Small Flood Risk Management Project Hatch, NM

Appendix A

Hydrology and Hydraulics

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DRAFT

US Army Corps
of Engineers ®
Albuquerque District

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1 - Introduction

1.1 Authorization

Under the authority of Section 205, Flood Control Act of 1948, as amended, the Albuquerque District (SPA) of the U.S. Army Corps of Engineers (USACE), in cooperation with Doña Ana Soil and Water Conservation District, will plan and construct a small flood risk reduction project.

1.2 Purpose of Hydrologic Analysis

The purpose of the hydrologic analysis is to determine new peak discharge frequency relationships and design hydrographs for a portion of the drainage area in Doña Ana County, New Mexico. This study establishes peak discharge frequency and flood hydrographs for eight events (50-percent, 20-percent, 10-percent, 4-percent, 2-percent, 1-percent, 0.5 -percent and 0.2-percent exceedance frequency events) specifically for existing conditions for Spring Canyon in Hatch, NM. Probable Maximum Flood hydrographs were also developed for the purposes of dam safety design.

2 - Spring Canyon Watershed

2.1 Watershed Description

Figure 1 shows the watershed boundaries. Development is urban and agriculture in the valley, and non-existent elsewhere in the watershed. Further development is not anticipated in the watershed; consequently, the future condition is the same as existing condition.

Spring Canyon rises in the Sierra de Las Uvas and flows northward towards the Village of Hatch, NM (Hatch) and the Rio Grande. Elevations range from almost 6000 feet in the Sierra de Las Uvas to 4030 feet at the confluence with the Rio Grande. Stream slopes are steep throughout most of the watershed, but are mild in the Rio Grande Valley. The Spring Canyon drainage area upstream from the Village is 7.18 square miles at Rodey Lateral. An existing feature, Spring Canyon Dam, is located within the watershed upstream from Hatch. Spring Canyon Dam was constructed by the Soil Conservation Service in 1939 for the purpose of detaining flood water and retaining sediment. It addresses 5.40 square miles of the 7.18 square mile watershed upstream from Hatch, leaving 1.78 square miles unaddressed. Spring Canyon Dam has an ungated low level outlet and has an existing storage capacity of 450 acre feet at the spillway crest, based on 2004 topographic mapping. The dam addresses the 1-percent exceedance (100-year frequency) event with no flow over the spillway. The 0.2-percent exceedance (500- year frequency) event will reach a maximum water surface elevation of 0.2 feet above the spillway crest. The subbasins shown on Figure 2.2.1 partition the 8.04 square miles of contributing drainage area at Hatch as follows:

- Subbasin IVB - Upper Spring Canyon Watershed, area = 5.4 square miles.

- Subbasin IVA - Lower Spring Canyon Watershed, area = 0.56 square miles.
- Subbasin V – Watershed containing small arroyos located immediately west of Spring Canyon that feed directly into a low ponding area at Rodey Lateral just upstream from Hatch, area = 1.22 square miles.
- Subbasin VIAI – Local Drainage area of the community of Hatch, area = 0.86 square miles.

The existing Spring Canyon Dam is a concrete gravity structure under the jurisdiction of the New Mexico Office of the State Engineer, Dam Safety Bureau (OSE-DSB) and has a hazard potential classification of "high" based on proximity to downstream residents. The Village of Hatch, NM is listed as the Owner. The last inspection report for Spring Canyon Dam was dated March, 17, 2014 and is included in Appendix A – Hydrology & Hydraulics. As sited in the OSE-DSB inspection report, the primary deficiency is related to the spillway capacity:

Spillway Capacity

The OSE rules and regulations require high hazard dams such as this to be capable of withstanding, without catastrophic failure, the flood discharge resulting from the critical Probable Maximum Precipitation event, which is termed the Probable Maximum Flood (PMF). A quick calculation of the capacity of the spillway using the weir equation and the PMF determined by the USACE Envelope Curve indicates a spillway capacity for this structure of approximately 80% of the PMF. The Owner needs to have an updated hydrologic and flood routing analysis performed by a qualified Professional Engineer licensed in New Mexico as part of the preparation of the forthcoming Emergency Action Plan. An Incremental Damage Assessment (IDA) is an option to determine if the inadequate spillway capacity is acceptable.

At the mouth of Spring Canyon, a training dike diverts flow into a low ponding area behind an embankment of Rodey Lateral. A 42 inch diameter corrugated metal pipe culvert (CMP) passes the ponded water under Rodey Lateral into the upper end of the Colorado Drain. The Rodey Lateral embankment is approximately 9 feet above the invert of the 42 inch CMP. The 42 inch CMP under the full 9 foot head is calculated to convey approximately 100 cfs if unobstructed.

The training dike is a non-engineered structure that is not routinely maintained by any agency. If the training dike fails due to piping or overtopping, water from Spring Canyon will not be diverted into the ponding area behind the Rodey Lateral embankment, but will instead continue directly west to Rodey Lateral.

There is no spillway at the ponding area behind the Rodey Lateral embankment. Any flood waters in excess of the capacity of the 42 inch diameter CMP will pond behind the Rodey Lateral embankment. If the flood water volume exceeds the storage capacity of the ponding area, then water will flow into and over Rodey Lateral. The volume of the low area behind the Rodey Lateral embankment is approximately 100 acre feet compared to the volume of the 10% chance (10-year) flood of 235 acre feet. This location will be considered for the proposed Hatch Dam to intercept flood waters and convey them through the Colorado Drain, which is described below, to mitigate flooding in Hatch, NM.

Rodey Lateral normally carries irrigation water and has effectively no capacity to convey additional flood waters. Consequently, flood flows, whether they are from a failure of the training dike or from an overflow of the ponding area, or both, will overtop Rodey Lateral and continue on to Colorado Drain. Rodey Lateral is not designed to withstand overtopping and would likely fail under this condition. Therefore, once overtopping occurs and Rodey Lateral is breeched, the entire flood volume is expected to enter Hatch.

Colorado Drain is an earthen channel intended for ground water relief and to convey excess irrigation water to the Rio Grande. It runs 3.7 miles to the south where it eventually joins the Rio Grande. The maximum channel capacity of Colorado Drain is calculated to be 300 cfs if well maintained with no obstructions. Flood flows in excess of the capacity of Colorado Drain flow directly into Hatch and adjacent agricultural lands. Canal embankments and raised roadways prevent the spread of flood waters so that the floods pond in Hatch until they gradually drain away.

2.2 Climate

The climate is semi-arid continental, with characteristically low annual precipitation, low humidity, high evaporation, wide temperature variations, and an abundance of clear, sunny days. Precipitation during the summer months is usually in the form of thunderstorms of short duration, resulting from convective or orographic lifting or a combination of both. The more intense of these storms follow a period of inflow of warm moist air from the Gulf of Mexico. Occasionally, precipitation occurs as a result of an invasion of tropical Pacific air. Moist air from the Gulf of Mexico or the Pacific Ocean produces the typical short-duration, high intensity, summer thunderstorms that produce floods in the watershed.

Frontal activity is prevalent in this area during the winter and early spring months and if moist air is present, rain or snow of light intensity results. Average daily temperatures at Hatch reach a low in January of 40.8°F and a high of 79.5°F in July. Precipitation averages range from a low of 0.19 inches in April to a high of 2.23 inches in August. Average annual precipitation is 9.58 inches at Hatch. A storm with 3.25 inches of rainfall, or more, in 24 hours, is estimated to be the 1-percent exceedance (100- year frequency) event. This means it has a 1% chance of being equaled, or exceeded, each year. Table 1 lists precipitation intensity-duration relationships for the study area.

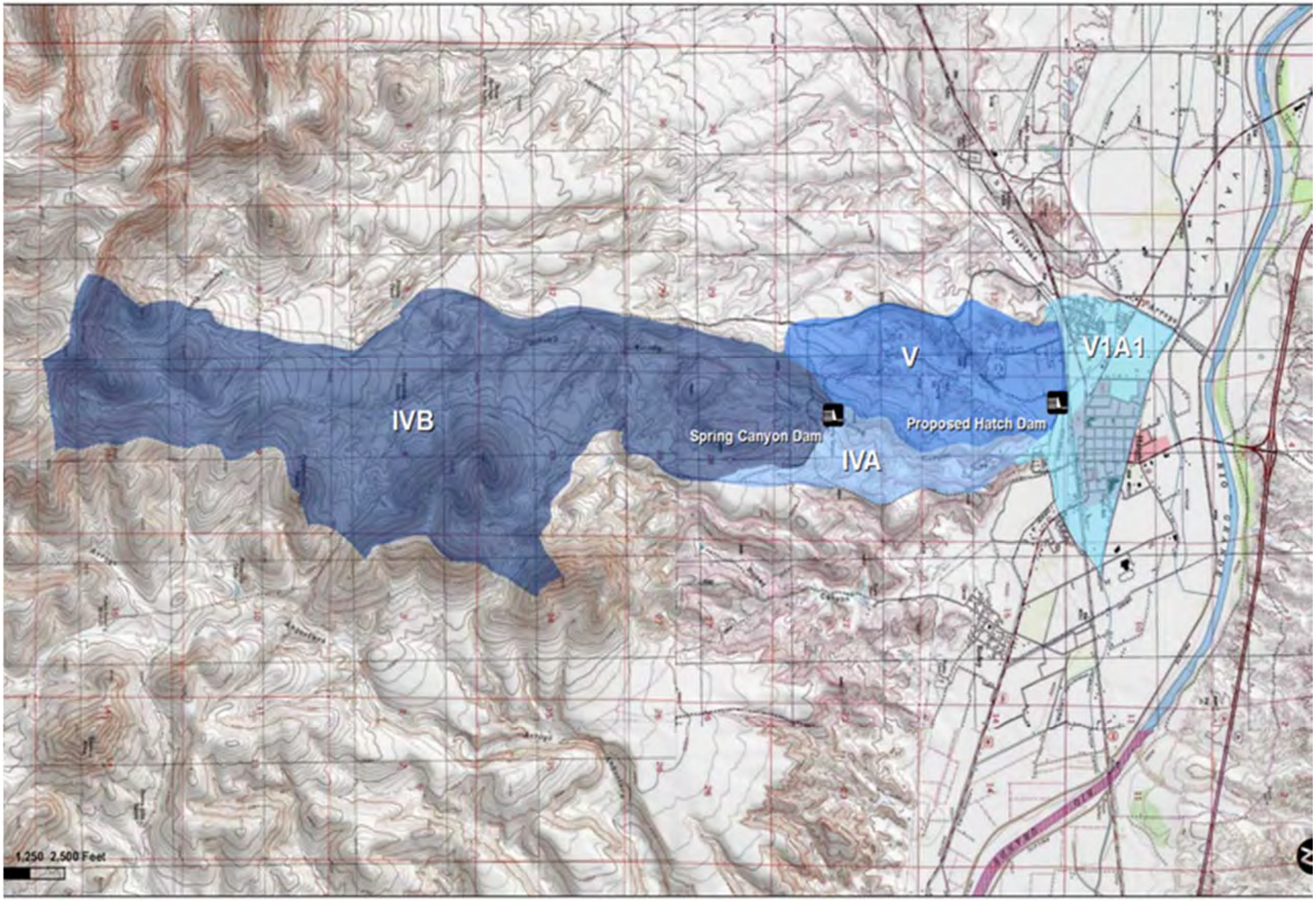

Figure 1 Watershed boundaries.

Table 1 Precipitation intensity-duration relationships for Spring Canyon watershed. Values listed are from NOAA Atlas 14 and are in inches.

Percent Chance Exceedance	5 min	10 min	15 min	30 min	60 min	2 hr	3 hr	6 hr	12 hr	24 hr
50%	0.28	0.43	0.53	0.71	0.88	1.00	1.06	1.21	1.33	1.46
20%	0.38	0.58	0.72	0.97	1.20	1.34	1.40	1.56	1.71	1.86
10%	0.46	0.69	0.86	1.16	1.43	1.60	1.67	1.84	2.00	2.17
4%	0.56	0.84	1.05	1.41	1.75	1.96	2.03	2.21	2.38	2.59
2%	0.63	0.96	1.19	1.60	1.98	2.24	2.31	2.49	2.66	2.91
1%	0.71	1.08	1.34	1.80	2.23	2.53	2.60	2.78	2.95	3.25
.5%	0.79	1.20	1.49	2.00	2.48	2.83	2.91	3.07	3.25	3.58
.2%	0.90	1.36	1.69	2.27	2.81	3.23	3.32	3.47	3.63	4.04
.1%	0.98	1.49	1.84	2.48	3.07	3.55	3.65	3.78	3.92	4.39

3 - Hydrologic Model Methodology

Due to the lack of stream gage data, a detailed HEC-HMS (HMS) model was developed using NOAA Atlas 14 precipitation frequency data. This method assumes that the rainfall frequencies used in the model will produce the same frequency run-off (i.e. 1% rainfall equates to 1% run-off).

3.1 HEC-HMS Model

This study uses the HEC-HMS software program for its hydrologic analysis. The program contains a number of uncoupled deterministic mathematical models, providing modelers with more choice as to methods deemed appropriate for a particular watershed. Errors introduced due to the use of uncoupled models are minimized by using a small time interval for calculations, 5 minutes in this case. All the mathematical models use constant parameter values, assuming that the values are stationary in time, when, of course, in reality they are not.

The HMS model consists of 5 major components: (1) the basin model, which is a physical description of the watershed; (2) the initial and constant loss method; (3) Snyder's unit hydrograph; (4) hydrograph routing: and (5) a meteorological model, which specifies how precipitation will be generated for each subbasin. The control specifications/information are used to control when model simulations start and stop, and the time interval for calculations. The following discussion will describe the methods and data used for this study analysis.

Many parameters from an existing hydrologic model (HEC-1) developed by Resource Technology, Inc., for the Doña Ana County Flood Commission were adapted for use in this study. Subarea parameters such as drainage area and unit hydrograph time of concentration were retained from the original model, but rainfall and hydrograph routing were adapted for this study.

3.2 Infiltration Rates

All of the models in this study used the initial and constant loss method. Published national soils and land use data is often used to develop values for the initial loss in inches, the constant loss in inches/hour, and percent impervious for each subbasin. Aerial photography data taken in 2004 and 2005 was used to verify land use and imperviousness within each subbasin. Engineering judgment was used to determine the actual values used in the models based on the nature of the published precipitation and evaporation rates of the study area. Table 3.3.1 lists the values used in this study.

Rainfall intensity-duration was obtained from NOAA Atlas 14. The hypothetical storm method was used to generate hyetographs. A storm duration of 24 hours and a computation period of five minutes were used. The depth-area reduction of 0.81 for 7.18 square miles was obtained from NOAA Technical Memorandum NWS Hydro-40.

3.3 Unit Hydrograph

The Synder synthetic unit hydrograph method was used for translating the precipitation into basin run-off. The HMS software also includes empirical methods that have been developed for estimating the time base of the hydrograph and the width at 50% peak flow. A previous study for the El Paso area, completed by the USACE Albuquerque District in 1982, developed a relationship between Snyder's C_t coefficient and drainage area slope, based on flood reconstructions in nearby drainages.

Snyder's method requires the calculation of t_p, the basin lag time in hours, and C_p, the unit hydrograph peaking coefficient. The basin lag time is defined as the length of time between the centroid of precipitation mass and the peak flow of the resulting hydrograph.

The coefficient C_p, sometimes called the storage coefficient, measures the steepness of the hydrograph that results from a unit of precipitation. Snyder's equation is shown below:

$$t_{p(hrs)}=C_t(LL_c)^{0.3}$$

where, C_t = basin coefficient related to the basin slope; L = longest flow path along the main stream from the outlet to the divide; and L_c = length along the main stream from the outlet to a point nearest the watershed centroid.

For all the subbasins in this study, the value of C_t was determined from the C_t versus slope curve developed for El Paso by the USACE Albuquerque District in 1982. The value of C_p in all subbasins was determined by the relationship: $C_p = C_p640$, where $C_p640 = 430$ for slopes < 0.015, or = 392 for slopes >0.015.

Snyder's time of concentration and storage coefficient were obtained from the relationship shown in Figure 2. The Snyder's parameters used in this analysis are listed in Table 2.

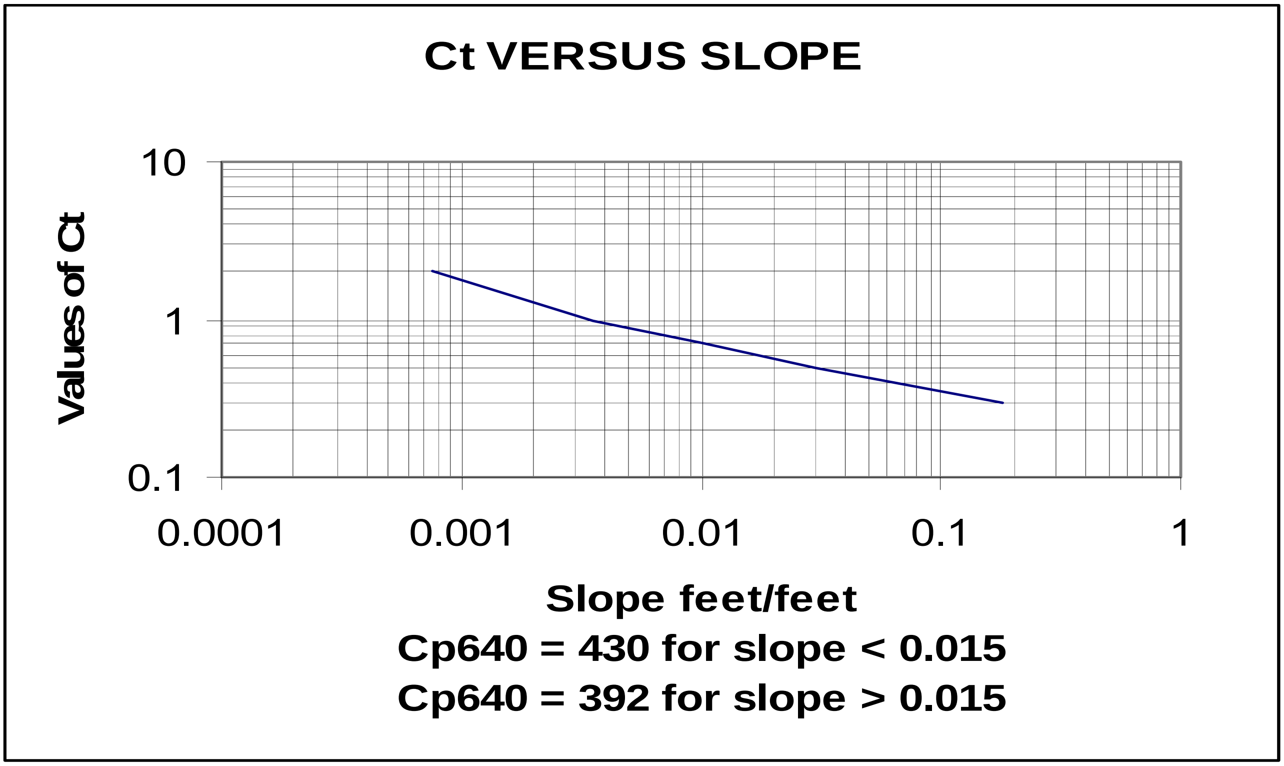

Figure 2 Snyder's Ct Versus Slope for Hatch area.

