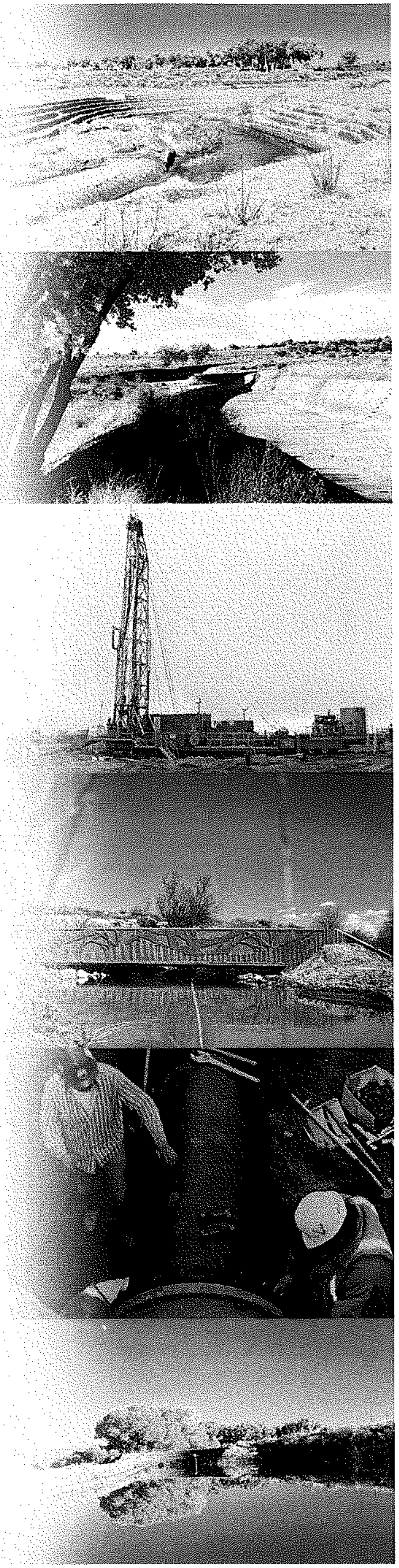
OLD PICACHO DRAINAGE MASTER PLAN



MARCH 2009

Prepared for
Dona Ana County Flood Commission
845 N. Motel Boulevard
Las Cruces, NM 88001

Prepared by:

Bohannan Huston INC.

ENGINEERING
SPATIAL DATA
ADVANCED TECHNOLOGIES

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I. Introduction

The objective of this drainage master plan (DMP) is to assess the unnamed arroyo that impacts the Old Picacho community and propose potential improvements. Bohannan Huston, Inc. (BHI) prepared hydrologic models for the community for both existing and future conditions. These models quantify the storm water runoff volumes and flow rates. The project area includes the community of Old Picacho, NM and surrounding areas which include the Donaldson Dam and its contributing watershed. **Figure 1: Vicinity Map** provides a graphical representation of the study area limits.

The emphasis of the master plan is to determine how to improve drainage issues within the community based upon information provided by Doña Ana County and local residents. The majority of problems appear to be related to the Donaldson Dam and the dam outfall conveyance. The system as a whole was evaluated and improvements were proposed such that the system can perform more effectively. Improvements proposed will mitigate many existing local drainage problems by improving the efficiency of the system. The improvements include modifying existing infrastructure and recommendations for maintenance for existing and proposed drainage infrastructure.

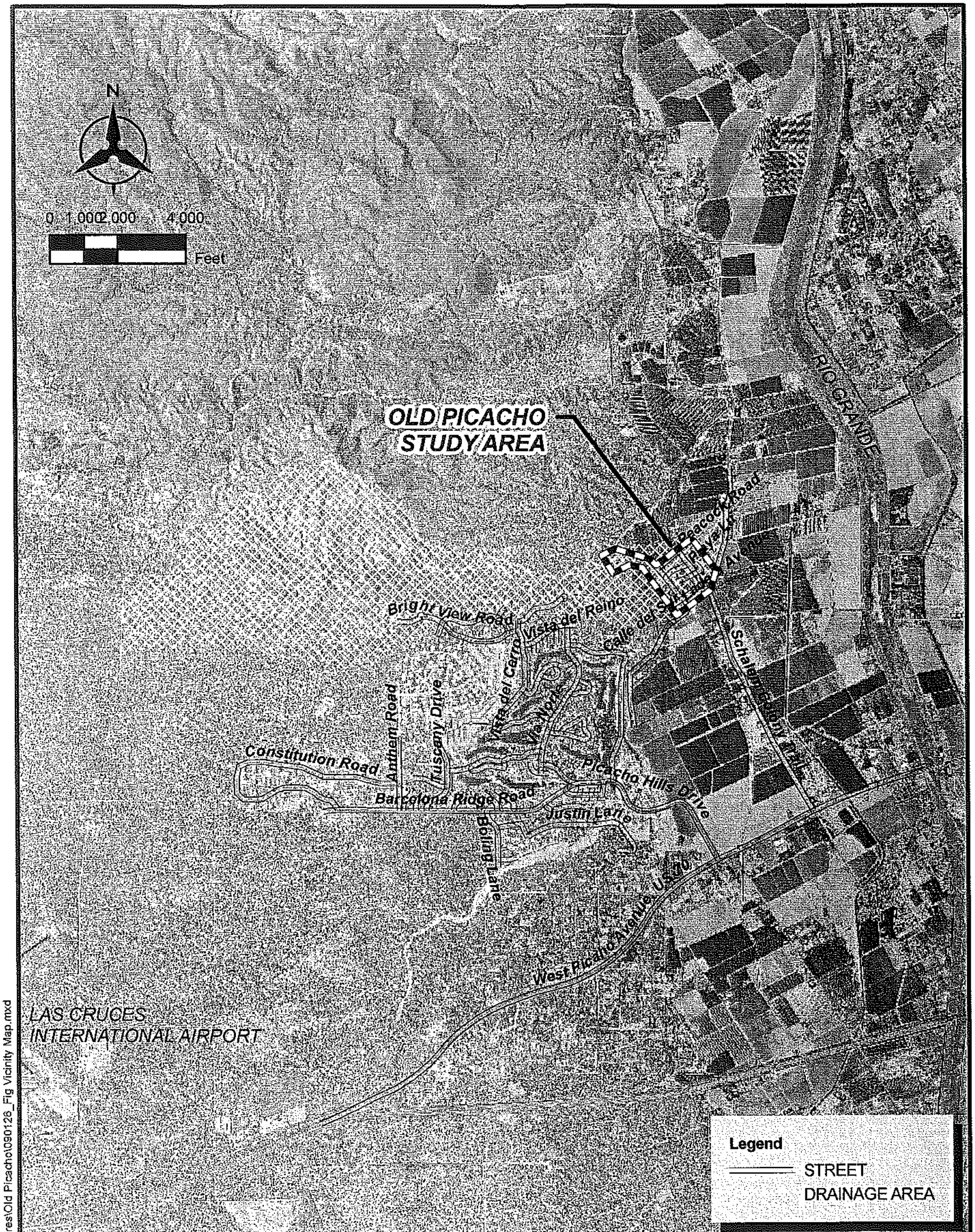
The 100-yr (1% chance) storm event is considered the standard design storm by Doña Ana County and the majority of local, state and federal agencies. Doña Ana County requested that the study area analysis for the 100-yr event assume a high antecedent soil moisture condition. Additionally, the effects of sediment loading within storm flows were included in the analysis. These analysis assumptions are conservative in quantifying storm runoff volumes and flow rates. The analysis and proposed improvements are geared toward protection of lives and property.

II. Existing Conditions

A. Drainage Patterns

Located along the west edge of the Rio Grande valley, the Old Picacho community is a medium density residential development. The residential development is surrounded by pecan fields to the north and west and agricultural fields to the south and east. Shalem Colony Trail serves as a portion of the eastern boundary of the drainage area. The mesa and Picacho Mountain serve roughly as the northern and western boundaries. The Picacho Hills community constitutes the southern boundary of the drainage area. In total, the contributing drainage area incorporates approximately 1232 acres (1.92 square miles) of land. The contributing drainage area ranges in elevation from 4957 ft, near Picacho Mountain, to 3905 at the eastern edge of the community. The study area generally slopes from west to east, with an average land slope of approximately 2.4 percent, excluding steep slopes along the escarpment.

Storm water generally flows eastward through the community. The principle drainage feature within the Old Picacho community is the Donaldson Dam and its small manmade outfall conveyance.



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OLD PICACHO DRAINAGE MASTER PLAN
FIGURE 1: VICINITY MAP

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CHECKED BY: LBS	PROJECT NO: 090126

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This drainage system conveys flows from the unnamed arroyo through the community. The clearly defined manmade conveyance channel ends near the intersection of Puerta Lane and Cuesta Road, southeast of the Dam. Where the channel ends, storm water spills onto farm land to the south of the above intersection. The remainder of the community appears to posses no other defined drainage systems. Local runoff is likely collected and conveyed in local roadways. It does not appear that runoff has a means to be conveyed or discharge to a defined outfall such as an agricultural drain or the Rio Grande.

B. Topographic Data

A Digital Elevation Model (DEM) was generated for the drainage area which represents the topographic characteristics of the ground surface. In 2004, Doña Ana County procured aerial photography and related lidar data for the county. The Old Picacho community is well established, and little has changed in the community since the 2004 mapping. This DEM was utilized in the creation of the hydrologic models.

C. Geology

The Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) database for Doña Ana County was utilized for the hydrologic analysis. Knowledge concerning the hydrologic character and performance of different soil types is critical in determining rainfall runoff. The Picacho Hills community and contributing drainage area contains approximately thirteen different soil types. For drainage analysis purposes, the NRCS group's soil types are grouped according to hydrologic performance. Soil composition, runoff potential and infiltration rates are used to classify soils in one of four hydrologic classes A, B, C or D. Generally, runoff rates increase from Group A to Group D soils.

Soils within the Old Picacho area include Group A, B and D soils, with the majority of the soils being Group D soils. **Figure 2: NRCS Soil Classification,** for a graphical representation of the soil distribution throughout the study area.

D. Land Use

The existing land use within the Old Picacho community was assessed using 2004 aerial photography of the area. Four general land uses were noted within the Old Picacho community and contributing basins: Agricultural, Residential–1 acre lot, Residential–1/3 acre lot, and undeveloped land. These land uses were utilized to prepare the existing conditions hydrologic model.

Those basins and sub-basins outside of the currently developed area of the Old Picacho community were assessed based upon the current property zoning and aerial photography. The existing condition model determined land use from aerial photography alone, while the future condition model used current aerial imagery with current zoning information for these areas.

To account for the additional zoning information for the undeveloped areas, one additional land usage was added, Residential-5 acre lot. The Residential – 5 acre land is characterized by residential development on 5 acre lots. **Figure 3: Land Use** detail land use and current zoning for existing and future conditions.

III. Historical Background

A. Previous Studies

In an effort to better understand the existing drainage conditions within the Old Picacho area, a review of existing literature related to the areas drainage systems was attempted but Doña Ana does not have any drainage reports concerning the Old Picacho area.

B. Site Visits

A site visit was conducted to better understand existing drainage conditions of the Old Picacho community and Donaldson Dam. This field visit was used to determine the general condition of the drainage system and identify potential trouble spots within the system. BHI staff, including Andrew Guerra and Brad Sumrall visited the site. Site visits were conducted on 3/8/2008 and 11/10/2008. In general the system appears to be undersized from both the storage and conveyance standpoints and requires maintenance. The Dam flood pool appears to be partially filled with sediment and the Dam embankment is in poor repair. Additionally, the Dam outfall conveyance channel appears to be considerably undersized and clogged by vegetation. Furthermore, it is unknown if the Dam was constructed to any engineering standard and the Office of the State Engineer Dam Safety Bureau issued a breech order for the Dam on February 20, 2006.

IV. Public Input

In an effort to determine how the system actually performs, Doña Ana County sought public input about the drainage conditions throughout the Picacho Hills community. Two public meetings have been held to-date collecting public input about their concerns and to propose potential improvements to the drainage system.

A. Meetings

Two public meetings were held in an effort to hear the concerns of local residents, October 20, 2008 and November 18, 2008. The principle goal of the October public meeting was to inform the public about the function of the Doña Ana County Flood Commission and the intent of the proposed Drainage Master Plan. The first meeting also sought to provide the community a forum to voice their initial concerns related to the drainage situation within the Old Picacho area. Public comment forms were provided to all attendees, allowing residents to provide detailed comments and concerns for review within the DMP. The first meeting was well attended by area residents, with over 60 individuals signing in and participating.

Representatives from Doña Ana County, including Paul Dugie, Tish Segovia, and Jorge Granados attended the meetings. Rob Richardson, Andrew Guerra, and Brad Sumrall attended the meetings on behalf of BHI. Additional information concerning advertisement, agendas and data obtained from the meeting can be found in **Appendix D: Public Input.**

B. Comments

Comment Sheets were provided to area residents who were encouraged to use these forms to provide detailed accounts of their concerns and observations to the County and BHI for review during the creation of the DMP. These community comments provided by residents were valuable in assessing the performance of the existing drainage system. Anecdotal information provided by county staff and local residents was used to assess local drainage concerns. The public noted high flow rates and localized overflows within the manmade channel conveyance discharging from the Donaldson Dam.

Please refer to **Figure 4: Community Comment Locations** for the summary of public comments and locations of public concern. Please refer to **Appendix D: Public Input** for the complete collection of public comments received.

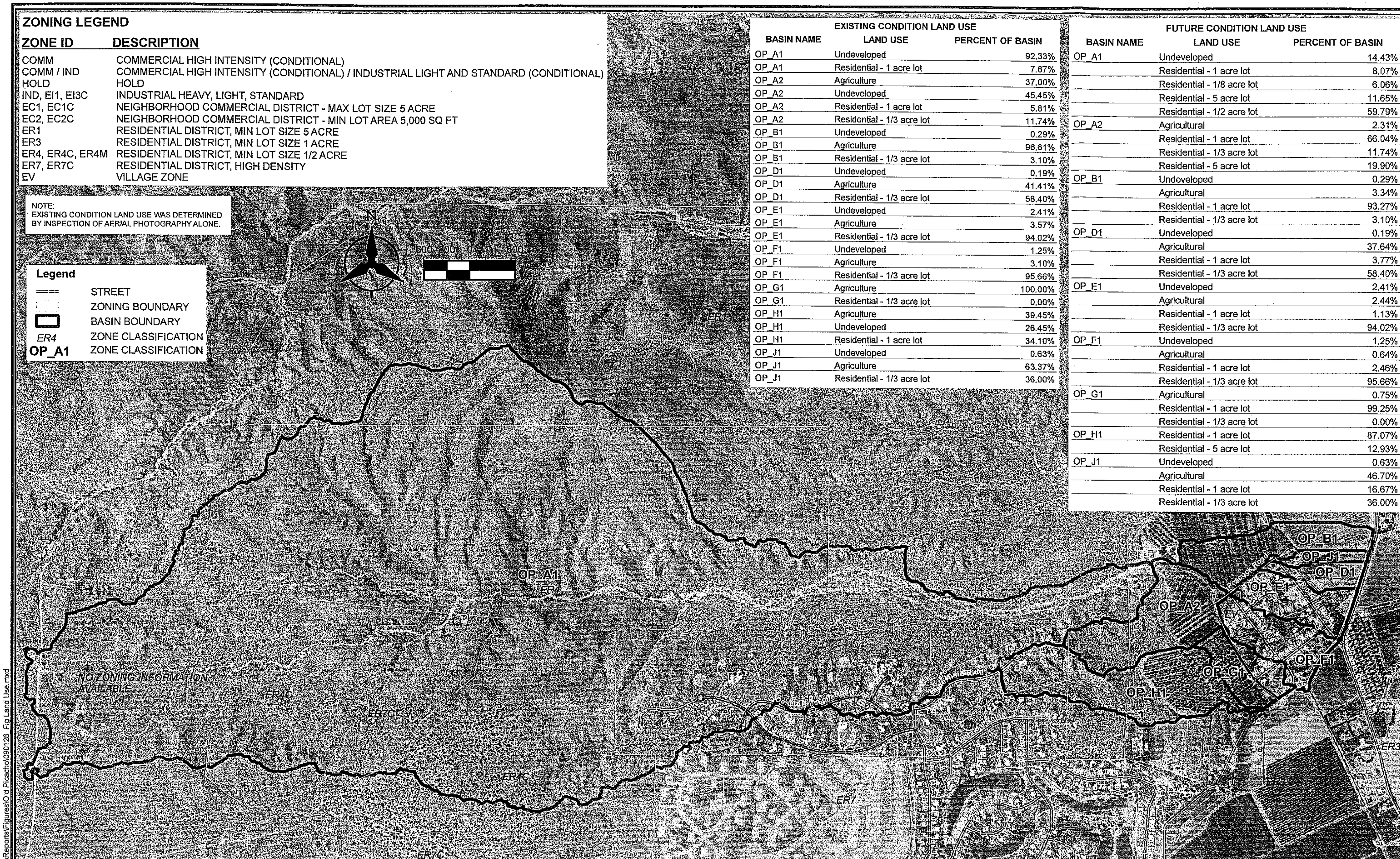
V. Watershed Analysis and Evaluation

A. Modeling Software and Analysis Methods

The hydrologic modeling within this study is based upon methods developed by the Army Corps of Engineers and the Natural Resources Conservation Service (NRCS) (formerly the Soil Conservation Service (SCS)). Modeling parameters include precipitation data, lag time calculations, curve number calculations, sediment bulking calculations, and routing methods. Each drainage area was evaluated for other physical parameters that affect runoff rates and volumes. The following computer applications were used to create the hydrologic models.

1. Geographic Information System (GIS) Processing System – HEC-GeoHMS

The public domain software HEC-GeoHMS 4.2 (Beta) was used for generating parameters needed for the hydrologic model and is an extension created for use with the ArcView Version 9.2 platform developed by ESRI, (Environmental Systems Research Institute). This software package utilizes a DEM to define basin limits and flow paths. The output from this program can be applied directly to the U.S. Army Corps of Engineers Hydrologic Modeling System (HEC-HMS) model. The data produced by this software package was reviewed for consistency, accuracy and precision.



ZONING LEGEND

ZONE ID	DESCRIPTION
COMM	COMMERCIAL HIGH INTENSITY (CONDITIONAL)
COMM / IND	COMMERCIAL HIGH INTENSITY (CONDITIONAL) / INDUSTRIAL LIGHT AND STANDARD (CONDITIONAL)
HOLD	HOLD
IND, EI1, EI3C	INDUSTRIAL HEAVY, LIGHT, STANDARD
EC1, EC1C	NEIGHBORHOOD COMMERCIAL DISTRICT - MAX LOT SIZE 5 ACRE
EC2, EC2C	NEIGHBORHOOD COMMERCIAL DISTRICT - MIN LOT AREA 5,000 SQ FT
ER1	RESIDENTIAL DISTRICT, MIN LOT SIZE 5 ACRE
ER3	RESIDENTIAL DISTRICT, MIN LOT SIZE 1 ACRE
ER4, ER4C, ER4M	RESIDENTIAL DISTRICT, MIN LOT SIZE 1/2 ACRE
ER7, ER7C	RESIDENTIAL DISTRICT, HIGH DENSITY
EV	VILLAGE ZONE

NOTE:
EXISTING CONDITION LAND USE WAS DETERMINED BY INSPECTION OF AERIAL PHOTOGRAPHY ALONE.

Legend

====	STREET
⁚ ⁚	ZONING BOUNDARY
▭	BASIN BOUNDARY
ER4	ZONE CLASSIFICATION
OP_A1	ZONE CLASSIFICATION

EXISTING CONDITION LAND USE

BASIN NAME	LAND USE	PERCENT OF BASIN
OP_A1	Undeveloped	92.33%
OP_A1	Residential - 1 acre lot	7.67%
OP_A2	Agriculture	37.00%
OP_A2	Undeveloped	45.45%
OP_A2	Residential - 1 acre lot	5.81%
OP_A2	Residential - 1/3 acre lot	11.74%
OP_B1	Undeveloped	0.29%
OP_B1	Agriculture	96.61%
OP_B1	Residential - 1/3 acre lot	3.10%
OP_D1	Undeveloped	0.19%
OP_D1	Agriculture	41.41%
OP_D1	Residential - 1/3 acre lot	58.40%
OP_E1	Undeveloped	2.41%
OP_E1	Agriculture	3.57%
OP_E1	Residential - 1/3 acre lot	94.02%
OP_F1	Undeveloped	1.25%
OP_F1	Agriculture	3.10%
OP_F1	Residential - 1/3 acre lot	95.66%
OP_G1	Agriculture	100.00%
OP_G1	Residential - 1/3 acre lot	0.00%
OP_H1	Agriculture	39.45%
OP_H1	Undeveloped	26.45%
OP_H1	Residential - 1 acre lot	34.10%
OP_J1	Undeveloped	0.63%
OP_J1	Agriculture	63.37%
OP_J1	Residential - 1/3 acre lot	36.00%

FUTURE CONDITION LAND USE

BASIN NAME	LAND USE	PERCENT OF BASIN
OP_A1	Undeveloped	14.43%
	Residential - 1 acre lot	8.07%
	Residential - 1/8 acre lot	6.06%
	Residential - 5 acre lot	11.65%
	Residential - 1/2 acre lot	59.79%
OP_A2	Agricultural	2.31%
	Residential - 1 acre lot	66.04%
	Residential - 1/3 acre lot	11.74%
	Residential - 5 acre lot	19.90%
OP_B1	Undeveloped	0.29%
	Agricultural	3.34%
	Residential - 1 acre lot	93.27%
	Residential - 1/3 acre lot	3.10%
OP_D1	Undeveloped	0.19%
	Agricultural	37.64%
	Residential - 1 acre lot	3.77%
	Residential - 1/3 acre lot	58.40%
OP_E1	Undeveloped	2.41%
	Agricultural	2.44%
	Residential - 1 acre lot	1.13%
	Residential - 1/3 acre lot	94.02%
OP_F1	Undeveloped	1.25%
	Agricultural	0.64%
	Residential - 1 acre lot	2.46%
	Residential - 1/3 acre lot	95.66%
OP_G1	Agricultural	0.75%
	Residential - 1 acre lot	99.25%
	Residential - 1/3 acre lot	0.00%
OP_H1	Residential - 1 acre lot	87.07%
	Residential - 5 acre lot	12.93%
OP_J1	Undeveloped	0.63%
	Agricultural	46.70%
	Residential - 1 acre lot	16.67%
	Residential - 1/3 acre lot	36.00%

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OLD PICACHO DRAINAGE MASTER PLAN	DRAWN BY: KWJ	DATE: JAN 2009	LAND USE FIGURE 3
	CHECKED BY: LBS	PROJECT NO: 090126	

Public Comments Summary		
Id	Problem	Resident
24	Pond outlet inadequate	Mardie Breadan
25	Ditch overflow	Mardie Breadan
31	Channel overtops	Geoffrey Smith, 4321 Ladera Ave

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OLD PICACHO DRAINAGE MASTER PLAN	DRAWN BY: KWJ	DATE: JAN. 2009	COMMUNITY COMMENT LOCATIONS - FIGURE 4
	CHECKED BY: LBS	PROJECT NO: 090126	

2. Hydrologic Modeling Software – HEC-HMS

The HEC-HMS program, Version 3.2, was used to prepare a hydrologic model of the Old Picacho area. This model was used to quantify storm water runoff volumes and flow rates for the study area. The U.S. Army Corps of Engineers Hydrologic Engineering Center developed HEC-HMS for watershed model creation based on user defined inputs. The HEC-HMS model for this DMP was created using data prepared within HEC-GeoHMS described above. Adjustments were made to the HEC-HMS model to reflect man-made controls such as culverts, arroyos and detention facilities not defined within the HEC-GeoHMS output. Digital copies of the existing and future condition HEC-HMS models are found on the CD in **Appendix C: Digital Data.**

B. Rainfall and Model Storm

This study applied the NM Type II-75 Rainfall Distribution which was developed to best model storm events for the region. This is a commonly applied distribution and is accepted by numerous State and Federal Agencies in New Mexico. For the purposes of this study, only the 100-yr return event was analyzed (1% chance). The 100-yr, 24-hr rainfall depth utilized for this study was obtained from NOAA Atlas 14, for a point at latitude 32.311° N and longitude 106.876° W. The total rainfall depth for this return period at this location is 3.5 inches. Please refer to **Appendix A: Hydrologic Calculations** for the detailed calculations used to generate the rainfall distribution for the study area.

C. Basin Topography

The DEM prepared for this study was utilized to define drainage basins, sub-basins, flow path lengths and slopes. The DEM is comprised of a series of squares, 5ft x 5ft, that are assigned one elevation, that define the land surface.

The DEM served as the basis for all further analysis from which flow direction and flow accumulation grids were created. The flow direction used the 8-point pour method, and is defined by the direction with the steepest descent in any of 8 directions derived from 8 polygonal cells surrounding a given point, or cell. The principle goal of the flow direction grid is to define the direction where water will flow. The flow accumulation grid was created by summarizing the number of upstream cells draining to a given cell. Essentially, the flow accumulation grid assists in defining flow paths within the study area. Streams were defined by a threshold number of cells draining to a given cell. Streams were divided into stream segments which define flows from the basin divide to a stream junction, between successive stream junctions or from a junction to the basin outlet. A watershed grid defines the contributing area for each stream segment. In essence the watershed grid assists in defining macro drainage basin areas.

In the final steps of processing the stream and watershed, grids were converted to vector representations, and watersheds were aggregated at confluences for computation efficiency.

Once the terrain preprocessing was complete, basins were evaluated, to both add new delineations based on structures such as culverts, flow barriers and ponds and to develop stream and watershed characteristics including stream length, basin slope, basin centroid, and centroid length. Analysis points were added to the model, based on known structures, and to investigate areas with known drainage issues. Once the analysis points were determined and inserted, new sub-basins were re-delineated.

Overall, basin boundaries were checked against topography and aerial photographs to ensure the processor had created logical boundaries. **Figure 5A: Basin Map** and **Figure 5B: Detailed Basin Map** display drainage basin and sub-basin delineation within the Old Picacho area. The calculated characteristics derived from HEC-GeoHMS include the sub-basin area, sub-basin slope, arroyo length, arroyo slope, and longest flow path.

