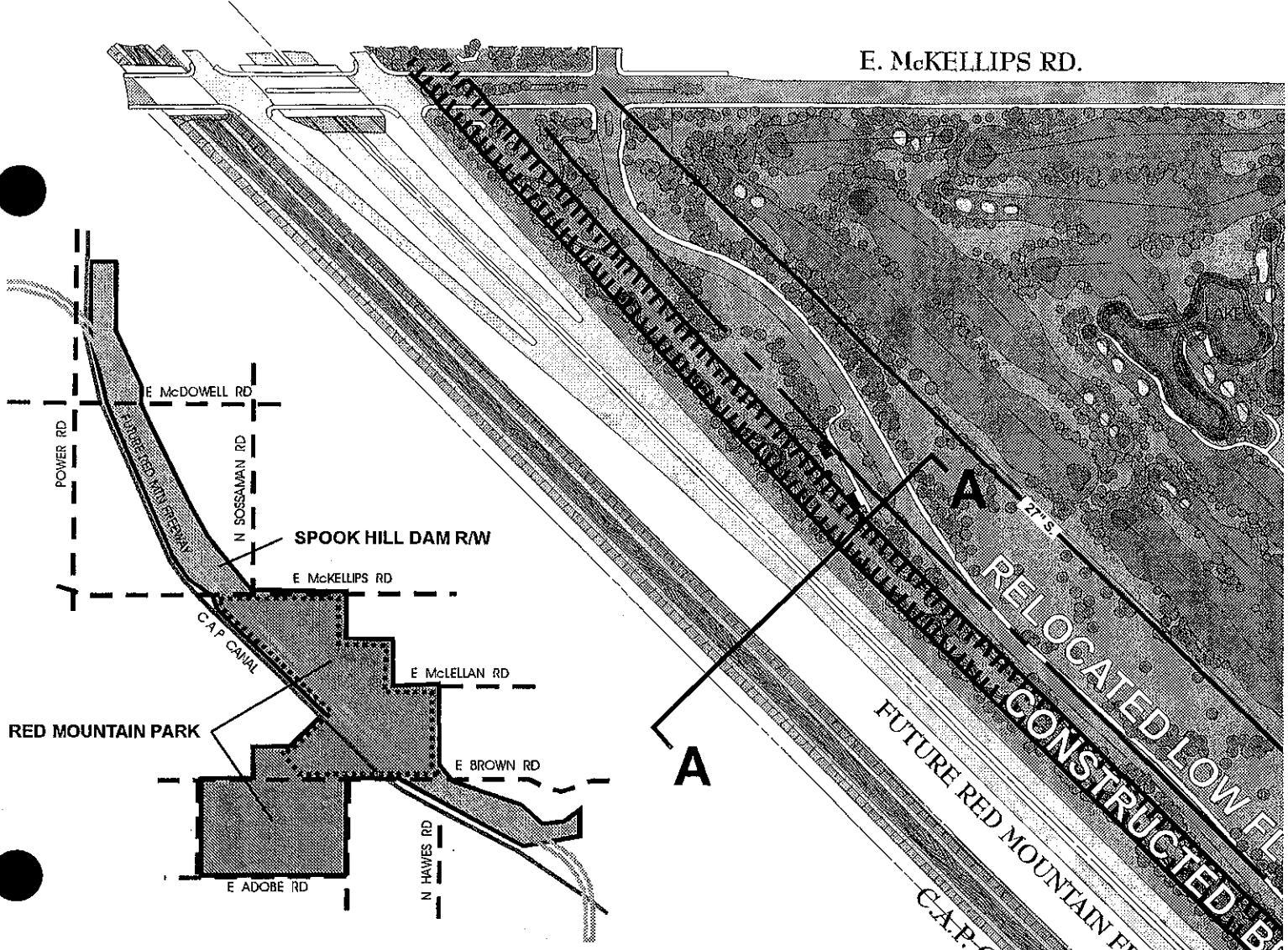
  -Use the data created as part of the larger detention pond analysis

  According to the spreadsheet, the cut volume required to provide 35 ac-ft of storage is right around 250,000 yd.^{3}