Table 2 Subbasin drainage area, Snyder's coefficients, loss rates, and impervious cover.

Subbasin Name	Drainage Area (sq mi)	Snyder's t_p (hrs)	Snyder's C_p	Initial Loss (inches)	Constant Loss (in/hr)	Impervious Cover (%)
IVB (Upper Spring Canyon Watershed)	5.40	1.19	0.61	0.9	0.2	0
IVA (Lower Spring Canyon Watershed)	0.56	0.62	0.61	0.9	0.2	0
V	1.22	0.53	0.61	0.9	0.2	0
V1A1	0.86	0.36	0.67	0.9	0.2	20

C_p= dimensionless peaking coefficient, t_p = time of hydrograph peak

3.4 Hydrograph Routing

The Muskingum-Cunge routing method was used in this analysis. This method requires determination of (1) the total length of the reach the hydrograph will be routed through, (2) the average slope for the whole reach, (3) the Manning’s n roughness coefficient averaged for the whole reach, and (4) a simplified physical description of a typical cross-section for the reach. The 8 point cross-sections for the model were developed using the Doña Ana County Flood Commission 2004 topographic mapping.

3.5 Flood Frequency Results

Peak discharges for selected locations are shown in Table 3. Inflow/outflow hydrographs and pool elevation/storage results from HEC-HMS modeling are shown in Figure 3. Because the HEC-HMS model is not calibrated, an equivalent period of record of 15 years was assigned for risk and uncertainty adjustments of average annual damages in accordance with guidance in EM 1110-2-1619, *Risk Based Analysis for Flood Damage Reduction Studies* (1996).

Table 3 Instantaneous peak discharges for selected locations.

Location (Concentration Points)	**Drainage Area (Sq. mi)**	50-percent exceedance (2- year frequency) event		20-percent exceedance (5- year frequency) event		10-percent exceedance (10- year frequency) event		4-percent exceedance (25- year frequency) event		2-percent exceedance (50- year frequency) event		1-percent exceedance (100- year frequency) event		0.5-percent exceedance (200- year frequency) event		0.2-percent exceedance (500- year frequency) event	
		(Cfs)	**(AF)**	**(Cfs)**	**(AF)**	**(Cfs)**	**(AF)**	**(Cfs)**	**(AF)**	**(Cfs)**	**(AF)**	**(Cfs)**	**(AF)**	**(Cfs)**	**(AF)**	**(Cfs)**	**(AF)**
Inflow to Spring Canyon Dam (IVB)	5.4	88	14	798	128	1342	214	2012	324	2498	406	3003	492	3500	579	4170	696
Outflow from Spring Canyon Dam (IVB to IVA)	5.4	52	13	158	124	180	168	192	188	201	197	211	207	221	217	582	280
Spring Canyon at Rodey Lateral (IVA + IVB + V)	7.18	58	16.5	540	164	913	235	1365	290	1665	327	1969	364	2260	403	2665	504
Spring Canyon at Hatch, NM (IVA + IVB + V + VIAI)	8.04	158	30	908	196	1477	282	2157	355	2633	405	3134	457	3625	509	4286	630

Hatch Dam HEC-HMS Results

0.2-percent exceedance (500-year frequency) event

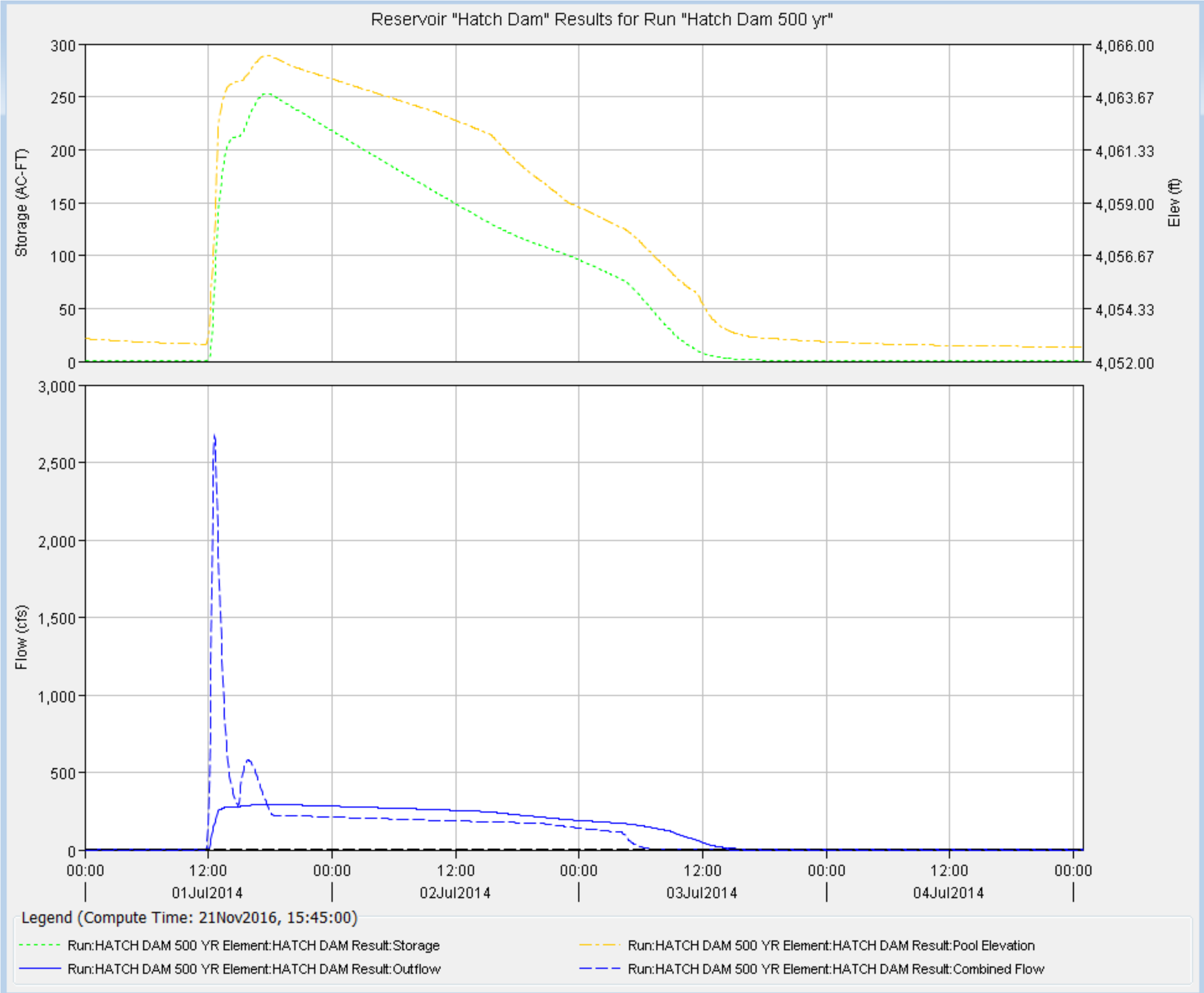

Figure 3 Inflow/outflow hydrographs and pool elevation/storage results from HEC-HMS modeling of Hatch Dam for the 0.2-percent exceedance (500-year frequency) event.

3.6 Development of the Probable Maximum Flood (PMF)

The PMF was developed for the proposed dam for dam safety purposes.

Probable maximum precipitation was developed using the guidance in *HMR 55A - PMP Estimates between the Continental Divide and the 103rd Meridian* (NOAA, June 1988). Total rain for the watershed is 14.47 inches for a six hour storm. The hyetograph is shown in Figure 4.

Infiltration rates for the PMF are 0.0 initial and 0.2 inches per hour constant. Snyder's T_c values were reduced by 0.8 for the PMF per guidance in *ER 1110-2-8 Explaining Flood Risk* (1992). Both the existing dam (Spring Canyon Dam) and proposed dam (Hatch Dam) were assumed full to spillway crest at the start of the PMF and the low level outlet was assumed plugged.

The proposed Hatch Dam was configured to divert the entire 0.2-percent exceedance (500- year frequency) event of 870 cfs into the reservoir, but to prevent most of the much larger PMF from entering. Figure 5 shows the PMF at the Spring Canyon diversion channel. Because of the greater depth of the PMF and the fact that the diversion channel has freeboard, the peak discharge of the PMF that enters the reservoir will exceed the design discharge of the diversion channel. The peak discharge of the PMF upstream of the diversion channel is 26,700 cfs. Of this, 25,200 cfs is designed to be diverted away from Hatch Dam. The remaining 1,500 cfs is designed to continue on into the Hatch Dam reservoir. This is almost double the 500-year design discharge of 870 cfs for the diversion channel.

Because there are uncontrolled drainage areas that are directly tributary to the proposed reservoir, a PMF spillway is still necessary. Figure 6 shows the PMF inflow and outflow for the proposed dam.

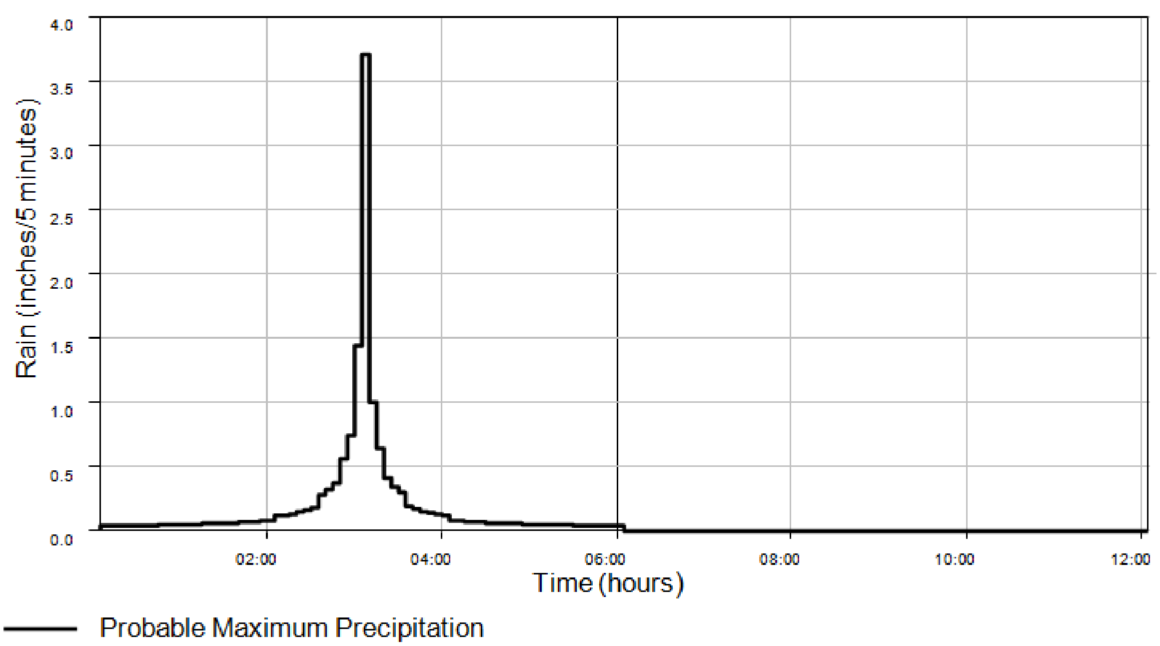

Figure 4 Hyetograph of the probable maximum precipitation. Values are rainfall in inches per five minute period.

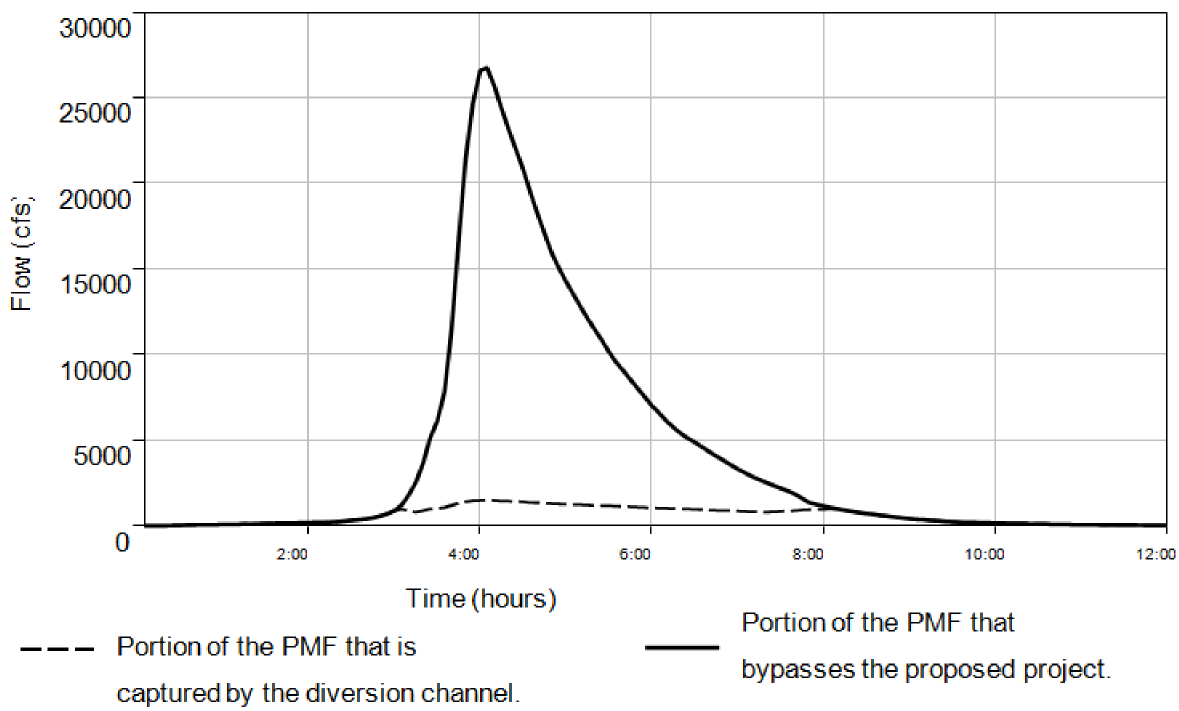

Figure 5 Probable maximum flood hydrographs at the Spring Canyon Diversion Channel.

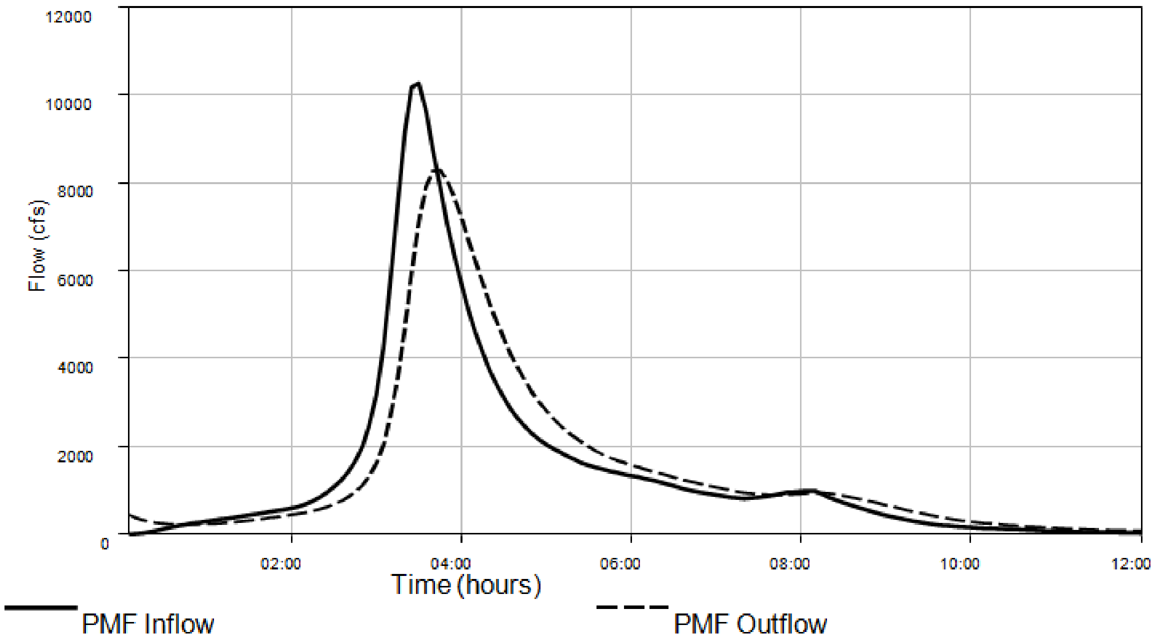

Figure 65 Probable maximum flood inflow and outflow hydrographs for the 0.2% chance (500-year) dam alternative.

3.7 Spring Canyon Pre-Project Inundation Mapping

Because flooding in Hatch is the result of ponding, the application of a riverine hydraulic model such as HEC-RAS is not appropriate. Instead inundation boundaries were determined with a storage elevation relationship in a HEC-HMS Model updated and refined from the original HEC-1 model developed by Resource Technology, Inc., for the Doña Ana County Flood Commission that was retained for use in this study.

Inflow into the ponding area in Hatch is from Spring Canyon. Outflow from the area is through the Colorado Drain and Hatch storm drain system. Peak water surface elevations were determined by routing the 50-percent, 20-percent, 10-percent, 4-percent, 2-percent, 1-percent, 0.5 -percent and 0.2-percent exceedance frequency events through the pond. See the pre-project inundation maps included in Appendix A – Hydrology & Hydraulics.

3.8 Spring Canyon Post-Project Inundation Mapping

Peak water surface elevations were determined by routing the 50-percent, 20-percent, 10-percent, 4-percent, 2-percent, 1-percent, 0.5 -percent and 0.2-percent exceedance frequency events through the proposed dam. No residual flooding from Spring Canyon occurs in Hatch, NM for events up to and including the design frequency. For example, there is no 0.2% chance (500-year) flood inundation from Spring Canyon in Hatch, NM for the recommended plan. There is, however, flooding from interior drainage that is not addressed by this project that may be addressed in the future by the local sponsor.

See the post-project inundation maps in Appendix A – Hydrology & Hydraulics which show interior drainage flooding in Hatch, NM.

4 - Hydraulic Analysis

A new dam is proposed to address flooding to Hatch, New Mexico. Three dam alternatives were analyzed. Each will address floods associated with different design flood frequencies described as follows:

- Dam A is sized to address the 4-percent exceedance (25- year frequency) event.
- Dam B is sized to address the 1-percent exceedance (100- year frequency) event.
- Dam C is sized to address the 0.2-percent exceedance (500- year frequency) event.