D. Loss Method (NRCS Curve Number)

NRCS curve numbers were assigned to each watershed area. The curve number seeks to capture the effects of land usage, soil type, soil condition, antecedent soil moisture content and vegetative growth on the hydrologic modeling. The curve number addresses indirectly initial abstraction and infiltration rates for soils. CN values are dimensionless and range from 0 to 100. The higher the CN value the greater the runoff volume and flow rate. This method is commonly utilized because of the method's relative simplicity and its ability to be adjusted to reflect field conditions.

The NRCS has generated curve numbers for a variety of different land usage types, vegetative cover types and general hydrologic condition of the soils. TR-55 is a NRCS technical release, and computer program, that provides detailed break downs of curve numbers for different land usage and land conditions. Upon review of the different land usages and conditions defined by TR-55, the Old Picacho area was divided into five different land usages and conditions. Please refer to **Table 1: Curve Number Summary** below which lists the curve numbers utilized for different land usages within the Old Picacho community.

Table 1 - Curve Number Summary

Cover type and hydrologic condition	CN for Wet Condition (High Antecedent Moisture Condition)			
	Soil Group A	Soil Group B	Soil Group C	Soil Group D
Agriculture - Straight Row Crop Residue Good	81	88	92	93
Desert shrub - poor	80	89	93	95
Residential - 5 acre lot	82	90	94	95
Residential - 1 acre lot	85	92	95	96
Residential - 1/3 acre lot	87	93	96	97

The CN values were adjusted, per TR-55 methodology, to reflect expected impervious percentages as noted within TR-55. Modeling assumed a hydrologic soil condition for watersheds in poor condition having limited potential to infiltrate runoff due to soil surface crusts, reduced vegetative cover and compaction due to human activity.

At the request of the County, the Old Picacho area was modeled for antecedent moisture condition III; saturated soil conditions. Modeling the area for moisture condition III, high antecedent soil moisture content, reduces infiltration rates thus increasing runoff volumes and flow rates from the drainage basins. The CN values provided by TR-55 are for antecedent moisture condition II – average conditions. Curve numbers were adjusted according to NRCS methodology to reflect the high antecedent moisture condition for the analysis. Refer to the curve number calculations that can be found in **Appendix A: Hydrologic Calculations** for additional information.

E. Hydrograph Transformations

For the majority of the Old Picacho area, the Upland Method was utilized to estimate travel times for drainage flows. The New Mexico Department of Transportation (NMDOT) utilizes the Upland Method of estimating travel times for flows for basins less than 200 acres. For basins larger than 200 acres a modified method was utilized to generate travel times. The Upland Method seeks to quantify travel times by classifying flow as either Overland Flow or Shallow Concentrated Flow. The upper extent of the sub-basins are characterized as Overland Flow, while the remainder of the basin is classified as Shallow Concentrated Flow. Using the flow classification and flow path slope the velocity, and subsequently lag time, can be computed for each sub-basin. **Appendix A: Hydrologic Calculations** contains the detailed lag time calculations.

F. Routing

This study utilized the Muskingum-Cunge procedure for channel routing, which is consistent with other local studies. This method is appropriate for natural channels such as arroyos, which are the dominant channel type encountered throughout the study area. The channel cross section geometry required for this method was derived from the DEMs created for the study. Mannings "n" values for the main arroyo channels were assumed to be 0.030 for both the channel bottom and overbank areas.

G. Hydraulic Structures

Structures such as culverts and reservoirs were located from drainage reports, aerial photos and field investigations. The locations of these structures served as some of the analysis points for sub-basin delineation. Pond operation in models was assessed by quantifying stage-storage-discharge relationships. Culvert capacities were determined using a hydraulic modeling software package, Bentley InRoads Storm and Sanitary - Drainage Structure Analyzer. This software employs the method described in the United

States Department of Transportation (USDOT) publication "Hydraulic Design of Highway Culverts," HDS-5. All structures were assumed to be maintained, free of sediment and obstructions when assessing their efficiency. **Figure 5B** provides a depiction of the location of known large drainage conveyance structures (ponds, culverts, etc.) and sub-basin delineation within the Old Picacho area.

H. Sediment Bulking

The Old Picacho contributing watershed is characterized by erosive soils. Storm flows commonly collect sediment and debris and have a direct impact on flow rates by increasing the volume of conveyed flow. This increase, referred to as bulking, was assessed for a nearby area by Mussetter Engineering in 2008 (Sediment Load Bulking Factors for Four Arroyos in the Overlook Subdivision, Las Cruces NM). This report determined the bulking factors that should be used when modeling storm runoff flow rates and volumes. Generally, the Overlook Subdivision is very similar in hydrologic character and soil type to that of the Old Picacho area. Flows accumulate along the mesa top and travel through the development along the eroded escarpment. The Overlook Subdivision is characterized principally by NRCS type Bluepoint series soils. The drainage basins most similar to those within the Old Picacho area are predominately Bluepoint series soils. Bluepoint soils typically have an NCRS soil classification of loamy sand or similar. The soils within the Old Picacho area are a mixture of soil types, principally from the Bluepoint series of soils. Noting similar soil types, current and future land use, and general basin characteristics, it is reasonable to use the findings from the Overlook Subdivision. This data is reasonable in the absence of a detailed sediment bulking analysis specific to the Old Picacho area. Please refer to **Appendix E – Soils Information** for additional information.

Bulking factors from the Mussetter report were utilized for the sediment bulking factors in the analysis of the Old Picacho area. **Table 2: Sediment Bulking Factor** summarizes the sediment bulking factors applied to each basin. Refer to **Appendix A: Hydrologic Calculations** for detailed calculations pertaining to sediment bulking.

Table 2 - Sediment Bulking Factor

BASIN NAME	Bulking Factor	
	Existing	Future
OP_A1	1.18	1.19
OP_A2	1.09	1.1
OP_B1	1.07	1.08
OP_D1	1.05	1.05
OP_E1	1.07	1.07
OP_F1	1.08	1.08
OP_G1	1.05	1.06
OP_H1	1.1	1.1
OP_J1	1.04	1.04

VI. Analysis Results and Recommendations

Two comprehensive watershed models were developed for the Old Picacho community and contributing area. One model captures the existing conditions of the study area while the other model serves to forecast the impact of future development within the study area. The future conditions model also includes proposed improvements and additions to the existing Old Picacho drainage system. BHI performed both hydrologic and hydraulic analysis of the Old Picacho community to evaluate existing and future conditions relative to runoff rates and volumes for the 100-year (1% chance) storm event.

The Old Picacho community is comprised of one major basin, sub-divided into smaller sub-basins. The sub-basins divide the macro basin at critical points along the known flow path. Basin OP_A1 is the largest basin within the study area, lying upstream of the Old Picacho community, totaling 1.65 sq mi. A summary of important basin characteristics used in analysis can be found in **Table 3: Basin Characteristics**, and supporting calculations can be found in **Appendix A: Hydrologic Calculations.** Figures 5A and 5B show the limits of each of the defined drainage basins in the models.

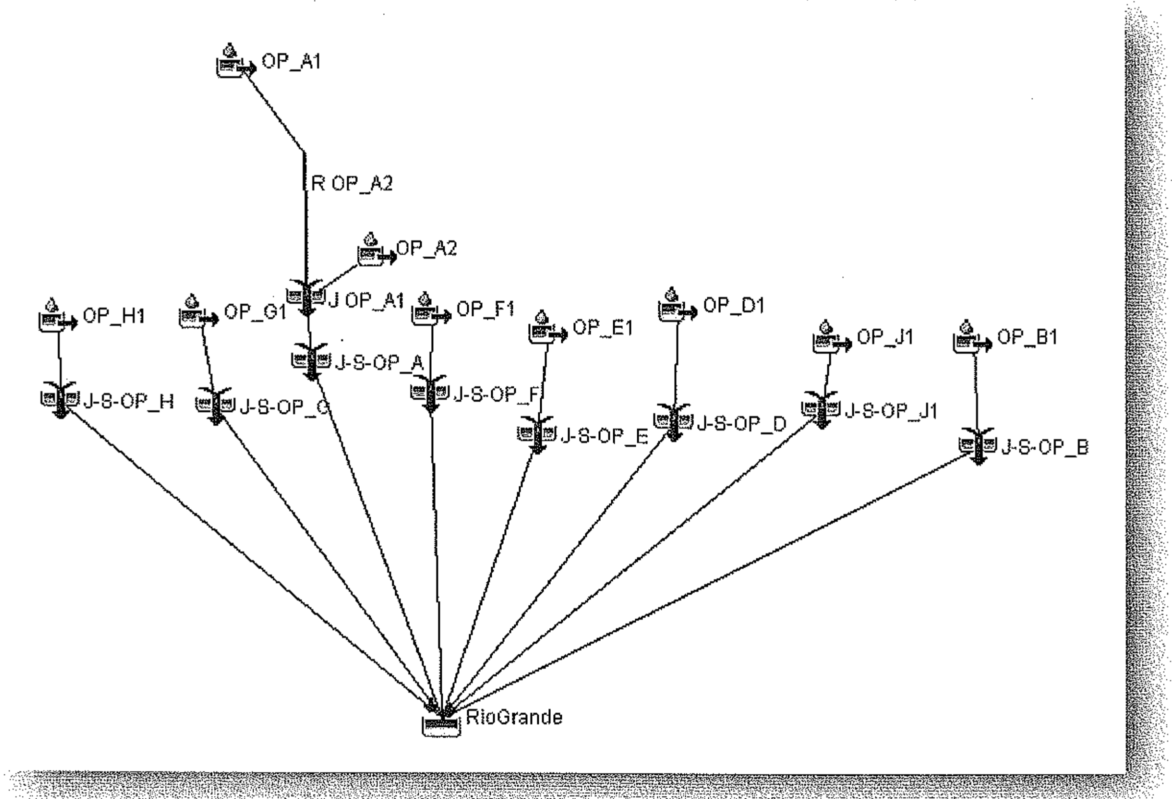
Table 3 - Basin Characteristics

NAME	Area	Weighted Whole Basin CN		Average Basin Slope	Longest Flow Path	Lag Time
	(Acre)	*Existing*	*Future*	*(%)*	*(FT)*	*(Min)*
OP_A1	1053.95	89	91	20.81	18,402	49.86
OP_A2	42.30	82	85	12.69	3,981	10.97
OP_B1	26.27	84	87	3.25	3,066	12.73
OP_D1	8.16	88	88	3.66	1,644	8.74
OP_E1	18.60	87	87	4.74	2,200	11.16
OP_F1	20.51	87	87	5.00	2,207	9.21
OP_G1	9.71	87	91	4.29	1,369	6.00
OP_H1	48.02	84	87	12.99	4,331	11.12
OP_J1	4.34	88	88	3.15	1,526	7.03

A. Hydrologic Analysis Results

A hydrologic model was prepared for the Old Picacho community and contributing offsite drainage basins for both existing and fully developed conditions. The existing conditions model represents conditions on the ground as of the 2004 aerial mapping activity. The future conditions model reflects fully developed conditions for all areas zoned for development based on Doña Ana County assessor's maps. This model includes the proposed improvements to the drainage system, to be discussed later in the report. The basin schematic is shown on **Figure 6: Hydrologic Model Schematic. Table 4: 100-Year Hydrologic Model Results – Existing and Future Conditions** provides flow rates and volumes for every basin, pond and analysis point for the study area. Junction / Analysis Points are shown in **Figures 5A and 5B.**

Figure 6 - Hydrologic Model Schematic



1. Unnamed Arroyo Basin (Donaldson Dam)

The Unnamed Arroyo Basin (Donaldson Dam) is comprised of sub-basin OP_A1. Flows from this basin collect within the Unnamed Arroyo and are conveyed into the Donaldson Dam. Flows increase approximately 20% from current to fully developed conditions. This watershed, given its significant size, will require careful management as development continues along its banks. Ultimately, channel stabilization along the arroyo banks and the outfall of the Donaldson Dam along with other improvements are necessary. These improvements are discussed in the recommendations section below.

2. Local Drainage Basins - Old Picacho Village

The Old Picacho community drainage system is simple in nature as there are no apparent drainage systems. Storm water collects on properties and local roadways where it pools, infiltrates into the soil or evaporates. It appears that storm drainage within Old Picacho is working successfully. The simple development nature of the Old Picacho community allows for localized storage and infiltration and negates the need for drainage infrastructure improvements as long as current levels of imperviousness are maintained.

Table 4 - 100 Yr Hydrologic Model Results-Existing and Future Conditions

Structure ID	Drainage Area (sq-mi)	Existing Condition		Future Condition	
		Runoff Volume (ac-ft)	Peak Discharge (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
Basins					
OP_A1	1.6468	242.9	1,997	264.1	2,189
OP_A2	0.0660955	6.8	179	7.8	206
OP_B1	0.0410479	4.5	109	5.2	125
OP_D1	0.0127428	1.6	49	1.6	48
OP_E1	0.0290673	3.6	95	3.6	95
OP_F1	0.0320472	4	117	4	117
OP_G1	0.0151704	1.9	60	2.2	70
OP_H1	0.0750339	8.5	212	9.6	242
OP_J1	0.006775	0.9	28	0.9	28
Junction / Analysis Points					
J OP_A1	1.7128955	249.3	2,003	271.8	2,197
J-S OP_A	1.7128955	-	-	271.8	2,197
J-S OP_B1	0.0410479	-	-	5.2	125
J-S OP_D1	0.0127428	-	-	1.6	48
J-S OP_E1	0.0290673	-	-	3.6	95
J-S OP_F	0.0320472	-	-	4	117
J-S OP_G	0.0151704	-	-	2.2	70
J-S OP_H	0.0750339	-	-	9.6	242
J-S OP_J1	0.006775	-	-	0.9	28
Ponds					
Donaldson Dam	1.6468	242.5	1,997	-	-
Outfalls					
Rio Grande	1.92478	-	-	298.9	2,228
J-S OP_A	1.7128955	249.3	2003	-	-
J-S OP_B1	0.0410479	249.3	2003	-	-
J-S OP_D1	0.0127428	4.5	109	-	-
J-S OP_E1	0.0290673	1.6	48	-	-
J-S OP_F	0.0320472	3.6	95	-	-
J-S OP_G	0.0151704	4	117	-	-
J-S OP_H	0.0750339	1.9	60	-	-
J-S OP_J1	0.006775	8.5	212	-	-

B. General Observations and Recommendations

The primary issue within the Old Picacho community is the volume of water flowing into the Donaldson Dam and through the Dam outfall channel. There are a number of solutions that can delay, detain or retain water to reduce flows upstream of the existing Donaldson Dam. These include land pitting, mild terracing, land ripping, root plowing and reseeding. The goal of all of these alternatives is to increase the amount of water that will be absorbed by soils, reducing runoff volumes and flow rates. Basin OP_A1 will most directly benefit from the implementation of one or more of these alternatives.

This basin extends westward onto currently undeveloped land. Minimizing flows off of the undeveloped land would improve the existing drainage issues within the Old Picacho community.

VII. Specific Drainage Improvement Recommendations

It is important to note that the proposed improvements are on both public and/or private property. Doña Ana County is traditionally limited to utilizing public funds on public property. As such, improvements on private property will require coordination and agreements between public and private entities. The Donaldson Dam and outfall are both privately owned and operated at this time.

The Donaldson Dam and outfall are of chief concern. The existing Dam is at the base of a large drainage basin. The Dam under existing conditions receives a 100-yr peak flow rate of 1997 cfs and a total storm runoff volume of 243 acre-ft. The Donaldson Dam currently has a maximum storage capacity of 10 ac-ft. The current capacity of the Dam is estimated using the 2004 aerial photography and lidar data. The Dam principle spillway consists of a single 36" CMP, determined during a BHI site visit. The combination of the Dam having a very small storage capacity and having a small principle spillway significantly reduces or negates the functionality of the existing Dam. Under future conditions the Dam will receive a 100-yr peak flow rate of 2188 cfs and a total storm runoff volume of 264 acre-ft. The Dam can withstand neither the existing condition 100-yr storm event nor the future condition 100-yr storm event. It is critical that the Dam or outfall be improved.

Work on the Dam's emergency spillway has recently been observed. However, the nature or design of this work is unknown at this time. Completely rehabilitating the Dam and outfall may prove to be cost prohibitive. However, strategic improvements in the interim will temporarily improve the operation of the Dam and public safety. Nevertheless, the Dam or outfall require rehabilitation to provide the standard level of public safety and protection of property and to meet Office of the State Engineer Dam Safety Bureau requirements.

A. Interim Improvements

The interim improvements should center around two key elements: preventing uncontrolled overtopping of the Dam embankment and improving the existing channel conveyance discharging from the Dam.

Hydraulic analysis of the Dam indicates that for both existing and future conditions, the Dam in its current configuration will be overtopped by the 100-yr storm event. In the event that the existing Dam is overtopped, the Dam may fail. Field investigations during the preparation of this report revealed that the Dam embankment may be in the process of being modified to include an improved emergency spillway. For the purposes of this report, it is assumed that an improved emergency spillway will prevent the uncontrolled overtopping of the dam embankment. This spillway should be sized to convey water through a sufficiently reinforced portion of the Dam such that the embankment integrity is not adversely impacted.

The existing channel conveyance leading away from the Donaldson Dam cannot convey the entire 100-yr peak flow for existing or ultimate conditions. Area residents have noted that this channel consistently overflows, causing flooding in the Old Picacho community. The channel can be improved to have a slightly higher flow capacity through enlargement and concrete lining. Concrete lining will improve the hydraulic efficiency of the channel while limiting the likelihood of failure due to excessive scour or erosion. Such improvements would reduce flooding along the channel for smaller, more common storm events.

The existing channel does not directly connect to the Rio Grande and currently spills onto adjacent farm land. An improved interim channel with greater capacity and concrete lining should also include the construction of a new channel connecting to the proposed Picacho Hills Diversion Channel. This channel system is intended to convey discharges from Picacho Hills directly to the Rio Grande or an agricultural drain nearby (Picacho Hills Drainage Master Plan, BHI 2009). This channel will reduce, but not eliminate, the frequency that farm land is flooded by storm water flows. The proposed interim channel is incapable of conveying the 100-yr storm event. The 100-yr storm event will cause flooding in the Old Picacho community, despite the interim improvements. The interim improvements will reduce the frequency that the Old Picacho community will be flooded by storm flows out of the Donaldson Dam. A conceptual cost estimate was assembled for the interim improvements to the outfall conveyance channel. This estimate is found in **Appendix B – Conceptual Capital Project Recommendations.**

Small detention ponds could be constructed along the current Donaldson Dam outfall. These ponds would attempt to mitigate the peak flow rates and volumes from the Donaldson Dam. However, such facilities would be costly and likely be unable to significantly improve the current drainage situation. Refer to **Figure 7: Proposed Drainage Improvements** for the proposed interim channel location.

B. Ultimate Improvements

The ultimate solution to improve drainage conditions within the Old Picacho area is to construct a properly sized outfall to the Rio Grande. As discussed earlier, the existing Dam is undersized and not constructed according to any known design requirements. Properly rehabilitating or reconstructing the existing Dam embankment to accommodate the 100-yr storm event is cost prohibitive. Additionally, proper maintenance activities for the Dam and Dam embankment are of chief concern, and may not be consistent. The existing Dam is privately owned, and thus subject to private management and maintenance. Long term operation and maintenance of the Dam would be more reliably accomplished by a public entity, such as Doña Ana County.

Rehabilitation and long term maintenance costs limit the Doña Ana County Flood Commission's interest in taking ownership of the existing Donaldson Dam. A new channel discharging directly to the Rio Grande must be constructed to divert storm flows away from the Old Picacho community. This existing Donaldson Dam will prevent sediment, debris, and chemical contaminates from being discharged directly into the Rio Grande.

The new arroyo conveyance channel must be designed to accommodate the future conditions 100-yr storm event. Due to property ownership and geometric restraints, the interim channel cannot be improved to accommodate the future 100-yr event. The most hydraulically efficient channel alignment diverts water along a reasonably straight, direct, route to the Rio Grande. The proposed channel alignment can be found in **Figure 7: Proposed Drainage Improvements**. A conceptual cost estimate was assembled for the construction of a new arroyo channel. This estimate can be found in **Appendix B – Conceptual Capital Project Recommendations.**

Appendix

APPENDIX A

Hydrologic and Hydraulic Calculations

- Rainfall Distribution
- Curve Number
- Lag Time
- Sediment Bulking
- Basin Characteristics
- Existing Pond Capacity
- HEC-HMS Output
- Channel Design

delta y	II-75	Accum x
0	0	0
0.028016	0.028016	1
0.033965	0.061981	2
0.043381	0.105362	3
0.060723	0.166085	4
0.040742	0.206828	4.5
0.05703	0.263858	5
0.038265	0.302123	5.25
0.053562	0.355685	5.5
0.092167	0.447852	5.75
2.315422	2.763274	6
0.149934	2.913209	6.25
0.067476	2.980685	6.5
0.044574	3.025258	6.75
0.033581	3.058839	7
0.04746	3.106299	7.5
0.035755	3.142054	8
0.050533	3.192587	9
0.03807	3.230658	10
0.030691	3.261349	11
0.025789	3.287138	12
0.04619	3.333327	14
0.040536	3.373863	16
0.036164	3.410027	18
0.032678	3.442705	20
0.029831	3.472536	22
0.027459	3.499995	24

100-yr Rainfall Distribution
Picacho Hills
BHI No: 090126
Prepared By: Kris Johnson
Date: 10/10/2008

Sheet Goal:

This sheet prepares a rainfall distribution with a consistent time step. Note that Column C (Accum x) transitions from hourly increments to quarter hour, to hourly to bihourly. Column E & F prepare a quarter hour distribution by linearly interpolating rainfall depths.

This sheet references the NM Type II-75 Unit Hyetograph multiplied by the appropriate actual rainfall depth. This calculation can be found on the Picacho Hills tab within this excel file.

Duration (hr)	Depth (inch)
0	0
0.25	0.007004
0.5	0.014008
0.75	0.021012
1	0.028016
1.25	0.036508
1.5	0.044999
1.75	0.05349
2	0.061981
2.25	0.072826
2.5	0.083672
2.75	0.094517
3	0.105362
3.25	0.120543
3.5	0.135724
3.75	0.150904
4	0.166085
4.25	0.187814
4.5	0.206828
4.75	0.2367
5	0.263858
5.25	0.302123
5.5	0.355685
5.75	0.447852
6	2.763274
6.25	2.913209
6.5	2.980685
6.75	3.025258
7	3.058839
7.25	3.081593
7.5	3.106299
7.75	3.123201
8	3.142054
8.25	3.154687
8.5	3.167321
8.75	3.179954
9	3.192587
9.25	3.202105
9.5	3.211622
9.75	3.22114
10	3.230658
10.25	3.23833
10.5	3.246003
10.75	3.253676
11	3.261349
11.25	3.267796
11.5	3.274243
11.75	3.28069
12	3.287138

12.25	3.292911
12.5	3.298685
12.75	3.304459
13	3.310232
13.25	3.316006
13.5	3.32178
13.75	3.327554
14	3.333327
14.25	3.338394
14.5	3.343461
14.75	3.348528
15	3.353595
15.25	3.358662
15.5	3.363729
15.75	3.368796
16	3.373863
16.25	3.378384
16.5	3.382904
16.75	3.387425
17	3.391945
17.25	3.396466
17.5	3.400986
17.75	3.405507
18	3.410027
18.25	3.414112
18.5	3.418197
18.75	3.422281
19	3.426366
19.25	3.430451
19.5	3.434536
19.75	3.43862
20	3.442705
20.25	3.446434
20.5	3.450163
20.75	3.453892
21	3.457621
21.25	3.461349
21.5	3.465078
21.75	3.468807
22	3.472536
22.25	3.475968
22.5	3.479401
22.75	3.482833
23	3.486265
23.25	3.489698
23.5	3.49313
23.75	3.496563
24	3.499995

Tabulation of the rainfall power curves for NM type IIa storms

n	hours x	time delta x	Type II-60 $y = 0.60 x^{0.160735}$ inches y	rainfall delta y	Type II-65 $y = 0.65 * x^{0.135549}$ inches y	rainfall delta y	Type II-70 $y = 0.70 * x^{0.112231}$ inches y	rainfall delta y	Type II-75 $y = 0.75 * x^{0.090521}$ inches y	rainfall delta y
1	0.00		0.000		0.000		0.000		0.000	
2	0.25	0.250	0.480	0.480	0.539	0.539	0.599	0.599	0.662	0.662
3	0.50	0.250	0.537	0.057	0.592	0.053	0.648	0.048	0.704	0.043
4	0.75	0.250	0.573	0.036	0.625	0.033	0.678	0.030	0.731	0.026
5	1.00	0.250	0.600	0.027	0.650	0.025	0.700	0.022	0.750	0.019
6	1.25	0.250	0.622	0.022	0.670	0.020	0.718	0.018	0.765	0.015
7	1.50	0.250	0.640	0.018	0.687	0.017	0.733	0.015	0.778	0.013
8	1.75	0.250	0.656	0.016	0.701	0.015	0.745	0.013	0.789	0.011
9	2.00	0.250	0.671	0.014	0.714	0.013	0.757	0.011	0.799	0.010
10	2.50	0.500	0.695	0.024	0.736	0.022	0.776	0.019	0.815	0.016
11	3.00	0.500	0.716	0.021	0.754	0.018	0.792	0.016	0.828	0.014
12	3.50	0.500	0.734	0.018	0.770	0.016	0.806	0.014	0.840	0.012
13	4.00	0.500	0.750	0.016	0.784	0.014	0.818	0.012	0.850	0.010
14	5.00	1.000	0.777	0.027	0.808	0.024	0.839	0.021	0.868	0.017
15	6.00	1.000	0.800	0.023	0.829	0.020	0.856	0.017	0.882	0.014
16	7.00	1.000	0.820	0.020	0.846	0.017	0.871	0.015	0.894	0.012
17	8.00	1.000	0.838	0.018	0.862	0.015	0.884	0.013	0.905	0.011
18	9.00	1.000	0.854	0.016	0.876	0.014	0.896	0.012	0.915	0.010
19	10.00	1.000	0.869	0.015	0.888	0.013	0.906	0.011	0.924	0.009
20	11.00	1.000	0.882	0.013	0.900	0.012	0.916	0.010	0.932	0.008
21	12.00	1.000	0.895	0.012	0.910	0.011	0.925	0.009	0.939	0.007
22	14.00	2.000	0.917	0.022	0.930	0.019	0.941	0.016	0.952	0.013
23	16.00	2.000	0.937	0.020	0.947	0.017	0.956	0.014	0.964	0.012
24	18.00	2.000	0.955	0.018	0.962	0.015	0.968	0.013	0.974	0.010
25	20.00	2.000	0.971	0.016	0.976	0.014	0.980	0.012	0.984	0.009
26	22.00	2.000	0.986	0.015	0.988	0.013	0.990	0.011	0.992	0.009
27	24.00	2.000	1.000	0.014	1.000	0.012	1.000	0.010	1.000	0.008