  Cost = $2.50/yd$^3

Spook Hill FRS Channel Design

Location	Station	Exist Chl Inv	Exist Chl Slope	Design Inv	Design Slope	Cut or Fill	LOB Existing Elev (ft)	LOB-EX (ft)	Design LOB	Design ROB	Depth (L) (ft)	Depth (R) (ft)	Elev(ML)	Elev(MR)	Sta (LOB)	Sta(ML)	Sta (BL)	Sta (C)	Sta (BR)	Sta(MR)	Sta (ROB)	Bottom Width	Top Width	S (L)	S(R)	Q Total (cfs)	"n"-value
Outlet	9548	1548.90	0.00053	1548.90	0.00181	0.00	1558.0	0.90	1558.9	1558.9	10.00	10.00	1553.9	1553.9	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	10000	1549.14	0.00053	1549.72	0.00181	-0.58	1558.2	1.48	1559.7	1559.7	10.00	10.00	1554.7	1554.7	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	10500	1549.40	0.00053	1550.62	0.00181	-1.22	1558.5	2.12	1560.6	1560.6	10.00	10.00	1555.6	1555.6	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	11000	1549.66	0.00053	1551.53	0.00181	-1.86	1558.8	2.76	1561.5	1561.5	10.00	10.00	1556.5	1556.5	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	11623	1549.99	0.00053	1552.65	0.00181	-2.66	1559.1	3.56	1562.7	1562.7	10.00	10.00	1557.7	1557.7	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	12000	1552.28	0.00609	1553.33	0.00181	-1.05	1561.4	1.95	1563.3	1563.3	10.00	10.00	1558.3	1558.3	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
Rectangular Starts	12250	1553.81	0.00609	1553.79	0.00181	0.02	1562.9	0.88	1563.8	1563.8	10.00	10.00	1558.8	1558.8	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	12600	1555.94	0.00609	1554.42	0.00181	1.52	1566.9	-1.52	1564.4	1564.4	10.00	10.00	1555.9	1555.9	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	13000	1558.37	0.00609	1555.14	0.00181	3.23	1568.4	-3.23	1565.1	1565.1	10.00	10.00	1558.4	1558.4	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	13500	1561.42	0.00609	1556.05	0.00181	5.37	1571.4	-5.37	1566.0	1566.0	10.00	10.00	1561.4	1561.4	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	14000	1564.46	0.00609	1556.95	0.00181	7.51	1574.5	-7.51	1567.0	1567.0	10.00	10.00	1564.5	1564.5	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	14373	1566.73	0.00609	1557.62	0.00181	9.11	1576.7	-9.11	1567.6	1567.6	10.00	10.00	1566.7	1566.7	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	15000	1566.86	0.00020	1558.76	0.00181	8.10	1576.9	-8.10	1568.8	1568.8	10.00	10.00	1566.9	1566.9	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	15500	1566.96	0.00020	1559.66	0.00181	7.29	1577.0	-7.29	1569.7	1569.7	10.00	10.00	1567.0	1567.0	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	16000	1567.06	0.00020	1560.57	0.00181	6.49	1577.1	-6.49	1570.6	1570.6	10.00	10.00	1567.1	1567.1	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	16500	1567.16	0.00020	1561.47	0.00181	5.69	1577.2	-5.69	1571.5	1571.5	10.00	10.00	1567.2	1567.2	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	17000	1567.26	0.00020	1562.38	0.00181	4.88	1577.3	-4.88	1572.4	1572.4	10.00	10.00	1567.3	1567.3	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	17500	1567.36	0.00020	1563.28	0.00181	4.08	1577.4	-4.08	1573.3	1573.3	10.00	10.00	1567.4	1567.4	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	18000	1567.46	0.00020	1564.18	0.00181	3.28	1577.5	-3.28	1574.2	1574.2	10.00	10.00	1567.5	1567.5	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	18500	1567.56	0.00020	1565.09	0.00181	2.47	1577.6	-2.47	1575.1	1575.1	10.00	10.00	1567.6	1567.6	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	19000	1567.66	0.00020	1565.99	0.00181	1.67	1577.7	-1.67	1576.0	1576.0	10.00	10.00	1571.0	1571.0	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	19500	1567.76	0.00020	1566.90	0.00181	0.86	1577.8	-0.86	1576.9	1576.9	10.00	10.00	1571.9	1571.9	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
Principal Spillway	20000	1567.86	0.00020	1567.80	0.00181	0.06	1577.9	-0.06	1577.8	1577.8	10.00	10.00	1572.8	1572.8	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2150	0.012
Transition Ends	20300	1580.00	0.00062	1570.00	0.00730	10.00	1580.0	0.00	1580.0	1580.0	10.00	10.00	1575.0	1575.0	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2150	0.02
	20600	1580.18	0.00062	1570.18	0.00062	10.00	1580.2	0.00	1580.2	1580.2	10.00	10.00	1575.2	1575.2	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2150	0.03
	21000	1580.43	0.00062	1570.43	0.00062	10.00	1580.4	0.00	1580.4	1580.4	10.00	10.00	1575.4	1575.4	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2150	0.03
	21500	1580.74	0.00062	1570.74	0.00062	10.00	1580.7	0.00	1580.7	1580.7	10.00	10.00	1575.7	1575.7	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2150	0.03
	22000	1581.05	0.00062	1571.05	0.00062	10.00	1581.0	0.00	1581.0	1581.0	10.00	10.00	1576.0	1576.0	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2150	0.03
McDowell Rd	22500	1581.36	0.00062	1571.36	0.00062	10.00	1581.4	0.00	1581.4	1581.4	10.00	10.00	1576.4	1576.4	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	23000	1581.66	0.00062	1571.66	0.00062	10.00	1581.7	0.00	1581.7	1581.7	10.00	10.00	1576.7	1576.7	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	23500	1581.97	0.00062	1571.97	0.00062	10.00	1582.0	0.00	1582.0	1582.0	10.00	10.00	1577.0	1577.0	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	24000	1582.28	0.00062	1572.28	0.00062	10.00	1582.3	0.00	1582.3	1582.3	10.00	10.00	1577.3	1577.3	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	24500	1582.59	0.00062	1572.59	0.00062	10.00	1582.6	0.00	1582.6	1582.6	10.00	10.00	1577.6	1577.6	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	25000	1582.90	0.00062	1572.90	0.00062	10.00	1582.9	0.00	1582.9	1582.9	10.00	10.00	1577.9	1577.9	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	25500	1583.20	0.00062	1573.20	0.00062	10.00	1583.2	0.00	1583.2	1583.2	10.00	10.00	1578.2	1578.2	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	26000	1583.51	0.00062	1573.51	0.00062	10.00	1583.5	0.00	1583.5	1583.5	10.00	10.00	1578.5	1578.5	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