The recommended dam alternative is sized for a 0.2-percent exceedance (500- year frequency) event and will be referred to as “Dam C” or “the dam” in the following portions of this write-up. Dam C will detain a storage capacity of 283 acre-feet (AF). This storage capacity consists of a 30 AF sediment pool and 253 AF of water. The maximum height of embankment for Dam C is 18.6 feet and the dam includes a roller compacted concrete spillway and concrete outlet works with gate and tower. Access roads will be required on both sides of the dam and ramps will also be constructed to access the top of the dam. Fencing will enclose the reservoir and gates will be provided as needed for access to the new dam. A new trapezoidal channel will transport runoff from nearby Spring Canyon into the reservoir of Dam C. A new storm drain line will be provided to collect and remove standing water located outside the proposed dam area. Drawings illustrating new Dam C project features are included in Civil Engineering Appendix J

4.1 Hydraulic Uncertainty

The standard deviation for hydraulic uncertainty is calculated and explained below.

Since HEC-RAS was not used to directly determine water surface elevations (WSEL) in Hatch, the method of selecting high and low “n” values to determine standard deviation was not used.

Water surface elevations for Hatch were determined using HEC-HMS and the Reservoir Inundation Calculator Tool (RIC Tool) in ESRI’s ArcGIS. Floodwater from Spring Canyon ponds in Hatch, and the level of ponding is determined by the outflow capacity of the Colorado Drain and the efficiency of the Hatch interior drainage system.

To determine the upper reasonable stage, the Colorado Drain culvert at the second crossing of Rodey Lateral was assumed completely plugged. This is considered reasonable as the culvert was observed partly blocked with a large stump on a previous visit. There is a large amount of woody material and a partly collapsed timber bridge upstream of the second crossing that provides additional floatable material that could collect at the mouth of the culvert.

The high ponding volume assumes the Hatch interior drainage system is blocked with debris and is non-functioning.

The expected ponding volume assumes the Hatch interior drainage system functions to handle the interior drainage only. It could also be partially blocked but functioning at some capacity.

The low volume assumes the Hatch interior drainage system is functioning at optimum capacity to provide 300 cfs outflow during entire flood event. This makes an assumption that the interior drainage system is efficient enough to deliver all runoff into the Colorado Drain at its discharge capacity of 300 cfs and no blockages or obstructions are limiting flow conveyance.

Table 4 Post project calculated flood frequency volumes for the town of Hatch.

Flood Frequency % chance event	High Volume (AF)	Expected Volume (AF)	Low Volume (AF)
50% (2-yr)*	30	8.4	1
20% (5-yr)*	196	142	35
10% (10-yr)	282	225	76
4% (25-yr)	355	298	128
2% (50-yr)	405	347	168
1% (100-yr)	457	399	209
.5% (200-yr)	509	450	251
.2% (500-yr)	630	571	348

* *Flow contained within existing drainage system, no flooding expected*

Table 5 Post project calculated flood frequency water surface elevation standard deviations for the town of Hatch.

Flood Frequency % chance event	High WSEL (ft)	Expected WSEL (ft)	Low WSEL (ft)	Std Deviation (high-low)/4
50% (2-yr)*	4052.5	4052.5	4052.5	.3
20% (5-yr)*	4053	4053	4053	.3
10% (10-yr)	4056.3	4055.9	4054.6	.425
4% (25-yr)	4056.7	4056.4	4055.2	.375
2% (50-yr)	4057	4056.7	4055.5	.375
1% (100-yr)	4057.2	4057.0	4055.8	.35
.5% (200-yr)	4057.5	4057.2	4056.1	.35
.2% (500-yr)	4058.1	4057.8	4056.7	.35

* *Flow contained within existing drainage system, no flooding expected*

Hatch is not flooded by Spring Canyon until flows overtop and fail Rodey Lateral. The low ponding area just upstream of Rodey Lateral has a volume capacity of approximately 100 AF and a 42" CMP discharge pipe with a maximum unobstructed conveyance capacity of 100 cfs just prior to overtopping. Therefore, it is assumed that 2-yr and 5-yr flows from Spring Canyon are contained and controlled under existing conditions. However, any flow greater than the 5-yr flow is expected to overtop and fail Rodey Lateral with all flood waters being delivered into Hatch.

Water surface elevations were estimated based on flood volume estimates for Hatch using ESRI's ArcGIS and current Aerial mapping with "Good Reliability". Table 5-2 on page 5-5 in *EM 1110-2-1619 - Risk-Based Analysis for Flood Damage Reduction Studies* (1 August 1996) indicates a minimum standard deviation of 0.3 would be appropriate for this condition. All standard deviations calculated for flood flows were greater than this minimum.

4.2 Hydraulic Design of the Diversion Channel

Flood flows from Spring Canyon will be diverted into the reservoir by an entrenched diversion channel. An existing training dike will be removed and replaced with the diversion channel. Hydraulic dimensions for the 4-percent exceedance (25-year frequency), the 1-percent exceedance (100-year frequency), and the 0.2-percent exceedance (500-year frequency) event trapezoidal channels were determined using the HEC-RAS model. The 0.2% chance channel has a design discharge of 870 cfs with a channel slope of 0.0117 ft/ft. It has an average bottom width of 10 feet and an average depth of 5.5 ft. The channel will be lined with soil cement with side slopes of 3 horizontal to 1 vertical (3:1 slope). See Figure 7 showing the flow distribution of the 0.2-percent exceedance (500-year frequency) event through the watershed.

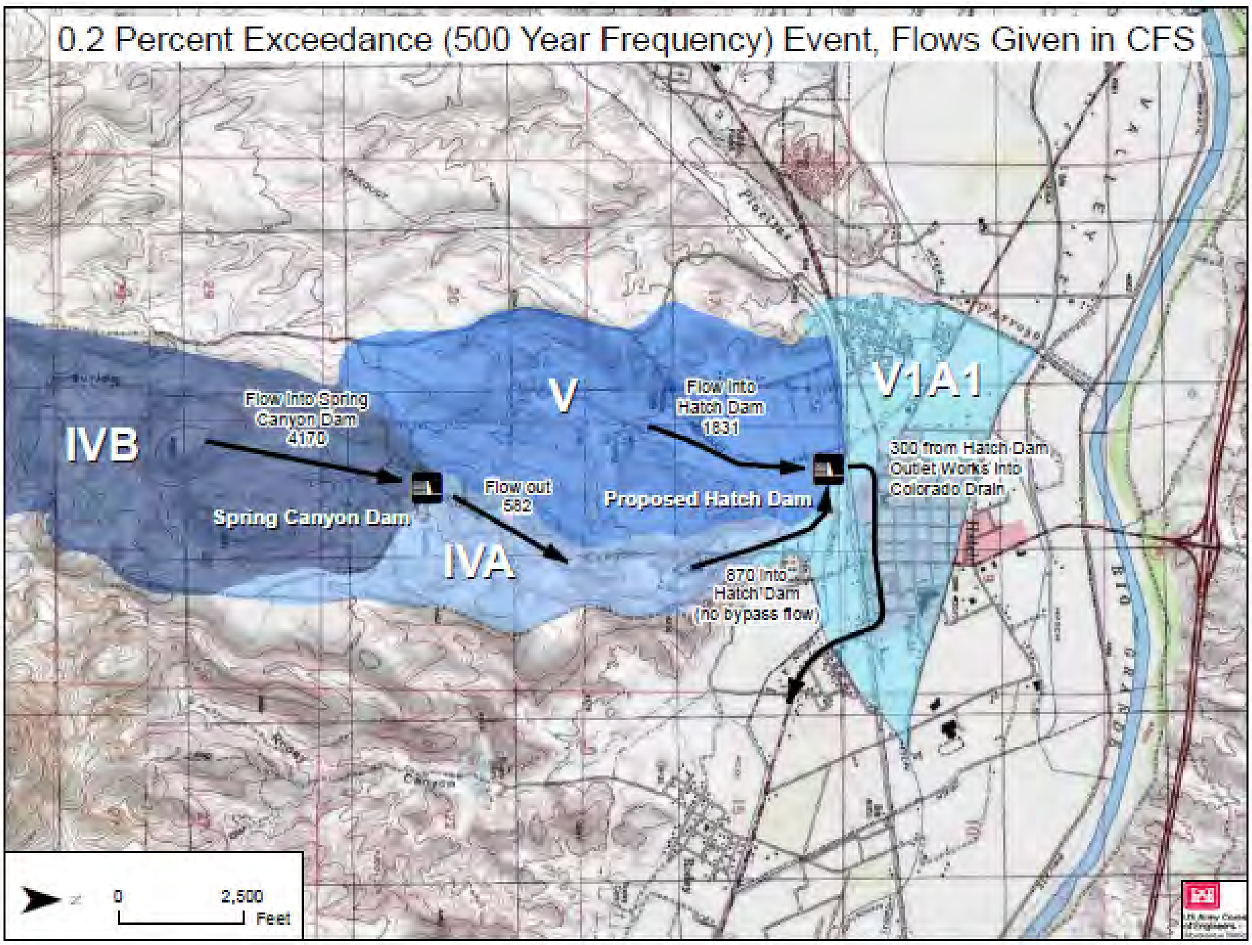

Figure 7 – Flow distribution for the 0.2-percent exceedance (500-year frequency) event

4.3 Hydraulic Design of the Spring Canyon Inlet

The Spring Canyon Diversion Channel was designed to divert the selected frequency flood into the reservoir area. Most flow in excess of the design frequency, including the PMF will continue down Spring Canyon and not be completely diverted into the reservoir.

Since significant cost savings would be realized if the size of the spillway for the Hatch Dam could be reduced, measures were taken to prevent most of the PMF from getting into the reservoir. The east, or right abutment of the proposed dam was extended across the downstream end of the diversion channel, and the diversion directs flow into the reservoir through two 5 ft by 9 ft concrete box culverts.

This has the effect of diverting the 0.2-percent exceedance (500-year frequency) event into the reservoir, but preventing most of the PMF from getting into the reservoir. The downstream face of the right abutment will be treated with soil cement revetment to protect the embankment from erosion. The top of the right abutment will be elevated to prevent overtopping of the embankment by the Spring Canyon PMF. The Spring Canyon PMF water surface elevations and velocities were determined using a HEC-RAS model. See Figure 8 showing the flow distribution of the PMF event through the watershed.

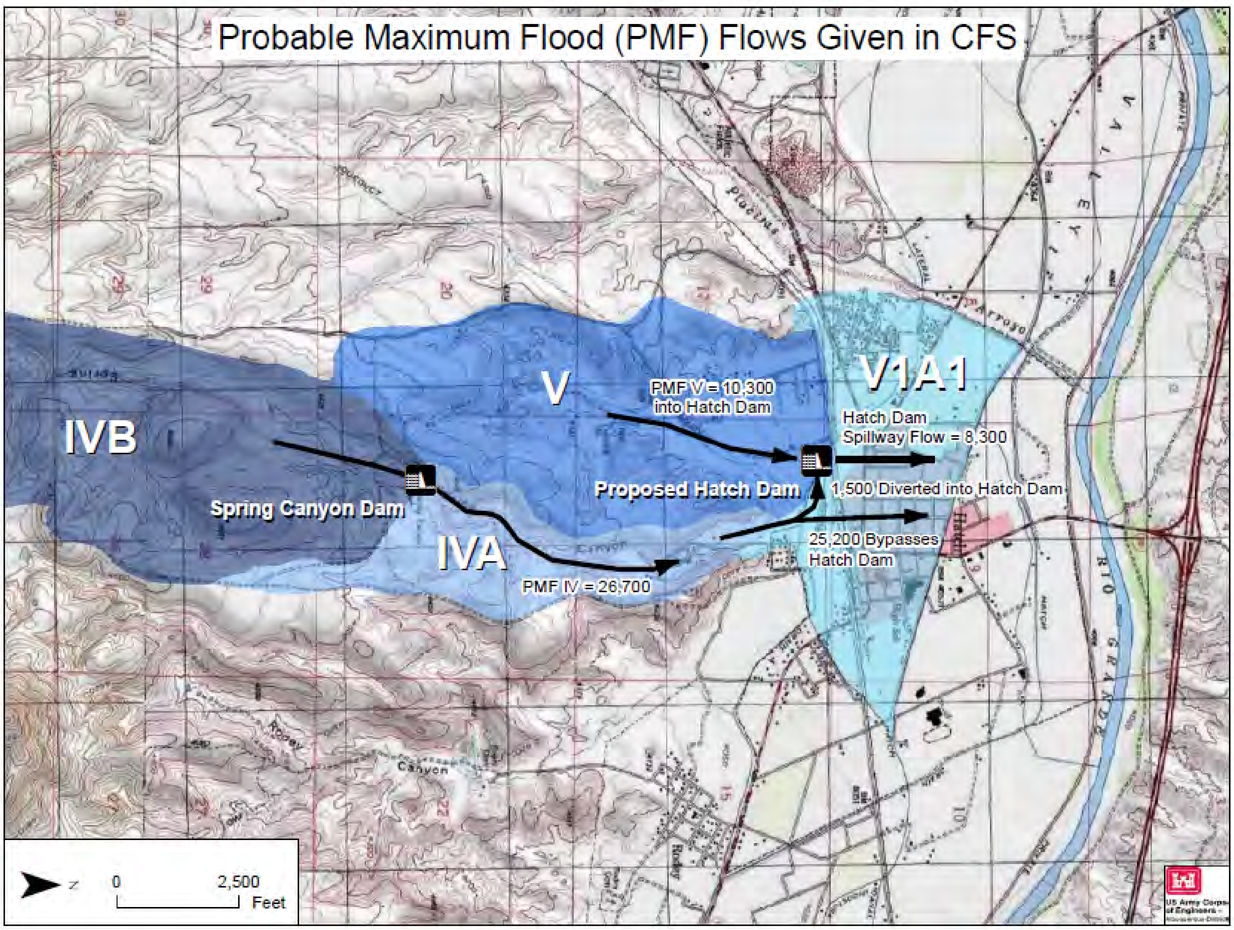

Figure 8 – Flow distribution for the PMF event

4.4 Colorado Drain Capacity

The capacity of Colorado Drain was determined with the application of a HEC-RAS model. Hydraulic dimensions and elevations of the drain were surveyed by the Doña Ana County Flood

Commission. The entire 3.7 miles was modeled; from the Rio Grande levee gates to the upstream crossing of Rodey Lateral.

The model shows there are currently several crossing structures that restrict flow in the Colorado Drain below its 300 cfs channel capacity between the project and its outfall to the Rio Grande. Within Hatch, there is only one crossing that restricts flow to less than 300 cfs. This is a second crossing of Rodey Lateral, which limits the flow exiting Hatch to 250 cfs before overtopping the channel. At this location, the Colorado Drain crosses under Rodey Lateral in a 4 foot high by 6 foot wide reinforced concrete box. The capacity issues associated with Colorado Drain have been discussed with the sponsor and they have expressed a desire to address these concerns.

4.5 Determination of Outlet Capacity

The outlet capacity of Dam C is limited to 300 cfs prior to flow overtopping the spillway. Dam C will also include an intake tower and gated outlet, which will provide flexibility to operate and maintain the facility. The outlet rating table was calculated using the orifice equation and modeled in HEC-HMS using an opening of 15 sq. ft. assuming a 3 foot high by 5 foot wide concrete box culvert (CBC). The design assumes normal dam outlet works operation will be with the gate fully open. The gate is provided to allow flexibility for maintenance and for the sponsor to make any needed modifications to downstream facilities. Since the proposed dam embankment is located just upstream of Rodey Lateral, the outlet must pass under Rodey Lateral to convey flood waters to Colorado Drain. This constrains the elevation and dimensions of the outlet.

4.6 Determination of Spillway Crest Elevations

Spillway crest elevations were determined for three different alternatives: a 4-percent exceedance (25-year frequency), a 1-percent exceedance (100-year frequency), and a 0.2-percent exceedance (500-year frequency) event pool. Rodey Lateral also constrains the elevation of the spillway crest. Any level of design requires a spillway crest elevation to be above the embankment for Rodey Lateral otherwise, the embankment would prevent spillway flow from safely passing through the dam.

Storage elevation tables used were adjusted for borrow in the reservoir area for the three alternatives as well as a 50 year accumulation of sediment in the reservoir area.

Spillway crest elevations were determined using a HEC-HMS model. The 4-percent exceedance (25-year frequency), the 1-percent exceedance (100-year frequency), and the 0.2-percent exceedance (500-year frequency) events were routed through the proposed dam. The spillway crest elevation was set equal to the maximum computed water surface elevation for the three floods. The PMF discharge of the spillway is 8300 cfs. The discharge versus stage relationship (rating table) for the PMF Spillway (Dam C Elevation = 4067.7 feet) is shown in Table 6.

Table 6 PMF Spillway Rating Table

Water Surface Elevation (feet)	4067.7	4069	4070	4071	4072.1	4073	4075.1
Discharge (cfs)	0	1364	3210	5518	8495	11231	18530

4.7 Hydraulic Design of the Spillway

The spillway is trapezoidal in cross section with 3:1 side slopes. The approach and downstream chute were modeled with 3:1 slopes also. The stage-discharge relationship of the spillway was determined using the weir equation. The design assumes normal dam outlet works operation will be with the gate fully open. However, for spillway design it was assumed the outlet works would be non-functioning (gate closed or otherwise plugged) so that the entire PMF would flow over the spillway. Various depths of flow were calculated to determine the spillway rating table with the Dam C weir length of 350 feet and using a weir coefficient of 2.63. Three feet of freeboard was provided for spillway flow. The computed stage-discharge relationship was then used to determine top of dam elevations as explained below.

4.8 Determination of Top of Dam Elevations

Top of dam elevations for Dam A, Dam B, and Dam C were determined by adding three feet of freeboard to the calculated water surface elevations of the PMF flow over the spillways using the weir equation as described in the previous section.

Both the existing Spring Canyon Dam and the proposed projects were assumed full to spillway crest at the start of the PMF. For the proposed dams, the PMF was routed through the dam with a starting water surface elevation equal to the proposed 4-percent exceedance, 1-percent exceedance, and 0.2-percent exceedance event spillway crest elevations. The outlet for the proposed dam was assumed to be plugged.

Routing the PMF through the proposed dam under these assumptions yielded conservative water surface elevations for all proposed dam alternatives. The top of dam elevations were then set to provide a minimum of 3 feet of freeboard to the computed PMF water surface elevation.

4.9 Appurtenant Features

The right, or east, abutment will be extended 600 feet upstream to tie into high ground to prevent the PMF from flanking the embankment on the east side.

A gradual slope will be placed in the reservoir area to prevent headcutting from upstream flows entering the dam.

A 24 inch diameter pipe along the landside toe of the left or west portion of the embankment will convey nuisance waters from a low area to the outlet of the reservoir to avoid saturation of the toe of the embankment.