NRCS-NM Type II Rainfall Distributions

Rearranged	delta x	Accum x	delta y	II-60	delta y	II-65	delta y	II-70	delta y	II-75	Type II
		0.00		0.0000		0.0000		0.0000		0.0000	0.0000
19	1.00	1.00	0.0134	0.0134	0.0115	0.0115	0.0097	0.0097	0.0080	0.0080	0.0105
17	1.00	2.00	0.0160	0.0294	0.0139	0.0254	0.0118	0.0215	0.0097	0.0177	0.0220
15	1.00	3.00	0.0201	0.0495	0.0175	0.0429	0.0149	0.0364	0.0124	0.0301	0.0345
13	1.00	4.00	0.0274	0.0769	0.0241	0.0570	0.0207	0.0572	0.0173	0.0475	0.0480
11	0.50	4.50	0.0180	0.0948	0.0159	0.0329	0.0138	0.0710	0.0116	0.0591	0.0553
9	0.50	5.00	0.0245	0.1193	0.0219	0.1049	0.0192	0.0902	0.0163	0.0754	0.0630
7	0.25	5.25	0.0161	0.1354	0.0145	0.1194	0.0128	0.1030	0.0109	0.0863	0.0670
5	0.25	5.50	0.0219	0.1573	0.0200	0.1393	0.0178	0.1207	0.0153	0.1016	0.0712
3	0.25	5.75	0.0361	0.1935	0.0334	0.1727	0.0302	0.1509	0.0263	0.1280	0.0756
1	0.25	6.00	0.4802	0.6736	0.5386	0.7114	0.5991	0.7500	0.6615	0.7895	0.0800
2	0.25	6.25	0.0566	0.7302	0.0531	0.7645	0.0485	0.7985	0.0428	0.8323	0.0846
4	0.25	6.50	0.0271	0.7573	0.0249	0.7893	0.0222	0.8207	0.0193	0.8516	0.0892
6	0.25	6.75	0.0185	0.7758	0.0168	0.8061	0.0148	0.8356	0.0127	0.8644	0.0940
8	0.25	7.00	0.0142	0.7901	0.0128	0.8189	0.0113	0.8468	0.0096	0.8740	0.0990
10	0.50	7.50	0.0207	0.8107	0.0184	0.8373	0.0160	0.8629	0.0136	0.8875	0.1093
12	0.50	8.00	0.0159	0.8266	0.0141	0.8514	0.0122	0.8750	0.0102	0.8977	0.1200
14	1.00	9.00	0.0231	0.8498	0.0202	0.8716	0.0173	0.8924	0.0144	0.9122	0.1470
16	1.00	10.00	0.0178	0.8676	0.0155	0.8871	0.0131	0.9055	0.0109	0.9230	0.1810
18	1.00	11.00	0.0146	0.8821	0.0126	0.8996	0.0107	0.9162	0.0088	0.9318	0.2350
20	1.00	12.00	0.0124	0.8946	0.0107	0.9103	0.0090	0.9252	0.0074	0.9392	0.6630
21	2.00	14.00	0.0224	0.9170	0.0192	0.9295	0.0161	0.9413	0.0132	0.9524	0.8200
22	2.00	16.00	0.0199	0.9369	0.0170	0.9465	0.0142	0.9555	0.0116	0.9640	0.8800
23	2.00	18.00	0.0179	0.9548	0.0152	0.9618	0.0127	0.9682	0.0103	0.9743	0.9210
24	2.00	20.00	0.0163	0.9711	0.0138	0.9756	0.0115	0.9797	0.0093	0.9836	0.9520
25	2.00	22.00	0.0150	0.9861	0.0127	0.9883	0.0105	0.9903	0.0085	0.9922	0.9770
26	2.00	24.00	0.0139	1.0000	0.0117	1.0000	0.0097	1.0000	0.0078	1.0000	1.0000

Picacho Hills Total NOAA Atlas 14 Depths (in)

100-yr, 24-hr depth =	3.5
10-yr, 24-hr depth =	2.21
2-yr, 24-hr depth =	1.44

Type B, 6-hour Distribution for Auxiliary Spillway Design

Time	Time in hours	rainfall
0.00	0.00	0.0000
0.02	0.12	0.0080
0.04	0.24	0.0162
0.06	0.36	0.0246
0.08	0.48	0.0333
0.10	0.60	0.0425
0.12	0.72	0.0524
0.14	0.84	0.0630
0.16	0.96	0.0743
0.18	1.08	0.0863
0.20	1.20	0.0990
0.22	1.32	0.1124
0.24	1.44	0.1265
0.26	1.56	0.1420
0.28	1.68	0.1595
0.30	1.80	0.1800
0.32	1.92	0.2050
0.34	2.04	0.2550
0.36	2.16	0.3450
0.38	2.28	0.4370
0.40	2.40	0.5300
0.42	2.52	0.6030
0.44	2.64	0.6330
0.46	2.76	0.6600
0.48	2.88	0.6840
0.50	3.00	0.7050
0.52	3.12	0.7240
0.54	3.24	0.7420
0.56	3.36	0.7590
0.58	3.48	0.7750
0.60	3.60	0.7900
0.62	3.72	0.8043
0.64	3.84	0.8180
0.66	3.96	0.8312
0.68	4.08	0.8439
0.70	4.20	0.8561
0.72	4.32	0.8678
0.74	4.44	0.8790
0.76	4.56	0.8898
0.78	4.68	0.9002
0.80	4.80	0.9103
0.82	4.92	0.9201
0.84	5.04	0.9297
0.86	5.16	0.9391
0.88	5.28	0.9483
0.90	5.40	0.9573
0.92	5.52	0.9661
0.94	5.64	0.9747
0.96	5.76	0.9832
0.98	5.88	0.9916
1.00	6.00	1.0000

100 Yr

Type II-75

$y = 0.75 * x^{0.090521}$ inches y	rainfall delta y
0	
2.315422	2.315
2.465357	0.150
2.557524	0.092
2.625	0.067
2.678562	0.054
2.723136	0.045
2.7614	0.038
2.794981	0.034
2.852011	0.057
2.899471	0.047
2.940214	0.041
2.975969	0.036
3.036692	0.061
3.087225	0.051
3.130606	0.043
3.168677	0.038
3.202641	0.034
3.233332	0.031
3.261349	0.028
3.287138	0.026
3.333327	0.046
3.373863	0.041
3.410027	0.036
3.442705	0.033
3.472536	0.030
3.499995	0.027

delta y	II-75	Accum x
	0	0
0.028016	0.028016	1
0.033965	0.061981	2
0.043381	0.105362	3
0.060723	0.166085	4
0.040742	0.206828	4.5
0.05703	0.263858	5
0.038265	0.302123	5.25
0.053562	0.355685	5.5
0.092167	0.447852	5.75
2.315422	2.763274	6
0.149934	2.913209	6.25
0.067476	2.980685	6.5
0.044574	3.025258	6.75
0.033581	3.058839	7
0.04746	3.106299	7.5
0.035755	3.142054	8
0.050533	3.192587	9
0.03807	3.230658	10
0.030691	3.261349	11
0.025789	3.287138	12
0.04619	3.333327	14
0.040536	3.373863	16
0.036164	3.410027	18
0.032678	3.442705	20
0.029831	3.472536	22
0.027459	3.499995	24

10 Yr

Type II-75

$y = 0.75 * x^{0.090521}$ inches y	rainfall delta y
0	
1.462024	1.462
1.556697	0.095
1.614894	0.058
1.6575	0.043
1.691321	0.034
1.719466	0.028
1.743627	0.024
1.764831	0.021
1.800841	0.036
1.830809	0.030
1.856535	0.026
1.879112	0.023
1.917454	0.038
1.949362	0.032
1.976754	0.027
2.000793	0.024
2.022239	0.021
2.041618	0.019
2.059309	0.018
2.075593	0.016
2.104758	0.029
2.130354	0.026
2.153189	0.023
2.173822	0.021
2.192658	0.019
2.209997	0.017

delta y	II-75	Accum x
	0	0
0.01769	0.01769	1
0.021446	0.039137	2
0.027392	0.066528	3
0.038342	0.104871	4
0.025726	0.130597	4.5
0.036011	0.166607	5
0.024161	0.190769	5.25
0.033821	0.224589	5.5
0.058197	0.282787	5.75
1.462024	1.74481	6
0.094673	1.839483	6.25
0.042606	1.882089	6.5
0.028145	1.910234	6.75
0.021204	1.931438	7
0.029968	1.961406	7.5
0.022577	1.983983	8
0.031908	2.015891	9
0.024039	2.03993	10
0.019379	2.059309	11
0.016284	2.075593	12
0.029166	2.104758	14
0.025595	2.130354	16
0.022835	2.153189	18
0.020634	2.173822	20
0.018836	2.192658	22
0.017338	2.209997	24

2 Yr

Type II-75

$y = 0.75 * x^{0.090521}$ inches y	rainfall delta y
0	
0.952631	0.953
1.014318	0.062
1.052238	0.038
1.08	0.028
1.102037	0.022
1.120376	0.018
1.136119	0.016
1.149935	0.014
1.173399	0.023
1.192925	0.020
1.209688	0.017
1.224399	0.015
1.249382	0.025
1.270173	0.021
1.288021	0.018
1.303684	0.016
1.317658	0.014
1.330285	0.013
1.341812	0.012
1.352422	0.011
1.371426	0.019
1.388104	0.017
1.402983	0.015
1.416427	0.013
1.428701	0.012
1.439998	0.011

delta y	II-75	Accum x
	0	0
0.011527	0.011527	1
0.013974	0.025501	2
0.017848	0.043349	3
0.024983	0.068332	4
0.016763	0.085095	4.5
0.023464	0.108559	5
0.015743	0.124302	5.25
0.022037	0.146339	5.5
0.03792	0.184259	5.75
0.952631	1.13689	6
0.061687	1.198577	6.25
0.027762	1.226339	6.5
0.018339	1.244678	6.75
0.013816	1.258494	7
0.019526	1.27802	7.5
0.014711	1.292731	8
0.020791	1.313522	9
0.015663	1.329185	10
0.012627	1.341812	11
0.01061	1.352422	12
0.019004	1.371426	14
0.016678	1.388104	16
0.014879	1.402983	18
0.013445	1.416427	20
0.012273	1.428701	22
0.011297	1.439998	24

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

New Mexico 32.311 N 106.876 W 4097 feet
from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006
Extracted: Thu Oct 9 2008

Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Docs | Return to State Map

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.22	0.33	0.41	0.56	0.69	0.79	0.83	0.94	1.03	1.13	1.22	1.39	1.59	1.76	2.23	2.66	3.22	3.69
2	0.28	0.43	0.54	0.72	0.89	1.02	1.07	1.20	1.31	1.44	1.55	1.77	2.02	2.25	2.86	3.38	4.08	4.68
5	0.38	0.58	0.72	0.97	1.20	1.37	1.42	1.57	1.70	1.87	2.00	2.30	2.63	2.95	3.70	4.34	5.18	5.93
10	0.46	0.70	0.86	1.16	1.44	1.65	1.70	1.86	2.00	2.21	2.37	2.71	3.11	3.49	4.34	5.06	5.98	6.82
25	0.56	0.85	1.06	1.42	1.76	2.03	2.08	2.25	2.39	2.69	2.89	3.27	3.76	4.24	5.18	6.00	7.00	7.93
50	0.64	0.98	1.21	1.63	2.02	2.33	2.39	2.55	2.69	3.08	3.30	3.71	4.27	4.82	5.83	6.71	7.75	8.73
100	0.73	1.11	1.37	1.85	2.29	2.64	2.71	2.86	3.00	3.50	3.75	4.16	4.80	5.44	6.48	7.42	8.48	9.51
200	0.81	1.24	1.54	2.07	2.56	2.97	3.04	3.19	3.31	3.95	4.22	4.64	5.36	6.07	7.13	8.12	9.18	10.24
500	0.94	1.43	1.77	2.38	2.95	3.42	3.50	3.63	3.72	4.59	4.89	5.35	6.12	6.93	8.02	9.05	10.08	11.16
1000	1.04	1.58	1.96	2.63	3.26	3.78	3.87	3.98	4.05	5.13	5.47	5.95	6.72	7.61	8.69	9.76	10.73	11.81

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting forces estimates near zero to appear as zero.

*** Upper bound of the 90% confidence interval**
Precipitation Frequency Estimates (inches)

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.25	0.38	0.47	0.64	0.79	0.90	0.94	1.06	1.15	1.24	1.33	1.51	1.73	1.92	2.43	2.89	3.48	3.99
2	0.33	0.49	0.61	0.83	1.02	1.16	1.22	1.35	1.47	1.57	1.69	1.93	2.21	2.46	3.11	3.68	4.43	5.07
5	0.43	0.66	0.82	1.11	1.37	1.56	1.62	1.77	1.90	2.04	2.19	2.51	2.87	3.22	4.02	4.72	5.62	6.42
10	0.52	0.79	0.98	1.32	1.64	1.87	1.93	2.08	2.23	2.43	2.60	2.97	3.40	3.82	4.73	5.51	6.50	7.39
25	0.64	0.97	1.20	1.61	2.00	2.30	2.35	2.52	2.66	3.01	3.22	3.63	4.16	4.69	5.70	6.60	7.66	8.65
50	0.73	1.11	1.38	1.85	2.29	2.63	2.69	2.85	2.99	3.52	3.75	4.18	4.79	5.41	6.48	7.46	8.54	9.59
100	0.82	1.25	1.55	2.09	2.59	2.98	3.05	3.20	3.34	4.10	4.36	4.78	5.48	6.18	7.30	8.35	9.44	10.52
200	0.93	1.41	1.75	2.35	2.91	3.35	3.43	3.56	3.69	4.75	5.03	5.42	6.22	7.03	8.16	9.29	10.36	11.47
500	1.07	1.62	2.01	2.71	3.35	3.86	3.94	4.07	4.16	5.80	6.07	6.46	7.33	8.24	9.38	10.62	11.61	12.72
1000	1.18	1.79	2.23	3.00	3.71	4.27	4.36	4.47	4.54	6.75	7.04	7.40	8.27	9.27	10.38	11.70	12.56	13.65

* The upper bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are greater than.
** These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

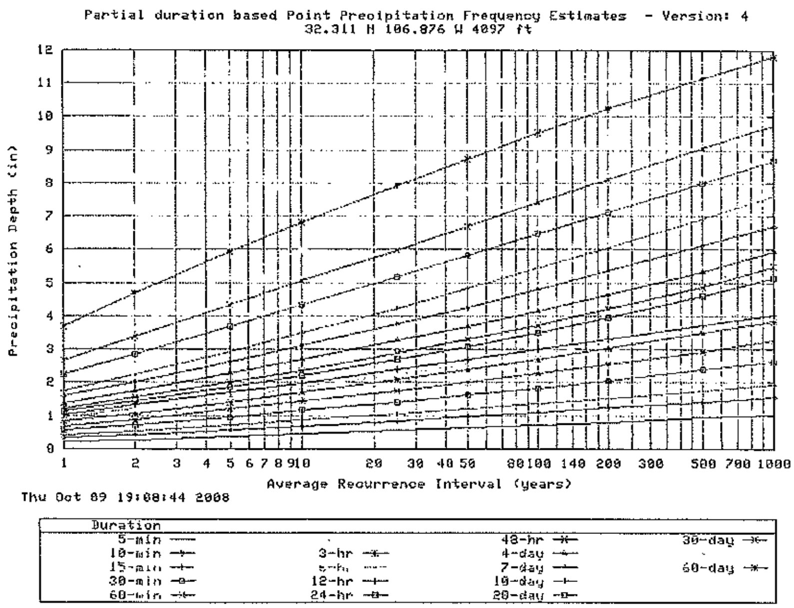
*** Lower bound of the 90% confidence interval**
Precipitation Frequency Estimates (inches)

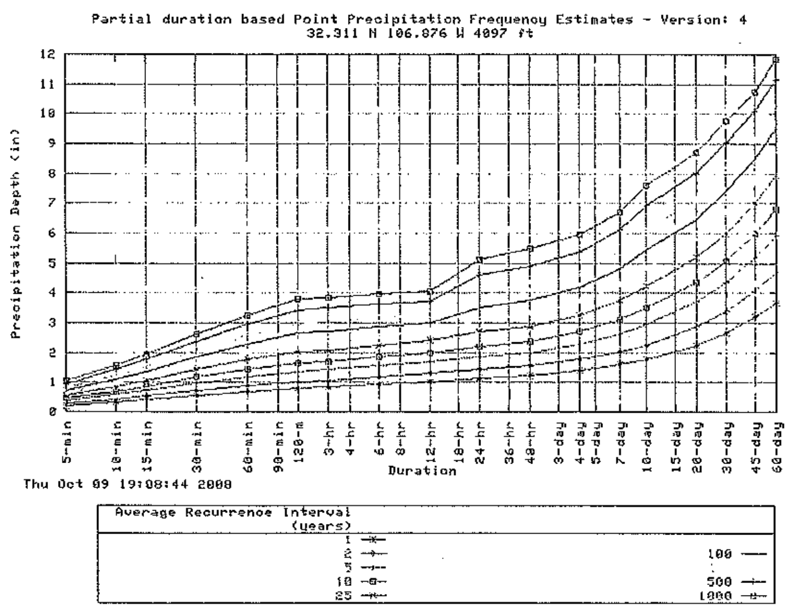
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.19	0.29	0.36	0.48	0.60	0.69	0.73	0.84	0.92	1.04	1.12	1.27	1.46	1.62	2.05	2.45	2.96	3.39
2	0.25	0.38	0.47	0.63	0.78	0.89	0.94	1.07	1.18	1.32	1.42	1.62	1.86	2.06	2.62	3.11	3.77	4.32
5	0.33	0.51	0.63	0.85	1.05	1.20	1.26	1.40	1.52	1.70	1.83	2.10	2.41	2.70	3.40	3.99	4.78	5.48
10	0.40	0.61	0.75	1.01	1.25	1.43	1.49	1.64	1.78	1.99	2.14	2.46	2.82	3.17	3.96	4.62	5.50	6.27
25	0.48	0.74	0.91	1.23	1.52	1.75	1.81	1.97	2.11	2.38	2.57	2.93	3.36	3.79	4.67	5.41	6.38	7.24
50	0.55	0.84	1.04	1.40	1.74	2.00	2.07	2.22	2.37	2.68	2.89	3.28	3.77	4.26	5.19	5.99	7.00	7.91
100	0.62	0.95	1.17	1.58	1.96	2.25	2.32	2.48	2.62	2.98	3.21	3.62	4.17	4.72	5.70	6.54	7.58	8.54
200	0.69	1.06	1.31	1.76	2.18	2.51	2.59	2.73	2.88	3.28	3.53	3.94	4.57	5.17	6.19	7.06	8.12	9.09
500	0.79	1.20	1.49	2.01	2.48	2.85	2.93	3.08	3.21	3.69	3.95	4.42	5.08	5.75	6.81	7.71	8.78	9.77
1000	0.87	1.32	1.64	2.21	2.73	3.12	3.21	3.35	3.46	3.99	4.30	4.81	5.47	6.19	7.26	8.19	9.24	10.24

* The lower bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are less than

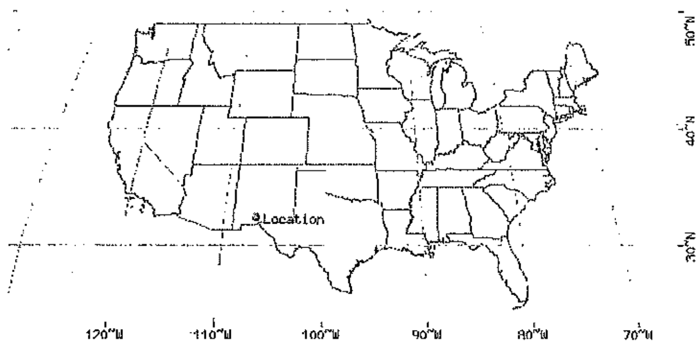
** These precipitation frequency estimates are based on a partial duration maxima series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

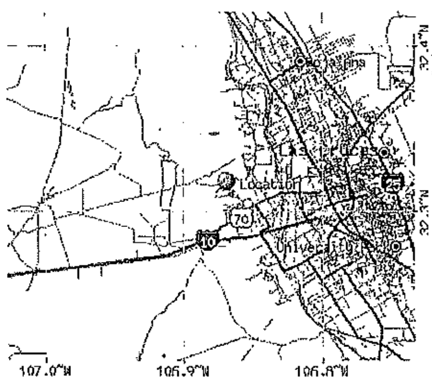
Text version of tables





Maps -





These maps were produced using a direct map request from the U.S. Census Bureau Mapping and Cartographic Resources Tiger Map Server.

Please read disclaimer for more information.

LEGEND

State	Connector
County	Stream
Indian Resv	Military Area
Lake/Pond/Ocean	National Park
Street	Other Park
Expressway	City
Highway	County

Scale 1:228583 0 2 4 6 8 mi / 0 2 4 6 8 10 km
*average--true scale depends on monitor resolution

Other Maps/Photographs -

View USGS digital orthophoto quadrangle (DOQ) covering this location from TerraServer; USGS Aerial Photograph may also be available from this site. A DOQ is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. Visit the USGS for more information.

Watershed/Stream Flow Information -

Find the Watershed for this location using the U.S. Environmental Protection Agency's site.

Climate Data Sources -

Precipitation frequency results are based on data from a variety of sources, but largely NCDC. The following links provide general information about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study, please refer to NOAA Atlas 14 Document.

Using the National Climatic Data Center's (NCDC) station search engine, locate other climate stations within:

+/-30 minutes ...OR... +/-1 degree of this location (32.311/-106.876). Digital ASCII data can be obtained directly from NCDC.

Find Natural Resources Conservation Service (NRCS) SNOTEL (SNOwpack TELemetry) stations by visiting the Western Regional Climate Center's state-specific SNOTEL station maps.

Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910
(301) 713-1669
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Curve Number Modification
Picacho Hills / Old Picacho Hills
BHI No. 090126
Date 10/30/2008
Prepared By: Kjohnson
Goal: Prepare CN values that are representative of the study area.

References: NRCS TR-55 (Table 2-2a through Table 2-2d & Figure 2-3)
NMDOT Drainage Manual

Assumptions: Developed areas within Picacho Hills / Old Picacho have following cover type and hydrologic condition:
Western desert urban areas, natural desert urban areas (pervious areas only)

Methodology: Adjust the pervious area CN to reflect average percent impervious area per NRCS requirements.
Adjust all CNs to reflect high antecedent moisture content within the soil per NRCS requirements.

	CN for Average Condition			
Cover type and hydrologic condition	A	B	C	D
Western desert urban area: Natural desert landscaping	63	77	85	88

		% Impervious adjusted CN			
Cover type and hydrologic condition	Average Percent impervious area	A	B	C	D
Residential - 1 acre lot	20	70	82	88	90
Residential - 1/3 acre lot	30	74	84	90	92
Residential - 1/8 acre lot	65	86	91	92	93

Note:
- Curve numbers increased / adjusted to represent increased impervious area due to development, per Figure 2-3 - Composite CN with connected impervious area (TR-

	CN for Average Condition				CN for Wet Condition (High Antecedent Moisture Condition)			
Cover type and hydrologic condition	A	B	C	D	A	B	C	D
Agriculture - Straight Row Crop ResidueGood	64	75	82	85	81	88	92	93
Desert shrub - poor	63	77	85	88	80	89	93	95
Residential - 1 acre lot (w/ % Impervious)	70	82	88	90	85	92	95	96
Residential - 1/3 acre lot (w/ % Impervious)	74	84	90	92	87	93	96	97
Residential - 1/8 acre lot (w/ % Impervious)	86	91	92	93	94	96	97	97
Open Space - golf courses	39	61	74	80	60	79	87	91

Note:
- Curve numbers increased / adjusted to represent the high antecedent moisture content for modeling purposes.
- Curve numbers adjusted per USDA SCS TR-55, 1986 (As found in table 3-5 NMDOT Drainage Manual, pg. 3-27)

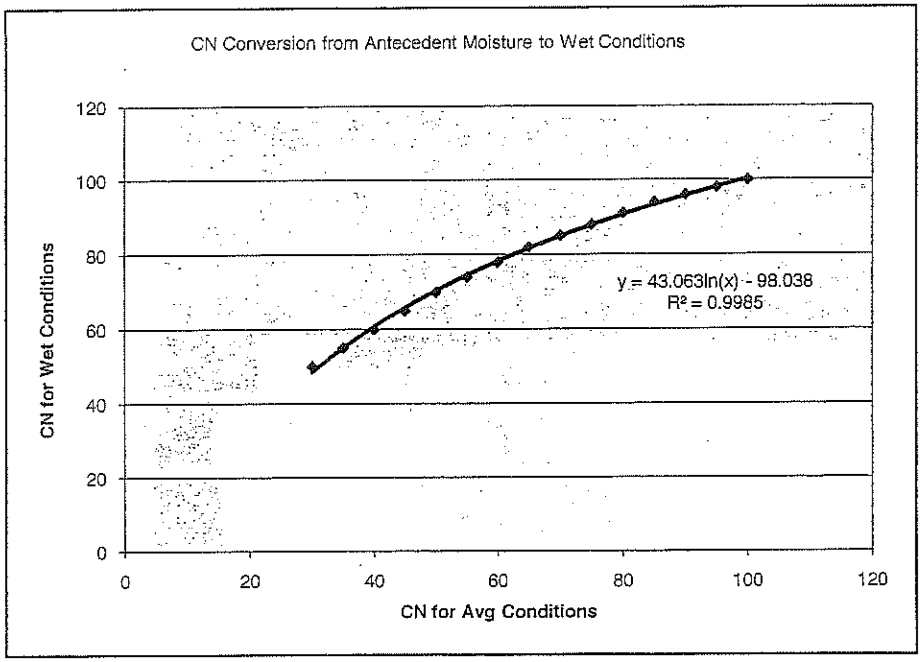


Table 3-5 - Conversion from Avg. Antecedent Moisture Conditions to Wet Conditions (NMDOT Drainage Manual)

CN for Avg. Conditions	CN (Wet)
100	100
95	98
90	96
85	94
80	91
75	88
70	85
65	82
60	78
55	74
50	70
45	65
40	60
35	55
30	50

Reference:
USDA, NRCS Conservation Engineering Division, TR-55 "Urban Hydrology for Small Watersheds" (June 1986)

Figure 2-3 Composite CN with connected impervious area.