800' S. Hermosa Vista	26500	1583.82	0.00062	1573.82	0.00062	10.00	1583.8	0.00	1583.8	1583.8	10.00	10.00	1578.8	1578.8	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	27000	1584.13	0.00062	1574.13	0.00062	10.00	1584.1	0.00	1584.1	1584.1	10.00	10.00	1579.1	1579.1	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	27500	1584.44	0.00062	1574.44	0.00062	10.00	1584.4	0.00	1584.4	1584.4	10.00	10.00	1579.4	1579.4	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	28000	1584.74	0.00062	1574.74	0.00062	10.00	1584.7	0.00	1584.7	1584.7	10.00	10.00	1579.7	1579.7	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	28500	1585.05	0.00062	1575.05	0.00062	10.00	1585.1	0.00	1585.1	1585.1	10.00	10.00	1580.1	1580.1	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	29000	1585.36	0.00062	1575.36	0.00062	10.00	1585.4	0.00	1585.4	1585.4	10.00	10.00	1580.4	1580.4	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	29500	1585.67	0.00062	1575.67	0.00062	10.00	1585.7	0.00	1585.7	1585.7	10.00	10.00	1580.7	1580.7	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	30000	1585.98	0.00062	1575.98	0.00062	10.00	1586.0	0.00	1586.0	1586.0	10.00	10.00	1581.0	1581.0	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
Sossaman Rd	30500	1586.28	0.00062	1576.28	0.00062	10.00	1586.3	0.00	1586.3	1586.3	10.00	10.00	1581.3	1581.3	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	3050	0.03
	31000	1586.59	0.00062	1576.59	0.00062	10.00	1586.6	0.00	1586.6	1586.6	10.00	10.00	1581.6	1581.6	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	3050	0.03
	31500	1586.90	0.00062	1576.90	0.00062	10.00	1586.9	0.00	1586.9	1586.9	10.00	10.00	1581.9	1581.9	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	3050	0.03
	32000	1587.21	0.00062	1577.21	0.00062	10.00	1587.2	0.00	1587.2	1587.2	10.00	10.00	1582.2	1582.2	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	3050	0.03
	32500	1587.52	0.00062	1577.52	0.00062	10.00	1587.5	0.00	1587.5	1587.5	10.00	10.00	1582.5	1582.5	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	3050	0.03
300' S. McLellan	33000	1587.82	0.00062	1577.82	0.00062	10.00	1587.8	0.00	1587.8	1587.8	10.00	10.00	1582.8	1582.8	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	3050	0.03
	33500	1588.13	0.00062	1578.13	0.00062	10.00	1588.1	0.00	1588.1	1588.1	10.00	10.00	1583.1	1583.1	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	3050	0.03
	34000	1588.44	0.00062	1578.44	0.00062	10.00	1588.4	0.00	1588.4	1588.4	10.00	10.00	1583.4	1583.4	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	3050	0.03
	34500	1588.75	0.00062	1578.75	0.00062	10.00	1588.7	0.00	1588.7	1588.7	10.00	10.00	1583.7	1583.7	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	3050	0.03
300' N. Brown Rd	35000	1589.06	0.00062	1579.06	0.00062	10.00	1589.1	0.00	1589.1	1589.1	10.00	10.00	1584.1	1584.1	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	35500	1589.36	0.00062	1579.36	0.00062	10.00	1589.4	0.00	1589.4	1589.4	10.00	10.00	1584.4	1584.4	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	36000	1589.67	0.00062	1579.67	0.00062	10.00	1589.7	0.00	1589.7	1589.7	10.00	10.00	1584.7	1584.7	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	36500	1589.98	0.00062	1579.98	0.00062	10.00	1590.0	0.00	1590.0	1590.0	10.00	10.00	1585.0	1585.0	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	37000	1590.29	0.00062	1580.29	0.00062	10.00	1590.3	0.00	1590.3	1590.3	10.00	10.00	1585.3	1585.3	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	37500	1590.60	0.00062	1580.60	0.00062	10.00	1590.6	0.00	1590.6	1590.6	10.00	10.00	1585.6	1585.6	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	38000	1590.90	0.00062	1580.90	0.00062	10.00	1590.9	0.00	1590.9	1590.9	10.00	10.00	1585.9	1585.9	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	38500	1591.21	0.00062	1581.21	0.00062	10.00	1591.2	0.00	1591.2	1591.2	10.00	10.00	1586.2	1586.2	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	39000	1591.52	0.00062	1581.52	0.00062	10.00	1591.5	0.00	1591.5	1591.5	10.00	10.00	1586.5	1586.5	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	39500	1591.83	0.00062	1581.83	0.00062	10.00	1591.8	0.00	1591.8	1591.8	10.00	10.00	1586.8	1586.8	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	40000	1592.14	0.00062	1582.14	0.00062	10.00	1592.1	0.00	1592.1	1592.1	10.00	10.00	1587.1	1587.1	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	40500	1592.44	0.00062	1582.44	0.00062	10.00	1592.4	0.00	1592.4	1592.4	10.00	10.00	1587.4	1587.4	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
Upstream End	41000	1592.75	0.00062	1582.75	0.00062	10.00	1592.8	0.00	1592.8	1592.8	10.00	10.00	1587.8	1587.8	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03