4.10 Reservoir Sediment Deposition

Based on observed deposition rates in the upstream Spring Canyon Dam and on regional soil loss factors, an average annual deposition rate of 0.6 acre/feet per year was used. A trap efficiency of 100% was assumed for the proposed dam. For a design life of 50-years, 30 acre feet of sediment will be deposited in the reservoir. All three dam alternatives included an additional 30 acre-feet of storage to the proposed reservoir volume to account for sediment accumulation over the life of the project.

SMALL FLOOD RISK MANAGEMENT PROJECT

HATCH, NM

Appendix B

Economics

November 2016

US Army Corps
of Engineers

Albuquerque District
South Pacific Division

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Table of Contents

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1 - Study Area

The study area comprises portions of the urbanized area within the Village of Hatch, New Mexico (Hatch), consisting of residential, public and commercial structures. Hatch is located in the northwest corner of Doña Ana County, New Mexico, near the Rio Grande River. Hatch is a fairly small population center within the county. The 2000 U.S. Census determined that 1,673 of the county's 174,682 people lived within the village. The 2010 Census identified 1,648 persons within the Village and 209,233 persons within the county. Agriculture comprises the main industry within the study area, while the county has a heavy government presence in the White Sands Test Facility (NASA and DoD) and the White Sands Missile Range (DoD).

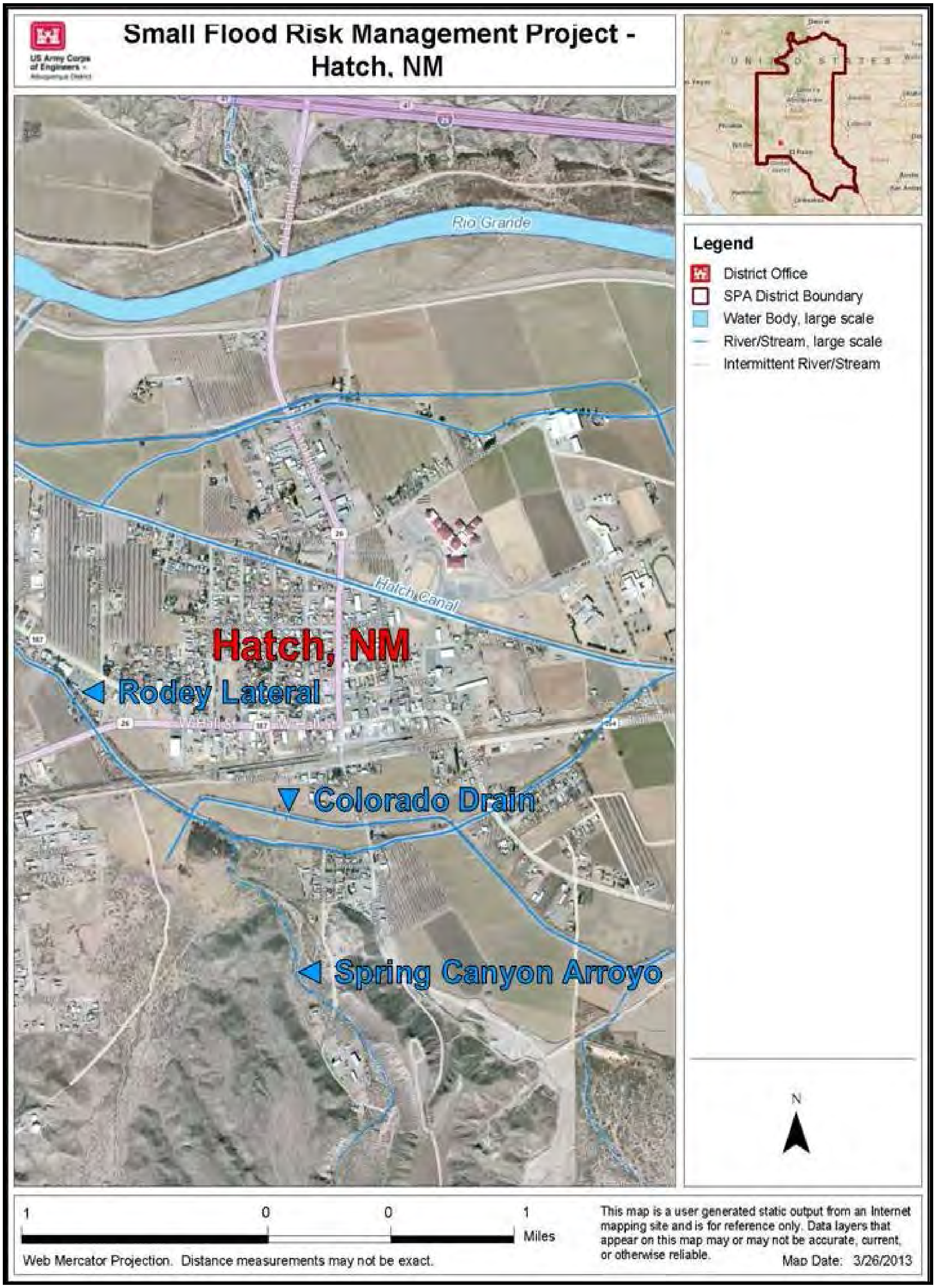
Hatch faces a flood threat from two drainages in the Las Uvas Mountains, which are immediately south of the village (Figure B-1). The village has received significant flooding, with up to three feet of water in 1988, 1992, and 2006 from these sources. Briefly, the two sources are termed throughout this report as Spring Canyon and Placitas Arroyo.

Hatch is located at the mouth of Spring Canyon. Floodwaters entering the village from this drainage have no clear pathway to the Rio Grande due to the construction of the elevated Hatch Main Canal (see Figure B-2). Consequently, floodwaters impounded behind the Hatch Main Canal remain in place until evaporated. The Rodey Lateral is another elevated drain that borders the Village along its southern edge and can impound flood waters from the Las Uvas Mountains. The main canal and lateral meet in a “V” east of the village.

Placitas Arroyo drains north from the Las Uvas mountains to the Rio Grande, with the arroyo channel paralleling the west side of the village. The village was flooded from Placitas Arroyo in 2006, but local efforts to increase channel capacity and to increase that capacity at road crossings have substantially mitigated the flood threat from the Placitas Arroyo. Further discussion on Placitas Arroyo can be found in section 6.0 of this appendix. This economic analysis will only focus on flood issues originating in Spring Canyon.

Figure B-1 - Study area (1 of 2)

Study area (2 of 2)



1.1 Environmental Justice

The planning and decision-making process for actions proposed by Federal agencies involves a study of other relevant environmental statutes and regulations, including Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, which was issued by President Clinton on February 11, 1994. The essential purpose of EO 12898 is to ensure the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no groups of people, including racial, ethnic, or socioeconomic groups should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, state, tribal, and local programs and policies. Also included with environmental justice are concerns pursuant to EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*. This EO directs Federal agencies to identify and assess environmental health and safety risks that may disproportionately affect children under the age of 18. These risks are defined as "risks to health or to safety that are attributable to products or substances that the child is likely to come into contact with or ingest."

Environmental justice considerations addressed in this assessment involve both population demographics, including ethnic, racial, or national origin characteristics, and persons in poverty, including children under age 18. In order to determine whether environmental impacts affect minority or low-income populations, it is necessary to establish a basis of comparison, referred to as the "region of comparison." This area consists of the geopolitical units that include the proposed project. Most environmental effects from the proposed action, in this instance, would be expected to occur in Doña Ana County.

EO 12898 (Environmental Justice) requires "to the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report of the National Performance Review, each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority populations and low-income populations…". Within a half of a mile, the study area is comprised of a mixture of income levels. Field investigation of the areas to be affected by the construction activities did not reveal the presence of community characteristics that would be considered disproportionately minority or low-income neighborhoods.

2 - General Computational Procedures

The assumptions and procedures used to analyze and quantify the economic variables are presented in this section. The hydro-economic model used to develop expected annual damages is based on discharge-frequency, stage-frequency, and depth-damage curves used to develop a damage-frequency curve. Depth-percent damage curves express dollar damages resulting from varying depths of water based on a percentage of the value of structure and contents.

Each surveyed property is assigned to a category (e.g., commercial, residential, public, apartment, transportation facilities, utilities, and vehicles) with as many subcategories (e.g., contents) as necessary, and details of ground and first floor elevations are noted. Each category has an associated depth-damage relationship expressed as a cumulative percentage of value for each foot of inundation. The depth-damage relationships were derived from historical data obtained from insurance companies, a recent commercial content survey, the Flood Insurance Administration, and Corps of Engineers experience. Note that the 2003 residential curves developed by the Institute of Water Resources (IWR) were used; thus, the residential content damages are a direct relationship to structure value. Table B-1 depicts the depth-damage relationships used in this study Table B-6, presented later in this appendix, displays the rating curves used in this study:

The elevation of each property (determined from GIS-based topographic maps and field investigations) is aggregated by location and structure type to compute the vertical distribution of damageable property at that location. Each property category is then tabulated in terms of the number of units, average value per unit and aggregate value, within consecutive inundation depth ranges for each location. That inventory is set into the Hydrologic Engineering Center's Flood Damage Analysis (FDA) ver. 1.4.1 to compute expected annual and equivalent annual damages (EAD).

This report contains descriptive tables (number of structures subject to flooding by event, value of damageable property by property type and event, and single occurrence damages associated with specific frequency events) that were generated as a reality check of the FDA analysis. The study area's floodplain is fairly wide and flat, such that structure first floor height has a tremendous bearing on start of damages and damages attributable to specific events. To compute the number of structures in a given floodplain, the FDA_StrucDetail.out file was consulted, which computes number of structures, value of damageable property, and single occurrence damages for specifically defined events. This computation assumes "without-risk" but serves as a consistency check on EAD and equivalent annual benefit calculations.

Table B-2 displays the number of damageable property units by floodplain, in the present and the future hydraulic conditions. Table B-3 presents the depreciated replacement values of those properties, by floodplain and hydraulic condition. As a quality check, these tables also display average value per structure, which is computed by dividing the number of structures in Table B-2 by the corresponding values in Tables B-3. The 2010 Census indicates the average household size in Hatch is 3.25 persons. Multiplying this figure by the number residential and apartment structures in the 1% chance and 0.2% chance floodplains suggest that the study area has a population at risk (PAR) of 949 persons in the 1% chance floodplain and 975 persons within the 0.2% chance floodplain.

Section 308 of the Water Resources Development Act of 1990 states "The Secretary shall not include in the benefit base for justifying Federal flood damage reduction projects...any new or substantially improved structure...built in the 100-year flood plain with a first floor elevation less than the 100-year flood elevation after July 1,1991." To comply with that requirement, the latest Flood Insurance Rate Maps (FIRM) of the study area were consulted and compared to identified study floodplains. The link below is where the latest FIRM data was acquired.

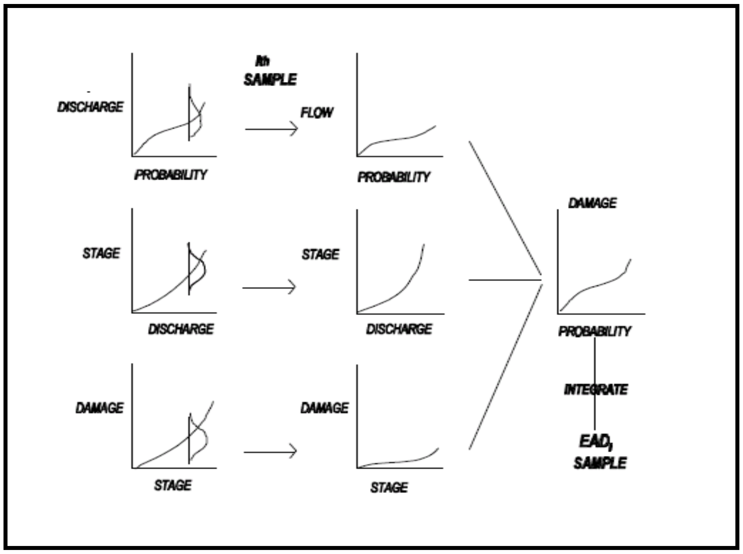
https://msc.fema.gov/webapp/wcs/stores/servlet/MapSearchResult?storeId=10001&catalogId=10001&langId=-1&panelIDs=35013C0210E$&Type=pbp&nonprinted=&unmapped=

The latest applicable FIRM mapping has an effective date of 9/27/1991 and applies to the Village of Hatch and adjacent unincorporated areas. The study area was evaluated against this mapping, and while there are areas on the FIRMs that indicate a flood problem, those areas are "Zone A" which means that no base flood elevations have been determined. The FIRM has been revised based upon a FEMA September 6, 1995 Flood Insurance Study (Doña Ana County, New Mexico and Incorporated Areas). That study did not compute base flood elevations for Hatch or other points in the study area. Consequently, there is no method by which to identify an elevation that structures should be built clear of to avoid the Section 308 exclusion, and all structures identified in the field inventory were included in benefit computations.

For each category, the aggregate value of property at each flood depth is combined with the depth-damage relationship to compute total, single event damages for each level of flooding. Table B-4 displays the single occurrence damages by category for the floodplain evaluated. This is combined with the discharge-frequencies of the reference floods to produce damage-frequency relationships. Damage-frequency relationships provide probable average annual damages for each category under the conditions of each reference flood, and can then be compared to the hydrologic, hydraulic, and economic data analyzed within HEC-FDA. Table B-5 presents the average annual damages computation from the HEC-FDA analysis.

Residual, average annual damages for each alternative, including the without project alternative, are obtained through consecutive iterations of the above computations for each alternative. The difference between damages in the without-project alternative and the residual damages for each alternative is the value of the benefits (inundation reduction) for each alternative. The following figure demonstrates the integration of hydrologic information, hydraulic data, and the economic information developed in this appendix to generate the EAD computation:

Figure B-2- EAD Development Methodology



3 - Value of Property

Hatch was surveyed in 2005 and reviewed in 2014 by using aerial photography from Google Earth and by conducting a quick visual check of the floodplain by vehicle. No significant growth occurred since the initial inventory. The property examined was categorized into residential, commercial, and public buildings, as well as, vehicles, streets and utilities, and outbuildings (sheds and detached garages). The field survey gathered primary data including structure description (quality of construction, construction materials, number of floors and presence of basements); an estimate of effective age for depreciation purposes; occupancy type; elevation above grade; an estimate of structure size in square feet, and; the number of nearby structures that share these attributes. Tables B-2 and B-3 show the number of property units affected and the value of damageable property by the 10-percent, 2-percent, 1-percent and 0.2 percent chance flood events, respectively. These tables were generated using HEC-FDA's FDA_StrucDetail.out file for descriptive purposes only, to better understand the nature of the damages reported by HEC-FDA.

Depreciated, replacement residential structure values were computed using the factors and methods described in the Real Estate Cost Handbook (Marshall and Swift Company, 2014). Corps regulations require that cost-benefit evaluations use depreciated replacement costs. Replacement cost is the cost of physically replacing (reconstructing) the structure. Depreciation accounts for deterioration occurring prior to flooding, and variation in remaining useful life of structures. Depreciated replacement cost computations include factors such as construction type (wood, masonry) and quality, effective age (for depreciation purposes), and local market prices that bring the value of the structure to what we'd expect to spend on a "replacement in kind" structure in the study area. That computation was then verified in the field through interviews with local realtors, and insurance agents to verify structure ages and replacement costs of structures in the floodplain. A windshield survey of all structures was also conducted to establish average first floor elevation above grade of structures in each damage reach. That "elevation above grade" was added to the ground surface elevation DTM data used in the hydraulic model to tie the economic inventory to the floodplain model. Commercial, public and apartment structures were inventoried in the field survey using the Marshall and Swift Marshall Valuation Service.

Content values were estimated from several sources. Residential content values were held at 50% of the structure value, which differs from the value of more than 55% of structure costs used by insurers contacted for this study. Where the IWR 2001 and 2003 structure and content depth-damage relationships were used, content damages are expressed as a percentage of structure value. Commercial and public content values were computed using CCI, developed by Marshall and Swift, which estimates content and inventory values based upon factors like SIC code for the property, size of the property in square feet.

Vehicle estimates were determined using in-house data and published surveys. Total vehicles in the floodplain depicted are for residential structures and apartments. The typical household in Doña Ana County has 1.83 vehicles. It is assumed that one of these vehicles is driven out of the floodplain before any flood event. The remaining 0.83 vehicles were distributed to the residential and apartment structures located within the 0.2 percent chance exceedance flood plain. It was assumed that all business-related vehicles were already evacuated from the floodplain.

3.1 Valuation of Roads, Railroads, Utilities, Agricultural and Emergency Services

Streets, roads, utility lines, railroads, and irrigation drains within each floodplain were measured using GIS, elevated to a median elevation for each particular flood for which floodplains were generated, and were "damaged" per elevation-damage relationships produced by the Galveston District (displayed in Table B-1). The value used in calculating the damages for utilities were referenced from http://www.corridorwatch.org/ttc/cw-plan0206-05design.htm. It was assumed that utility quantities (expressed in linear feet) were identical to paved street quantities. Values for railroads were referenced from http://freight.transportation.org/doc/FreightRailReport.pdf and http://www.aar.org/PubCommon/Documents/AboutTheIndustry/Overview.pdf. The resulting damages per event were then probability-adjusted per the likelihood of the event, and summed to compute equivalent annual damages. A sample of that calculation follows:

Figure B-3 - Sample Event-Damage Calculation (Actual $'s)

Freq	**Interval**	**Value**	**Single Occ.**	**Total**
0		36,715,390.98		
	0.002		36,715,390.98	73,430.78
0.002		36,715,390.98		
	0.008		30,868,198.44	246,945.59
0.01		25,021,005.91		
	0.01		23,370,744.67	233,707.45
0.02		21,720,483.42		
	0.08		16,093,455.23	1,287,476.42
0.1		10,466,427.03		
	0.01		5,233,213.52	52,332.14
0.11		0.00		
Sum				1,893,892.37

Construction costs for roads were referenced from the Florida and Virginia Department of Transportation. Emergency costs were derived from locations that have had similar flood characteristics (Carlsbad, NM).

Agricultural acreage was measured using aerial photography of the floodplains used in this study. Agricultural valuation and damage assessment for crops within the study area was calculated using crop budgets from the NMSU Cooperative Extension Service for the study area. Using the same hydrologic data developed for recreation damage assessment, the crop budget was applied to a typical calendar year to calculate sunk costs if the flood event were to occur before the harvest. The long duration events predicted suggest a total loss of that year's crop if the event occurs before the harvest. Flood events occurring after harvest activities were conservatively assumed not to damage the value of the agricultural land, since the crop was already harvested. Officials at the Natural Resources Conservation Service provided estimates of crop composition (alfalfa hay, wheat, green chile, corn) and relative distribution.

Emergency services include the costs of evacuation, reoccupation, disaster relief, and other similar expenses. The emergency costs incurred are dependent upon factors including number of residences damaged, evacuated, etc. Factors used in this study are based upon historical flooding in Carlsbad, NM and interviews with American Red Cross personnel.