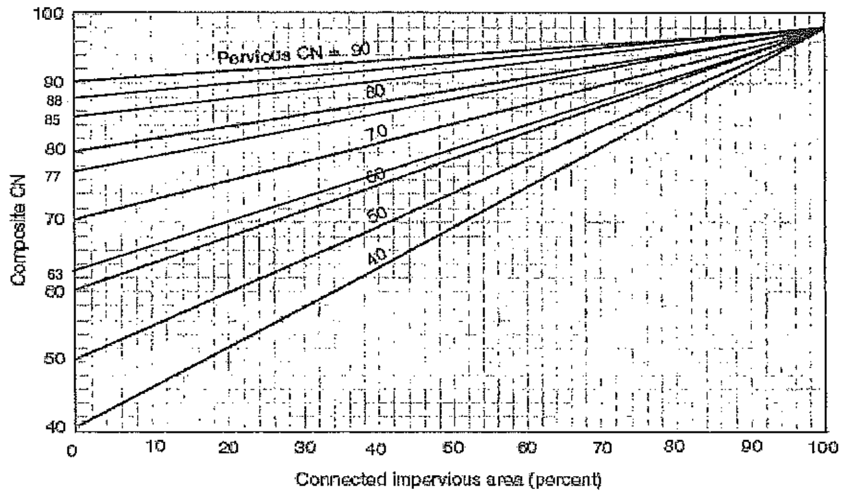
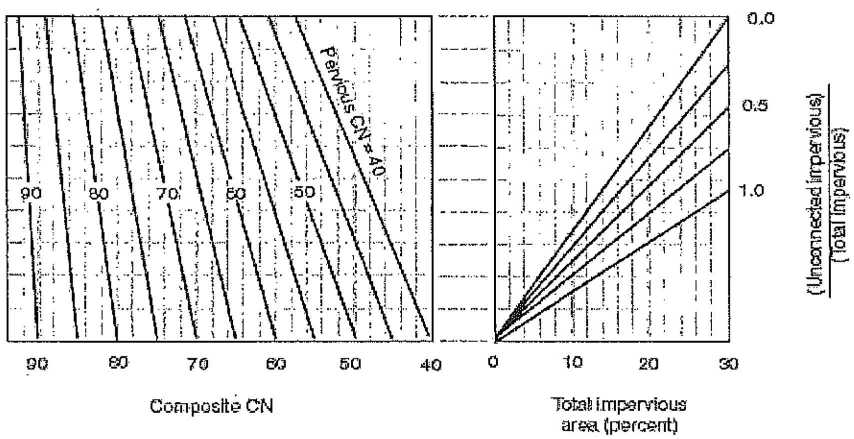


Figure 2-4 Composite CN with unconnected impervious areas and total impervious area less than 30%



Future Condition Curve Number Modification
Picacho Hills / Old Picacho Hills
BHI No. 090126
Date 10/31/2008
Prepared By: Kjohnson
Goal: Prepare CN values that are representative of the study area.

References: NRCS TR-55 (Table 2-2a through Table 2-2d & Figure 2-3)
NMDOT Drainage Manual

Assumptions: Developed areas within Picacho Hills / Old Picacho have following cover type and hydrologic condition:
Western desert urban areas, natural desert urban areas (pervious areas only)
5 acre residential lot % impervious is approximated from the 2 acre residential percent impervious value.

Methodology: Adjust the pervious area CN to reflect average percent impervious area per NRCS requirements.
Adjust all CNs to reflect high antecedent moisture content within the soil per NRCS requirements.

	CN for Average Condition			
Cover type and hydrologic condition	**A**	**B**	**C**	**D**
Western desert urban area: Natural desert landscaping	63	77	85	88

		% Impervious adjusted CN			
Cover type and hydrologic condition	**Average Percent impervious area**	**A**	**B**	**C**	**D**
Residential - >5 acre lot	8	66	79	86	89
Residential - 1 acre lot	20	70	82	88	90
Residential - 1/2 acre lot	25	72	83	89	91
Residential - 1/3 acre lot	30	74	84	90	92
Residential - 1/8 acre lot	65	86	91	92	93

Note:
- Curve numbers increased / adjusted to represent increased impervious area due to development, per Figure 2-3 - Composite CN with connected impervious area (TR-55)

		CN for Average Condition				CN for Wet Condition (High Antecedent Moisture Condition)			
	Cover type and hydrologic condition	A	B	C	D	A	B	C	D
1	Agriculture - Straight Row Crop ResidueGood	64	75	82	85	81	88	92	93
2	Desert shrub - poor	63	77	85	88	80	89	93	95
6	Open Space - golf courses	39	61	74	80	60	79	87	91
7	Residential - 5 acre lot	66	79	86	89	82	90	94	95
3	Residential - 1 acre lot	70	82	88	90	85	92	95	96
8	Residential - 1/2 acre lot	72	83	89	91	86	92	95	96
4	Residential - 1/3 acre lot	74	84	90	92	87	93	96	97
5	Residential - 1/8 acre lot	86	91	92	93	94	96	97	97
9	Commercial / Business	89	92	94	95	95	97	98	98
10	Industrial	81	88	91	93	91	95	96	97

Note:

- Curve numbers increased / adjusted to represent the high antecedent moisture content for modeling purposes.
- Curve numbers adjusted per USDA SCS TR-55, 1986 (As found in table 3-5 NMDOT Drainage Manual, pg. 3-27) & WinTR-55 Program

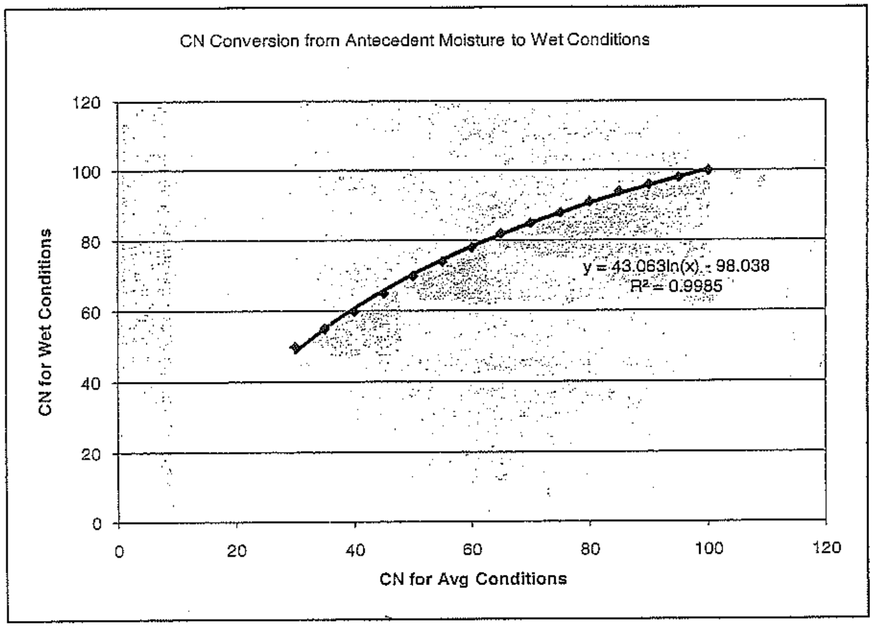


Table 3-5 - Conversion from Avg. Antecedent Moisture Conditions to Wet Conditions (NMDOT Drainage Manual)

CN for Avg. Conditions	CN (Wet)
100	100
95	98
90	96
85	94
80	91
75	88
70	85
65	82
60	78
55	74
50	70
45	65
40	60
35	55
30	50

Reference:
USDA, NRCS Conservation Engineering Division, TR-55 "Urban Hydrology for Small Watersheds" (June 1986)

Figure 2-3 Composite CN with connected impervious area.

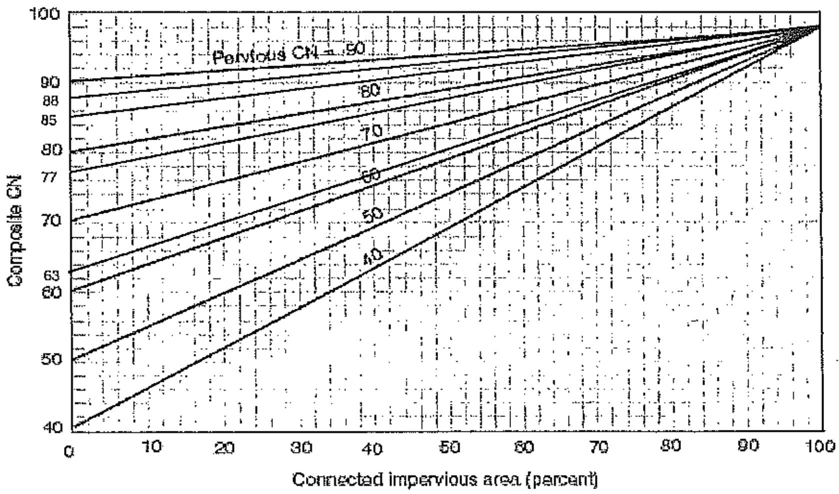
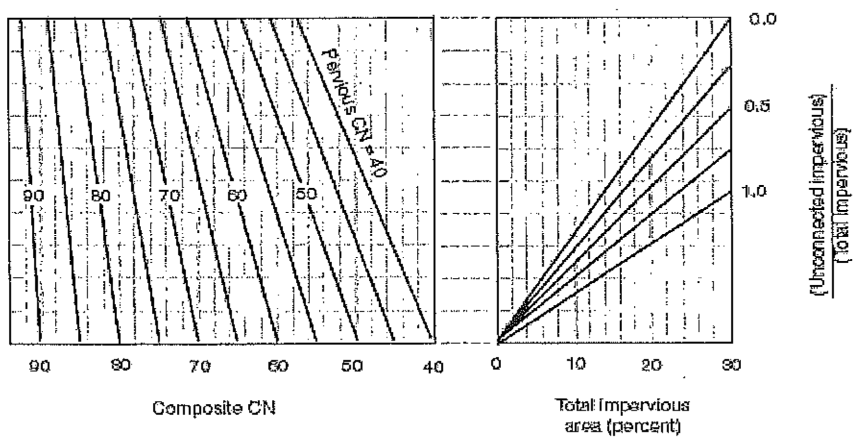


Figure 2-4 Composite CN with unconnected impervious areas and total impervious area less than 30%



Existing & Future Condition Lag Time Calculations

Old Picacho

BHI No. 090126

Date: 11/6/2008

Prepared By: JT O'Brien

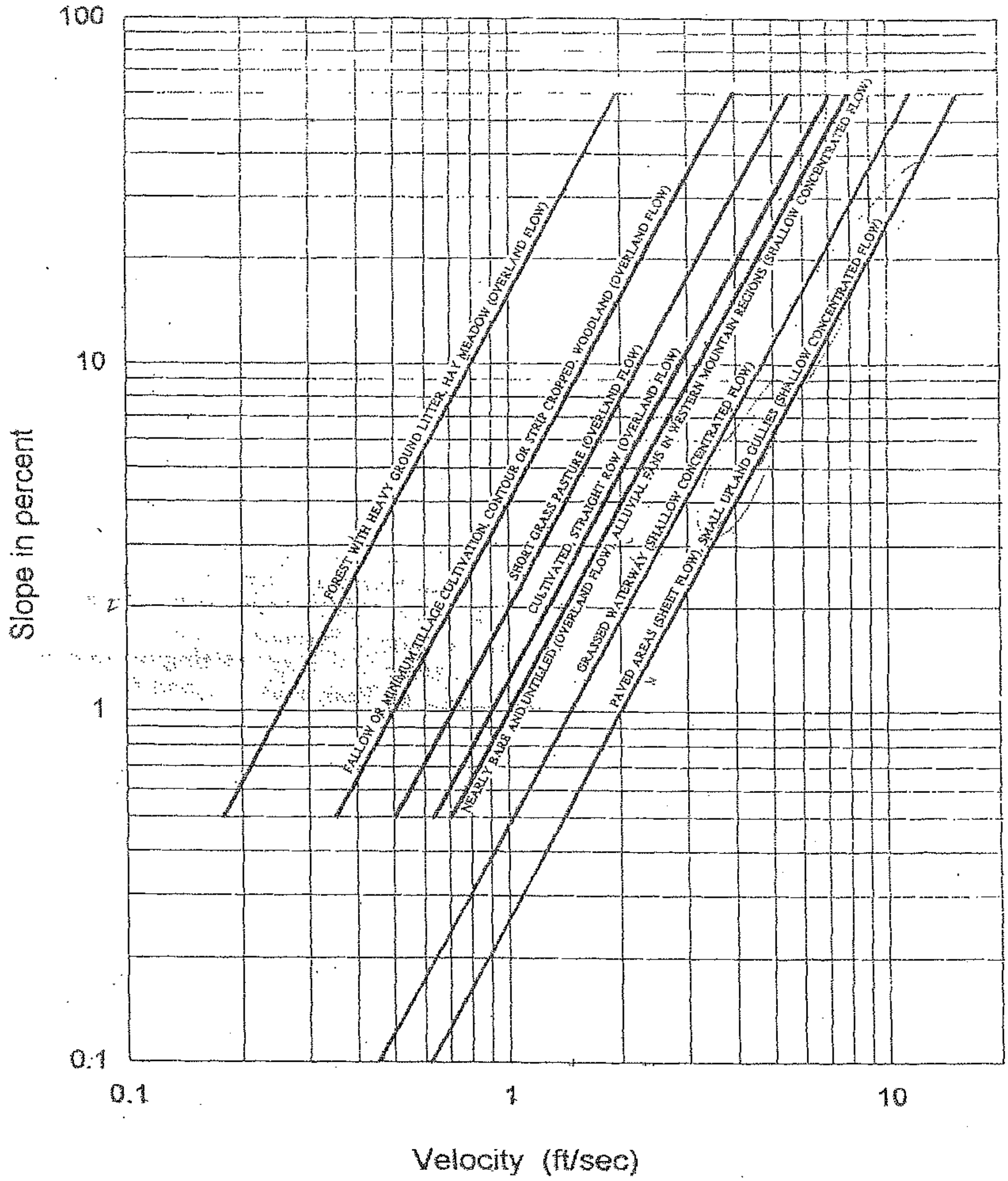
References: NMDOT Drainage Manual - Volume 1, Hydrology (1995): Section 3.3.1.4.1 The Upland Method
This section is a modified SCS method for watersheds less than 2000 acres in size.

Assumptions: Conservative assumptions in the use of nomograph for Flow Velocities should account for any variation in Lag time for existing conditions to future development conditions.

Note: 1. Sheet Velocity & Shallow Velocity are interpolated from NMDOT Drainage Manual Volume 1, Figure 3-10.
2. Using Nearly Bare and Untilled (Overland Flow) & Small Upland Gulleys (Shallow Concentrated Flow)

Basin	Area (ac)	Area (mi^2)	Sheet Slope (ft/ft)	Conc Slope (ft/ft)	Channel Length (ft)	Sheet Length (ft)	Shallow Length (ft)	Sheet Vel (ft/sec)	Shallow Vel (ft/sec)	Tc (min)	Tc (hr)	AdjustedTc (hr)	Adjusted Tl (min)
Old Pichacho													
OP-A1	1053.9	1.647	0.125	0.031	18401.0	400.0	18001.0	3.30	3.70	83.11	1.385096	1.39	49.86
OP-A2	42.3	0.066	0.177	0.028	3981.0	400.0	3581.0	3.90	3.60	18.29	0.304802	0.30	10.97
OP-B1	26.3	0.041	0.018	0.018	3066.2	400.0	2666.2	1.40	2.70	21.22	0.35366	0.35	12.73
OP-C1	902.2	1.410	0.556	0.036	14539.6	400.0	14139.6	7.60	3.80	62.89	1.048217	1.05	37.74
OP-D1	8.2	0.013	0.014	0.014	1643.9	400.0	1243.9	1.20	2.30	14.57	0.242822	0.24	8.74
OP-E1	18.6	0.029	0.014	0.014	2200.4	400.0	1800.4	1.20	2.30	18.60	0.31003	0.31	11.16
OP-F1	20.5	0.032	0.019	0.019	2207.3	400.0	1807.3	1.45	2.80	15.36	0.255927	0.26	9.21
OP-G1	9.7	0.015	0.022	0.022	1368.7	400.0	968.7	1.60	3.10	9.37	0.156243	0.17	6.00
OP-H1	48.0	0.075	0.102	0.040	4331.0	400.0	3931.0	3.10	4.00	18.53	0.308829	0.31	11.12
OP-J1	4.3	0.007	0.018	0.018	1525.5	400.0	1125.5	1.40	2.70	11.71	0.195159	0.20	7.03

Flow Velocity Nomagraph for Overland (Sheet) and Shallow Concentrated Flows
Old Picacho
Reference: NMDOT Drainage Manual - Volume 1, Hydrology 1995



Note: For watercourses with slopes less than 0.5 percent, use the overland flow velocity given for 0.5 percent, except for shallow concentrated flow where a flatter slope may be considered.

Figure 3-10
Flow Velocities for Overland and Shallow Concentrated Flows

Modified from SCS, NEH-4, 1972

Old Picacho Tc calculations.

For small basins where contours do not have any obvious grade breaks - the output from the GIS longest flow path was used. Guidance from the NMDOT manual specifically uses the slope in the flowpath. For basins with obvious breaks then a slope for the upper and lower basin was developed. below:

OP - A2 upper basin: S = 75'/423' = 0.177 = 17.7%

lower basin: S = 30'/1060 = 0.028 = 2.8%.

OP - H1 upper basin: S = 50/490 = 0.102 = 10.2%

Lower basin S = 75/1,870 = 0.040

OP - A1 upper basin. S = 75/600 = 12.5%.

Lower basin. S = 4400 - 3975 / 13,600' = 0.0313 = 3.13%

OP - C1 upper basin S = 250/450 = 0.556 = 55.6%

S = 4275 - 3905 / 10,240 = 0.036

080373

Bohannan ▲ Huston INC.

PROJECT NAME ______ SHEET ______ OF ______ ENGINEERING ▲
PROJECT NO. ______ BY ______ DATE ______ SPATIAL DATA ▲
SUBJECT ______ CH'D ______ DATE ______ ADVANCED TECHNOLOGIES ▲

Existing Condition Sediment Bulking Approximation

Old Picacho

BHI NO. 090126

Date: 29-Dec-08

Prepared By: Kjohnson

Revised By: DGrochowski

Goal:

Utilize data and analysis from the Overlook Subdivion project to prepare sediment bulking values for the Picacho Hills area.

Data:

Taken from Sediment Load Bulking Factors for Four Arroyos in the Overlook Subdivsion, Las Cruces, NM Report Letter

P:\090126\WR\Delivery from Others\Mussetter Engineering - Overlook Sub\Overlook Subdivision Bulking Factor Summary-5-9-08.pdf

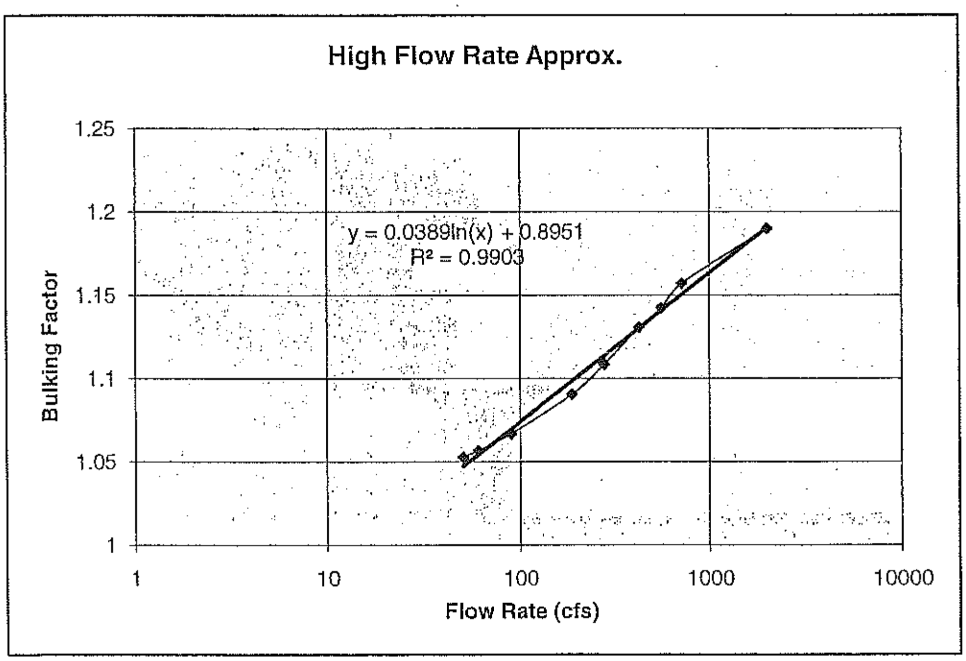
Data Analysis:

To better approximate the bulking factor at higher flow rates the below graph and trendline was created. However, flow rates 2-20 cfs were excluded from the trendline in an effort to better approximate the trendline.

Table 4. Summary of computed bulking factors... (pg. 6)

Stream 17

	D50 = 0.5 mm	
Flow (cfs)	Existing/Proposed Conditions	
2	1.0143	
5	1.0203	
10	1.0275	
20	1.0364	
50	1.0525	
60	1.0567	
89	1.0666	
187	1.0904	
277	1.1084	
424	1.1307	
558	1.1424	
715	1.157	
2000	1.19	Value approximated by Mussetter via phone conversation.



Existing Condition Sediment Bulking Approximation

Old Picacho

BHI NO. 090126

Date: 29-Dec-08

Prepared By: Kjohnson

Revised By: DGrochowski

Basin Name	Flow Rate (cfs)	Bulking Factor (flows > 50cfs)	Bulking Factor (flows <50cfs)	Bulking Factor (rounded)
OP_A1	1692.2	1.184274226		1.18
OP_A2	164	1.093484804		1.09
OP_B1	101.6	1.074858594		1.07
OP_D1	46	0	1.050353	1.05
OP_E1	88.7	1.06957661		1.07
OP_F1	108.3	1.07734281		1.08
OP_G1	57.5	1.052714434		1.05
OP_H1	193.1	1.099838799		1.1
OP_J1	26.6	0	1.039942	1.04

Note:

1 Flow rates referenced within this sheet are taken from HEC-HMS Output summary excel file.
P:\090126\WR\Calculations\Misc Calcs\090126 HEC-HMS Output_OP.xls - Tab "Existing No_Bulking"

2 Bulking factors are approximated using calculated trendline equation for all flow rates equal to or above 50cfs.

3 Bulking factors are approximated by linear interpolation for all flow rates less than 50 cfs.

__Future Condition Sediment Bulking Approximation__

Old Picacho
BHI NO. 090126
Date: 29-Dec-08
Prepared By: Kjohnson
Revised By: DGrochowski

Goal:

Utilize data and analysis from the Overlook Subdivion project to prepare sediment bulking values for the Picacho Hills area.

Data:

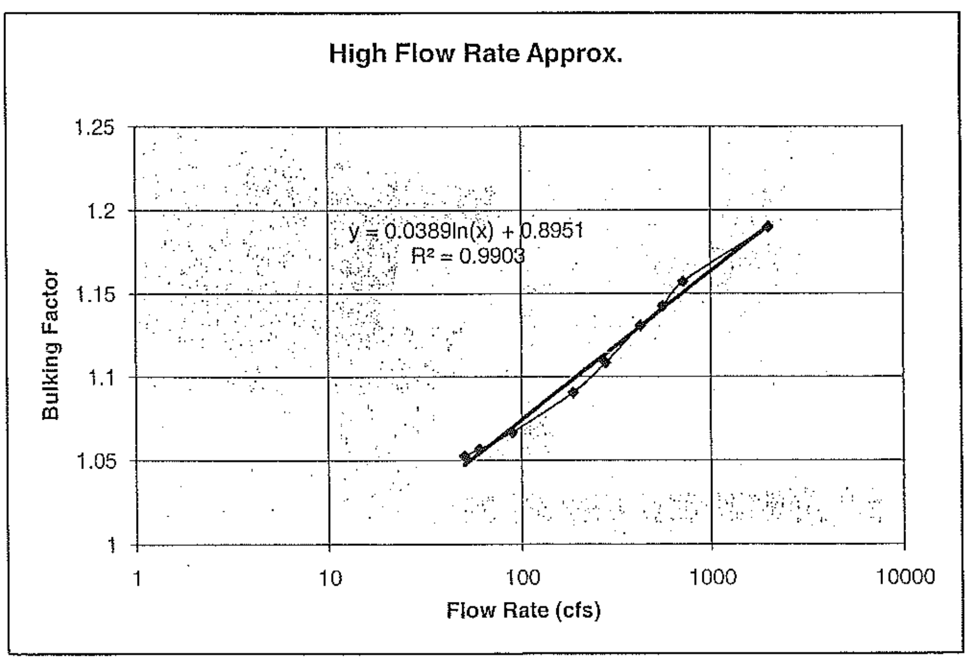
Taken from Sediment Load Bulking Factors for Four Arroyos in the Overlook Subdivsion, Las Cruces, NM Report Letter
P:\090126\WR\Delivery from Others\Mussetter Engineering - Overlook Sub\Overlook Subdivision Bulking Factor Summary-5-9-08.pdf

Data Analysis:

To better approximate the bulking factor at higher flow rates the below graph and trendline was created. However, flow rates 2-20 cfs were excluded from the trendline in an effort to better approximate the trendline.

Table 4. Summary of computed bulking factors... (pg. 6)
Stream 17

	D50 = 0.5 mm	
Flow (cfs)	**Existing/Proposed Conditions**	
2	1.0143	
5	1.0203	
10	1.0275	
20	1.0364	
50	1.0525	
60	1.0567	
89	1.0666	
187	1.0904	
277	1.1084	
424	1.1307	
558	1.1424	
715	1.157	
2000	1.19	Value approximated by Mussetter via phone conversation.