VICINITY MAP

LEGEND:

RELOCATED LOW FLOW CHANNEL

CONSTRUCTED BERM

P PLAY AREA

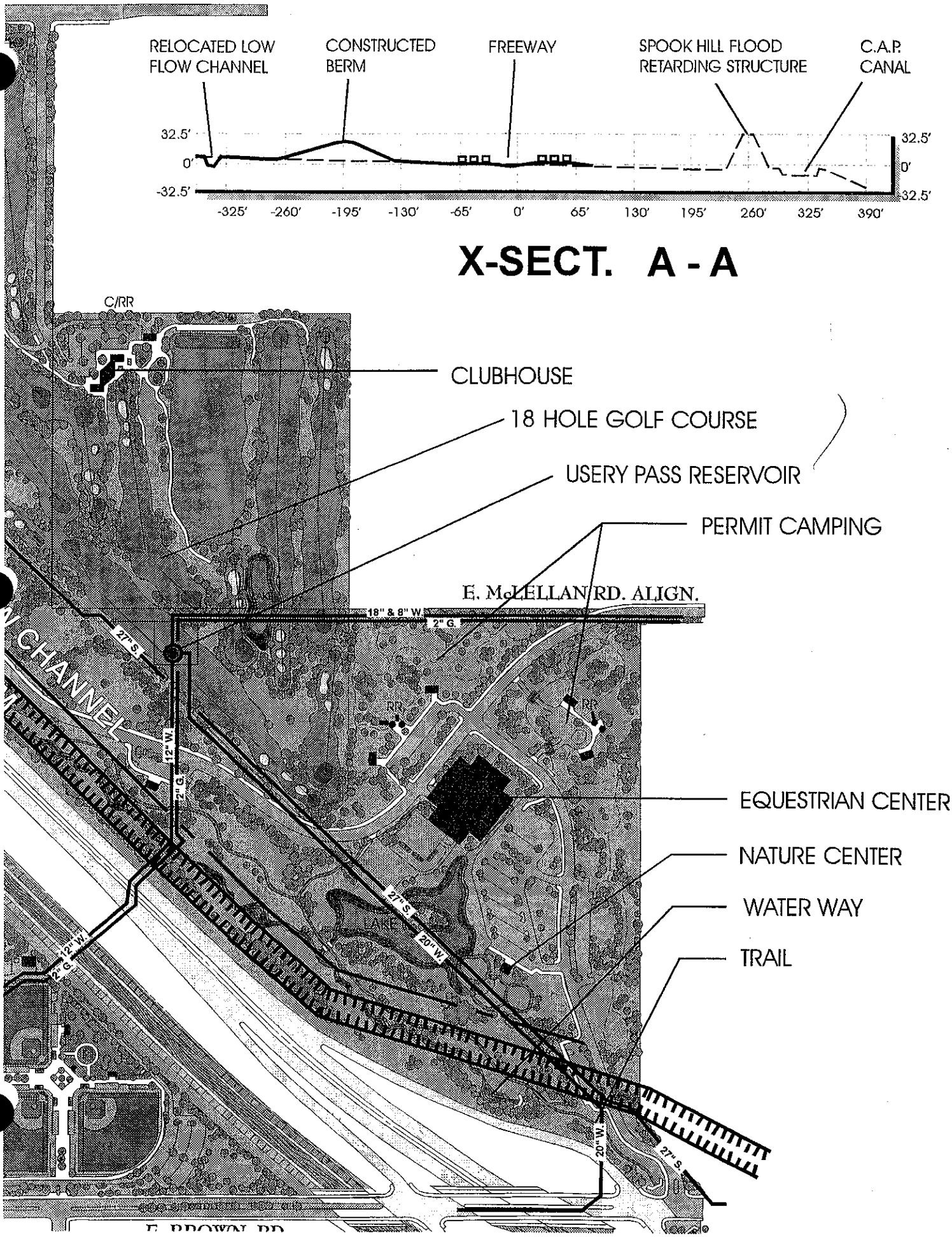
RR RESTROOMS

C/RR CONCESSION/RESTROOMS

NOTE:

ALL PARK FACILITIES ARE PROPOSED UNLESS INDICATED AS EXISTING

Proposed Facilities at
RED MOUNTAIN PARK
(Freeway Impact Overlay)


RELOCATED LOW FLOW CHANNEL
CONSTRUCTED BERM
FREEWAY
SPOOK HILL FLOOD RETARDING STRUCTURE
C.A.P. CANAL
32.5'
0'
-32.5'
-325'
-260'
-195'
-130'
-65'
0'
65'
130'
195'
260'
325'
390'
X-SECT. A - A
C/RR
CLUBHOUSE
18 HOLE GOLF COURSE
USERY PASS RESERVOIR
PERMIT CAMPING
E. McLELLAN RD. ALIGN.
18" & 8" W.
2" G.
27" S.
RR
12" W.
2" G.
EQUESTRIAN CENTER
NATURE CENTER
WATER WAY
TRAIL
LAKE
20" W.