4 - Sources of Uncertainty

The major sources of economic uncertainty include many of the same variables identified above in the damage estimate analysis and others noted as follows:

1. Value of property;
2. Value of property contents;
3. Flood stage at which damage begins;
4. First floor elevations of structures;
5. Responses to flood forecasts and warnings;
6. Flood fighting efforts;
7. Cleanup costs;
8. Business losses;
9. Depth-percent damage curves;
10. Estimate of the stage associated with a given discharge;
11. Estimate of damage for a given flood stage; and
12. Estimate of future land use.

Principal sources of error affecting the depth-damage relationship were examined in a risk and uncertainty framework. Those sources of error are 1) errors associated with the damageable property elevation, 2) errors associated with the values of structures in the floodplain inventory, 3) errors associated with values of structure contents in the floodplain inventory, and 4) errors associated with the damage functions used against the floodplain inventory.

There are numerous factors which affect the frequency distributions as well as the rating curves for the study area's hydraulic reaches. Those factors are discussed in detail in the Hydrology & Hydraulics Appendix.

<u>Elevation of damageable property</u>: Per EM 1110-2-1619, a standard deviation of 0.4 feet was used to account for the uncertainty associated with the elevation of damageable property. In the floodplain, the flooding depths are relatively shallow and the flood plains are large and flat; therefore, an elevation difference of one foot could potentially double the damages associated with a given stage. The 0.4 feet standard deviation was used for two reasons. First, since the economic inventory was conducted by a visual windshield inspection, the first floor elevations of structures were estimated rather than measured. Second, the digital terrain model (DTM) used to develop specific frequency event floodplains introduces a source of uncertainty relative to elevation. Structure first floor elevation is likely the single largest source of error in this study; lowering the inventory one standard deviation (0.4 feet) had the effect of increasing EAD by $772,821.

<u>Structure value</u>: It was assumed that the estimated structure value, which was derived from property tax information and a field inventory, has a standard deviation of 15 percent of the structure value. This assumption is based on prior Albuquerque District

studies, and prior experience of the Ft. Worth District, which developed that estimate from interviews with various County Assessor's offices.

The structure inventory values and associated error distribution were then used to compute floodplain inventory that incorporates errors concerning structure value. It was assumed that the estimated structure value (derived from field inventory and consultations with Realtors, insurance agents) could be off by 15% of the structure value. The floodplain inventory was then assessed using these assumptions, dropping all values more than three standard deviations from the reported (mean) value. The resulting distribution of structure values with error would contain 99% of possible values given the assumptions above.

<u>Content value:</u> The error distribution associated with content value varied by structure type due to the fact that different structures types (i.e. car dealership, furniture store, etc) contain different contents within them.   In terms of average annual damages for residential contents, the damage curves relate to the structure value rather than the content value.

The content value error distribution varied by structure type. Corps guidance stipulates residential content values should be held to no more than 50% of structure values, though local insurers note that contents are valued at 55-60% of structure value, or more. Residential and apartment content value distributions with error were fixed to the error distributions associated with residential and apartment structures. New depth-percent damage relationships published by IWR in 2001 and 2003 compute content damages as a percentage of structure value. Content valuation in this appendix is for illustrative purposes only, and content damages for residences use the IWR methods. Commercial and public contents used standard deviations that were equal to the content value to develop the content value with error. All content relationships were truncated to eliminate the possibility of negative values.

<u>Depth-percent damage relationship</u>: Depth-percent damage curves are among the most important and least exact data in benefit estimation. Depth-percent damage curves express dollar damages resulting from varying depths of water based on a percentage of the value of structure and contents. Errors associated with the depth-damage functions were applied after the structure and content values were determined. The errors associated with the depth-percent damage relationship were evaluated for structures and contents of all occupancy types. The standard deviations used were those estimated by IWR for residential structures and contents, which comprise the majority of the damages.

The errors associated with the depth-percent damage relationship were evaluated for structures and contents of commercial and public occupancy types. It was assumed that the damage value used +/- 40% of that value would contain the true damages for a given stage 95% of the time. The 40% standard deviation came from prior Albuquerque District studies, depth-percent damage relationships developed by Galveston and Albuquerque Districts through post-flood surveys of property owners, and interviews with local business owners. Residential and apartment structures and contents use the IWR depth-percent damage relationships, which include errors for each stage presented. Errors associated with the depth-percent damage functions used were applied after the uncertain structure and content values were determined.

5 - HEC-FDA Use

Consistent with the requirements set forth in EC 1105-2-412, *Assuring Quality of Planning Models*, HEC-FDA version 1.4.1 was used to compute EAD. Corps guidance stipulates that the plan which reasonably maximizes net national economic development benefits, consistent with the Federal objective, be identified. Project benefits for flood risk management measures are identified through successive iterations of existing and future without-project scenarios, changing key hydrologic and/or hydraulic variables as the measures warrant. HEC-FDA is the only model certified for formulation and evaluation of flood risk management plans using risk analysis methods, and was used in this study. Damages were computed in August 2014 price levels at the FY 14 interest rate of 3.5%. Dam C, the Tentatively Selected Plan, was updated using current cost (deflated to August 2014 price levels) and calculated at the FY 17 interest rate of 2.875%. The period of analysis is 50 years.

6 - Placitas Arroyo

Placitas Arroyo runs through agricultural fields on the west side of Hatch, in an area with few structures or other improvements. Hatch was flooded by flows from Placitas Arroyo in August 2006. The Village of Hatch is currently planning additional improvements that are expected to substantially increase channel capacity. Current hydraulic analysis indicates the Placitas Arroyo could safely contain the mean 1% chance exceedance event if the planned improvements are made. After the improvements are made the Placitas Arroyo, the floodplain will be distinct and separate from the Spring Canyon floodplain, so any proposed solutions on Spring Canyon will not carry a residual risk of flooding from Placitas Arroyo. Additional discussion of the Placitas Arroyo can be found in the Hydrology & Hydraulic Appendix.

7 - Potential Flood Damages

It is currently estimated that the mean 1-percent chance exceedance flood would cause damages of about $23.6 million to structures and contents in the study area. Table B-4 presents the single occurrence damages associated with the 10%, 2%, 1%, and 0.2% chance flows in the assorted floodplains. These tables were generated using HEC-FDA results for descriptive purposes only, to better understand the nature of the damages reported by HEC-FDA. HEC-FDA was used to compute average and equivalent annual damages for structures and their contents, as well as vehicles only. It should be noted that many intangible damages (such as loss of life, disruption to community services, and increased health risks) that could occur because of flooding are not represented in these damage values.

Future flood damages resulting from basin development/growth in the floodplain or from future Hydrologic and Hydraulic changes have not been included, but are not expected to be significant for several reasons: 1) local realtors contacted noted that growth in Hatch and the surrounding area has been flat and may remain stagnant in the future, 2) local realtors have noted that most recent development in the study area has occurred outside the floodplain, and 3) hydrologic and hydraulic conditions are not expected to change from current conditions.

8 - Average Annual Damages

Table B-5 presents the average (equivalent) annual damages that could occur from flooding in the study area without any flood protection, by land use category and floodplain. Risk and uncertainty analysis was used to derive average annual damages. Hydrologic and hydraulic uncertainty was combined through Monte Carlo simulations within HEC-FDA. When flooding from all sources is considered, the study area faces the risk of approximately \$2.8 million in average annual damages to just structures and their contents (\$3.2 million over all damage categories). A sensitivity analysis was conducted to illustrate that when HEC-FDA was computed “without risk”, the total EAD damages decreased roughly by \$635,500. FDA will use all uncertainties in values (such as structure content, other), first floor stage and depth damage functions to compute stage damage. If not selected (i.e. computing without risk) the stage damage is computed without these uncertainties.

9 - Alternatives Considered

Several alternative dam heights in Spring Canyon, with sizes corresponding to the mean 1% chance exceedance event stage to the mean 0.2% chance exceedance event stage, were evaluated in a framework incorporating elements of risk and uncertainty in hydrology, hydraulics and economics. Any analysis of alternatives must include the no action alternative. If no action is taken, the floodplains defined by the study will continue to suffer damages described in Table B-5.

The table which follows describes how the alternative dam sizes were selected to contain specific flood events. Given the Risk and Uncertainty framework used in plan selection, it is inappropriate to describe an alternative in terms of "level of protection." The terms ("Dam A", “Dam B” “Dam C” and “Dam D") describe a dam that corresponds to a designated level of protection. Project performance measurements (formerly known as reliability) are discussed in section 14.0 of this appendix.

9.1 Alternative Dams Evaluated

The following four dams were evaluated:

Dam A........................Dam designed to contain between the 4% and 2% chance event
Dam B........................Dam designed to contain the 1% chance event
Dam C........................Dam designed to contain the .002% chance event
Dam D[1] ....Dam conceptualized to contain events exceeding the .002% chance event

10 - Average Annual Cost

Table B-7 shows, for each alternative, construction cost, interest during construction, total investment cost, interest and amortization costs, OMRR&R costs, and total average annual costs. The period of construction is assumed to be less than 12 months with equal mid-monthly payments and no project benefits until the project phase is complete. All three dam sizes are expected to be completed within a year, therefore no interest during construction was calculated. The FY 2017 Federal interest rate of 2.875% was used in the calculations to further refine the cost of the selected plan.

11 - Average Annual Benefits

Equivalent annual residual damage and benefit computations for the flood control alternatives considered are depicted in Tables B-8A to B-8C. Table B-10 shows the expected net benefits to structures and contents. Benefit determination for the post project condition was computed by changing the event-flow relationship to remove damaging flows from lesser magnitude events. Table B-11 shows the expected B/C ratio for the proposed alternatives.

12 - Benefit-Cost Comparisons and Plan Selection

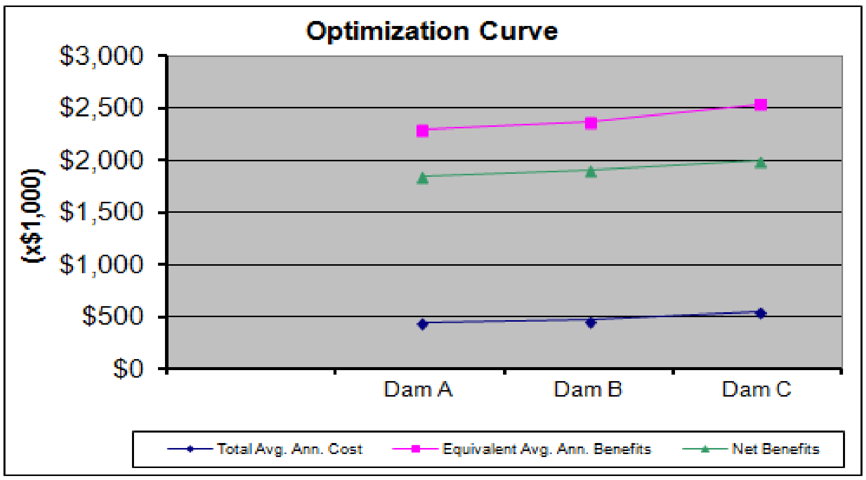
Table B-7 displays annualized equivalent annual benefit and cost information, discounting future benefits of flood control (which remains the same due to unchanging

[1] Described in Section 12 of the Economic Appendix

H&H and economic growth assumptions) and amortizing those benefits over the project life. Dam C figures were also updated to display the current net benefits and B/C ratio based on the updated cost (December 2015, deflated to August 2014 price level) at the current interest rate at calculation (FY17 – 2.875%). Dam A and Dam B still display the figures based on August 2014 figures and the FY 14 (3.5%) interest rate.

Table B-7 show the average annual benefits, average annual costs, the benefit/cost ratio, and net average annual benefits, for dam alternatives considered. The plan that maximizes net benefits is a dam on Spring Canyon (referred to in this appendix as the "Dam C") with a benefit/cost ratio of 6.9 and $2.2 million in net benefits. Figure B-4 displays the Optimization Curve for Dams A-C.

Figure B-4 – Optimization Curve



Due to the fact that Dam "C" is the NED plan and coincidently the largest dam analyzed, the PDT analyzed a hypothetical Dam "D". It was determined that a larger Dam "D" would not be economically feasible for the following reasons. First, current dam cost used the existing borrow from the dam's reservoir as source material for new dam construction material. Borrow for a larger dam would require the purchase and transport of additional borrow. Other cost such as real estate and potentially higher mitigation costs increase substantially as the dam footprint increases. Secondly, Dam "C" captures over 79% of EAD, and the additional costs are expected to substantially offset the remaining benefits. The remaining damages are a result of interior flooding within the Village of Hatch and will not decrease with an increase in the dam height.

13 - Impact of Addressing Flood Risk in Four Accounts (NED, NER, OSE, RED):

The Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, (March 10,1983), establish four accounts to facilitate the evaluation and display of effects of alternative plans. They are described in ER 1105-2-100, *Planning Guidance Notebook*, paragraph. 2-3. The evaluation of the recommended plan against those accounts follows:

- The National Economic Development (NED) account displays changes in the economic value of the national output of goods and services. The damages and benefits described in this appendix describe NED impacts of flooding in the study area and the effects of alternatives designed to address the flood threat.

- The Environmental Quality (EQ) account displays non-monetary effects on ecological, cultural, and aesthetic resources including the positive and adverse effects of ecosystem restoration plans. The array of plans described in this appendix have flood risk management as their stated goals. EQ benefits or impacts are identified within the Environmental appendix to this report.

- The Regional Economic Development (RED) account displays changes in the distribution of regional economic activity (e.g., income and employment). This account is typically used to capture the regional impacts of a large capital infusion of project implementation dollars on income and employment throughout the study area through the use of income and employment multipliers. A recent study for the Nuclear Watch of New Mexico suggests that public sector multipliers tend to be below 1.5, while the Department of Energy claimed multipliers of 2.4 to 3.5 in fiscal year 1998. (Dumas, L.J., Economic Multipliers and the Economic Impact of DOE Spending in New Mexico, March 2003) The important point to be made here is that a large infrastructure project in the Middle Rio Grande Valley will have a positive impact on local income and employment.

- The Other Social Effects (OSE) account displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation and others. In most cases, impacts of proposed projects not covered in other accounts are described and evaluated here. Generally, the plans described here meet USACE criteria for project adequacy (completeness, effectiveness, efficiency, and acceptability). In the unfortunate circumstance that the proposed dam was exceeded, the resultant flood magnitude, timing, and duration is not expected to become even more severe than the existing without-project and future without-project conditions.

14 - Project Performance

Besides a strict benefit/cost comparison, another measure of the effectiveness of flood protection is its ability to contain damaging floods where there was limited protection before. Limitations of the analysis package preclude a rigorous analysis of project performance, but inspection of the available data could provide decision makers a glimpse of the nature of the flood problem and how the project will act to contain it. Table B-12 presents the likelihood of flood stages being exceeded by specific flood events at the typical cross section used within the study in the without-project and with-project conditions. One scenario was developed to describe the effectiveness of the various alternatives considered.

14.1 Vulnerable Location Identified

A reference point was selected in the without-project scenario where the flood flow would exceed the start of damages first, or most often. Project performance was evaluated at that reference point for all project sizes that effect that location. For each alternative and project size, that reference point was selected in the protected area where residual flows for the events analyzed would exceed the start of damages most often, wherever that reference point may be. For purposes of this analysis, this reference point is important in that start of damages flows occur most frequently, thus the term "vulnerable location" is applied. The vulnerable location does not move to other reference points as various project sizes are applied to the floodplain. With that in mind, project performance tables indicate only where the pre-project condition is worst, as there are several other reference points where dam protection is much improved. The project performance tables also describe project performance within the most vulnerable location within the study area as a set of probabilities of structural alternatives containing various damaging flood events.

Table B-12 presents the probability that the alternative, and various sizes of that alternative, would contain the specified events, for the specified scenarios. Table B-13 presents the probability that each evaluated alternative would be exceeded on an annual basis by damaging flood events. Table B-13 presents the long term risk of exceedance (likelihood that project will be exceeded over an extended time frame) for indicated time frames.

15 - Evaluation of Non-Structural Alternatives

A variety of non-structural flood damage reduction measures were identified, which could be used to meet the planning objectives. The initial evaluation of these measures is discussed below.

15.1 Floodplain Management Regulations

Doña Ana County participates in the National Flood Insurance Program (NFIP), which is administered through the Federal Emergency Management Agency (FEMA). FEMA has published FIRMs for both jurisdictions that identify Special Flood Hazard Areas for the Rio Grande River and tributaries. For local jurisdictions to maintain eligibility in the NFIP, minimum levels of floodplain management regulations must be adopted and enforced. Due to the existence of floodplain management regulations and enforcement, this measure was not carried forward for alternative evaluation.

15.2 Flood Warning Systems

A flood warning and preparedness system is often the most cost effective flood mitigation measure comprised of computer hardware, software, technical activities and/or organizational arrangements aimed at decreasing flood hazards. Advanced warning is not generally effective in reducing structural damages (outside of sandbagging efforts given early warning); the primary benefits of such a system are credited for providing early evacuation of residents and reduction in damages to vehicles and structure contents.

A flood warning system would present benefits by reducing the amount of residential contents subject to flooding. The high residual damages, as well as the other infrastructure (roads, agriculture, utilities, public and commercial properties), suggests that a flood warning system is ineffective and incomplete on its own. Further, relative to the structural alternative presented it’s impossible for a flood warning system to provide greater net benefits. Lastly, hydraulic analysis suggests any flood from Spring Canyon will inundate the village in 20 minutes, which is an incredibly short window to identify the flood threat, and remove lives and property from the inundation area. It is expected that a flood warning system will generate very little NED benefits in this case.

15.3 Flood Proofing

Flood proofing offers the opportunity to provide flood protection on an individual structure-by-structure basis or for a group of structures. Flood proofing techniques typically include buyouts, relocation, elevation, floodwalls or levees, and dry flood proofing. Elevation, buyout, and relocation are the most dependable of these flood proofing methods. Flood proofing costs can vary substantially depending on the type of flood proofing method being considered and the type, size, age, and location of the structure(s). Flood proofing techniques considered for alternative development are:

1) <u>Relocation of Existing Structures</u>: Relocation is perhaps the most dependable flood proofing technique since it totally eliminates flood damages, minimizes the need for flood insurance, and allows for the restoration/reclamation of the floodplain. This technique requires the physical relocation of flood prone

structures outside of the identified flood hazard area. This also requires purchase of the flood prone property; selecting and purchasing a new site; and lifting/moving the structure to the new site.

Corps experience has indicated that relocations and buyouts only work when the land left behind is repurposed to some other public good, such as a public park or reuniting the acquired land with the floodway. In its *Homeowner's Guide to Retrofitting* (December 2009, page 3-28, Table 3-9), FEMA estimates relocation costs at between $99 and $116 per square foot (2009 dollars), which exceeds the depreciated replacement costs of just about every structure in the floodplain. Relocations also do nothing for the flood risk to public properties.