Future Condition Sediment Bulking Approximation

Old Picacho

BHI NO. 090126

Date: 29-Dec-08

Prepared By: Kjohnson

Revised By: DGrochowski

Basin Name	Flow Rate (cfs)	Bulking Factor (flows > 50cfs)	Bulking Factor (flows <50cfs)	Bulking Factor (rounded)
OP_A1	1839.2	1.187514644		1.19
OP_A2	187.6	1.098714738		1.1
OP_B1	115.5	1.079846624		1.08
OP_D1	46	0	1.050353	1.05
OP_E1	88.7	1.06957661		1.07
OP_F1	108.3	1.07734281		1.08
OP_G1	66.3	1.058253987		1.06
OP_H1	220.3	1.104965121		1.1
OP_J1	26.6	0	1.039942	1.04

Note:

1 Flow rates referenced within this sheet are taken from HEC-HMS Output summary excel file.
P:\090126\WR\Calculations\Misc Calcs\090126 HEC-HMS Output_OP.xls - Tab "Future No_Bulking"

2 Bulking factors are approximated using calculated trendline equation for all flow rates equal to or above 50cfs.

3 Bulking factors are approximated by linear interpolation for all flow rates less than 50 cfs.

Existing Conditions Basin Characteristics

Old Picacho

BHI No. 090126

Prepared By: Kris Johnson

Date: 6-Nov-08

Data Source: Data contained within this spreadsheet is the combination of data from two GIS shape files. (Subasins & Longestflowpath)

Note:
1. All data was generated within ARC-MAP using HEC-GeoHMS 4.2 (Beta). All data was verified for validity and reasonability.
2. Curve numbers were generated to address land treatment type and soil type specific to the basin.
P:\090126\WR\Calculations\Misc Calcs\090126_CurveNo01_Existing.xls
3. Weighted CN values were generated by HEC-GeoHMS 4.2 (Beta)

Note:
Red text are basins that are not included in HEC-HMS model.

NAME	Weighted Basin CN	Weighted Whole Basin CN	Lag Method	Area_HMS (SQ MI)	Area (Acre)	Basin Slope (%)	LongestFL (FT)	Longest Flow Path Slope (FT/FT)	Longest Flow Path ElevUP	Longest Flow Path ElevDS
OP_A1	89.21	89.00	SCS CNLag	1.646789	1053.95	20.8140	18401.56	0.0281	4484.00	3967.00
OP_A2	81.63	82.00	SCS CNLag	0.066095	42.30	12.6862	3981.01	0.0359	4053.00	3910.00
OP_B1	83.59	84.00	SCS CNLag	0.041048	26.27	3.2499	3066.15	0.0176	3960.00	3906.00
OP_D1	88.00	88.00	SCS CNLag	0.012743	8.16	3.6608	1643.90	0.0140	3929.00	3906.00
OP_E1	87.05	87.00	SCS CNLag	0.029067	18.60	4.7393	2200.38	0.0141	3937.00	3906.00
OP_F1	87.12	87.00	SCS CNLag	0.032047	20.51	4.9975	2207.33	0.0195	3947.00	3904.00
OP_G1	87.06	87.00	SCS CNLag	0.015170	9.71	4.2945	1368.68	0.0219	3943.00	3913.00
OP_H1	84.36	84.00	SCS CNLag	0.075034	48.02	12.9880	4331.01	0.0358	4068.00	3913.00
OP_J1	87.81	88.00	SCS CNLag	0.006775	4.34	3.1521	1525.52	0.0177	3933.00	3906.00

Future Conditions Basin Characteristics

Old Picacho

BHI No.: 090126
Prepared By: Kris Johnson
Date: 6-Nov-08
Data Source: Data contained within this spreadsheet is the combination of data from two GIS shape files. (Subasins & Longestflowpath)

Note:
1. All data was generated within ARC-MAP using HEC-GeoHMS 4.2 (Beta). All data was verified for validity and reasonability.
2. Curve numbers were generated to address land treatment type and soil type specific to the basin.
   P:\090126\WR\Calculations\Misc Calcs\090126_CurveNo01_Future.xls
3. Weighted CN values were generated by HEC-GeoHMS 4.2 (Beta)
4. Curve numbers adjusted to relate future development condition.

Note:
Red text are basins that are not included in HEC-HMS model.

NAME	Weighted BasinCN	Weighted Whole Basin CN	LagMethod	Area_HMS (SQ MI)	Area (Acre)	Average Basin Slope (%)	LongestFL (FT)	Longest Flow Path Slp (FT/FT)	Longest Flow Path ElevUP	Longest Flow Path ElevDS
OP_A1	91.42	91.00	SCS CNLag	1.646797	1053.95	20.8140	18401.56	0.0281	4484.00	3967.00
OP_A2	84.70	85.00	SCS CNLag	0.066095	42.30	12.6862	3981.01	0.0359	4053.00	3910.00
OP_B1	87.34	87.00	SCS CNLag	0.041048	26.27	3.2499	3066.15	0.0176	3960.00	3906.00
OP_D1	88.12	88.00	SCS CNLag	0.012743	8.16	3.6608	1643.90	0.0140	3929.00	3906.00
OP_E1	87.09	87.00	SCS CNLag	0.029067	18.60	4.7393	2200.38	0.0141	3937.00	3906.00
OP_F1	87.22	87.00	SCS CNLag	0.032047	20.51	4.9975	2207.33	0.0195	3947.00	3904.00
OP_G1	91.02	91.00	SCS CNLag	0.015170	9.71	4.2945	1368.68	0.0219	3943.00	3913.00
OP_H1	86.87	87.00	SCS CNLag	0.075034	48.02	12.9860	4331.01	0.0358	4068.00	3913.00
OP_J1	88.47	88.00	SCS CNLag	0.006775	4.34	3.1521	1525.52	0.0177	3933.00	3906.00

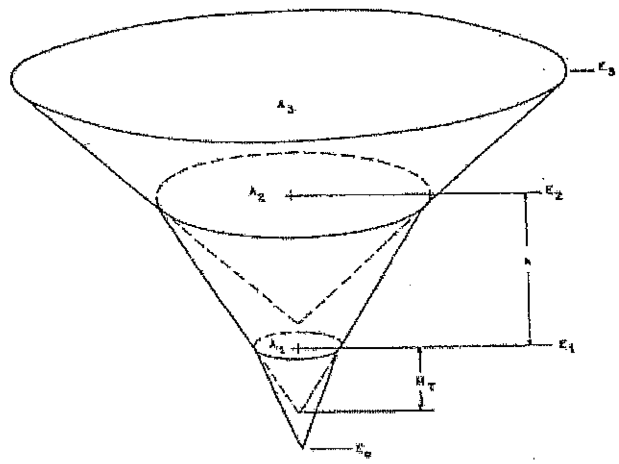
Existing Donaldson Dam
Old Picacho
BHI No: 090126
Date: 10/21/2008
Prepared By: Kris Johnson
Data and Assumptions:
1 InRoads DTM generated for existing Dam configuration.
2 InRoads pond volume command utilized to obtain stage storage curve.

Elevation	Incremental Volume cu ft	Cumulative Volume cu ft	Acre-Feet	Surface Area sq ft
3956.5	0	0	0	1468.03
3957	1074.6075	1074.6075	0.0247	3683.788
3957.5	2215.4714	3290.0789	0.0755	6624.939
3958	3810.1007	7100.1797	0.163	10977.27
3958.5	5739.9905	12840.17	0.2948	14035.19
3959	7036.3245	19876.495	0.4563	16719.15
3959.5	8191.074	28067.569	0.6443	19819.23
3960	9413.991	37481.56	0.8605	22446.65
3960.5	10451.7193	47933.279	1.1004	27636.1
3961	12023.4374	59956.716	1.3764	44405.91
3961.5	13634.5842	73591.301	1.6894	61812.02
3962	15117.7632	88709.064	2.0365	65808.62
3962.5	16894.8985	105603.96	2.4243	70234.27
3963	18980.9965	124584.96	2.8601	72289.33
3963.5	21121.8875	145706.85	3.345	73913.35
3964	23413.936	169120.78	3.8825	76096.46
3964.5	26239.8664	195360.65	4.4849	81540.97
3965	29321.232	224681.88	5.158	82111.08
3965.5	32145.7139	256827.59	5.896	93279.25
3966	37330.2465	294157.84	6.7529	101658.4
3966.5	42880.9058	337038.75	7.7373	111066.8
3967	27054.9388	364093.69	8.3584	130941.9
3967.5	72642.1566	436735.84	10.0261	171605.7
3968	0	436735.84	10.0261	0
3968.5	0	436735.84	10.0261	0

11

HEC-1 - Manual
"Flood Hydrograph Package"

If pumps or dam breaks are not being simulated, an outflow rating curve is computed for 20 elevations which span the range of elevations given for storage data. Storages are computed for those elevations. The routing is then accomplished by the modified Puls method using the derived storage-outflow relation. For level-pool reservoir routing with pumping or dam-break simulation, outflows are computed for the orifice and weir equations for each time interval.



$$\Delta V_{12} = \frac{h}{3}(A_1 + A_2 + \sqrt{A_1 A_2})$$

$$H_T = h/(\sqrt{A_2/A_1} - 1)$$

Where

ΔV_{12} = volume between base areas 1 and 2,

A_i = surface area of base i,

E_i = elevation of base i,

h = vertical distance ($E_2 - E_1$) between bases A_1 and A_2, and

H_T = height of truncated part of cone.

Figure 3.11 Conic Method for Reservoir Volumes

(3) Trapezoidal and Ogee Spillways. Trapezoidal and ogee spillways (Corps of Engineers, 1965) may be simulated as shown in Figure 3.12. The outflow rating curve is computed for 20 stages which span the range of given storage data. If there is a low-level outlet, the stages are evenly spaced between the low-level outlet and the maximum elevation, with the spillway crest located at the tenth elevation. In the absence of a low-level outlet, the second stage is at the spillway crest.

Existing Condition Basin HEC-HMS Model Results - Bulked Flows -

Old Picacho

BHI No. 090126

Date: 1/13/2009

Prepared By: Kjohnson

Structure ID	Drainage Area (SQ MI)	Time of Peak	Volume (AC-FT)	Peak Discharge (cfs)	Drainage Area (AC)	Discharge (cfs/ac)
Basin						
OP_A1	1.6468	01Jan2009, 06:46	242.9	1996.8	1053.95	1.895
OP_A2	0.0660955	01Jan2009, 06:06	6.8	178.8	42.30	4.227
OP_B1	0.0410479	01Jan2009, 06:08	4.5	108.7	26.27	4.138
OP_D1	0.0127428	01Jan2009, 06:04	1.6	48.3	8.16	5.922
OP_E1	0.0290673	01Jan2009, 06:06	3.6	94.9	18.60	5.101
OP_F1	0.0320472	01Jan2009, 06:04	4	116.9	20.51	5.700
OP_G1	0.0151704	01Jan2009, 06:02	1.9	60.4	9.71	6.221
OP_H1	0.0750339	01Jan2009, 06:08	8.5	212.4	48.02	4.423
OP_J1	0.006775	01Jan2009, 06:02	0.9	27.7	4.34	6.388
Junction Points						
J OP_A1	1.7128955	01Jan2009, 06:50	249.3	2003.4		
Ponds						
Donaldson Dam	1.6468	01Jan2009, 06:46	242.5	1996.7		
Routing						
R OP_A2	1.6468	01Jan2009, 06:50	242.4	1995.5		
Outfalls						
J-S OP_ A	1.7128955	01Jan2009, 06:50	249.3	2003.4		
J-S OP_B1	0.0410479	01Jan2009, 06:50	249.3	2003.4		
J-S OP_D1	0.0127428	01Jan2009, 06:08	4.5	108.7		
J-S OP_E1	0.0290673	01Jan2009, 06:04	1.6	48.3		
J-S OP_ F	0.0320472	01Jan2009, 06:06	3.6	94.9		
J-S OP_G	0.0151704	01Jan2009, 06:04	4	116.9		
J-S OP_H	0.0750339	01Jan2009, 06:02	1.9	60.4		
J-S OP_J1	0.006775	01Jan2009, 06:08	8.5	212.4		

Existing Condition Basin HEC-HMS Model Results - No Sediment Bulking -

Old Picacho

BHI No. 090126

Date: 1/13/2009

Prepared By: Kjohnson

Structure ID	Drainage Area (SQ MI)	Time of Peak	Volume (AC-FT)	Peak Discharge (cfs)	Drainage Area (AC)	Discharge (cfs/ac)
Basin						
OP_A1	1.6468	01Jan2009, 06:46	205.8	1692.2	1053.95	1.606
OP_A2	0.0660955	01Jan2009, 06:06	6.3	164	42.30	3.877
OP_B1	0.0410479	01Jan2009, 06:08	4.2	101.6	26.27	3.867
OP_D1	0.0127428	01Jan2009, 06:04	1.5	46	8.16	5.640
OP_E1	0.0290673	01Jan2009, 06:06	3.4	88.7	18.60	4.768
OP_F1	0.0320472	01Jan2009, 06:04	3.7	108.3	20.51	5.280
OP_G1	0.0151704	01Jan2009, 06:02	1.8	57.5	9.71	5.922
OP_H1	0.0750339	01Jan2009, 06:08	7.7	193.1	48.02	4.021
OP_J1	0.006775	01Jan2009, 06:02	0.8	26.6	4.34	6.135

Future Condition Basin HEC-HMS Model Results - Bulked Flows -

Old Picacho

BHI No. 090126

Date: 3/24/2009

Prepared By: Kjohnson

Structure ID	Drainage Area (SQ MI)	Time of Peak	Volume (AC-FT)	Peak Discharge (cfs)	Drainage Area (AC)	Discharge (cfs/ac)
Basin						
OP_A1	1.6468	01Jan2009, 06:44	264.1	2188.7	1053.95	2.077
OP_A2	0.0660955	01Jan2009, 06:06	7.8	206.3	42.30	4.877
OP_B1	0.0410479	01Jan2009, 06:08	5.2	124.7	26.27	4.747
OP_D1	0.0127428	01Jan2009, 06:04	1.6	48.3	8.16	5.922
OP_E1	0.0290673	01Jan2009, 06:06	3.6	94.9	18.60	5.101
OP_F1	0.0320472	01Jan2009, 06:04	4	116.9	20.51	5.700
OP_G1	0.0151704	01Jan2009, 06:02	2.2	70.3	9.71	7.241
OP_H1	0.0750339	01Jan2009, 06:06	9.6	242.3	48.02	5.046
OP_J1	0.006775	01Jan2009, 06:02	0.9	27.7	4.34	6.388
Junction Points						
J OP_A1	1.7128955	01Jan2009, 06:48	271.8	2196.7		
J-S-OP_A	1.7128955	01Jan2009, 06:48	271.8	2196.7		
J-S-OP_B	0.0410479	01Jan2009, 06:08	5.2	124.7		
J-S-OP_D	0.0127428	01Jan2009, 06:04	1.6	48.3		
J-S-OP_E	0.0290673	01Jan2009, 06:06	3.6	94.9		
J-S-OP_F	0.0320472	01Jan2009, 06:04	4	116.9		
J-S-OP_G	0.0151704	01Jan2009, 06:02	2.2	70.3		
J-S-OP_H	0.0750339	01Jan2009, 06:06	9.6	242.3		
J-S-OP_J1	0.006775	01Jan2009, 06:02	0.9	27.7		
Routing						
R OP_A2	1.6468	01Jan2009, 06:48	264	2187.4		
Outfalls						
RioGrande	1.92478	01Jan2009, 06:48	298.9	2228.2		

Future Condition Basin HEC-HMS Model Results - No Sediment Bulking -

Old Picacho

BHI No. 090126

Date: 1/13/2009

Prepared By: Kjohnson

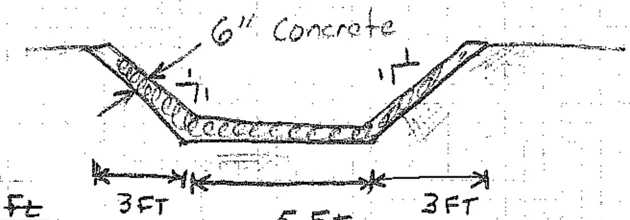
Structure ID	Drainage Area (SQ MI)	Time of Peak	Volume (AC-FT)	Peak Discharge (cfs)	Drainage Area (AC)	Discharge (cfs/ac)
Basin						
OP_A1	1.6468	01Jan2009, 06:44	222	1839.2	1053.95	1.745
OP_A2	0.0660955	01Jan2009, 06:06	7.1	187.6	42.30	4.435
OP_B1	0.0410479	01Jan2009, 06:08	4.8	115.5	26.27	4.397
OP_D1	0.0127428	01Jan2009, 06:04	1.5	46	8.16	5.640
OP_E1	0.0290673	01Jan2009, 06:06	3.4	88.7	18.60	4.768
OP_F1	0.0320472	01Jan2009, 06:04	3.7	108.3	20.51	5.280
OP_G1	0.0151704	01Jan2009, 06:02	2.1	66.3	9.71	6.829
OP_H1	0.0750339	01Jan2009, 06:06	8.7	220.3	48.02	4.588
OP_J1	0.006775	01Jan2009, 06:02	0.8	26.6	4.34	6.135

- Interim Improvement Channel Design -

Assumptions:

- ☐ Use approximately the existing geometry of the existing Dam outfall channel.
- ☐ Concrete line the existing channel.
- ☐ ~~At~~ From the intersection of Puerta Lane and Cuesta Road construct a new channel w/ the same depth as the original channel conveyance.
- ☐ Increase width of new channel to convey similar flow rates to that of the improved existing channel outfall.
- ☐ Tie the new channel into the proposed Picacho Hills Diversion system channel network.
- ☐ 6" Thick Concrete
- ☐ See Attached Calculations which rely on Mannings Equation to determine channel flow capacity

Section 1

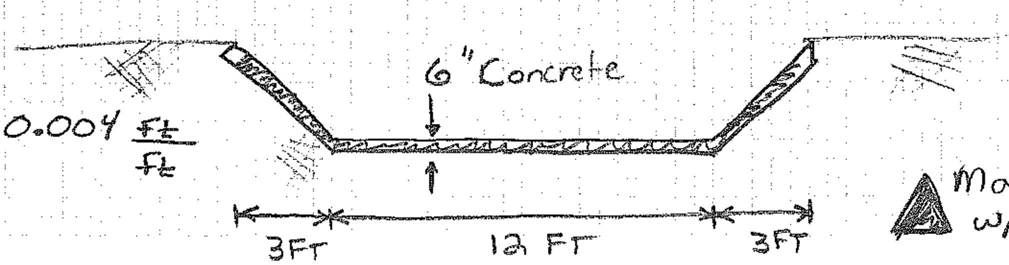


Slope = 0.015 Ft/Ft

Max capacity w/ 1.5' Freeboard

141 cfs

Section 2



Slope = 0.004 Ft/Ft

Max Capacity w/ 1.5' Freeboa

169 cfs

Bohannan ▲ Huston INC.

PROJECT NAME Old Picacho	SHEET 1	OF 3	ENGINEERING
PROJECT NO. 090126	BY K Johnson	DATE 3/13/2009	SPATIAL DATA
SUBJECT Interm Improvement Channel design & analysis	CH'D [illegible]	DATE 3/16/09	ADVANCED TECHNOLOGIES

Interim Channel Design
Old Picacho
BHI No. 090126
Date: 03/13/2009
Prepared By: Kris Johnson
Path: P:\090126\WR\Calculations\Misc Calcs\Proposed Channel Outfalls\
090126_Interim Channels_OP.txt

Section 1

Goal: Improve the existing channel approximately to the intersection of Puerta Lane and Cuesta Road. Determine the capacity of an improved channel section along the existing outfall channel alignment. Assume the channel will be concrete lined.

Assumptions: Fully grouted riprap or shotcrete channel section.
MANNING'S N = 0.013 SLOPE = 0.015

POINT	DIST	ELEV	POINT	DIST	ELEV	POINT	DIST	ELEV
1.0	0.0	3.0	3.0	8.0	0.0			
2.0	3.0	0.0	4.0	11.0	3.0			

WSEL FT.	DEPTH INC	FLOW AREA SQ.FT.	FLOW RATE (CFS)	WETTED PER (FT)	FLOW VEL (FPS)	TOPWID PLUS OBSTRUCTIONS	TOTAL ENERGY (FT)
0.100	0.100	0.510	1.503	5.283	2.946	5.200	0.235
0.200	0.200	1.040	4.759	5.566	4.576	5.400	0.526
0.300	0.300	1.590	9.342	5.849	5.875	5.600	0.837
0.400	0.400	2.160	15.084	6.131	6.983	5.800	1.158
0.500	0.500	2.750	21.890	6.414	7.960	6.000	1.486
0.600	0.600	3.360	29.701	6.697	8.839	6.200	1.815
0.700	0.700	3.990	38.475	6.980	9.643	6.400	2.146
0.800	0.800	4.640	48.186	7.263	10.385	6.600	2.477
0.900	0.900	5.310	58.814	7.546	11.076	6.800	2.808
1.000	1.000	6.000	70.349	7.828	11.725	7.000	3.138
1.100	1.100	6.710	82.781	8.111	12.337	7.200	3.467
1.200	1.200	7.440	96.108	8.394	12.918	7.400	3.795
1.300	1.300	8.190	110.327	8.677	13.471	7.600	4.123
1.400	1.400	8.960	125.440	8.960	14.000	7.800	4.449
1.500	1.500	9.750	141.448	9.243	14.508	8.000	4.774 ← Max channel capacity w/ 1.5 FT Freeboard
1.600	1.600	10.560	158.357	9.525	14.996	8.200	5.098
1.700	1.700	11.390	176.169	9.808	15.467	8.400	5.421
1.800	1.800	12.240	194.893	10.091	15.923	8.600	5.743
1.900	1.900	13.110	214.533	10.374	16.364	8.800	6.065
2.000	2.000	14.000	235.098	10.657	16.793	9.000	6.386
2.100	2.100	14.910	256.594	10.940	17.210	9.200	6.707
2.200	2.200	15.840	279.031	11.223	17.616	9.400	7.027
2.300	2.300	16.790	302.416	11.505	18.012	9.600	7.346
2.400	2.400	17.760	326.759	11.788	18.399	9.800	7.665
2.500	2.500	18.750	352.068	12.071	18.777	10.000	7.984
2.600	2.600	19.760	378.352	12.354	19.147	10.200	8.302
2.700	2.700	20.790	405.622	12.637	19.510	10.400	8.621
2.800	2.800	21.840	433.887	12.920	19.867	10.600	8.939
2.900	2.900	22.910	463.155	13.202	20.216	10.800	9.257

Section 2

Goal: Design a new channel to tie the above improved channel, from the intersection of Puerta Lane and Cuesta Road, to the Rio Grande. This channel will connect the Donaldson Dam outfall channel to the proposed Picacho Hills Diversion system. Assume the channel will be concrete lined.

MANNING'S N = 0.013 SLOPE = 0.004

POINT	DIST	ELEV	POINT	DIST	ELEV	POINT	DIST	ELEV
1.0	0.0	3.0	3.0	15.0	0.0			
2.0	3.0	0.0	4.0	18.0	3.0			

WSEL FT.	DEPTH INC	FLOW AREA SQ.FT.	FLOW RATE (CFS)	WETTED PER (FT)	FLOW VEL (FPS)	TOPWID PLUS OBSTRUCTIONS	TOTAL ENERGY (FT)
0.100	0.100	1.210	1.866	12.283	1.542	12.200	0.137
0.200	0.200	2.440	5.915	12.566	2.424	12.400	0.291
0.300	0.300	3.690	11.612	12.849	3.147	12.600	0.454
0.400	0.400	4.960	18.737	13.131	3.778	12.800	0.622
0.500	0.500	6.250	27.156	13.414	4.345	13.000	0.794
0.600	0.600	7.560	36.775	13.697	4.864	13.200	0.968
0.700	0.700	8.890	47.527	13.980	5.346	13.400	1.145
0.800	0.800	10.240	59.357	14.263	5.797	13.600	1.323
0.900	0.900	11.610	72.222	14.546	6.221	13.800	1.502
1.000	1.000	13.000	86.089	14.828	6.622	14.000	1.682
1.100	1.100	14.410	100.928	15.111	7.004	14.200	1.863
1.200	1.200	15.840	116.715	15.394	7.368	14.400	2.044
1.300	1.300	17.290	133.431	15.677	7.717	14.600	2.226
1.400	1.400	18.760	151.057	15.960	8.052	14.800	2.408

2/3

1.500	1.500	20.250	169.581	16.243	8.374	15.000	2.591
1.600	1.600	21.760	188.988	16.525	8.685	15.200	2.773
1.700	1.700	23.290	209.269	16.808	8.985	15.400	2.956
1.800	1.800	24.840	230.415	17.091	9.276	15.600	3.138
1.900	1.900	26.410	252.417	17.374	9.558	15.800	3.321
2.000	2.000	28.000	275.271	17.657	9.831	16.000	3.503
2.100	2.100	29.610	298.969	17.940	10.097	16.200	3.686
2.200	2.200	31.240	323.508	18.223	10.356	16.400	3.868
2.300	2.300	32.890	348.883	18.505	10.608	16.600	4.050
2.400	2.400	34.560	375.092	18.788	10.853	16.800	4.232
2.500	2.500	36.250	402.132	19.071	11.093	17.000	4.414
2.600	2.600	37.960	430.002	19.354	11.328	17.200	4.596
2.700	2.700	39.690	458.699	19.637	11.557	17.400	4.777
2.800	2.800	41.440	488.223	19.920	11.781	17.600	4.959
2.900	2.900	43.210	518.573	20.202	12.001	17.800	5.140

← Max channel capacity w/ 1.5 FT freeboard

Ultimate Improvement Channel Design

Assumptions

- Use of the 100-YR Future conditions HEC-HMS model to obtain channel design flow rate
- Riprap lined channel sides
- The interim channel is assumed to have been constructed & conveys it's max flow capacity. All other flows will be diverted to the proposed channel.
- See manning's roughness calc attached: P:\090126\WR\Calculations\misc calcs\\proposed channel outfalls\\090126 Channel Roughness_OP.xlsx

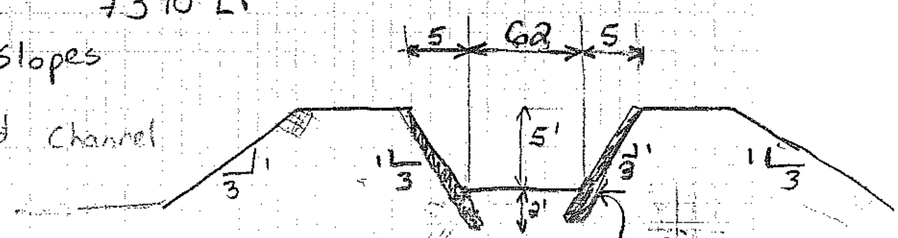
- Peak outflow for 100-yr, storm event
  2228 cfs

- Peak design flow for new outfall channel

$$Q_{100\text{-}yr} = 2228 - 141 \text{ cfs}$$
$$= \underline{2087 \text{ cfs}}$$

- Channel design criteria:
  - Channel Max Depth 5 FT
  - Channel Avg. Slope: 0.0069 ft/ft
  - Channel length: 7390 LF
  - 3:1 side slopes
  - Assume a perched Channel
  - 1.5' Freeboard

Drop 51 ft from dam outfall to River



See attached design calculation.