RED MOUNTAIN FREEWAY

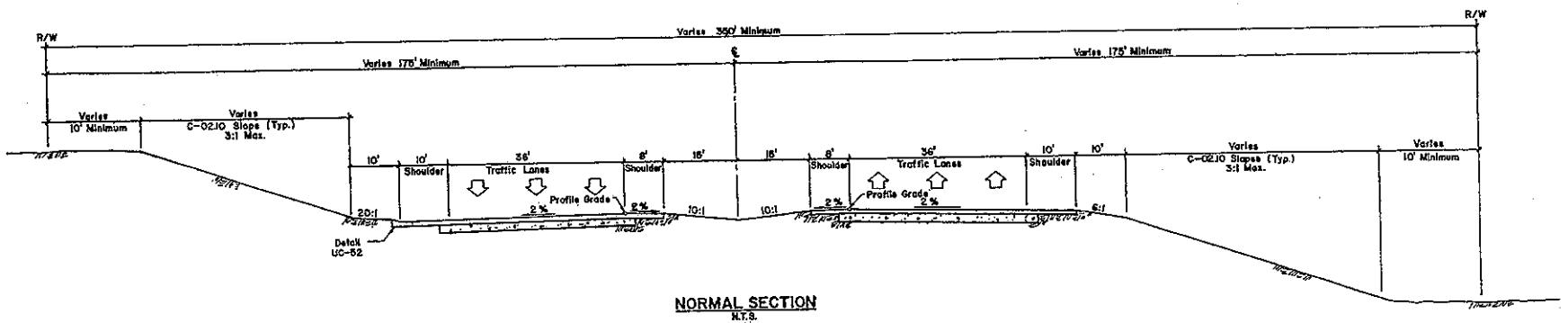
MARICOPA COUNTY

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	202L MA H067301C	5	28	

Parsons Brinckerhoff Quade & Douglas, Inc.

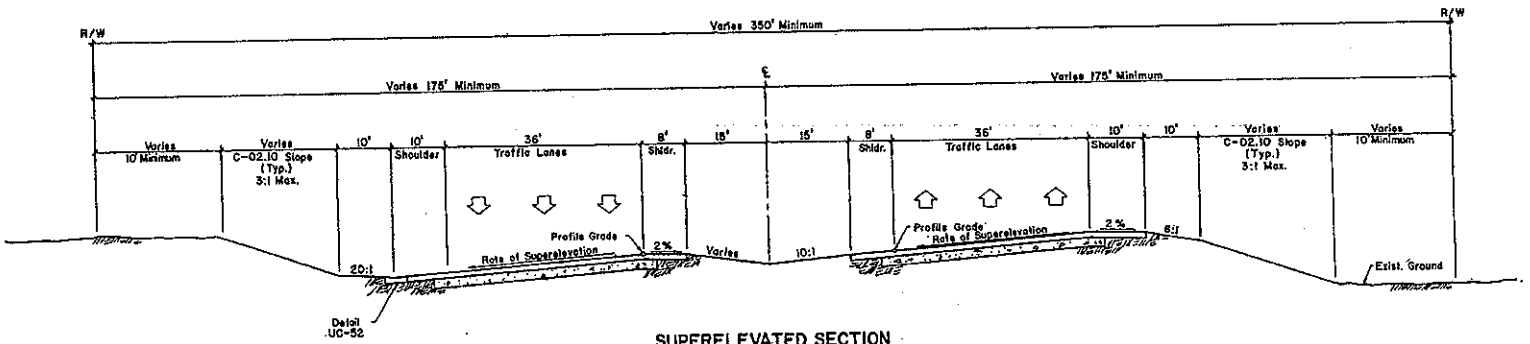
DATE FOR THE CONSULTING ENGINEER

DESIGN D.W.R. | DRAWN M.A.T. | CHECKED D.W.R.



NORMAL SECTION

N.T.S.



SUPERELEVATED SECTION

N.T.S.

Note:

The Typical Sections Shown On This Plan Are Conceptual Only And Subject To Refinement During Final Design.