2) Buyout or Acquisition: This technique requires the purchase of the flood prone property and structure; demolition of the structure; relocation assistance; and applicable compensation required under Federal and State law. This alternative typically requires voluntary relocation by the property owners and/or eminent domain rights exercised by the non-federal sponsor. As stated previously with relocations, acquiring properties in a floodplain has limited utility. Repurposing land for a public good like a park is also infeasible, as it would represent an incomplete solution to the flood problem.

3) Retrofitting or Dry Flood Proofing: Dry flood proofing of existing structures is a common flood proofing technique applicable for flood depths of three (3) feet or less on buildings that are structurally sound. Installation of temporary closures or flood shields is a commonly used flood proofing technique. A flood shield is a watertight barrier designed to prevent the passage of floodwater though doors, windows, ventilating shafts, and other openings of the structure exposed to flooding. Such shields are typically made of steel or aluminum and are installed on structures only prior to expected flooding. However, flood shields can only be used on structures with walls that are strong enough to resist the flood-induced forces and loadings. Exterior walls must be made watertight in addition to the use of flood shields. This technique is not applicable to areas subject to flash flooding (less than one hour) or where flow velocities are greater than three (3) feet per second. It would also not be applicable to mobile homes, due to the type of construction and typical lack of anchoring to a foundation.

   Aside from the cost, dry flood proofed homes and businesses can still suffer flood damages due to the potentially incomplete nature of the solution. Enclosures for windows and doors require human intervention in order to fully implement the solution and, this action would have to occur in a relatively short time frame. Although flood stages are not expected to exceed 3 feet, suggesting the flood proofing measures could be effective, the lack of sufficient warning (less than 20 minutes) suggests the flood proofed properties would not be sealed in time. Due to the incomplete nature and limited applicability of this flood proofing method, it was not carried forward for alternative evaluation.

4) Localized Levees or Floodwalls: Ring levees or floodwalls can be built around individual structures to protect single or small groups of structures. Ring levees are earthen embankments with stable or protected side slopes and a wide top. Floodwalls are generally constructed of masonry or concrete and are designed to withstand varying heights of floodwaters and hydrostatic pressure. Closures (e.g., for driveway access) are typically manually operated based on flood forecasting and prediction that would alert the operator. Disadvantages of levees or berms are: 1) can impede or divert flow of water in a floodplain; 2) can block natural drainage; 3) susceptible to scour and erosion; 4) give a false sense of security; and 5) take up valuable property space. Disadvantages of floodwalls are: 1) high cost; 2) closures for openings required, and 3) give a false sense of security.

   In this evaluation, Hatch represents a relatively concentrated location receiving flood damages. There are no separable elements within the Village that could be afforded complete or effective flood protection.

5) Elevation of Structures: Existing structures can be elevated or raised above the potential flood elevation. Structures can be raised on concrete columns, metal posts, piles, compacted earth fill, or extended foundation walls. Elevated structures must be designed and constructed to withstand anticipated hydrostatic and hydrodynamic forces and debris impact resulting from flooding. The access and utility systems of the structures to be raised would need to be modified to ensure they are safe from flooding.

   FEMA has estimated that elevation in place for slab-on-grade homes (the most common foundation type in the study area) can cost $80-88 per square foot (2009 dollars) for a frame home, and $88-96 per square foot for a masonry home (FEMA, *Homeowner's Guide to Retrofitting*, December 2009, page 3-20, Table 3-3). That value exceeds the per square foot depreciated replacement cost of most of the improvements in the floodplain, which makes this alternative infeasible.

16 - Plan for Updating Project Benefits in the Future

At the time that a project update is required, the significant assumptions regarding hydrology and hydraulics will be reviewed. All pertinent economic assumptions shall be reviewed. After determining whether there have been changes in the basic assumptions, the following shall be analyzed:

- Residential neighborhoods shall be sampled to determine current values. Real estate agents, appraisers, and the Marshall and Swift Valuation Service will be used in updating residential values.

- Discussions with local realtors and businessmen combined with field sampling will be made to determine whether major changes have occurred to businesses existing at the time of the initial inventory. Important changes affecting structure or content values will be included in the update. As is the case of residential values, the Marshall and Swift Valuation Service and local appraisers and realtors will be contacted regarding commercial values.

- After consultation with city planners and examining city building permits, residential, public and commercial growth since the inventory was taken shall be sampled as needed within the floodplain. The growth shall be included, as appropriate, in the updated benefit computations.

The results of the reanalysis shall be documented in a "Special Evaluation Report" (SER).

Table B-1 - Depth-Damage Relationships.

DEPTH-DAMAGE RELATIONSHIPS

(expressed as proportion of property value)

	Stage (ft.)									
	1	2	3	4	5	6	7	8	9	10
Structures										
1 story no bsmt.	0.23	0.32	0.40	0.47	0.53	0.59	0.63	0.67	0.71	0.73
1 story no bsmt. (comm./public)	0.14	0.21	0.26	0.29	0.30	0.41	0.43	0.44	0.45	0.46
1 story w/ bsmt.	0.32	0.39	0.46	0.52	0.59	0.65	0.70	0.74	0.78	0.80
2 story no bsmt.	0.15	0.21	0.26	0.31	0.36	0.41	0.45	0.49	0.52	0.56
2 story no bsmt. (comm./public)	0.16	0.28	0.37	0.43	0.47	0.49	0.50	0.51	0.55	0.58
2 story w/ bsmt.	0.22	0.27	0.32	0.37	0.42	0.47	0.52	0.56	0.61	0.65
Mobile home	0.44	0.64	0.73	0.78	0.80	0.81	0.82	0.84	0.86	0.88
Metal	0.07	0.10	0.15	0.18	0.20	0.23	0.28	0.33	0.37	0.40
Outbuilding	0.25	0.35	0.41	0.46	0.54	0.65	0.71	0.80	0.85	0.90
Contents										
1 story no bsmt. (Residential)*	0.13	0.18	0.22	0.26	0.29	0.32	0.34	0.36	0.37	0.38
2 story no bsmt. (Residential)*	0.09	0.12	0.16	0.19	0.21	0.24	0.26	0.28	0.30	0.32
1 story w/ bsmt. (Residential)*	0.19	0.22	0.25	0.27	0.30	0.32	0.35	0.36	0.38	0.39
2 story w/ bsmt. (Residential)*	0.14	0.16	0.18	0.20	0.22	0.24	0.27	0.29	0.32	0.34
Mobile home (Residential)**	0.27	0.50	0.64	0.70	0.76	0.78	0.79	0.81	0.83	0.92
Motel, Office, Church (1 story)**	0.35	0.50	0.60	0.68	0.74	0.78	0.81	0.83	0.85	0.87
Motel, Office, Church (2 story)**	0.26	0.39	0.48	0.55	0.61	0.67	0.73	0.78	0.83	0.87
Food Related**	0.55	0.70	0.85	0.90	0.95	0.95	0.95	0.95	0.95	0.95
Gas Station, Car Service**	0.22	0.43	0.70	0.92	0.95	0.95	0.95	0.95	0.95	0.95
Retail (1 story)**	0.18	0.30	0.59	0.70	0.90	0.95	0.95	0.95	0.95	0.95
Retail (2 story)**	0.12	0.22	0.34	0.54	0.74	0.83	0.87	0.91	0.93	0.95
Clothing Store**	0.35	0.45	0.67	0.83	0.95	0.95	0.95	0.95	0.95	0.95
Car Dealership**	0.10	0.72	0.80	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Furniture Store**	0.75	0.85	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Outbuilding Contents**	0.30	0.51	0.62	0.67	0.69	0.71	0.80	0.85	0.90	0.95
Vehicles	0.05	0.17	0.20	0.75	0.80	0.85	0.90	0.95	0.95	0.95

Table B-1 - Depth-Damage Relationships, continued

		-2	-1	0	1	2	3	4	5	6	7	8	9	10	25
Vehicles	80	0	0	0	0.05	0.17	0.2	0.75	0.8	0.85	0.95	0.95	0.95	0.95	0.95
RGMCC	89	0	0	0	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56	0.63	0.7	0.95
Canals, lateral drains	90	0	0	0	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88	0.95	1	1
Feeder Ditches (earthen)	91	0	0	0	0.2	0.4	0.6	0.8	1	1	1	1	1	1	1
Feeder Ditches (concrete)	92	0	0	0	0.01	0.14	0.21	0.28	0.35	0.42	0.49	0.56	0.63	0.7	0.95
Railroad	85	0	0	0	0.03	0.04	0.12	0.15	0.18	0.21	0.31	0.64	0.76	0.82	0.95
Unimproved Road	81	0	0	0	0.4	0.6	0.8	1	1	1	1	1	1	1	1
Paved 2 lane Rd.	82	0	0	0	0.11	0.22	0.35	0.5	0.66	0.76	0.76	0.76	0.76	0.76	0.76
Paved 4 lane Rd.	83	0	0	0	0.11	0.2	0.3	0.4	0.5	0.6	0.7	0.7	0.7	0.7	0.7
Interstate Highway	84	0	0	0	0.04	0.08	0.13	0.18	0.23	0.28	0.33	0.35	0.37	0.39	0.49
Bridge	86	0	0	0	0.01	0.03	0.06	0.08	0.12	0.17	0.21	0.23	0.25	0.26	0.65
Utility Lines	87	0	0	0	0.06	0.13	0.22	0.32	0.42	0.52	0.63	0.76	0.88	0.92	0.95

Table B-2 – Number of Structures, Without-Project Conditions, Hatch, NM

Land Use Category	EVENT							
	10%		2%		1%		0.20%	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Residential	263.00		290.00		291.00		299.00	
Commercial	75.00		89.00		90.00		92.00	
Public	21.00		27.00		27.00		27.00	
Apartments	1.00		1.00		1.00		1.00	
Vehicles	260.00		294.00		294.00		295.00	
TOTAL	360.00		407.00		409.00		419.00	

Table B-3 – Value of Damageable Property for Structures, Contents and Vehicles, Without-Project Conditions, Hatch, NM

Land Use Category	EVENT (x $1,000 August 2014 price level)							
	10%		2%		1%		0.20%	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
$/str	$42.76		$41.94		$41.93		$41.47	
Residential	11,245		12,162		12,202		12,399	
Res. Content	9,855		10,529		10,549		10,702	
$/str	$142.85		$142.13		$144.69		$150.84	
Commercial	10,714		12,650		13,022		13,877	
Comm. Content	18,352		19,481		19,704		20,171	
$/str	$836.17		$869.83		$869.83		$869.83	
Public	17,560		23,485		23,485		23,485	
Pub. Content	1,651		4,000		4,000		4,000	
$/str	$43.70		$43.70		$43.70		$43.70	
Apartments	44		44		44		44	
Apt. Contents	22		22		22		22	
	$10.42		$10.41		$10.41		$10.41	
Vehicles	2,709		3,060		3,060		3,070	
Total	**69,442**		**82,374**		**83,029**		**84,700**	

Table B-4 – Single Occurrence Damages to Structures and Contents, Without-Project Conditions, Hatch, NM

Land Use Category	(x $1,000 August 2014 price level) EVENT 10% Mean	SD	2% Mean	SD	1% Mean	SD	0.20% Mean	SD
Residential	3,037	-	4,039	-	4,388	-	5,174	-
Res. Content	1,481	-	1,964	-	2,134	-	2,573	-
Commercial	1,174	-	1,925	-	2,185	-	2,810	-
Comm. Content	4,144	-	8,713	-	10,787	-	14,347	-
Public	1,142	-	2,051	-	2,239	-	2,687	-
Pub. Content	809	-	1,605	-	1,902	-	2,311	-
Apartment	9	-	11	-	12	-	14	-
Apt. Content	3	-	3	-	4	-	4	-
Subtotal - Structures		-		-		-		-
	5,362	-	8,026	-	8,824	-	10,685	-
Subtotal - Contents		-		-		-		-
	6,437	-	12,285	-	14,827	-	19,235	-
Subtotal - Structures and Contents		-		-		-		-
	11,799	-	20,311	-	23,651	-	29,920	-
								-
								-
Total	**11,799**	-	**20,311**	-	**23,651**	-	**29,920**	-

Table B-5 – Average Annual Damages by Land Use Category, Hatch, NM

LAND USE CATEGORY	Average Annual Damages (x $1,000 August 2014 price level) 3.50% interest rate	Probability Avg. Ann. Damages Exceed Indicated Amount				
		0.95	0.75	0.5	0.25	0.05
Residential	857.29	-	-	-	-	-
		-	-	-	-	-
Commercial	1183.64	-	-	-	-	-
		-	-	-	-	-
Public	753.77	-	-	-	-	-
		-	-	-	-	-
Apartment	2.60	-	-	-	-	-
		-	-	-	-	-
		-	-	-	-	-
		-	-	-	-	-
		-	-	-	-	-
		-	-	-	-	-
Subtotal - Structures and Contents		-	-	-	-	-
	2,797.30	-	-	-	-	-
Streets, roads	88.93	-	-	-	-	-
Utilities	0.13	-	-	-	-	-
Railroad	1.81	-	-	-	-	-
Vehicles	156.17	-	-	-	-	-
Agriculture	0.73	-	-	-	-	-
Irr. Drains	0.47	-	-	-	-	-
		-	-	-	-	-
Emergency Costs	45.68	-	-	-	-	-
		-	-	-	-	-
TOTAL	**3,091.22**	-	-	-	-	-

Table B-6 – Rating Curves Used in HED-FDA 1.4.1, Hatch, NM

		0.5	0.2	0.1	0.04	0.02	0.01	0.005	0.002		0.5	0.2	0.1	0.04	0.02	0.01	0.005	0.002
WSP_Station	Invert	Stage	Stage	Stage	Stage	Stage	Stage	Stage	Stage		Q	Q	Q	Q	Q	Q	Q	Q
1	4052	4052.5	4053	4053.5	4054	4054.3	4054.8	4055.2	4056		130	490	757	1074	1302	1536	1757	2037
2	4052	4052.5	4053	4053.5	4054	4054.3	4054.8	4055.2	4056		130	490	757	1074	1302	1536	1757	2037
3	4052	4052.5	4053	4053.5	4054	4054.3	4054.8	4055.2	4056		130	490	757	1074	1302	1536	1757	2037
4	4052	4052.5	4053	4053.5	4054	4054.3	4054.8	4055.2	4056		130	490	757	1074	1302	1536	1757	2037
5	4052	4052.5	4053	4053.5	4054	4054.3	4054.8	4055.2	4056		130	490	757	1074	1302	1536	1757	2037

Table B-7 – Comparison of Cost and EAD for the Proposed Project, Hatch, NM

Comparison of Costs and Equivalent Annual Benefits for the Proposed Project					
HATCH, NM (Spring Canyon) FLOODPLAIN					
		Dam A - Aug 2014 price levels and calculated @ 3.5% interest rate	**Dam B** - Aug 2014 price levels and calculated @ 3.5% interest rate	**Dam C** - Aug 2014 price levels and calculated @ 3.5% interest rate	****Current Dam C** - Aug 2014 price levels and calculated @ FY 17 2.875% interest rate
Construction Cost		8,494.25	8,344.01	9,110.69	7320.00
Env Mitigation		0.00	0.00	0.00	0.00
Real Estate		650.00	650.00	650.00	442.00
PED		901.31	901.31	901.31	1026.00
Total First Cost		10,045.56	9,895.32	10,662.00	9338.38
IDC, Construction		0.00	0.00	0.00	0.00
Total, Interest During Construction		0.00	0.00	0.00	0.00
Total Investment		10,045.56	9,895.32	10,662.00	9338.38
Avg. Ann. Cost		428.28	421.87	454.56	354.37
OMRR&R		22.55	22.55	22.55	21.54
Total Avg. Ann. Cost		450.83	444.42	477.11	375.91
Equivalent Avg. Ann. Benefits		2191.7	2273.2	2431.7	2611.08
Benefit/Cost Ratio		4.9	5.1	5.1	6.9
Net Benefits		1740.9	1828.7	1954.6	2235.17

** Dam C December 2015 cost deflated to August 2014 price levels to match Benefits price level

Table B-8A – Equivalent Annual Benefits by Land Use Category for Dam A

LAND USE CATEGORY	Average Annual Benefits (x $1,000 August 2014 price level) FY 14 interest rate 3.50%		
	EAD	Residual Damages	Benefits
Residential	857.29	376.23	481.06
Commercial	1183.64	176.78	1006.86
Public	753.77	267.05	486.72
Apartments	2.60	1.56	1.04
Subtotal - Structures and Contents	2797.30	821.62	1975.68
Streets, roads	88.93	23.64	65.29
Utilities	0.13	0.03	0.10
Railroad	1.81	0.48	1.33
Vehicles	156.17	41.29	114.88
Agriculture	0.73	0.19	0.54
Irr. Drains	0.47	0.12	0.35
Emergency Costs	45.68	12.14	33.54
TOTAL	**3091.22**	**899.52**	**2191.69**

Table B-8B – Equivalent Annual Benefits by Land Use Category for Dam B

LAND USE CATEGORY	Average Annual Benefits (x $1,000 August 2014 price level) FY 14 interest rate 3.50%		
	EAD	Residual Damages	Benefits
Residential	857.29	363.04	494.25
Commercial	1183.64	134.01	1049.63
Public	753.77	249.25	504.52
Apartments	2.60	1.53	1.07
Subtotal - Structures and Contents	2797.30	747.83	2049.47
Streets, roads	88.93	21.51	67.42
Utilities	0.13	0.03	0.10
Railroad	1.81	0.44	1.37
Vehicles	156.17	36.90	119.27
Agriculture	0.73	0.18	0.55
Irr. Drains	0.47	0.11	0.36
Emergency Costs	45.68	11.05	34.63
TOTAL	**3091.22**	**818.05**	**2273.16**

Table B-8C – Equivalent Annual Benefits by Land Use Category for Dam C

LAND USE CATEGORY	Average Annual Benefits (x $1,000 October 2016 price level)		
		FY 17 interest rate 2.875%	
	EAD	Residual Damages	Benefits
Residential	914.23	327.52	586.71
Commercial	1238.51	56.80	1181.71
Public	802.15	210.87	591.28
Apartments	2.72	1.50	1.22
Subtotal - Structures and Contents	2957.61	596.69	2360.92
Streets, roads	88.93	17.57	71.36
Utilities	0.13	0.03	0.10
Railroad	1.81	0.35	1.46
Vehicles	166.94	27.32	139.62
Agriculture	0.73	0.16	0.57
Irr. Drains	0.47	0.09	0.38
Emergency Costs	45.68	9.01	36.67
TOTAL	**3262.30**	**651.22**	**2611.08**

Table B-9 – Expected Value of EAD and EAD Reduced for Proposed Projects

Plan	Expected Annual Damage (x $1,000) August 2014 price level		
	Without Plan*	With Plan**	Benefits
No Action	3,091.22	3,091.22	0.00
Dam A	3,091.22	899.52	2,191.69
Dam B	3,091.22	818.05	2,273.16
Dam C	3,091.22	651.22	2,611.08