PROJECT NAME Old Picacho	SHEET 1	OF 3	ENGINEERING
PROJECT NO. 090126	BY K Johnson	DATE 3/13/2009	SPATIAL DATA
SUBJECT Ultimate Improvement	CH'D DJM	DATE 3/16/09	ADVANCED TECHNOLOGIES

Bohannan Huston Inc.

- Option 2 - Channel Design

Weighted Mannings Roughness
Old Picacho Hills
BHI No. 090126
Date: 03/25/2009
Prepared By: Kris Johnson
Path: P:\090126\WR\Calculations\Misc Calcs\Proposed Channel Outfalls\090126 Channel Roughness_OP.xlsx

Goal:
Determine approximate mannings roughness for use in modeling channels

Assumptions:
3:1 Side Slopes

Earthen Channel Bottom roughness	0.023	per NMDOT Drainage Manual - Volume 2 Hydraulics, Table 2-3
Riprap side roughness	0.045	value chosen to be between value for d50= 2-inch rock and 6-inch as defined by NMDOT Drainage Manual - Volume 2 Hydraulics, Table 2-3

Results:

Channel Section No.	Bottom Width (FT)	Depth (FT)	Slope Length (FT)	Weighted 'n'
Ultimate Channel	62	5	15.81	0.031

2/3

Ultimate Channel Design
Old Picacho
BHI No. 090126
Date: 03/25/2009
Prepared By: Kris Johnson
Path: P:\090126\WR\Calculations\Misc Calcs\Proposed Channel Outfalls\
090126_Ultimate Channel_OP.txt

==

Goal: Design a partially riprap lined channel to convey the 100-yr storm event to the Rio Grande. This channel will convey the future condition 100-yr storm flow rate from the entire Old Picacho area. A portion of the peak flow rate will be conveyed to the River via the proposed interim channel.

Assumptions:
1. Roughness calculated by the following spreadsheet:
   P:\090126\WR\Calculations\Misc Calcs\Proposed Channel Outfalls\090126 Channel Roughness_OP.xlsx
2. 1.5 FT Freeboard
3. 3:1 Side Slopes
4. Riprap lining will only be placed on the channel walls, not the channel bottom.

MANNING'S N = 0.031 SLOPE = 0.007

POINT	DIST	ELEV	POINT	DIST	ELEV	POINT	DIST	ELEV
1.0	0.0	5.0	3.0	77.0	0.0			
2.0	15.0	0.0	4.0	92.0	5.0			

	WSEL FT.	DEPTH INC	FLOW AREA SQ.FT.	FLOW RATE (CFS)	WETTED PER (FT)	FLOW VEL (FPS)	TOPWID PLUS OBSTRUCTIONS	TOTAL ENERGY (FT)	
	0.500	0.500	31.750	78.846	65.162	2.483	65.000	0.596	
	1.000	1.000	65.000	252.161	68.325	3.879	68.000	1.234	
	1.500	1.500	99.750	499.548	71.487	5.008	71.000	1.890	
	2.000	2.000	136.000	813.619	74.649	5.982	74.000	2.557	
	2.500	2.500	173.750	1190.471	77.811	6.852	77.000	3.230	
	3.000	3.000	213.000	1627.832	80.974	7.642	80.000	3.908	
***	3.500	3.500	253.750	2124.362	84.136	8.372	83.000	4.590	***
	4.000	4.000	296.000	2679.304	87.298	9.052	86.000	5.274	
	4.500	4.500	339.750	3292.299	90.460	9.690	89.000	5.961	
	5.000	5.000	385.000	3963.264	93.623	10.294	92.000	6.648	

APPENDIX B

Conceptual Capital Project Recommendations

- Cost Estimates

Conceptual Cost Estimate

Old Picacho Drainage Master Plan

BHI No : 090126
Date: 3/25/2009
Prepared By: Kris Johnson
Reviewed By: Dan Grochowski

Interim Improvements

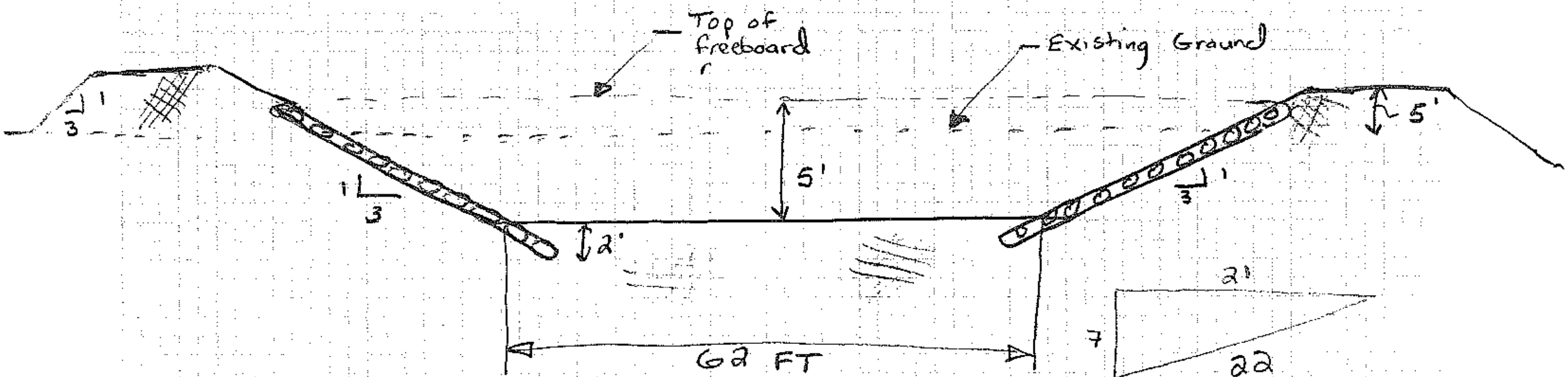
	Item Description	Approx. Quantity	Unit	Unit Price	Total	
Temporary Diversion Channel Improvement	Excavation, Placement and Compaction	17265	CY	$15	$	258,975.00
	Concrete Channel Lining - 6"	14975	SY	$83	$	1,242,925.00
	Removal and Disposal of Existing Riprap	653	CY	$134	$	87,502.00
				Construction Cost Subtotal	$	1,589,402.00
				25% Contingency	$	397,350.50
				Construction Total	$	1,986,752.50
				Soft Costs	$	496,688.13
				Project Total	$	**2,483,440.63**

Ultimate Improvements

	Item Description	Approx. Quantity	Unit	Unit Price	Total	
Arroyo Improvements	Excavation, Placement and Compaction	50600	CY	$15	$	759,000.00
	Wire-tied Riprap	18150	SY	$175	$	3,176,250.00
				Construction Cost Subtotal	$	3,935,250.00
				25% Contingency	$	983,812.50
				Construction Total	$	4,919,062.50
				Soft Costs	$	1,229,765.63
				Project Total	$	**6,148,828.13**

Assumptions

- ☐ 1.5 Thick riprap lining the sides of the channel
- ☐ Earthen bottom
- ☐ Toe riprap into ground 2ft



Channel Length

7,425 LF

Volume per LF

$\forall = 2\left[(22\ FT)(1.5\ FT)\right] = \left[33\ \frac{cu\,ft}{LF}\right]2$

$\forall = 490{,}050$ cu ft

$\forall = 18{,}150$ cy

Bohannan Huston INC.

ENGINEERING
SPATIAL DATA
ADVANCED TECHNOLOGIES

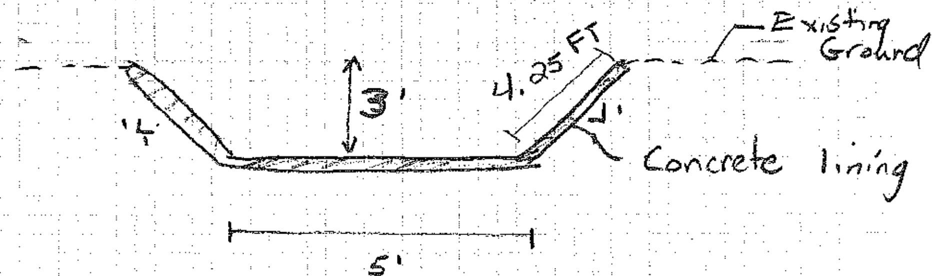
PROJECT NAME Old Picacho	SHEET 1	OF 1	
PROJECT NO. 090126	BY KJohnson	DATE 3/25/2009	
SUBJECT Ultimate	CH'D [illegible]	DATE 3/25/09	

Option 2 - Quantities - Riprap

Assume

- Only area that needs armoring for the 100 yr storm event plus 1.5 ft freeboard will be concrete lined.
- 6" Thick channel lining

Section 1



Channel Length

2,610 Ft

Surface Area

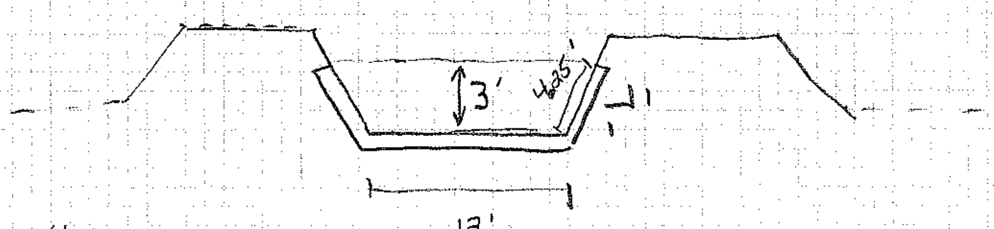
SA = (13.5 FT)(2,610)/9

SA = 3,915 Sq. Yd

Volume: 653 cy

↳ use this quantity for removal & disposal of existin riprap lining

Section 2



Channel Length: 4,855 LF

SA = (20.5 FT)(4,855 FT)/9

SA = 11,060 Sq. yd

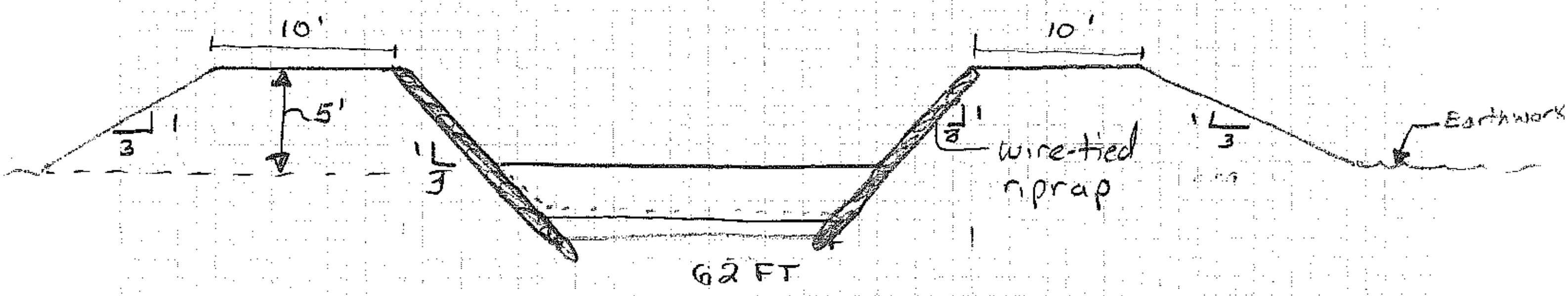
Bohannan Huston Inc.

PROJECT NAME Old Picacho	SHEET 1	OF 1		ENGINEERING
PROJECT NO. 090126	BY KJohnson	DATE 3/24/2009		SPATIAL DATA
SUBJECT Interim	CH'D RJH	DATE 3/25/09		ADVANCED TECHNOLOGIES

Option 1 - Quantities - Concrete

Assumption

- Assume new channel is perched, according to the following section.
- Assume soils will be obtained by over excavating the Channel bottom.
- Assume the volume of earthwork will be reduced by the volume of wire tied riprap installed



Channel Length
7,425 LF

Volume per LF

$$V_{w/out\ Riprap} = [5'(10') + \frac{1}{2}(5)(15) + \frac{1}{2}(5)(15)]$$

$$V_{w/out\ riprap} = 250 \ \frac{cu\ ft}{LF}$$

$$V_{w/out\ riprap} = 68,750 \ cy$$

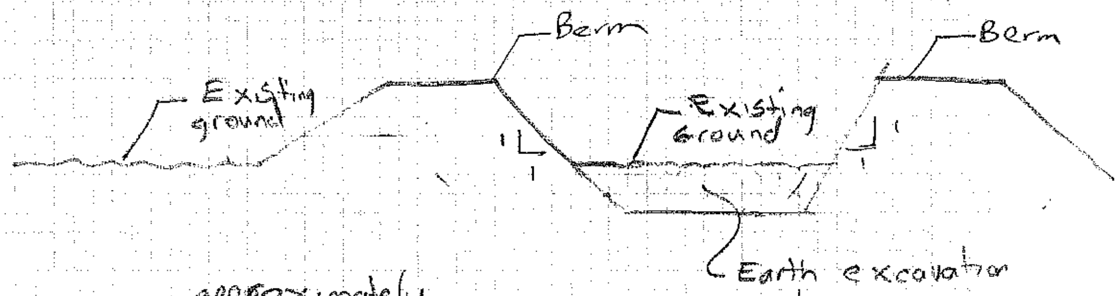
see riprap Quantity Calc.

$$V_{w/Riprap} = 68,750 - 18,150 \ cy$$

$$= 50,600 \ cy$$

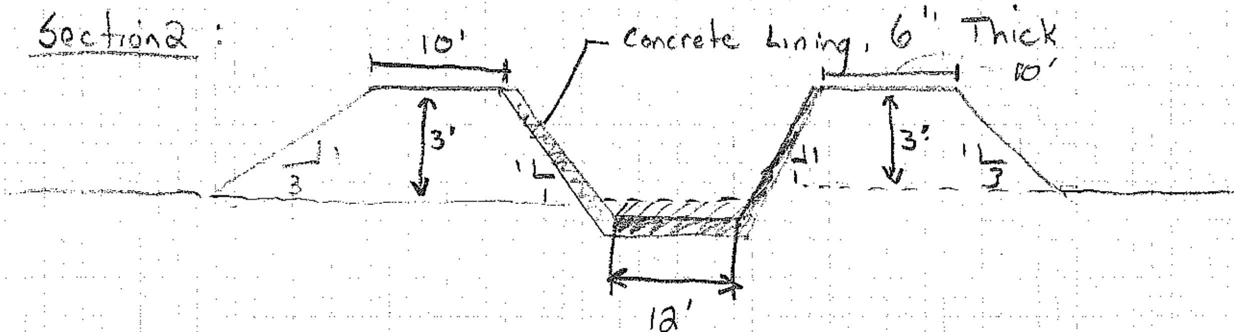
Assumption

- Quantity of earthwork for improving the ~~the~~ existing channel is negligable.
- Assume the new channel connecting to the Picacho Hills Diversion is perched.
- Assume soils needed to build berms for the channel sides will be excavated from the channel bottom



Section 1: Utilizes the approximately original channel gemetry.

Section 2:



Channel Length: 4,855 FT

Volume per LF

$$V = [3'(10') + \frac{1}{2}(3)(9) + \frac{1}{2}(3)(3)] \times 2$$

$$= 96 \frac{cf}{LF}$$

$$\Delta\ V = \underline{17,265\ cy}$$

Bohannan Huston Inc.

PROJECT NAME Old Picacho SHEET 1 OF 1

PROJECT NO. 090126 BY K Johnson DATE 3/24/2009

SUBJECT Interim CH'D EJU DATE 3/25/09

ENGINEERING
SPATIAL DATA
ADVANCED TECHNOLOGIES

Option 1 ① ...

APPENDIX C

Digital Data

- HEC-HMS Model

APPENDIX D

Public Input

Public Meeting Notice

Picacho Hills and Old Picacho Drainage Management Plan

Date: August 20, 2008

Time: 6:00 – 7:30 PM

Location: Doña Ana County Complex
845 N. Motel Blvd
Room 111
Las Cruces, NM

For information contact: Tish Segovia, P.E.
Doña Ana Flood Commission
Phone: 575 525-5554

This will be the initial public meeting to gather information regarding drainage and storm water system improvements for Old Picacho and Picacho Hills areas.

Public Meeting Notice

Picacho Hills and Old Picacho Drainage Master Plan

Date: November 19, 2008

Time: 5:30 PM – 7:00 PM

Location: Doña Ana County Complex
845 N. Motel Blvd
Room 111
Las Cruces, NM

For information contact: Tish Segovia, P.E.
Doña Ana Flood Commission
Phone: 575-525-5554

This will be the second public meeting to present preliminary findings regarding the drainage and storm water system improvements for Old Picacho and Picacho Hills areas.

Diana Gomez

From:	Mota, Adolph [amota@lcsun-news.com]
Sent:	Wednesday, November 12, 2008 2:02 PM
To:	Diana Gomez
Subject:	RE: Picacho Hill DMP

Just wanted to let you that I have Schedule the notice in the paper for November 16
Ad # 1001110256
Pub No 41204
Cost $ 30.67

From: Diana Gomez [mailto:dgomez@bhinc.com]
Sent: Wednesday, November 12, 2008 12:45 PM
To: Mota, Adolph
Cc: Brad Sumrall; Andrew Guerra
Subject: FW: Picacho Hill DMP

Hi Adolph,
Please run the attached public meeting notice on Sunday, November 16, 2008 paper in the Community Brief section.
Please charge it to the Bohannan Huston account; and send me the tear sheet with the price on it as proof that it will run.
If you have any questions please let me know.

Thank you,
Diana Gomez
Administrative Assistant
Las Cruces Office
Bohannan Huston, Inc.
425 South Telshor Blvd., Suite C-103
Las Cruces, NM 88011-7237
www.bhinc.com
voice: 575.532.8670 facsimile: 575.532.8680

From: Andrew Guerra
Sent: Wednesday, November 12, 2008 11:16 AM
To: Diana Gomez
Subject: Picacho Hill DMP

Diana,

I made a few changes to the advertisement concerning Picacho Hills DMP. Tish agrees to use this one. Can you find it somewhere in your heart to help me get it to the papers today.
I'll buy you another Banana Nut!

Andrew Guerra, E.I.
Bohannan Huston Inc.
425 South Telshor Boulevard, Suite C-103

Name (Primary) :

Company (Primary) : BOHANNAN HUSTON

Ad # : 1001054572

Width : 1

Depth : 51

Surface : 51.00

Ad Sales Rep. : 315 - Adolph Mota

Class Code : 0114 - Public/Special Notices

Ad Type :

Account # : 1147794

Start Date : 08/18/08

Stop Date : 08/18/08

Rate : LCCOMSKIP - LC COMMERCIAL SKIP

Box Number : 0 - (None)

Ad Rated Cost : $130.18

Extra : $9.61

Total : $139.79

Run Status : I

DOÑA ANA COUNTY NEW MEXICO

Public Meeting Notice

Picacho Hills and Old Picacho Drainage Management Plan

Date: August 20, 2008
Time: 6:00 - 7:30pm

Location: Doña Ana County Complex
845 N. Motel Blvd
Room 111
Las Cruces, NM

For information contact: Tish Segovia, P.E.
Doña Ana Flood Commission
Phone: 575 525-5554

This will be the initial public meeting to gather information regarding drainage and storm water system improvements for Old Picacho and Picacho Hills areas.

www.lcsun-news.com

LAS CRUCES SUN-NEWS

256 W. Las Cruces Ave. P.O. Box 1749 Las Cruces, NM. 88005
(505) 541-5400

Date: 12/04/08

BOHANNAN HUSTON
425 S. TELSHOR SUITE C-103
LAS CRUCES, NM 88011
(505) 532-8670

Ad#	Publication	Class	Start	Stop	Times	AS/400 Acct
1001110256	LAS CRUCES	0152 - Legal Notices	11/16/2008	11/16/2008	1	720420
1001110256	LAS CRUCES	0152 - Legal Notices	11/16/2008	11/16/2008	1	720420

Total Cost:	$30.67
Payment:	$0.00
Balance Due:	$30.67

TEXT:

Public Meeting NoticePicacho Hills and Old Picacho Drainage Mast

090126 009 02 ENGLCS 12/9/08
DESCRIPTION Public Mtg. Notice Adv.
ENTERED DATE 12/11/08 VOUCHER # 63334
ENTERED BY Diana G.

Name (Primary) :

Company (Primary) : BOHANNAN HUSTON

Ad # : 1001110256

Width : 1

Depth : 44

Surface : 44.00

Ad Sales Rep. : 315 - Adolph Mota

Class Code : 0152 - Legal Notices

Ad Type :

Account # : 1147794

Start Date : 11/16/08

Stop Date : 11/16/08

Rate : LCLEGAL - LC REG LEGAL 11/28/05 NEW RATE

Box Number : 0 - (None)

Ad Rated Cost : $28.64

Extra : $2.03

Total : $30.67

Run Status : I

Public Meeting Notice

Picacho Hills and Old Picacho Drainage Master Plan

Date: November 19, 2008

Time: 5:30 PM - 7:00 PM

Location: Doña Ana County Complex 845 N. Motel Blvd Room 111 Las Cruces, NM

For information contact: Tish Segovia, P.E. Doña Ana Flood Commission Phone: 575-525-5554

This will be the second public meeting to present preliminary findings regarding the drainage and storm water system improvements for Old Picacho and Picacho Hills areas.

Pub No. 41204
Pub Date. Nov 16,2008

www.lcsun-news.com

LAS CRUCES SUN-NEWS

PROOF OF PUBLICATION

Lou Hendren, being duly sworn, deposes and says that he is the Classified Manager of the Las Cruces Sun-News, a newspaper published daily in the county of Dona Ana, State of New Mexico; that the notice __41204_is an exact duplicate of the notice that was published once a week/day in regular and entire issue of said newspaper and not in any supplement thereof for 1 _consecutive week(s)/day(s), the first publication was in the issue dated ___November 16,2008_and the last publication was November 16,2008 .

Despondent further states this newspaper is duly qualified to publish legal notice or advertisements within the meaning of Sec. Chapter 167, Laws of 1937.

Signed [signature]

Classified Manager
Official Position

STATE OF NEW MEXICO
ss.
County of Dona Ana
Subscribed and sworn before me this 2 **day of** December 2008

[signature]
Notary Public in and for

Dona Ana County, New Mexico
September 22, 2012
My Term Expires

OFFICIAL SEAL
ERIN N. OWENS
Notary Public
State of New Mexico
My Comm. Expires 9-22-12

Public Meeting Notice

Picacho Hills and Old Picacho Drainage Master Plan

Date:
November 19, 2008

Time:
5:30 PM - 7:00 PM

Location: Doña Ana County Complex
845 N. Motel Blvd
Room 111
Las Cruces, NM

For information contact:
Tish Segovia, P.E.

Doña Ana Flood Commission

Phone: 575-525-5554

This will be the second public meeting to present preliminary findings regarding the drainage and storm water system improvements for Old Picacho and Picacho Hills areas.