RED MOUNTAIN FREEWAY
MAINLINE TYPICAL SECTIONS

DESIGN CONCEPT PLANS

Arizona Department of Transportation

RED MOUNTAIN FREEWAY

PARSONS BRINCKERHOFF

DATE: OCT 1988

RED MOUNTAIN FREEWAY

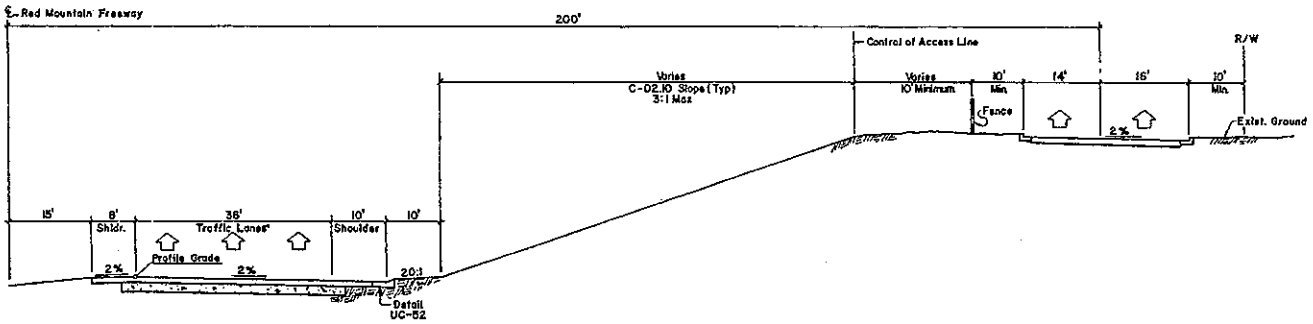
MARICOPA COUNTY

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ	203 L MA HOR 3 0 0	4	28	

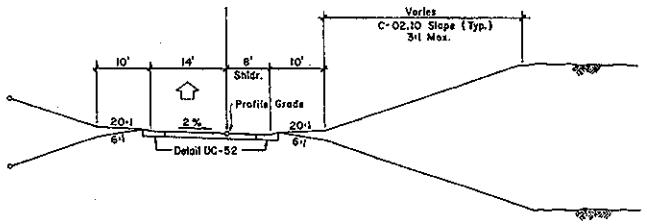
Parsons Brinckerhoff Quade & Douglas, Inc.

DATE FOR THE CONSULTING ENGINEER

DESIGN D.W.R. | DRAWN M.A.T. | CHECKED D.W.R.



SOUTHBOUND
HALF SECTION WITH FRONTAGE ROAD
BETWEEN
UNIVERSITY DRIVE & BROADWAY ROAD
NORTHBOUND IS SYMMETRICAL
N.T.S.



TYPICAL RAMP SECTION

Note:
The Typical Sections Shown On This Plan Are Conceptual Only And Subject To Refinement During Final Design.

RED MOUNTAIN FREEWAY
RAMP & FR. RD. TYPICAL SECTIONS

RED MOUNTAIN FREEWAY

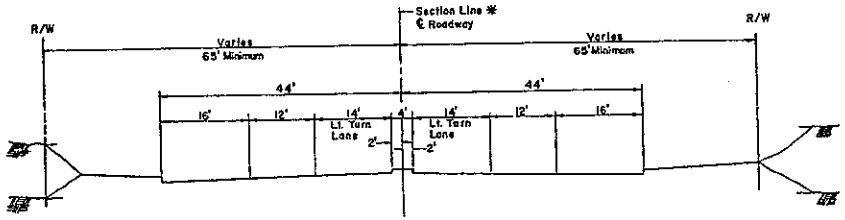
MARICOPA COUNTY

FHWA REGION	STATE	PROJECT NO	SHEET NO	TOTAL SHEETS	AS BUILT
9	ARIZ	202L MA H0873010	5	28	

Parsons Brinckerhoff Quade & Douglas, Inc.

DATE — FOR THE CONSULTING ENGINEER

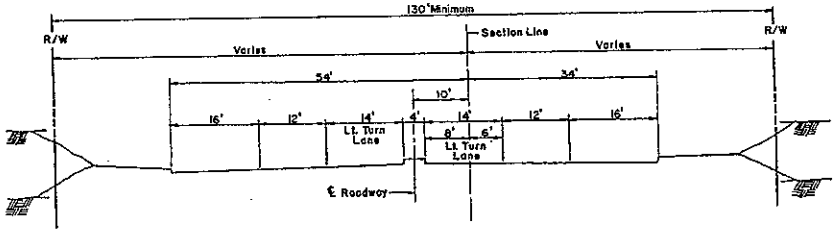
DESIGN D.W.R. | DRAWN S.B.B. | CHECKED D.W.R.



TYPICAL SECTION THRU INTERCHANGE AREA

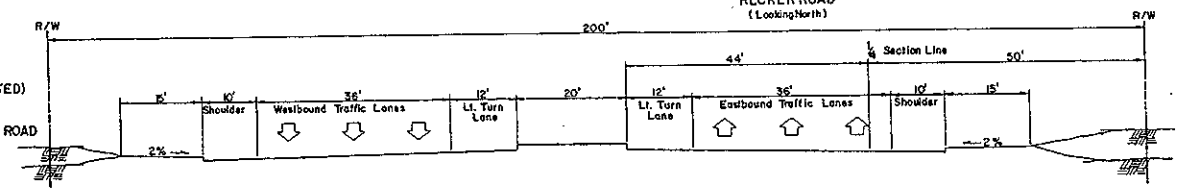
VAL VISTA DRIVE
GREENFIELD ROAD
BROADWAY ROAD
UNIVERSITY DRIVE
MC KELLIPS ROAD
THOMAS ROAD (RELOCATED)
BROWN ROAD