* Total from Table B-5   ** Residual damages total from Tables B-8A through B-8C

Table B-10 – Expected Value of Net Benefits for Proposed Projects

Plan	Expected Annual NED Benefit and NED Cost (x $1,000) August 2014 price levels*		
	Benefits	Cost	Net Benefits
No Action	0.00	0.00	0.00
Dam A	2,191.69	450.83	1,740.86
Dam B	2,273.16	444.42	1,828.74
Dam C	2,611.08	375.91	2,235.17

* Dam C December 2015 cost deflated to August 2014 price levels

Table B-11 – Expected Value of Benefit/Cost Ratios for Proposed Projects

Plan	Expected Benefit/Cost Ratio
No Action	0.0
Dam A	4.9
Dam B	5.1
Dam C	6.9

Table B-12 – Conditional Probability of Design Non-Exceedance

Without Project Base Year Performance Target Criteria:
Event Exceedance Probability = 0.01
Residual Damage = 5.00 %

Plan Name	Stream Name	Damage Reach Name	Damage Reach Description	Target Stage	Target Stage Annual Exceedance Probability		Conditional Non-Exceedance Probability by Events					
					Median	Expected	10%	4%	2%	1%	.4%	.2%
Without	Spring Canyon	Spring Canyon 1	Station 1--10 year	4053.50	0.1686	0.1708	0.1872	0.1253	0.1039	0.0892	0.0768	0.0700
		Spring Canyon 2	Station 2--50 year	4053.19	0.1865	0.2098	0.1352	0.0903	0.0751	0.0647	0.0561	0.0514
		Spring Canyon 3	Station 3--100 year	4054.44	0.1317	0.1233	0.3266	0.2232	0.1850	0.1584	0.1357	0.1232
		Spring Canyon 4	Station 4--500 year	4053.90	0.1502	0.1459	0.2493	0.1675	0.1388	0.1191	0.1021	0.0926
		Spring Canyon 5	Station 5--10 year sheetflow	4053.47	0.1700	0.1729	0.1835	0.1228	0.1019	0.0875	0.0753	0.0686
With-project A	Spring Canyon	Spring Canyon 1	Station 1--10 year	4053.50	0.1005	0.1148	0.4915	0.2875	0.2113	0.1636	0.1268	0.1083
		Spring Canyon 2	Station 2--50 year	4053.19	0.1511	0.1750	0.3161	0.1700	0.1226	0.0936	0.0716	0.0609
		Spring Canyon 3	Station 3--100 year	4054.44	0.0163	0.0402	0.8565	0.6423	0.5195	0.4262	0.3432	0.2980
		Spring Canyon 4	Station 4--500 year	4053.90	0.0474	0.0711	0.6937	0.4569	0.3510	0.2768	0.2171	0.1870
		Spring Canyon 5	Station 5--10 year sheetflow	4053.47	0.1039	0.1186	0.4770	0.2768	0.2034	0.1571	0.1218	0.1037
With-project B	Spring Canyon	Spring Canyon 1	Station 1--10 year	4053.50	0.1005	0.1165	0.4825	0.2817	0.2077	0.1600	0.1247	0.1065
		Spring Canyon 2	Station 2--50 year	4053.19	0.1511	0.1752	0.3153	0.1711	0.1232	0.0936	0.0719	0.0614
		Spring Canyon 3	Station 3--100 year	4054.44	0.0121	0.0383	0.8643	0.6653	0.5443	0.4510	0.3675	0.3227
		Spring Canyon 4	Station 4--500 year	4053.90	0.0534	0.0745	0.6744	0.4422	0.3385	0.2665	0.2100	0.1814
		Spring Canyon 5	Station 5--10 year sheetflow	4053.47	0.1039	0.1200	0.4683	0.2717	0.1997	0.1538	0.1196	0.1022
With-project C	Spring Canyon	Spring Canyon 1	Station 1--10 year	4053.50	0.1005	0.1150	0.4931	0.2910	0.2165	0.1695	0.1316	0.1117
		Spring Canyon 2	Station 2--50 year	4053.19	0.1512	0.1749	0.3179	0.1730	0.1260	0.0968	0.0738	0.0626
		Spring Canyon 3	Station 3--100 year	4054.44	0.0086	0.0318	0.8938	0.7190	0.6124	0.5255	0.4450	0.3982
		Spring Canyon 4	Station 4--500 year	4053.90	0.0474	0.0698	0.7006	0.4709	0.3691	0.2955	0.2321	0.2000
		Spring Canyon 5	Station 5--10 year sheetflow	4053.47	0.1039	0.1187	0.4783	0.2801	0.2080	0.1626	0.1260	0.1068

Table B-13 – Conditional Probability of Design Non-Exceedance and Annual Performance and Equivalent Long-Term Exceedance Probability

Without Project Base Year Performance Target Criteria:
Event Exceedance Probablility = 0.01
Residual Damage = 5.00 %

Plan Name	Stream Name	Damage Reach Name	Damage Reach Description	Target Stage	Target Stage Annual Exceedance Probability		Long-Term Risk (years)		
					Median	Expected	10	30	50
Without	Spring Canyon	Spring Canyon 1	Station 1--10 year	4053.50	0.1686	0.1708	0.8464	0.9907	0.9999
		Spring Canyon 2	Station 2--50 year	4053.19	0.1865	0.2098	0.9051	0.9972	1.0000
		Spring Canyon 3	Station 3--100 year	4054.44	0.1317	0.1233	0.7316	0.9627	0.9986
		Spring Canyon 4	Station 4--500 year	4053.90	0.1502	0.1459	0.7933	0.9806	0.9996
		Spring Canyon 5	Station 5--10 year sheetflow	4053.47	0.1700	0.1729	0.8502	0.9913	0.9999
With-project A	Spring Canyon	Spring Canyon 1	Station 1--10 year	4053.50	0.1005	0.1148	0.7046	0.9526	0.9978
		Spring Canyon 2	Station 2--50 year	4053.19	0.1511	0.1750	0.8539	0.9918	0.9999
		Spring Canyon 3	Station 3--100 year	4054.44	0.0163	0.0402	0.3368	0.6418	0.8717
		Spring Canyon 4	Station 4--500 year	4053.90	0.0474	0.0711	0.5214	0.8416	0.9749
		Spring Canyon 5	Station 5--10 year sheetflow	4053.47	0.1039	0.1186	0.7169	0.9573	0.9982
With-project B	Spring Canyon	Spring Canyon 1	Station 1--10 year	4053.50	0.1005	0.1165	0.7101	0.9547	0.9980
		Spring Canyon 2	Station 2--50 year	4053.19	0.1511	0.1752	0.8543	0.9919	0.9999
		Spring Canyon 3	Station 3--100 year	4054.44	0.0121	0.0383	0.3235	0.6236	0.8583
		Spring Canyon 4	Station 4--500 year	4053.90	0.0534	0.0745	0.5388	0.8556	0.9791
		Spring Canyon 5	Station 5--10 year sheetflow	4053.47	0.1039	0.1200	0.7216	0.9591	0.9983
With-project C	Spring Canyon	Spring Canyon 1	Station 1--10 year	4053.50	0.1005	0.1150	0.7051	0.9528	0.9978
		Spring Canyon 2	Station 2--50 year	4053.19	0.1512	0.1749	0.8538	0.9918	0.9999
		Spring Canyon 3	Station 3--100 year	4054.44	0.0086	0.0318	0.2764	0.5546	0.8016
		Spring Canyon 4	Station 4--500 year	4053.90	0.0474	0.0698	0.5150	0.8362	0.9732
		Spring Canyon 5	Station 5--10 year sheetflow	4053.47	0.1039	0.1187	0.7173	0.9575	0.9982

Table B-14 – EAD Reduced and Distributed by Plans for Dams A, B and C

Equivalent Annual Damage Analysis

File Help

Hatch 205 FDA
Equivalent Annual Damage Reduced and Distributed by Plans
(Damage in $1,000's)

Discount Rate: 3.500
Analysis Period: 50 Years

Plan Name	Plan Description	Equivalent Annual Damage			Probability Damage Reduced Exceeds Indicated Values		
		Total Without Project	Total With Project	Damage Reduced	.75	.50	.25
Without	Without project condition	2953.46	2953.46	0.00	0.00	0.00	0.00
With-project A	Small Dam	2953.46	862.91	2090.55	625.42	1953.25	3374.94
With-project B	Medium Dam	2953.46	784.73	2168.73	633.47	1986.97	3484.76
With-project C	Large Dam	2953.46	632.34	2321.13	660.68	2064.64	3691.11

------ - Computations have not been completed.
\+ - Something has changed and computations need to be redone.

Table B-15 – EAD Reduced and Distributed by Plans for Dam C (updated)

Equivalent Annual Damage Analysis

File Help

Hatch 205 FY 17 Update
Equivalent Annual Damage Reduced and Distributed by Plans
(Damage in $1,000's)

Discount Rate: 2.875
Analysis Period: 50 Years
Version 1.4.1, Jan 22, 2016; Less Simple Method (0.010)

Plan Name	Plan Description	Equivalent Annual Damage			Probability Damage Reduced Exceeds Indicated Values		
		Total Without Project	Total With Project	Damage Reduced	.75	.50	.25
Without	Without project condition	3124.55	3124.55	0.00	0.00	0.00	0.00
With-project A	Small Dam	------	------	------	------	------	------
With-project B	Medium Dam	------	------	------	------	------	------
With-project C	Large Dam	3124.55	624.00	2500.55	1274.39	2152.17	3462.70

------ - Computations have not been completed.
\+ - Something has changed and computations need to be redone.

8 Environmental

8-01 Correspondence:

Appendix 1
Correspondence

8-02 Appendix 1a- Public Scoping Letter, Mailing List, Scoping Comments and Corps' Responses to Comments

Appendix 1a
Public Scoping letter, mailing list, Scoping comments, and Corps' Responses to Comments

8-03 Public Scoping Letter:

March 13, 2006

Planning, Project and Program Management Division
Planning Branch
Environmental Resources Section

Dear XXXXX:

The U.S. Army Corps of Engineers, Albuquerque District, (Corps) in cooperation with and at the request of the Doña Ana County Flood Commission, is planning a project that would reduce the flood damage to the Village of Hatch, New Mexico from Spring Canyon. See Figure below for the project site location. This scoping letter is to solicit issues and comments on the project under the National Environmental Policy Act (NEPA).

The rehabilitation work would be conducted under Section 205 of the Flood Control Act of 1948 (Public Law 80-858), as amended. Section 205 provides authority to the Secretary of the Army, acting through the Chief of Engineers, to plan and construct small local flood protection projects which have not already been specifically authorized by Congress. A project is accepted for construction only after detailed investigation clearly shows its engineering feasibility, environmental acceptability, and economic justification.

The Village of Hatch is located in the northwest corner of Doña Ana County, New Mexico, near the Rio Grande. It is approximately 35 miles northwest of Las Cruces, New Mexico at the intersection of US highway 85 and state highway 26. The entire Village is in the 100-year floodplain. Significant flooding occurred in 1987 with up to two feet of water in the streets of Hatch. Flow comes from two sources from the west, which travel through the city toward the Rio Grande. Spring Canyon, 7.2 square miles of total drainage area, has an upstream detention dam controlling 5.4 square miles and detention storage areas at its downstream end. As the flow goes overbank it enters Hatch and leaves several smaller ponding areas at Main Street and at the Railroad embankments.

The proposed work would consist of constructing an earthen embankment dam with a concrete spillway and an inlet channel from Spring Canyon. Barrow material for the dam would be obtained from the area directly behind the proposed dam. The outlet works would drain water from the reservoir into the Colorado drain. The inlet channel, which would bring water from the Spring Canyon to the dam, would be constructed with gabion and riprap. An additional channel would also be needed on the exterior of the dam to drain the water that collects there currently and direct it into the Colorado drain. Figure 2 illustrates where these features would be located. Proposed construction is scheduled to start in 2008.

Please inform us of any issues you feel need to be addressed in the Environmental Assessment for this proposed project. Send your correspondence within 30 days from the date of this letter to:

U.S. Army Corps of Engineers, Albuquerque District
Attn: Mrs. Danielle A. Galloway, Biologist
Environmental Resources Section
4101 Jefferson Plaza NE
Albuquerque, NM 87109-4335

If you have any questions or need additional information, please contact Mrs. Galloway at (505) 342-3661, or e-mail address danielle.a.galloway@spa02.usace.army.mil.
Thank you for your time and attention.

Sincerely,

Julie A. Hall
Chief, Environmental Resources Section

Enclosures (2)

Scoping Letter Sent to:

U.S. Fish and Wildlife Service (MacMullin)
U.S. Environmental Protection Agency (Lawrence)
U.S. Army Corps of Engineers (Manger)
Natural Resources Conservation Service (Pacheco)
Bureau of Reclamation (Hansen)
U.S. Federal Emergency Management Agency (Orwat)

Energy, Minerals, and Natural Resources Department (Sivinski)
New Mexico Department of Transportation (Dominguez)
New Mexico Environmental Department (Kelley)
New Mexico State Engineer (D'Antonio)
New Mexico Department of Game and Fish (Stevenson)
Middle Rio Grande Conservancy District (Shah)
Doña Ana Flood Commission (Dugie)
Elephant Butte Irrigation District (Esslinger)
Sierra Soil and Water Conservation District (Fahl)
Village of Hatch (Nordyke)
Doña Ana County (Vásquez Butler)
International Boundary and Water Commission (Hernandez)
Burlington, Northern and Santa Fe Railroad (Hartley, Thomson, Lara)

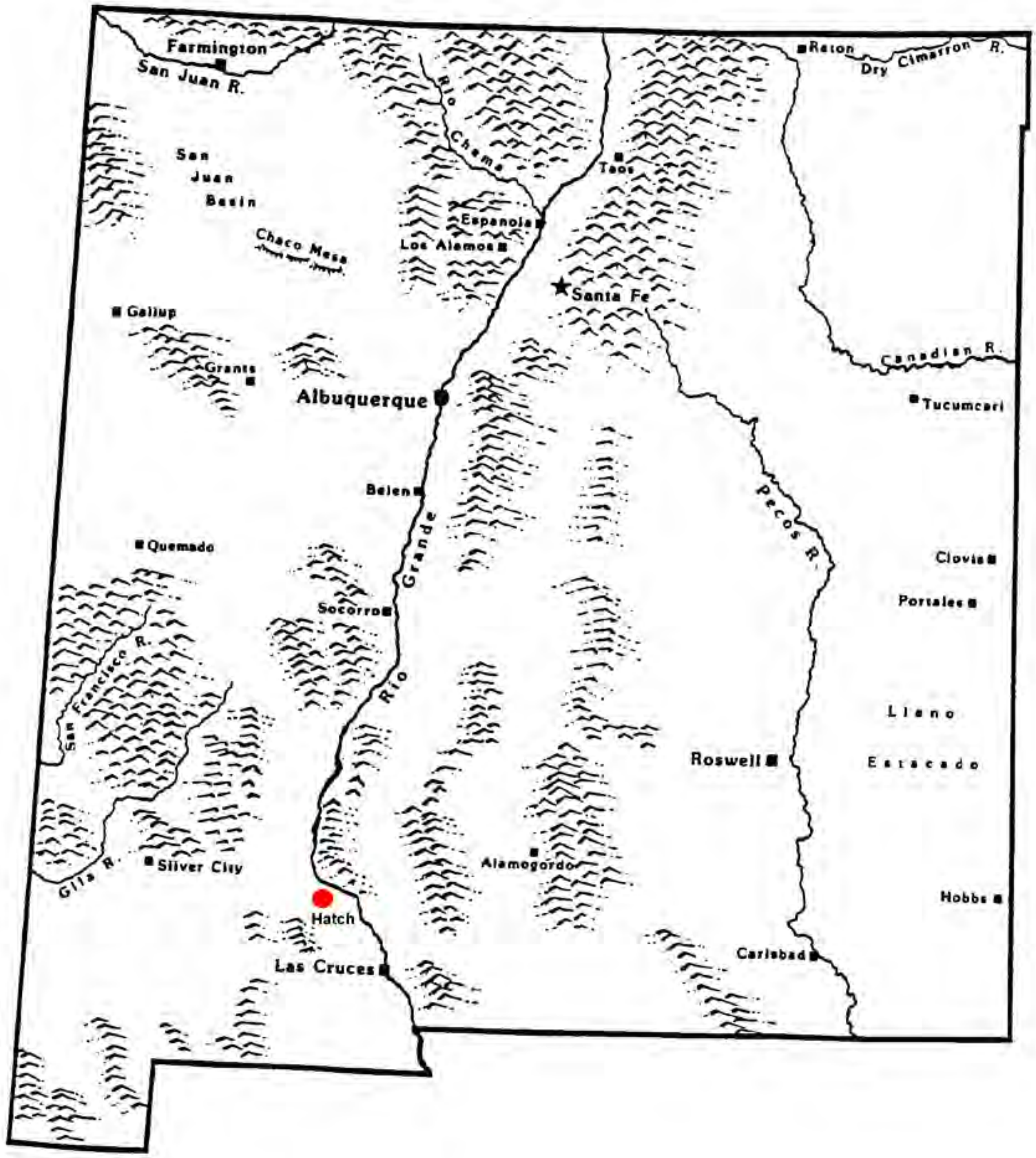


Figure 1. Project Location for the Proposed Flood Reduction Facilities in the Village of Hatch, Doña Ana County, New Mexico.