Pub No. 41204
Pub Date. Nov 16,2008

8/20/08

STREET ADDRESS ~~COMPANY~~	NAME	TELEPHONE NUMBER	email address ~~FACSIMILE NUMBER~~
1600 Via Turquesa	Bernie Kute	647-8970	bgkute@comcast.net
ETZ	LEON BILLSTONE	624-6294	[illegible]
Alto Estates 3	Scott Hofbauer	526-3451	—
1606 VIA DIAMANTE	LARRY GOFORTH	527-1707	—
6065 Linda Vista Dr	Michelle Archuleta	526-3303	—
1211 Vintage Ct	JILL JOHNSON	635-2490	jaj1130@msn.com
10022 Catalonia Ct	Sylvia Bizzell	524 9273	[illegible]@msn.com
2214 PEPPER RD	LOU BIAD	523 4857	APRILBIAD@AOL.com
6620 BUTTERFIELD RIDGE Dr	ROBERT POTTER	523-5254	VETTE@2POTTERS.NET
10 1072 La Quinta St	MARY BLOOMINGBURG	647-9590	
1440 Vista Valley Ln.	Julie Ogaz	525-0253	[illegible].com
7010 BARCELONA RIDGE RD	JOHN R. WILLIAMS	525-0575	DICKWILLIAMS,1@VET[illegible].com
10600 SAN MARCOS Ct	Cliff Terry	5235568	TerryALC@AOL.com
6676 Vista Hermosa	Mary Bruegger	523-1712	jimmary@mac.com
4167 Calle del Centro	Manuel [illegible]	526-8929	
2225 Pepper Road	Cristan Brand	526-0503	Cristan 14 @ MSN
1212 Titania Court	Kelly Dickson	525 0805	kellydickson@earthlink.net
6750 Bright View RD	Ed Rozylowicz	647-5834	ROZYLOWICZ@Q.com
1310 Picacho Hills Drive Ste 1	TOMMY ETTERLING	523-2500	Tommy@Picachomountain.com
20 10070 Tuscany Dr.	Jacqueline Rosch	526-1261	
" "	Robert Rosch	526-1261	
21 Las Casitas	Rosemary Chaffee	525-4694	
6796 Via Campestre	Rebecca McNair	526-9369	vaepm9@yahoo
6843 Via Campestre	Oliver Mizes	527-0609	oliver@cybermesa.com
6715 Bright View Road	[illegible]	524-[illegible]	[illegible]@aol.com
1378 Vista Del Oro			
3245 Picacho	Rivera Vicente	527-2023	Vicentemartha@msn.com
1436 Fairway Village Dr.	Kathy Rodman	523-6411	Krodman@comcast.net
	DIANA ALBA, SUN-NEWS	541-5443	dalba@lcsun-news.com
6751 Via Campestre	Juliana Porter	541-1521	
31 1236 Regency Ct	David Zeenay	523-0913	phpaala@yahoo.com

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6780 Bright View	Chuck Mueller	575 647-4095	CHUCK_WAGONWHEEL@HOTMAIL.COM
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1380 Via Norte	Franklin McKay	644-1762	mcmckay@zianet.com
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8140 Constitution	Jan/Lamar Harrison	5419984	harrison134@msn.com
1229 Academy Ct.	David + Verona Wright	526-6122	gr8scape@comcast.net
2280 Pepper Rd	Vicky Schneider	523-1692	
10 1200 Titania Ct	Tim Henderson	649 5771	TimHenderson(A)Remax.net
6807 VIA CAMPESTRE	Bill/Lomita Cline	523-4501	
10088 Catalonia Ct	Barry Sloshnoy	202-6243	BSWENZ@msn.com
10040 SAN MARCOS CT	Jim Haynoe	524-9399	JimHaynoe3@msn.com
2935 San Lorenzo Ct	Ruben Aguirre	523-2500	ruben@picachomountain.com
6795 Via Campestre	Charles Mullis	523-0655	chad.mullis@us.army.mil
10072 San Saviner Ct	David Sachs	526-6410	dasachs@msn.com
4400 Cresta Del Rd	Albert T. Carrillo	525-3453	
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6 "	Jeff Schutte	9080077	" "
20 6499 Desert Blossom Rd	Gary Roverman	523-4003	forn6tech@yahoo.com

D

8/20/08

~~COMPANY~~ STREET ADDRESS	NAME	TELEPHONE NUMBER	~~FACSIMILE NUMBER~~ email address
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1390 Via Norte	Mo Quigley	647-9203	mquigley3@aol.com.
CLARE + HARVEY KAPLER	10000 TUSCANY	525-1382	CEK10000@HOTMAIL
1200 Regency Ct.	Larry Felhauer	526-2715	LCFEL61@msn.com
4321 Ladera	Lynn Smith	525 3970	lkindsmith@yahoo.com
~~[illegible]~~ 10080 TUSCANY DR.	DON MILLER	~~[illegible]~~ 526-9607	~~[illegible]~~ SEE RAYMILLER @HOTMAIL
39 Las Casitas	Cheryl Fox-Nelson	647-1631	cfnsolfgo@comcast.net
4300 Ladera	Veronica Moran	541-0651	mjvmoran@aol.com
4300 Ladera	Juan Moran	541-0659	" "
~~[illegible]~~ 1310 Picacho Hills	Kenny Jameson	523-2500	Kenny@PicachoMountain.com
6819 Via Campestre	J.P. Scoggin	650-7040	Patrick.Scoggin@gmail.com
1519 Fairway Village Dr	R.H. Cohen	525-8760	
3100 Peralta Lane	Jim Para	526-8991	N/A
2801 W Picacho SP 6	Rebecca Najera	5267748	N/A
2801 W. Picacho Sp 25	Graciela Hunt	541 1570	

5

STREET ADDRESS ~~COMPANY~~	NAME	TELEPHONE NUMBER	email address ~~FACSIMILE NUMBER~~
6796 VIA CAMPESTRE	ED McNAIR	526-9369	RAEAM@YAHOO.COM
4321 Ladera	Geoffrey Smith	525-3970	gsmith@nmsu.edu
1536 Fairway Village	T. Leighton	526-6256	

(3)

8/20/08

STREET ADDRESS ~~COMPANY~~	NAME	TELEPHONE NUMBER	email addr ~~FACSIMILE NUMBER~~
6789 VIA CAMPESTRE	JACK FRETER	(575) 524-2104	JFRETER2@NETZERO.NET
	Jason Moberly		moberly@nmsu.edu
3081 Puerta Lane	Mandie Brandon	526-5517	mcbrandon@yahoo.com

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Picacho Hills Drainage Master Plan

Public Meeting #1

August 20, 2008

Agenda

---

1. Introduction, (6:00 pm – 6:10 pm)
   Doña Ana County Flood Commission

   a. Presenters
   b. History
   c. Funding

2. Project Overview, Brad Sumrall, P.E. (6:10 pm – 6:15 pm)
   Bohannan Huston, Inc.

   a. Intent of Project
   b. Project and Meeting Schedule

3. Community Participation (6:15 pm – 7:25 pm)

   a. Review of Aerial Photos
   b. Comment Form

4. Conclusion of Public Meeting #1 (7:25 pm – 7:30 pm)

Drainage Ordinance

Erosion

SCS 1D Program

TR20 II-75 rainfall distribution

Barcelona Rd - culverts & DI

Picacho Hills Drainage Master Plan

Public Meeting #2
Sign In Sheet

November 19, 2008

Name:	Physical Address:	Phone #:	Email:
Scott Holtzclaw	1618 Vista Norte	526-3451	
ROD BLASCHE			
MARTY	1595 VISTA DEL CERRO	524-2989	
DAN CARR	2301 El Camino Rea #201	647-0016	

Picacho Hills Drainage Master Plan

Public Meeting #2
Sign In Sheet

November 19, 2008

Name:	Physical Address:	Phone #:	Email:
John Kutney	5613 Mira Montes	525-8470	John.Kutney@Hotmail.com
Tom Clark	1600 Via Diamante	647-1959	trclark13@Comcast.net
Dominic Scarinne	1232 Sonnet Ct	(602) 207-7378	
Robin & Diane Fovargue	1448 Fairway Village Dr	526-9510	robin.fovargue@sympatico.ca
David Rea	1232 Regency Ct.	647-9214	dmhrea@comcast.net
Jerry & Barbara Farber	8080 Constitution Rd.	526-1702	geraldfarber@hotmail.com
Danny Suggs	6745 Bright View rd.	647-2672	dksuggs@zianet.com
A F Walch	6865 Via Emma	639-2083	

Picacho Hills Drainage Master Plan

Public Meeting #2
Sign In Sheet

November 19, 2008

Name:	Physical Address:	Phone #:	Email:
William Cline	6807 Via Campestre	523-4501	—
Steve Ramirez	256 W. Las Cruces Ave.	541-5452	svamirez@lcsun-news.com
Steven R. Sears	1513 Fairway Village Drive	647 2764	SSEARS@DA.STATE.NM.US

Picacho Hills Drainage Master Plan
Dona Ana County

OLD PICACHO

COMMENT SHEET / HOJA PARA COMENTARIOS

Public Meeting / Reunion de Participacion Ciudadana
Wednesday Aug 20, 2008 /Miercoles Agosto 20, 2008

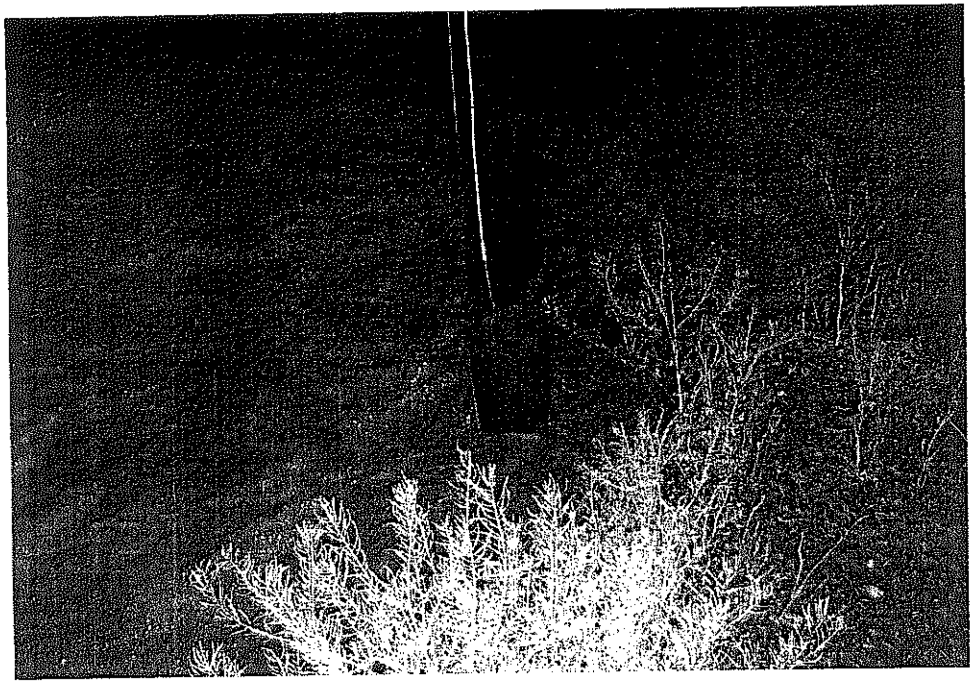
My family & I live on a three-acre tract of land on the corner of Ladera and Cuesta (4321 Ladera). On the southwest side of our property is what used to be a concrete-lined ditch that had been used for irrigation. The ditch connects to the arroyo on which Donaldson dam was built. Since we moved here in 1999, either in the Spring or Summer rains, the ditch has overflown it's banks & flooded much of our property. In the Spring of 2007, ditch waters during a storm ate 2 or 3 feet down into the soil at the base of a utility pole between our house and the neighbors house. We have lined some of this area w/ concrete. Send me an email if you want me to send photos of ditch water.

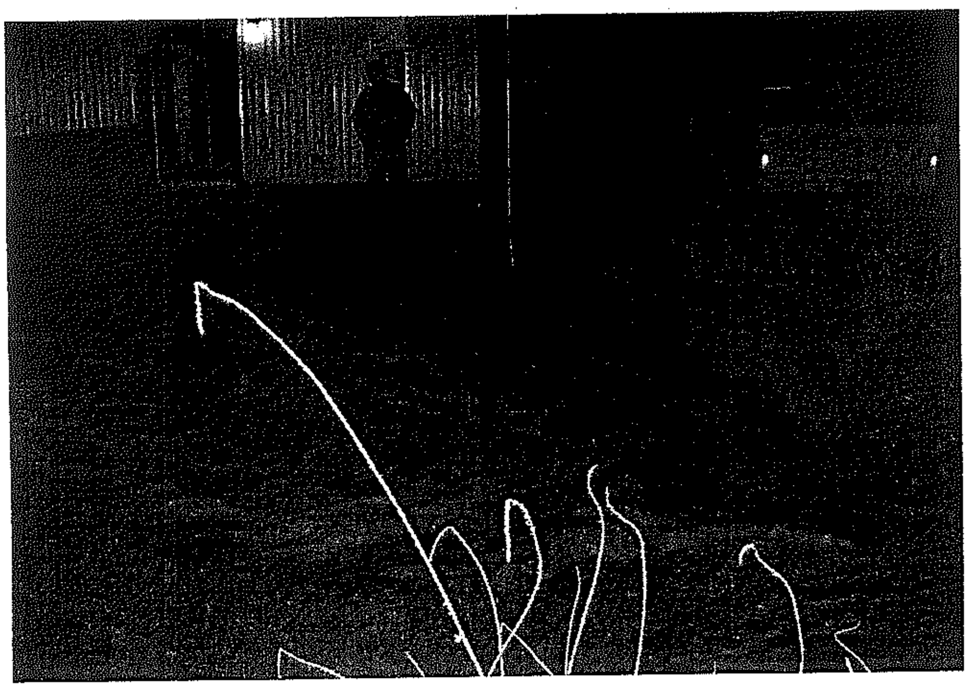
Mail to / Envie por correo a:		Please print clearly Por favor escriba claramente
Bohannan Huston, Inc 425 S. Telshor Blvd. Suite C-103 Las Cruces, NM 88011 (575) 532-8680	Name/ Nombre:	GeoFFrey Smith
	Address/ Direccion:	4321 Ladera Ave
	Phone/ Telefono:	(575) 525-3970
	E-mail/ Direccion Electronica:	gsmith@nmsu.edu

Our address also appears on the opposite side of this form, which if folded may be mailed to us directly. /Nuestra direccion aparece en el lado opuesto de esta forma, de tal manera que si la dobla y pega con cinta adhesiva, puede enviarnosla directamente..

May 2007. Flood waters at base of utility pole

Damage to concrete ditch





If electronic copies are needed email me (Geoffrey Smith): gsmith@nmsu.edu

Picacho Hills Drainage Master Plan
Dona Ana County

COMMENT SHEET / HOJA PARA COMENTARIOS

Public Meeting / Reunion de Participacion Ciudadana
Wednesday Aug 20, 2008 /Miercoles Agosto 20, 2008

This is a sewer manhole located in an arroyo to the rear of 10040 San Marcos Ct in Picacho Hills. In previous rains sewer pipe has been torn up and now deep erosion is taking place all around the manhole.

Mail to / Envie por correo a:		Please print clearly Por favor escriba claramente
Bohannan Huston, Inc 425 S. Telshor Blvd. Suite C-103 Las Cruces, NM 88011 (575) 532-8680	Name/ Nombre:	JAMES HAYHOE
	Address/ Direccion:	10040 SAN MARCOS CT
		LAS CRUCES, NM 88007
	Phone/ Telefono:	575 524-9399
	E-mail/ Direccion Electronica:	JimHayHoe3@msn.com

Our address also appears on the opposite side of this form, which if folded may be mailed to us directly. /Nuestra direccion aparece en el lado opuesto de esta forma, de tal manera que si la dobla y pega con cinta adhesiva, puede enviarnosla directamente..

Picacho Hills Drainage Master Plan
Dona Ana County

OC D
Picacho
Contact Pon

COMMENT SHEET / HOJA PARA COMENTARIOS

Public Meeting / Reunion de Participacion Ciudadana
Wednesday Aug 20, 2008 /Miercoles Agosto 20, 2008

The private property earthen dam known as The Donaldson Dam, which holds approx. 10 acre ~~ft~~ of water from Picacho Arroyo. The outlet channel drains into a small irrigation type ditch not adequate to handle the volume of water which regularly flows. The result is residents in Old Picacho + adjacent areas fighting the runoff and the ~~fito~~ final ending of the flow washing out Cuesta Trail a County Road at the point of wash out. (Cuesta is also partly private) The current drain for Donaldson Dam is not logical due to several 90° turns restricting flow and causing erosion + backing up of flood water. It seems a straighter line of flow would be more appropriate. Although the impression is ~~to~~ that this is not a pressing agenda item the fact is the residents of this area ~~to~~ have been dealing with this issue for 25-30 years. We feel it is time to address this as a priority.

A larger Corp. Type ~~to~~ dam would be the best solution.

Mail to / Envie por correo a:		Please print clearly Por favor escriba claramente
Bohannan Huston, Inc 425 S. Telshor Blvd. Suite C-103 Las Cruces, NM 88011 (575) 532-8680	Name/ Nombre:	Mardie Brandon
	Address/ Direccion:	3081 Puerta Lane
	Phone/ Telefono:	575-526-5517
	E-mail/ Direccion Electronica:	mcbrandon322@yahoo.com

Our address also appears on the opposite side of this form, which if folded may be mailed to us directly. /Nuestra direccion aparece en el lado opuesto de esta forma, de tal manera que si la dobla y pega con cinta adhesiva, puede enviarnosla directamente..

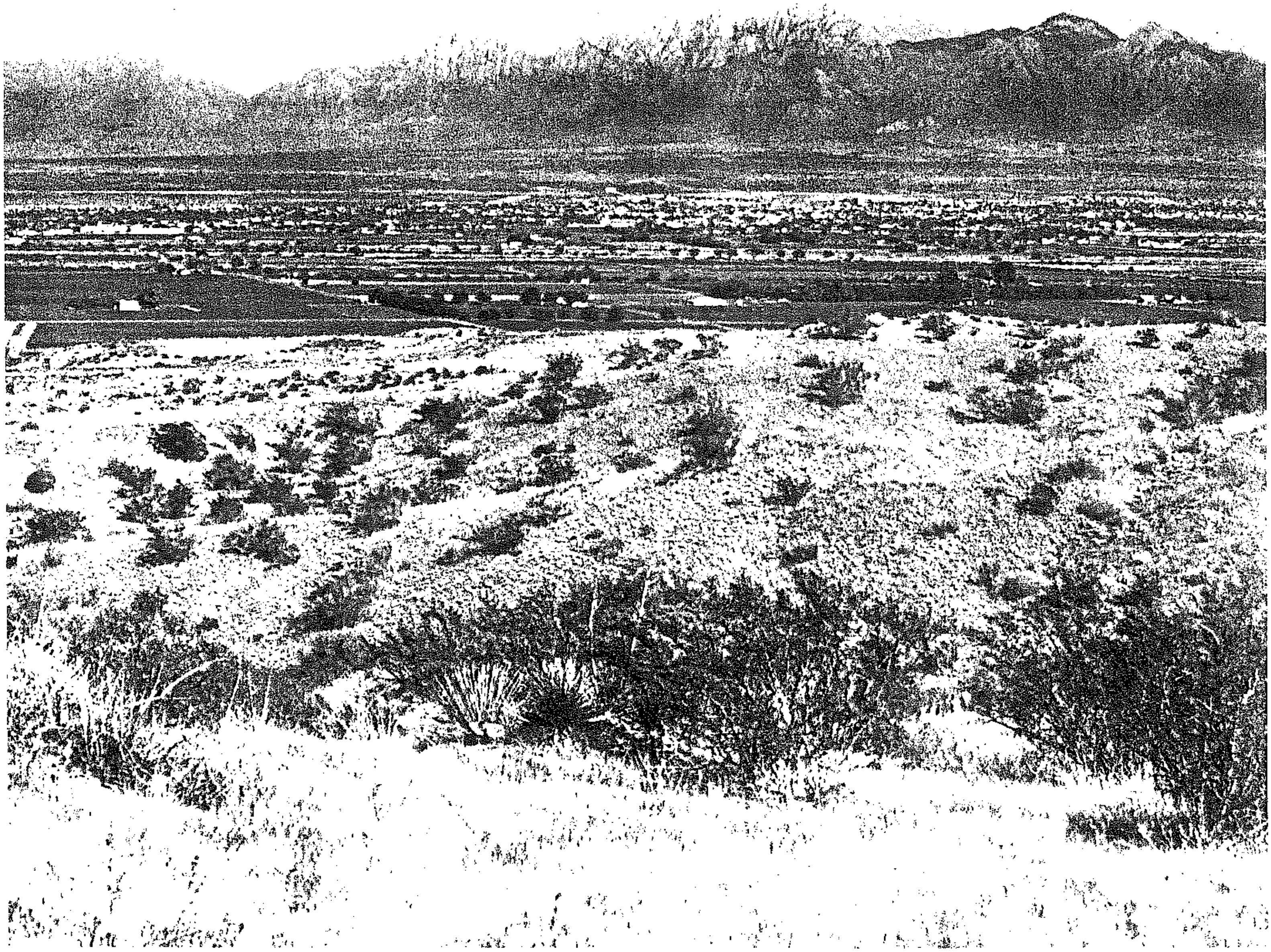
Call for Donaldson Dam Visit, Cell # 575-635-1281

APPENDIX E

Soils Information

Soil Survey of

Doña Ana County Area New Mexico



ɩd States Department of Agriculture, Soil Conservation Service
ɩperation with
d States Department of the Interior, Bureau of Land Management
Mexico Agricultural Experiment Station

536

TABLE 13.--ENGINEERING INDEX PROPERTIES

[The symbol > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Ad------------------ Adelino	0-10	Sandy clay loam	SC, CL	A-6	0	100	100	90-100	45-80	25-35	10-15
	10-28	Loam, sandy clay loam, clay loam.	SC, CL	A-6	0	100	100	90-100	35-75	25-35	10-15
	28-60	Sandy loam, sandy clay loam, loam.	SM, SM-SC	A-2, A-4	0	100	100	90-100	30-40	20-30	NP-10
Ae------------------ Adelino	0-5	Clay loam--------	SC, CL	A-6	0	100	100	90-100	45-80	25-35	10-15
	5-27	Loam, silty clay loam, clay loam.	SC, CL	A-6	0	100	100	90-100	35-75	25-35	10-15
	27-60	Sandy loam, sandy clay loam, loam.	SM, SM-SC	A-2, A-4	0	100	100	90-100	30-40	20-30	NP-10
AF*:											
Aftaden-------------	0-2	Loamy sand-------	SM	A-1, A-2	0-35	90-100	85-95	40-70	15-25	---	NP
	2-18	Fine sandy loam, sandy loam, gravelly sandy loam.	SM-SC, SM	A-2, A-4	5-15	75-95	70-95	55-85	30-45	15-25	NP-10
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
Onite---------------	0-5	Loamy sand-------	SM	A-2	0	100	100	50-95	15-35	---	NP
	5-18	Sandy loam, gravelly sandy loam.	SM	A-2	0	75-100	65-100	50-95	15-35	---	NP
	18-60	Loamy sand, gravelly sandy loam, sandy loam.	SM	A-1, A-2	0	65-100	60-100	45-85	10-35	---	NP
Ag------------------ Agua	0-12	Loam-------------	ML, SM	A-4	0	100	100	70-95	40-70	20-30	NP-5
	12-23	Loam, fine sandy loam, very fine sandy loam.	ML, SM	A-4	0	100	100	70-95	40-70	20-30	NP-5
	23-60	Sand, fine sand	SP, SP-SM, SM	A-3, A-2	0	100	100	60-90	0-15	---	NP
Ah------------------ Agua	0-12	Clay loam--------	CL	A-6	0	100	100	90-100	70-80	30-40	10-20
	12-24	Loam, fine sandy loam, very fine sandy loam.	ML, SM	A-4	0	100	100	70-95	40-70	20-30	NP-5
	24-60	Sand, fine sand	SP, SP-SM, SM	A-3, A-2	0	100	100	60-90	0-15	---	NP
AJ*----------------- Agua Variant	0-11	Fine sandy loam	ML, SM	A-4	0	100	100	70-95	40-70	20-30	NP-5
	11-28	Very fine sandy loam, loam.	CL-ML, SM-SC, ML, SM	A-4	0	100	100	75-90	40-70	20-30	NP-10
	28-60	Sand, fine sand	SP, SP-SM, SM	A-3, A-2	0	100	100	60-90	0-15	---	NP

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
AK*:											
Agua Variant-------	0-13	Fine sandy loam	ML, SM	A-4	0	100	100	70-95	40-70	20-30	NP-5
	13-23	Very fine sandy loam, loam.	CL-ML, SM-SC, ML, SM	A-4	0	100	100	75-90	40-70	20-30	NP-10
	23-60	Sand, fine sand	SP, SP-SM, SM	A-3, A-2	0	100	100	60-90	0-15	---	NP
Belen Variant------	0-4	Silty clay--------	CH, CL	A-7, A-6	0	100	100	95-100	85-100	30-70	15-40
	4-21	Clay, silty clay	CH, MH	A-7	0	100	100	95-100	90-100	50-70	20-40
	21-38	Fine sandy loam, loam, very fine sandy loam.	CL-ML	A-4	0	100	100	75-95	50-75	20-30	5-10
	38-60	Very fine sand	SM, ML	A-4	0	100	100	75-90	35-55	---	NP
AL*:											
Akela--------------	0-3	Gravelly sandy loam.	SM, GM	A-2, A-4, A-1	5-10	50-75	50-75	30-60	15-25	20-25	NP-5
	3-14	Very gravelly sandy loam, very gravelly loam.	SP-SM, GP-GM, SM, GM	A-1	5-10	40-60	30-50	20-40	5-15	15-20	NP-5
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
Akela--------------	0-3	Gravelly sandy loam.	SM, GM	A-2, A-4, A-1	5-10	50-75	50-75	30-60	15-25	20-25	NP-5
	3-14	Very gravelly sandy loam, very gravelly loam.	SP-SM, GP-GM, SM, GM	A-1	5-10	40-60	30-50	20-40	5-15	15-20	NP-5
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
AM*:											
Aladdin------------	0-2	Gravelly sandy loam.	SM	A-2, A-1	0-5	70-90	50-75	25-50	15-30	15-25	NP-5
	2-68	Gravelly sandy loam, gravelly fine sandy loam, gravelly loam.	SM, SM-SC, ML, CL-ML	A-1, A-2, A-4	0-5	70-90	50-75	25-65	15-55	20-30	NP-10
Coxwell------------	0-3	Gravelly sandy loam.	SM-SC, SM	A-4, A-2	0-15	75-85	70-85	45-60	25-35	15-30	NP-10
	3-13	Gravelly sandy clay loam, gravelly clay loam.	SC, CL, SM-SC, CL-ML	A-6, A-2	0-15	60-75	60-75	60-75	30-55	25-40	5-20
	13-33	Very gravelly sandy clay loam, very gravelly clay loam.	GC, GP-GC	A-2	0	25-50	10-40	10-35	5-20	25-35	5-15
	33	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Anapra-------------	0-16	Silt loam--------	CL	A-6,	0	100	100	90-100	60-85	25-35	10-15
	16-28	Silty clay loam, clay loam.	CL	A-6	0	100	100	85-100	75-90	25-35	10-15
	28-60	Fine sand, loamy fine sand.	SM, SM-SC	A-2, A-4	0	100	95-100	65-80	10-40	15-25	NP-10

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ao: Anapra	0-28	Clay loam	CL	A-6, A-7	0	100	100	90-100	60-85	30-50	12-30
	28-60	Fine sand, loamy fine sand.	SM, SM-SC	A-2, A-4	0	100	95-100	65-80	10-40	<25	NP-7
Ap*: Anthony	0-18	Fine sandy loam	SM, ML	A-4	0	95-100	90-100	55-85	35-65	20-30	NP-5
	18-38	Fine sandy loam, sandy loam.	SM	A-2, A-4	0	95-100	90-100	50-85	30-50	20-30	NP-5
	38-60	Loamy very fine sand.	SM	A-4	0	95-100	90-100	50-85	35-50	20-30	NP-5
Vinton	0-12	Fine sandy loam	SM, ML	A-4	0	100	100	70-85	40-55	20-30	NP-5
	12-60	Loamy sand, loamy fine sand, fine sandy loam.	SM	A-2	0	95-100	90-100	55-80	15-30	---	NP
Ar*: Anthony	0-13	Loam	CL-ML, CL	A-4, A-6	0	100	100	85-100	60-80	25-35	5-15
	13-60	Fine sandy loam, sandy loam, loamy very fine sand.	SM	A-2, A-4	0	95-100	90-100	50-85	30-50	20-30	NP-5
Vinton	0-16	Loam	CL-ML, CL	A-4, A-6	0	100	100	85-100	60-80	25-35	5-15
	16-60	Loamy sand, loamy fine sand, fine sand, loam.	SM	A-2	0	95-100	90-100	55-80	15-30	---	NP
As*: Anthony	0-15	Clay loam	CL-ML, CL	A-4, A-6	0	100	100	85-100	60-80	25-35	5-15
	15-60	Fine sandy loam, sandy loam, loamy very fine sand.	SM	A-2, A-4	0	95-100	90-100	50-85	30-50	20-30	NP-5
Vinton	0-15	Clay loam	CL-ML, CL	A-4, A-6	0	100	100	85-100	60-80	25-35	5-15
	15-60	Loamy sand, loamy fine sand, fine sand.	SM	A-2	0	95-100	90-100	55-80	15-30	---	NP
At: Armijo	0-10	Loam	CL, CL-ML	A-4, A-6	0	100	100	95-100	75-85	20-30	5-15
	10-52	Clay loam, clay, silty clay.	CH	A-7	0	100	100	95-100	50-100	50-75	25-50
	52-60	Stratified very fine sandy loam to loamy fine sand.	SM	A-2, A-4	0	100	100	60-85	25-50	---	NP-5
Aw: Armijo	0-15	Clay loam	CL, CL-ML	A-4, A-6	0	100	100	95-100	75-85	20-30	5-15
	15-42	Sandy clay, clay, silty clay.	CH	A-7	0	100	100	95-100	50-100	50-75	25-50
	42-60	Stratified very fine sandy loam to loamy fine sand.	SM	A-2, A-4	0	100	100	60-85	25-50	---	NP-5