* Does Not Apply To THOMAS ROAD



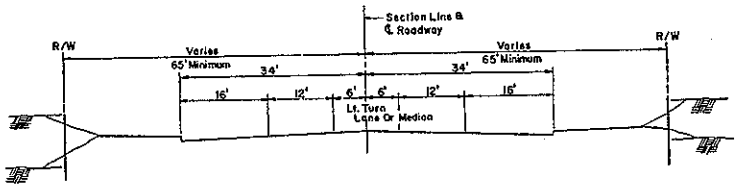
TYPICAL SECTION THRU INTERCHANGE AREA

RECKER ROAD
(Looking North)



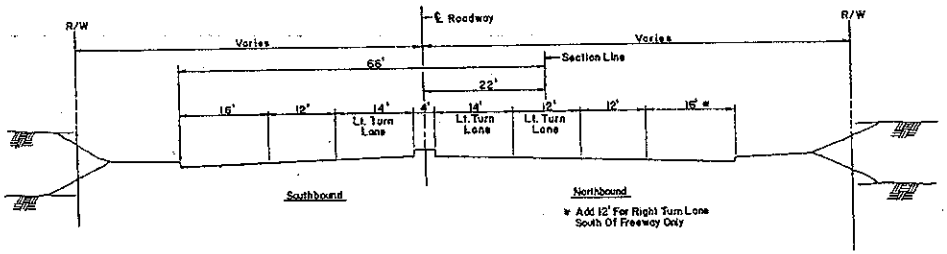
TYPICAL SECTION THRU OVERPASS AREA

MAIN STREET (APACHE TRAIL)
(Looking East)



TYPICAL SECTION THRU INTERCHANGE AREA

SOUTHERN AVENUE
MC DOWELL ROAD



TYPICAL SECTION SOUTH OF INTERCHANGE AREA

HIGLEY ROAD
(Looking North)

Note:

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RED MOUNTAIN FREEWAY
CROSSROADS TYPICAL SECTIONS

DESIGN CONCEPT PLANS

Arizona Department of Transportation

RED MOUNTAIN FREEWAY

PARSONS BRINCKERHOFF

DATE: OCT 1988

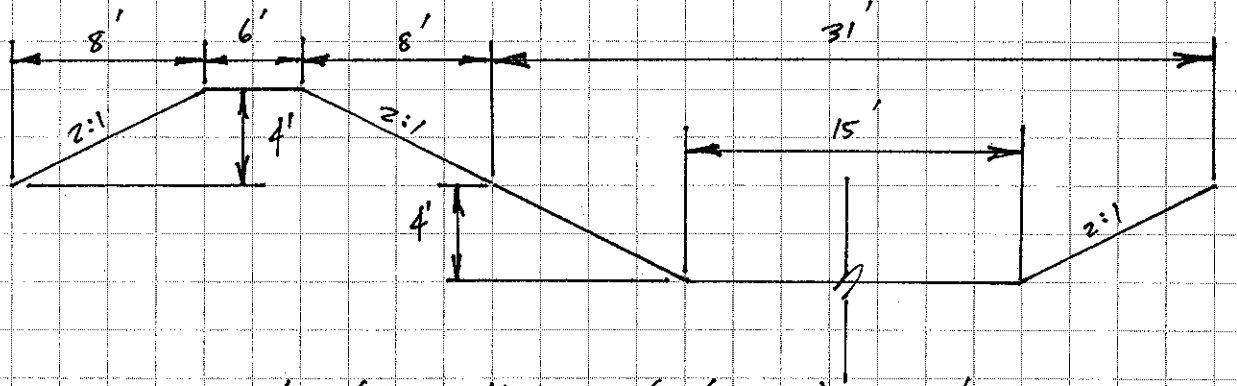
PROJECT Spook Hill NO. 99989

CALC'D BY JDS CHK'D BY _____

SHEET _____ OF _____ DATE 6/14/01

- Determine the area of disturbance for the Pass Mountain alternative.

Estimate of cross section – Berm & channel



Assume constructed width = 31' + 6' + 2(8') = 53'
Add 15' of disturbance on each side during construction

Total W = 53' + 2(15') = 83'

Determine total length of improvements from the exhibits

L = 1460.26 + 499.88 + 453.12 + 2541.49 + 302.04 + 2726.57
= 7983.36 ft use 8000'

Area of disturbance = 83'(8000')/43560 = 15.24 ac

– This area does not include and any access roads

- Determine the number of homes taken and accesses restricted by construction for the various alternatives.