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ax----------- Armijo	0-12	Clay-------------	CL, CH	A-7	0	100	100	95-100	85-95	45-70	25-45
	12-60	Sandy clay, clay, silty clay.	CH	A-7	0	100	100	95-100	50-100	50-75	25-50
	60-70	Stratified very fine sandy loam to loamy fine sand.	SM	A-2, A-4	0	100	100	60-85	25-50	---	NP-5
Be----------- Belen	0-12	Loam-------------	CL, CL-ML	A-4, A-6	0	100	100	95-100	75-95	20-30	5-15
	12-24	Clay, silty clay, silty clay loam.	CH, MH	A-7	0	100	100	95-100	90-100	50-70	20-40
	24-60	Fine sandy loam, loam, silt loam.	CL, ML	A-4	0	100	100	75-95	50-85	20-30	5-10
Bf----------- Belen	0-11	Clay loam--------	CL	A-6	0	100	100	95-100	85-95	30-40	15-25
	11-26	Clay, silty clay, silty clay loam.	CH, MH	A-7	0	100	100	95-100	90-100	50-70	20-40
	26-60	Loam, silt loam, very fine sandy loam.	CL, ML	A-4	0	100	100	75-95	50-85	20-30	5-10
Bg----------- Belen	0-11	Clay-------------	CH, MH	A-7	0	100	100	95-100	90-100	50-70	20-40
	11-30	Clay, silty clay, silty clay loam.	CH, MH	A-7	0	100	100	95-100	90-100	50-70	20-40
	30-60	Fine sandy loam, loam, silt loam.	CL, ML	A-4	0	100	100	75-95	50-85	20-30	5-10
BH*---------- Belen Variant	0-4	Silty clay-------	CH, CL	A-7, A-6	0	100	100	95-100	85-100	30-70	15-40
	4-21	Clay, silty clay	CH, MH	A-7	0	100	100	95-100	90-100	50-70	20-40
	21-38	Fine sandy loam, loam, very fine sandy loam.	CL-ML	A-4	0	100	100	75-95	50-75	20-30	5-10
	38-60	Very fine sand	SM, ML	A-4	0	100	100	75-90	35-55	---	NP
BJ*:											
Berino-------	0-4	Loamy fine sand	SM, SP-SM	A-2	0	95-100	95-100	50-95	10-35	---	NP
	4-60	Sandy clay loam, sandy loam.	SC, SM-SC, CL, CL-ML	A-6, A-4	0	95-100	95-100	65-80	35-55	20-35	5-15
Bucklebar----------	0-6	Sandy loam-------	SM, ML	A-2, A-4	0	95-100	95-100	60-85	30-55	15-25	NP-5
	6-25	Sandy clay loam, clay loam.	SM-SC, SC, CL-ML, CL	A-6, A-4	0-5	90-100	90-100	60-85	40-60	25-35	5-15
	25-38	Loam	ML, CL-ML	A-4	0-5	95-100	95-100	80-100	60-80	25-35	5-10
	38-60	Silty clay loam, loam.	CL-ML, CL	A-4, A-6	0-5	95-100	95-100	85-100	60-90	25-40	5-15
Dona Ana----------	0-5	Fine sandy loam	SM	A-2, A-4	0	95-100	90-100	60-85	30-50	15-25	NP-5
	5-60	Sandy clay loam, sandy loam, loam.	SC, SM-SC	A-6, A-4	0	95-100	90-100	80-90	35-50	25-40	5-15
BK*:											
Berino-------	0-5	Fine sandy loam	SM	A-2, A-4	0	95-100	95-100	60-95	30-50	---	NP
	5-60	Sandy clay loam, sandy loam.	SC, SM-SC, CL, CL-ML	A-6, A-4	0	95-100	95-100	65-80	35-55	20-35	5-15

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
BK*:											
Dona Ana	0-6	Fine sandy loam	SM	A-2, A-4	0	95-100	90-100	60-85	30-50	15-25	NP-5
	6-60	Sandy clay loam, sandy loam, loam.	SC, SM-SC	A-6, A-4	0	95-100	90-100	80-90	35-50	25-40	5-15
BL*:											
Berino	0-8	Fine sandy loam	SM	A-2, A-4	0	95-100	95-100	60-95	30-50	---	NP
	8-60	Sandy clay loam, sandy loam.	SC, SM-SC, CL, CL-ML	A-6, A-4	0	95-100	95-100	65-80	35-55	20-35	5-15
Pintura	0-60	Loamy fine sand	SP-SM, SM	A-3, A-2	0	100	100	70-95	5-25	---	NP
Bm Bluepoint	0-12	Loamy sand	SM	A-2	0	90-100	90-100	75-85	20-35	---	NP
	12-60	Stratified loamy fine sand to loamy sand.	SM	A-2	0	90-100	90-100	70-80	15-25	---	NP
Bn Bluepoint	0-18	Loamy sand	SM	A-2	0	90-100	90-100	75-85	20-35	---	NP
	18-60	Stratified loamy fine sand to loamy sand.	SM	A-2	0	90-100	90-100	70-80	15-25	---	NP
BO Bluepoint	0-17	Loamy sand	SM	A-2	0	90-100	90-100	75-85	20-35	---	NP
	17-60	Stratified loamy fine sand to loamy sand.	SM	A-2	0	90-100	90-100	70-80	15-25	---	NP
BP*:											
Bluepoint	0-19	Loamy sand	SM	A-2	0	90-100	90-100	75-85	20-35	---	NP
	19-60	Stratified loamy fine sand to loamy sand.	SM	A-2	0	90-100	90-100	70-80	15-25	---	NP
Caliza	0-22	Very gravelly sandy loam.	GP-GM, GM	A-1	0	30-50	25-45	15-35	5-20	20-30	NP-5
	22-60	Very gravelly loamy sand, very gravelly sand.	GP, GP-GM	A-1	0	25-50	20-40	10-30	0-10	---	NP
Yturbide	0-15	Loamy sand	SM	A-1, A-2	0	80-95	75-90	40-70	15-30	---	NP
	15-26	Gravelly loamy sand.	SM, SP-SM	A-1, A-2	0	65-80	60-75	35-55	10-20	---	NP
	26-60	Gravelly sand, gravelly loamy sand, loamy sand.	SP-SM	A-1, A-2, A-3	0-5	60-80	55-75	30-60	5-10	---	NP
Br Brazito	0-5	Loamy fine sand	SM	A-2	0	95-100	95-100	70-85	15-30	---	NP
	5-60	Fine sand, sand	SP, SP-SM	A-3	0	95-100	95-100	65-85	0-10	---	NP
Bs Brazito	0-15	Very fine sandy loam.	ML, SM, CL-ML, SM-SC	A-4	0	95-100	95-100	75-90	35-55	20-30	NP-10
	15-60	Fine sand, sand	SP, SP-SM	A-3	0	95-100	95-100	65-85	0-10	---	NP
CA*:											
Cacique	0-2	Loamy sand	SM	A-2	0	100	100	50-80	15-35	---	NP
	2-25	Sandy clay loam, sandy loam.	SC	A-2, A-6	0	90-100	85-100	65-90	30-50	25-35	10-15
	25	Indurated	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
CA*:											
Cruces------------	0-2	Loamy sand--------	SM	A-2	0	90-100	90-100	70-90	15-35	---	NP
	2-14	Fine sandy loam, sandy clay loam.	CL-ML, SM-SC, SC, CL	A-2, A-4	0	90-100	80-100	80-90	30-60	20-30	5-10
	14	Indurated--------	---	---	---	---	---	---	---	---	---
Simona------------	0-7	Loamy sand-------	SM	A-2	0	100	100	90-100	15-35	---	NP
	7-18	Fine sandy loam, sandy loam, gravelly fine sandy loam.	SM	A-2, A-4	0-5	70-100	65-100	50-100	20-50	---	NP
	18	Indurated--------	---	---	---	---	---	---	---	---	---
Cb*:											
Canutio-----------	0-10	Gravelly sandy loam.	SM-SC, SC	A-1, A-2	5-25	60-75	60-70	30-40	10-30	20-40	5-20
	10-60	Very gravelly sandy loam, very gravelly loamy sand, gravelly loamy sand.	GP-GC, SC, GC, SP-SC	A-2	10-20	45-75	45-70	25-40	5-20	20-40	5-20
Arizo-------------	0-15	Gravelly sandy loam.	GM	A-1, A-2	0-15	50-60	50-60	30-55	15-35	---	NP
	15-60	Stratified very gravelly sand to loamy sand.	GP-GM, GP	A-1	0-15	25-55	20-50	10-30	0-10	---	NP
CH*:											
Cave--------------	0-16	Gravelly sandy loam.	SM-SC	A-2, A-4	0-5	70-90	60-75	40-65	25-50	25-30	5-10
	16	Indurated--------	---	---	---	---	---	---	---	---	---
Harrisburg--------	0-3	Fine sandy loam	SM	A-4	0	95-100	90-100	70-85	40-50	20-30	NP-5
	3-24	Fine sandy loam, gravelly fine sandy loam.	SM	A-2, A-4	0	60-90	60-90	40-70	15-45	20-30	NP-5
	24	Indurated--------	---	---	---	---	---	---	---	---	---
DR*:											
Dona Ana----------	0-5	Fine sandy loam	SM	A-2, A-4	0	95-100	90-100	60-85	30-50	15-25	NP-5
	5-60	Sandy clay loam, sandy loam, loam.	SC, SM-SC	A-6, A-4	0	95-100	90-100	80-90	35-50	25-40	5-15
Reagan------------	0-23	Clay loam--------	CL	A-6, A-7	0	95-100	95-100	90-100	70-95	35-45	20-30
	23-71	Silty clay, silty clay loam, loam.	CL	A-6, A-7	0	95-100	95-100	85-100	65-95	35-50	20-30
DS. Dumps											
Ge---------------- Glendale	0-8	Loam-------------	SM, ML	A-4	0	95-100	95-100	75-85	40-60	20-30	NP-5
	8-60	Clay loam, silty clay loam, very fine sandy loam.	CL	A-6	0	100	100	95-100	75-90	30-40	15-25
Gf---------------- Glendale	0-8	Clay loam--------	CL	A-6	0	100	100	95-100	75-90	30-40	15-25
	8-60	Clay loam, silty clay loam, very fine sandy loam.	CL	A-6	0	100	100	95-100	75-90	30-40	15-25

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Gg----------------- Glendale	0-12	Clay loam--------	CL	A-6	0	100	100	80-95	75-90	30-40	15-25
	12-60	Clay loam, silty clay loam.	CL	A-6	0	100	100	80-95	75-90	30-40	15-25
HD*. Haplargids											
Hf----------------- Harkey	0-13	Fine sandy loam	SM	A-4	0	100	100	60-70	35-50	---	NP
	13-56	Very fine sandy loam, loam, silt loam.	ML	A-4	0	100	100	85-100	75-90	20-30	NP-5
	56-60	Fine sand	SP-SM, SM	A-3, A-4	0	100	100	70-95	5-25	---	NP
Hg----------------- Harkey	0-18	Loam-------------	ML	A-4	0	100	100	90-100	65-90	20-30	NP-5
	18-60	Very fine sandy loam, loam, silt loam.	ML	A-4	0	100	100	85-100	75-90	20-30	NP-5
Hh----------------- Harkey	0-10	Loam-------------	ML	A-4	0	100	100	90-100	65-90	20-30	NP-5
	10-47	Very fine sandy loam, loam, silt loam.	CL-ML, ML, CL	A-4	0	100	100	85-100	75-90	20-30	NP-10
	47-60	Loamy sand	SM	A-1, A-2	0	85-100	75-100	45-80	10-30	---	NP
Hk----------------- Harkey	0-12	Clay loam--------	CL	A-6	0	100	100	85-100	70-80	30-40	10-20
	12-60	Fine sandy loam, loam, silt loam.	ML	A-4	0	100	100	85-100	75-90	20-30	NP-5
MN*: Masonfort---------	0-3	Sandy loam-------	SM	A-2, A-4	0-5	85-100	80-100	50-70	25-40	20-30	NP-5
	3-18	Sandy loam, gravelly sandy loam.	SM, GM	A-1, A-2	0-10	60-100	55-95	35-65	15-35	20-30	NP-5
	18	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Nickel-------------	0-8	Gravelly sandy loam.	GM, SM	A-1, A-2	0-5	55-80	50-75	30-70	10-30	---	NP
	8-60	Very gravelly sandy loam, very gravelly fine sandy loam, gravelly sandy loam.	GP-GM, GM, SP-SM, SM	A-1	0-10	30-60	20-55	15-35	5-15	---	NP
Mo----------------- Mimbres	0-10	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	75-95	25-45	10-25
	10-60	Silty clay loam, silt loam, clay loam.	CL	A-6, A-7	0	100	100	90-100	75-95	25-45	10-25
MR*: Minlith-----------	0-3	Loamy sand-------	SM, SP-SM	A-1, A-2	0-5	85-100	75-100	45-80	10-30	---	NP
	3-13	Very gravelly loamy sand, very gravelly loamy fine sand.	GP-GM, GM, SP-SM, SM	A-1	5-25	45-60	40-50	20-40	5-15	---	NP
	13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
MR*:											
Onite	0-5	Loamy sand	SM	A-2	0	100	100	50-95	15-35	---	NP
	5-27	Sandy loam, gravelly sandy loam.	SM	A-2	0	75-100	65-100	50-95	15-35	---	NP
	27-60	Loamy sand, gravelly sandy loam, sandy loam.	SM	A-1, A-2	0	65-100	60-100	45-85	10-35	---	NP
MS*:											
Motoqua	0-2	Cobbly loam	GM-GC, GC	A-4, A-6	25-30	65-85	60-75	50-65	35-50	20-35	5-15
	2-20	Very cobbly silt loam, very cobbly loam.	GM-GC, GC	A-4, A-6	25-45	55-65	55-65	50-55	35-40	20-35	5-15
	20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
NB*:											
Nickel	0-2	Very gravelly sandy loam.	GP-GM, GM,	A-1, A-2	0-5	25-55	20-50	15-45	5-35	---	NP
	2-60	Very gravelly sandy loam, very gravelly fine sandy loam, gravelly sandy loam.	GP-GM, GM, SP-SM, SM	A-1	0-10	30-60	20-55	15-35	5-15	---	NP
Badland.											
NU*:											
Nickel	0-5	Very gravelly fine sandy loam.	GM, GP-GM	A-1, A-2	0-5	25-55	20-50	15-45	5-35	---	NP
	5-60	Very gravelly sandy loam, very gravelly fine sandy loam, gravelly sandy loam.	GP-GM, GM, SP-SM, SM	A-1	0-10	30-60	20-55	15-35	5-15	---	NP
Upton	0-14	Gravelly sandy loam.	CL, GC, SC	A-4, A-6	0-5	65-85	60-75	51-70	35-55	25-38	10-15
	14-22	Cemented	---	---	0-50	---	---	---	---	---	---
	22-60	Variable	---	---	0-20	---	---	---	---	---	---
OP*:											
Onite	0-5	Loamy sand	SM	A-2	0	100	100	50-95	15-35	---	NP
	5-18	Sandy loam, gravelly sandy loam.	SM	A-2	0	75-100	65-100	50-95	15-35	---	NP
	18-60	Loamy sand, gravelly sandy loam, sandy loam.	SM	A-1, A-2	0	65-100	60-100	45-85	10-35	---	NP
Pajarito	0-8	Fine sandy loam	SM, SM-SC	A-2, A-4	0	100	100	85-100	30-45	10-20	NP-5
	8-25	Fine sandy loam, sandy loam.	SM, SM-SC	A-2, A-4	0	90-100	85-100	60-100	25-45	10-20	NP-5
	25-60	Fine sandy loam, sandy loam, loam, fine sand.	SM, ML	A-4, A-2	0	90-100	85-100	60-95	20-55	20-30	NP-5

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
OP*:											
Pintura	0-60	Fine sand	SP-SM, SM	A-3, A-2	0	100	100	70-95	5-25	---	NP
OR*:											
Onite	0-5	Loamy fine sand	SM	A-2	0	100	100	50-95	15-35	---	NP
	5-20	Sandy loam, gravelly sandy loam.	SM	A-2	0	75-100	65-100	50-95	15-35	---	NP
	20-60	Loamy sand, gravelly sandy loam, sandy loam.	SM	A-1, A-2	0	65-100	60-100	45-85	10-35	---	NP
Pintura	0-60	Fine sand	SP-SM, SM	A-3, A-2	0	100	100	70-95	5-25	---	NP
Pa Pajarito	0-12	Fine sandy loam	SM, SM-SC	A-2, A-4	0	100	100	85-100	30-45	10-20	NP-5
	12-20	Fine sandy loam, sandy loam.	SM, SM-SC	A-2, A-4	0	90-100	85-100	60-100	25-45	10-20	NP-5
	20-60	Fine sandy loam, sandy loam, loam.	SM, ML	A-4, A-2	0	90-100	85-100	60-95	20-55	20-30	NP-5
Pb*:											
Pajarito	0-14	Loamy fine sand	SM	A-2	0	100	100	85-100	25-35	---	NP
	14-28	Fine sandy loam, sandy loam.	SM, SM-SC	A-2, A-4	0	90-100	85-100	60-100	25-45	10-20	NP-5
	28-60	Fine sandy loam, sandy loam, loamy very fine sand.	SM, ML	A-4, A-2	0	90-100	85-100	60-95	20-55	20-30	NP-5
Pintura	0-10	Loamy fine sand	SP-SM, SM	A-3, A-2	0	100	100	70-95	5-25	---	NP
	10-60	Fine sand	SP-SM, SM	A-3, A-2	0	100	100	70-75	5-25	---	NP
PN*:											
Pinaleno	0-2	Very gravelly sandy loam.	GM	A-1	0-15	30-55	25-50	15-35	10-20	20-30	NP-5
	2-20	Very gravelly sandy loam, very gravelly sandy clay loam.	GM-GC	A-2	0-20	30-55	25-50	15-45	10-25	25-30	5-10
	20-37	Very gravelly sandy loam.	GM	A-1	0-20	30-55	25-50	15-35	10-20	20-30	NP-5
	37-60	Very gravelly loamy sand.	GP-GM, GM	A-1	0-20	30-55	25-50	15-35	5-15	---	NP
Nolam	0-2	Very gravelly fine sandy loam.	GM	A-1, A-2	0	35-50	35-50	25-40	15-30	---	NP
	2-17	Very gravelly sandy clay loam, very gravelly sandy loam.	GM-GC, GC, GP-GC	A-2	0	35-50	35-50	25-45	10-25	25-40	5-15
	17-40	Very gravelly sandy loam.	GM, GP-GM	A-1	0	35-50	35-50	20-35	10-20	---	NP
	40-71	Very gravelly sand, very gravelly loamy sand.	GM, GP-GM	A-1	0	35-50	35-50	20-35	5-15	---	NP
RE. Riverwash											

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
RF*: Riverwash.											
Arizo	0-12	Gravelly loamy sand.	GM	A-1	0-15	50-75	50-75	20-45	15-25	---	NP
	12-60	Stratified very gravelly sand to very gravelly loamy sand.	GP-GM, GP	A-1	0-15	25-55	20-50	10-30	0-10	---	NP
RG*: Rock outcrop.											
Argids.											
RH*: Rock outcrop.											
Argids.											
RL*: Rock outcrop.											
Lozier	0-6	Stony loam	GC, SC, CL	A-2, A-4, A-6	5-20	40-80	30-70	25-65	20-60	25-35	10-15
	6-11	Very stony loam	GC	A-2, A-4	35-70	35-65	30-60	30-50	20-40	25-35	10-15
	11	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
RT*: Rock outcrop.											
Torriorthents.											
SH*: Simona	0-2	Sandy loam	SM	A-4	0	100	100	90-100	35-50	---	NP
	2-12	Fine sandy loam, sandy loam, gravelly fine sandy loam.	SM	A-2, A-4	0-5	70-100	65-100	50-100	20-50	---	NP
	12	Indurated	---	---	---	---	---	---	---	---	---
Harrisburg	0-8	Fine sandy loam	SM	A-4	0	95-100	90-100	70-85	40-50	20-30	NP-5
	8-24	Fine sandy loam, sandy loam.	SM	A-2, A-4	0	95-100	90-100	55-85	30-50	20-30	NP-5
	24	Indurated	---	---	---	---	---	---	---	---	---
ST*: Stellar	0-3	Clay loam	CL	A-6	0	100	100	90-100	70-95	30-40	10-20
	3-28	Clay, sandy clay, clay loam.	CH, CL, SC	A-7	0	100	100	80-95	45-90	40-60	15-30
	28-60	Clay loam, sandy clay loam, gravelly clay loam.	CL, GC, SC	A-6, A-7	0-5	65-100	60-100	55-100	45-70	30-50	10-25
Stellar, flooded	0-5	Clay loam	CL	A-6	0	100	100	95-100	70-80	30-40	10-20
	5-31	Clay	CL, CH	A-7	0	100	100	90-100	70-90	40-55	15-30
	31-60	Sandy clay loam, clay loam.	SM-SC, SC, CL-ML, CL	A-4, A-6	0	95-100	90-100	80-95	40-75	25-40	5-15

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
TE*:											
Tencee	0-7	Very gravelly sandy loam.	GM, GP-GM	A-1	0-25	35-50	25-45	15-40	5-20	20-30	NP-5
	7	Indurated	---	---	---	---	---	---	---	---	---
Upton	0-16	Gravelly sandy loam.	CL, GC, SC	A-4, A-6	0-2	65-85	60-75	51-70	35-55	25-35	10-15
	16-22	Cemented	---	---	0-50	---	---	---	---	---	---
	22-60	Variable	---	---	0-20	---	---	---	---	---	---
TF*:											
Terino	0-2	Very gravelly sandy loam.	GP-GM, GM, SM, SP-SM	A-1, A-2, A-3	0-5	35-60	25-50	15-45	5-30	---	NP
	2-15	Very gravelly sandy clay loam, very gravelly sandy loam.	GM-GC, GM, GC, GP-GM	A-1, A-2	0-5	35-55	25-50	20-45	10-30	20-30	NP-10
	15-32	Indurated	---	---	---	---	---	---	---	---	---
	32-60	Very gravelly sandy loam, very gravelly loamy sand.	GP-GM, GM	A-1	0-10	35-55	25-50	15-40	5-20	---	NP
Casito	0-6	Very gravelly sandy loam.	GM, GP-GM	A-1	0-5	35-50	30-50	15-35	10-25	---	NP
	6-12	Very gravelly sandy clay loam.	GM-GC, GC, GP-GC	A-1, A-2	0-5	30-50	25-50	20-45	10-30	20-30	5-15
	12-28	Indurated	---	---	---	---	---	---	---	---	---
	28-60	Very gravelly sandy loam, very gravelly loamy sand.	GM, GP-GM	A-1	0-5	35-50	30-50	15-40	5-20	---	NP
Pinaleno	0-2	Very gravelly sandy loam.	GM	A-1	0-15	30-55	25-50	15-35	10-20	20-30	NP-5
	2-30	Very gravelly sandy loam, very gravelly sandy clay loam.	GM-GC	A-2	0-20	30-55	25-50	15-45	10-25	25-30	5-10
	30-40	Very gravelly sandy loam.	GM	A-1	0-20	30-55	25-50	15-35	10-20	20-30	NP-5
	40-60	Very gravelly loamy sand.	GP-GM, GM	A-1	0-20	30-55	25-50	15-35	5-15	---	NP
Vf Vinton Variant	0-14	Fine sandy loam	SM, ML	A-4	0	100	100	70-90	40-65	15-25	NP-5
	14-32	Loamy sand, loamy fine sand, fine sand.	SM	A-2	0	100	100	50-85	15-35	---	NP
	32-42	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	42-60	Sand	SP, SP-SM, SM	A-2, A-3	0	100	100	60-80	0-15	---	NP
Vg Vinton Variant	0-16	Sandy clay loam	SC, CL	A-6	0	100	100	80-95	35-75	30-40	10-15
	16-33	Loamy sand, loamy fine sand, fine sand.	SM	A-2	0	100	100	50-85	15-35	<20	NP
	33-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
WH*:											
Wink	0-2	Fine sandy loam	SM,	A-2	0-5	90-100	90-100	80-100	15-35	15-25	NP-5
	2-26	Fine sandy loam, loam.	SM, SM-SC	A-2 A-4	0-5	90-100	90-100	80-100	25-45	15-25	NP-10
	26-60	Sandy loam	SM-ML	A-2, A-4	0	95-100	95-100	60-85	30-55	15-25	NP-5
Harrisburg	0-4	Loamy fine sand	SM	A-2	0	95-100	90-100	75-85	25-35	---	NP
	4-24	Fine sandy loam, sandy loam.	SM	A-2, A-4	0	95-100	90-100	55-85	30-50	20-30	NP-5
	24	Indurated	---	---	---	---	---	---	---	---	---
Simona	0-2	Sandy loam	SM	A-4	0	100	100	90-100	35-50	---	NP
	2-7	Fine sandy loam, sandy loam, gravelly fine sandy loam.	SM	A-2, A-4	0-5	70-100	65-100	50-100	20-50	---	NP
	7	Indurated	---	---	---	---	---	---	---	---	---
WP*:											
Wink	0-10	Loamy fine sand	SM, SM-SC	A-2	0-5	90-100	90-100	80-100	15-35	15-25	NP-5
	10-20	Fine sandy loam, loam.	SM, SM-SC	A-4	0-5	90-100	90-100	80-100	25-45	15-25	NP-10
	20-60	Sandy loam, loamy fine sand	SM	A-2, A-4	0	90-100	90-100	55-85	25-50	15-30	NP-5
Pintura	0-60	Loamy fine sand	SP-SM, SM	A-3, A-2	0	100	100	70-95	5-25	---	NP

* See description of the map unit for composition and behavior characteristics of the map unit.

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