– Use Landiscor images to estimate impacts

No homes would be taken because pipe construction would be within the Roadway right-of-way

WOOD/PATEL

CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS • CONSTRUCTION MANAGERS

PROJECT Spook Hill NO. 99989

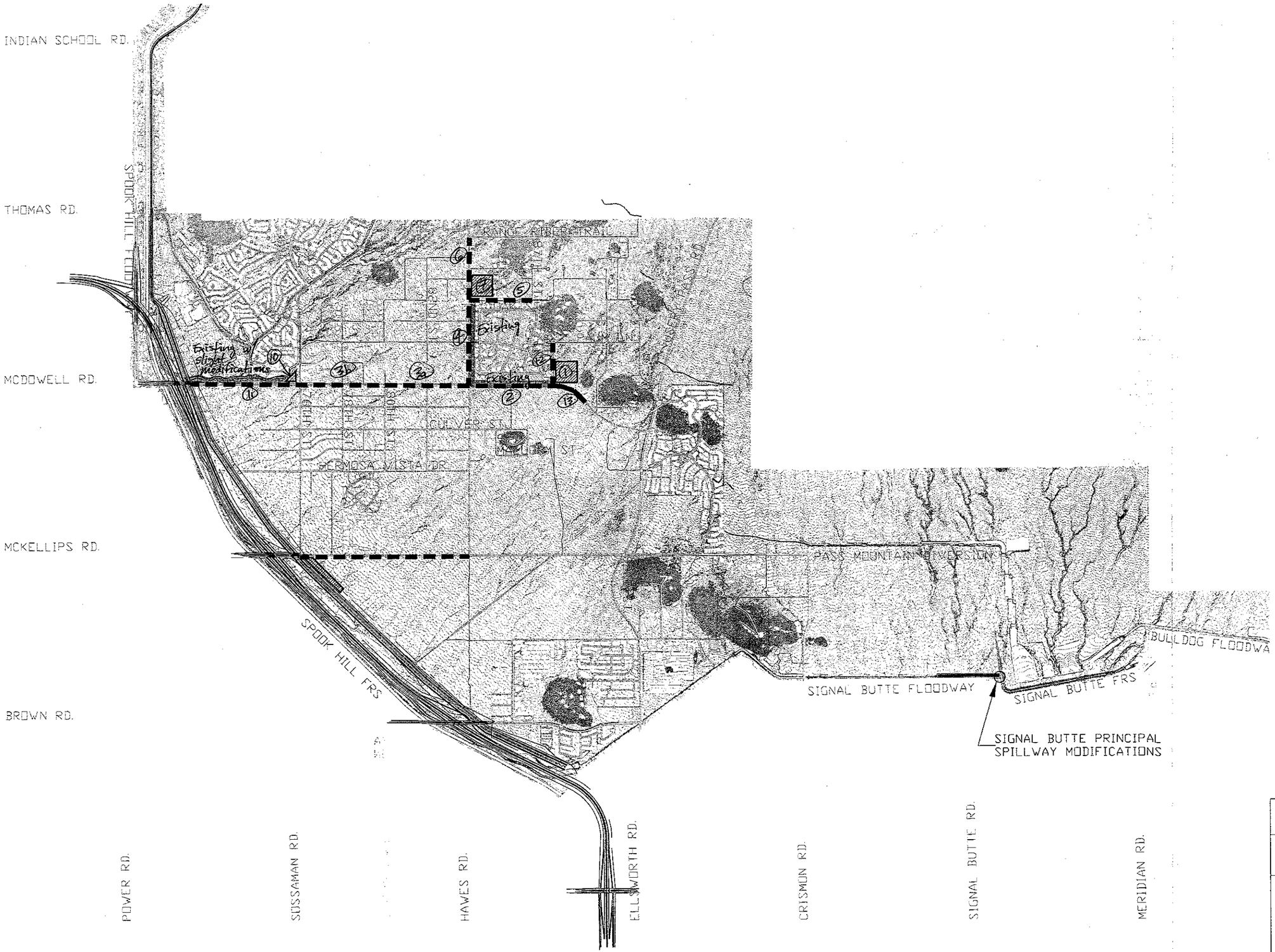
CALC'D BY JDS CHK'D BY

SHEET OF DATE 6/14/01

—Determine the number of driveways blocked by construction activities

McDowell Segment	Affected Residences	Assumptions/Notes
2	0	existing channel
3a	10	North side blocked only
3b	13	" " " "
4	0	existing channel
5	8	
6	8	East side only
11	0	existing channel
12	0	
13	0	
Total	39	— All Alternatives

McKellips — No residences blocked



LEGEND

- PROPOSED CHANNEL
- RIGHT OF WAY
- SERVICE ROAD
- BERM/CHANNEL
- PROPOSED STRUCTURE
- FREEWAY
- FLOODWAY IMPROVEMENTS
- MCDOWELL ROAD ALTERNATIVE 2E
- MCKELLIPS ROAD ALTERNATIVE 2E
- DETENTION BASIN

N

0 1500 3000 6000

Scale in Feet

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY ENGINEERING DIVISION

NON-JURISDICTIONAL WITH PASS MOUNTAIN

	BY	DATE
DESIGNED	R. HINER	12/00
DRAWN	R. WAGNER	12/00
CHECKED	A. PATEL	12/00

WOOD, PATEL & ASSOCIATES, INC.
2051 WEST NORTHERN, SUITE 100
PHOENIX, ARIZONA (602) 335-8500

DRAWING NO. NONJUR-WPM.DWG

PLATE 1

SHEET OF 1 4