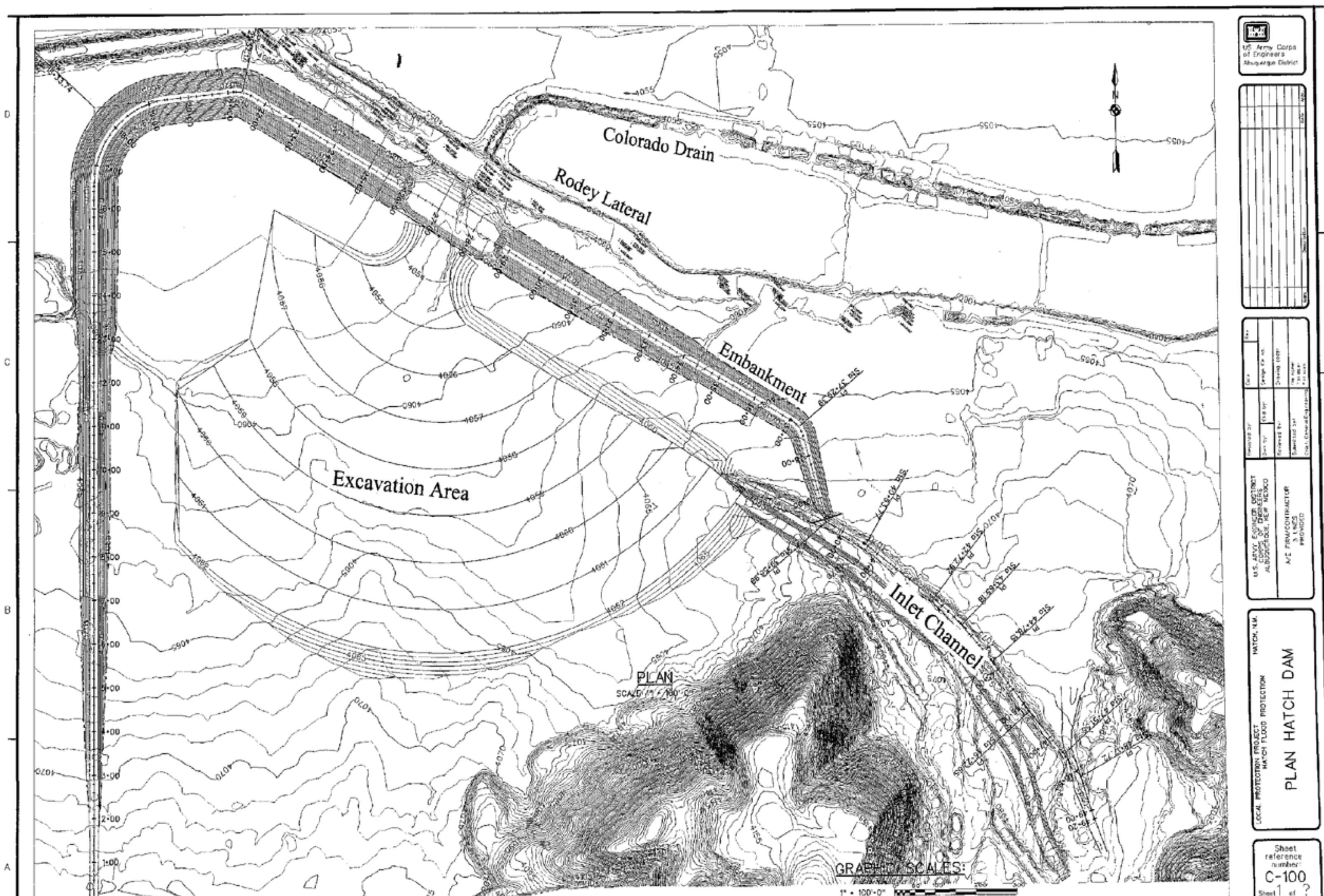


Figure 2. Proposed Site Locations for Flood Reduction Facilities in the City of Hatch, Doña Ana County, New Mexico.

8-04 Hatch Scoping Letter Distribution List:

Hatch Scoping Letter Distribution List

Ms. Susan MacMullin
Field Supervisor
U.S. Fish and Wildlife Service
NM Ecological Services Field Office
2105 Osuna Road NE
Albuquerque, New Mexico 87113

Mr. Rob Lawrence
USEPA, Region 6
Office of Planning and Coordination (6EN-XP)
1445 Ross Avenue
Dallas, Texas 75202-2733

Ms. Jean Manger
Acting Chief, Regulatory Branch
U.S. Army Corps of Engineers
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109-3435

Mr. Robert Sivinski
New Mexico Forestry and Resources Conservation Division
Energy, Minerals, and Natural Resources Department
P.O. Box 1948
Santa Fe, New Mexico 87504-1948

Mr. James Orwat
Project Manager
Federal Emergency Management Agency
Mitigation Division
Region VI – Federal Center
800 North Loop 288
Denton, Texas 76201-3698

Mr. David Pacheco
State Conservation Engineer
Natural Resources Conservation Service
6200 Jefferson NE, Suite 305
Albuquerque, New Mexico 87109

Mr. Steve Hansen
Deputy Area Manager
Bureau of Reclamation
505 Marquette NW, Suite 1313
Albuquerque, New Mexico 87102-2161

Mr. Subhas K. Shah
Chief Engineer
Middle Rio Grande Conservancy District
P.O. Box 581
Albuquerque, New Mexico 87103

Mr. Tod Stevenson
New Mexico Department of Game and Fish
Conservation Services Division
P.O. Box 25112
Santa Fe, New Mexico 87504

Mr. John R. D'Antonio, Jr.
State Engineer
New Mexico State Engineer
Bataan Memorial Bldg.
P.O. Box 25102
Santa Fe, New Mexico 87504-5102

Mr. Ed Kelley, Director
Water and Waste Management Division
New Mexico Environmental Department
Harold Runnels Building
P.O. Box 26110
Santa Fe, New Mexico 87502

Mr. Alvin Dominguez
District Engineer
New Mexico Department of Transportation
District I
2919 E. Pine Street
Deming, New Mexico 88030

Mr. Oscar Vásquez Butler
District 1 Commissioner
Dona Ana County
180 W. Amador
Las Cruces, New Mexico 88005

Mr. Paul Dugie
Dona Ana County Flood Commission
251 W. Amador
Las Cruces, New Mexico 88001

Mr. Gary Esslinger
Treasurer Manager
Elephant Butte Irrigation District
530 S. Melendres
P.O. Drawer 1509
Las Cruces, New Mexico 88004-1509

Ms. Merry Jo Fahl
District Manager
Sierra Soil and Water Conservation District
2101 S. Broadway
Truth or Consequences, New Mexico 87901

Mr. Luis Hernandez, Jr.
Civil Engineer
International Boundary Water Commission
4171 N. Mesa, Suite C-310
El Paso, Texas 79902-1441

Mr. Judd Nordyke
Mayor, Village of Hatch
P.O. Box 250
Hatch, New Mexico 87937

Mr. Lyn Hartley
Director Pubic Projects
Burlington, Northern and Santa Fe Railroad
4515 Kansas Avenue
Kansas City, Kansas 66106

Mr. Bill Thomson
Manager Public Projects
Burlington, Northern and Santa Fe Railroad
4515 Kansas Avenue
Kansas City, Kansas 66106

Mr. Harry Lara
Project Engineer
Burlington, Northern and Santa Fe Railroad
1624 First Street, NW
Albuquerque, NM 87102

8-05 Scoping Comments:

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
6200 Jefferson NE
Albuquerque, New Mexico 87109
Phone: (505) 761-4400 **Fax**: (505) 761-4462
Web site: www.nm.nrcs.usda.gov

March 22, 2006

U.S. Army Corps of Engineers, Albuquerque District
Mrs. Danielle A. Galloway, Biologist
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109-3435

RE: Scoping request for Hatch, New Mexico Spring Canyon Flood Protection Project

Dear Mrs. Galloway:

The Natural Resources Conservation Service (NRCS) assisted Caballo Soil and Water Conservation District (SWCD) in the design and construction of Rodey and Porter-Weisenhunt dams. A Civilian Conservation Corps (CCC) camp, managed by the Soil Erosion Service, assisted the Village of Hatch in the design and construction of the existing Spring Canyon Dam. These three dams are Federally assisted flood control structures with NRCS as the assisting agency.

See the attached map. It shows Spring Canyon, Rodey, and Porter-Weisenhunt dams. There is a fourth dam, Porter Private that shares the Porter-Weisenhunt outlet channel. All four dams drain into the Colorado or Hatch Drains (the Colorado Drain turns into the Hatch Drain between the outlets of Rodey Dam and the Porter dams).

Floodwater releases from the Rodey and Porter-Weisenhunt dams were limited to 36 cfs and 13 cfs, respectively. When these two dams were constructed the Bureau of Reclamation was managing the Elephant Butte Irrigation District, and the Bureau placed these release restrictions on SCS (currently NRCS) and Caballo SWCD because the Colorado/Hatch Drain had limited capacity.

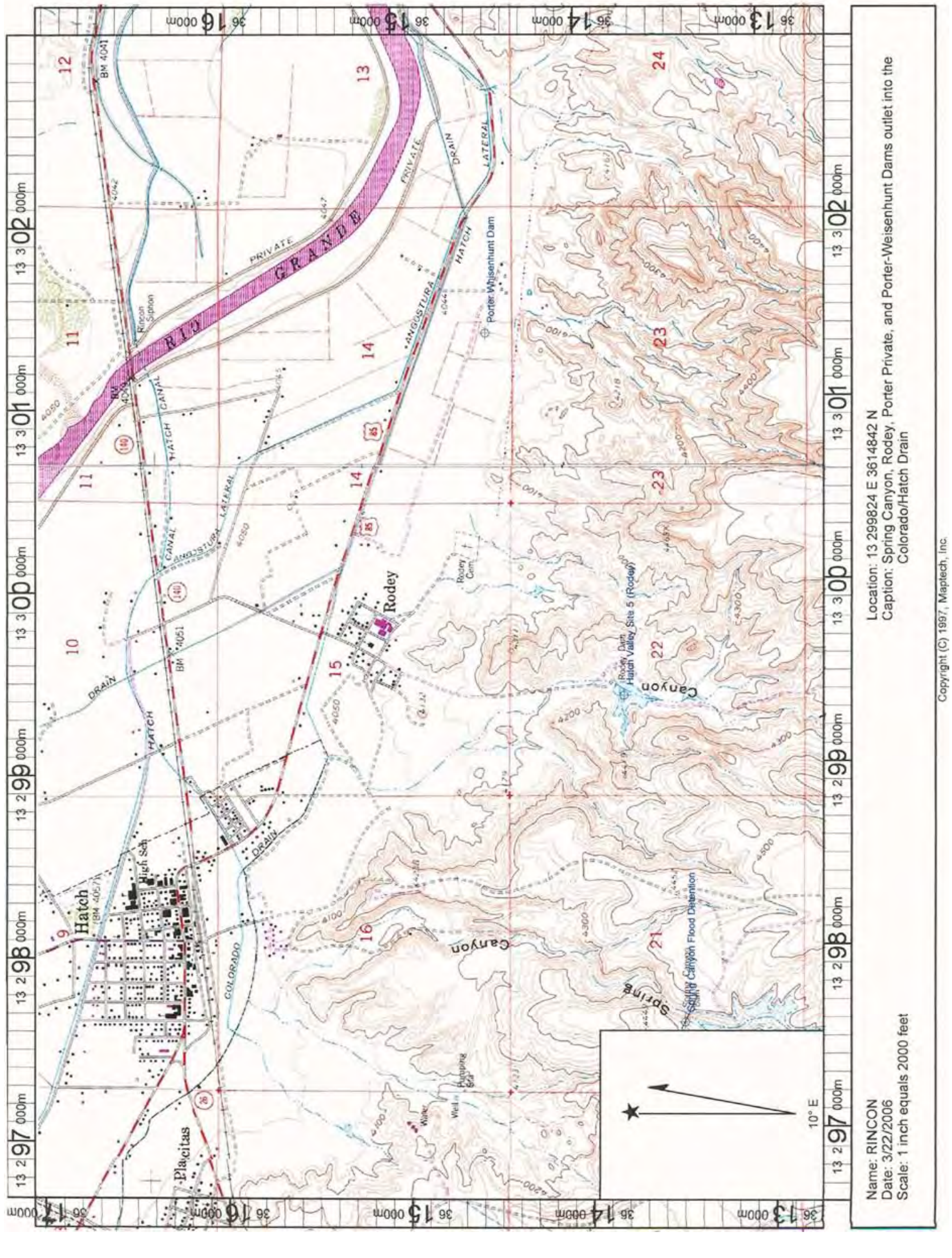
NRCS is concerned that releases from the proposed Spring Canyon Dam would fill the drain to capacity and those downstream releases from the Rodey, Porter Private, and Porter-Weisenhunt dams would then appear to cause flooding by adding floodwater discharges to the drain, which would already be flowing full.

NRCS also has an interest in the effect the proposed project might have on the existing Spring Canyon Dam.

Thank you for the opportunity to comment.

Sincerely,

ROSENDO TREVIÑO III
State Conservationist


Name: RINCON
Date: 3/22/2006
Scale: 1 inch equals 2000 feet
Location: 13 299824 E 3614842 N
Caption: Spring Canyon, Rodey, Porter Private, and Porter-Weisenhunt Dams outlet into the Colorado/Hatch Drain
Copyright (C) 1997, Maptech, Inc.
10° E
Hatch
Rodey
Placitas
RIO GRANDE
PRIVATE
ANGOSTURA
HATCH
CANAL
LATERAL
DRAIN
COLORADO
Rincon Siphon
Porter Whisenhunt Dam
Rodey Dam Hatch Valley Site 5 (Rodey)
Spring Canyon Flood Detention
Spring
Canyon
Rodey Cem

GOVERNOR
Bill Richardson

DIRECTOR AND SECRETARY
TO THE COMMISSION
Bruce C. Thompson

STATE OF NEW MEXICO
DEPARTMENT OF GAME & FISH

One Wildlife Way
Post Office Box 25112
Santa Fe, NM 87504
Phone: (505) 476-8008
Fax: (505) 476-8128

Visit our website at www.wildlife.state.nm.us
For basic information or to order free publications: 1-800-862-9310.

April 10, 2006

Mrs. Danielle A. Galloway, Biologist
U.S. Army Corps of Engineers, Albuquerque District
Environmental Resources Section
4101 Jefferson Plaza NE
Albuquerque, NM 87109-4335

Re: Scoping for Proposed Flood Reduction Facilities in the City of Hatch, Dona Ana County, NM
NMGF No. 10727

Dear Mrs. Galloway:

In response to your letter dated March 14, 2006, we received regarding the proposed Flood Reduction Facilities in the City of Hatch, Dona Ana County, NM, the New Mexico Department of Game and Fish (Department) identified several issues we would like addressed during the NEPA analysis for this proposed project. The Department supports providing for public safety of the City of Hatch during flood events.

The economic analysis should take into account future climate change and consider the likelihood of extreme precipitation events and the probability of flood events in Dona Ana County. Past records of flood events are not likely to provide a valid baseline for future predictions of extreme weather or flood events.

Following construction, the excavated surfaces behind the dam should be seeded with certified weed-free native vegetation to provide wildlife habitat and to reduce wind erosion. Monitoring protocols should be addressed to insure success of the reseeding efforts. If the excavated surface soils comprise well-developed horizons, consider stockpiling this material for re-distribution on the surface following final grading. Construction of the earthen embankment dam should include measures to minimize surface erosion. The upper end of the inlet channel (Station 49+20) should be constructed using designs and materials that will prevent development of a headcut in Spring Canyon. The lower end of the inlet channel where it enters the excavation area should be constructed using designs and materials that will prevent development of a headcut within the inlet channel itself.

The letter and figure do not describe the concrete spillway structure in detail. It is not clear whether the facility is intended to store runoff until it evaporates or whether there is provision for regulated release of collected water. The Department believes the spillway structure should include drainage features such as a head gate to allow management of surface water that collects behind the dam. During times of inundation behind the dam, the collected water should be managed to provide aquatic habitat for wildlife. Because of the risk of avian botulism developing in water bodies when environmental conditions combine to favor toxin production, including a head gate in the spillway structure would allow the collected water to be drained into the Colorado Drain to prevent botulism outbreaks.

We suggest that the long-term operation and maintenance plans for the facility should include how to manage sediment accumulation behind the dam. Project planning should also consider how long-term operation and maintenance of the facility can address adequate drainage capacity in the Colorado Drain.

Thank you for the opportunity to provide scoping comments on the proposed Flood Reduction Facilities Project for the City of Hatch. If you have any questions, please contact Randy Floyd at (505) 476-8091 or randy.floyd@state.nm.us .

Sincerely,

Lisa Kirkpatrick

Lisa Kirkpatrick, Chief
Conservation Services Division

LK/rf

xc: Russ Holder, Acting Ecological Services Field Supervisor, USFWS
Luis Rios, SW Area Operations Chief, NMGF
Pat Mathis, SW Area Habitat Specialist, NMGF

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Mexico Ecological Services Field Office
2105 Osuna NE
Albuquerque, New Mexico 87113
Phone: (505) 346-2525 Fax: (505) 346-2542

MAR 21 2006

Thank you for your recent request for information on threatened or endangered species or important wildlife habitats that may occur in your project area. The New Mexico Ecological Services Field Office has posted lists of the endangered, threatened, proposed, candidate and species of concern occurring in all New Mexico Counties on the Internet. Please refer to the following web page for species information in the county where your project occurs: http://ifw2es.fws.gov/NewMexico/SBC_intro.cfm. If you do not have access to the Internet or have difficulty obtaining a list, please contact our office and we will mail or fax you a list as soon as possible.

After opening the web page, find New Mexico Listed and Sensitive Species Lists on the main page and click on the county of interest. Your project area may not necessarily include all or any of these species. This information should assist you in determining which species may or may not occur within your project area.

Under the Endangered Species Act, as amended (Act), it is the responsibility of the Federal action agency or its designated representative to determine if a proposed action "may affect" endangered, threatened, or proposed species, or designated critical habitat, and if so, to consult with us further. Similarly, it is their responsibility to determine if a proposed action has no effect to endangered, threatened, or proposed species, or designated critical habitat. If your action area has suitable habitat for any of these species, we recommend that species-specific surveys be conducted during the flowering season for plants and at the appropriate time for wildlife to evaluate any possible project-related impacts. Please keep in mind that the scope of federally listed species compliance also includes any interrelated or interdependent project activities (e.g., equipment staging areas, offsite borrow material areas, or utility relocations) and any indirect or cumulative effects.

Candidates and species of concern have no legal protection under the Act and are included on the web site for planning purposes only. We monitor the status of these species. If significant declines are detected, these species could potentially be listed as endangered or threatened. Therefore, actions that may contribute to their decline should be avoided. We recommend that candidates and species of concern be included in your surveys.

Also on the web site, we have included additional wildlife-related information that should be considered if your project is a specific type. These include communication towers, power line safety for raptors, road and highway improvements and/or construction, spring developments and livestock watering facilities, wastewater facilities, and trenching operations.

Under Executive Orders 11988 and 11990, Federal agencies are required to minimize the destruction, loss, or degradation of wetlands and floodplains, and preserve and enhance their natural and beneficial values. We recommend you contact the U.S. Army Corps of Engineers for permitting requirements under section 404 of the Clean Water Act if your proposed action could impact floodplains or wetlands. These habitats should be conserved through avoidance, or mitigated to ensure no net loss of wetlands function and value.

The Migratory Bird Treaty Act (MBTA) prohibits the taking of migratory birds, nests, and eggs, except as permitted by the U.S. Fish and Wildlife Service. To minimize the likelihood of adverse impacts to all birds protected under the MBTA, we recommend construction activities occur outside the general migratory bird nesting season of March through August, or that areas proposed for construction during the nesting season be surveyed, and when occupied, avoided until nesting is complete.

We suggest you contact the New Mexico Department of Game and Fish, and the New Mexico Energy, Minerals, and Natural Resources Department, Forestry Division for information regarding fish, wildlife, and plants of State concern.

Thank you for your concern for endangered and threatened species and New Mexico's wildlife habitats. We appreciate your efforts to identify and avoid impacts to listed and sensitive species in your project area.

Sincerely,

Russell Holder

Russell Holder
Acting Field Supervisor

8-06 Corps' Responses to Comments:

NRCS Comment:

NRCS is concerned that releases from the proposed Spring Canyon Dam would fill the drain to capacity and those downstream releases from the Rodey, Porter Private, and Porter-Weisenhunt dams would then appear to cause flooding by adding floodwater discharges to the drain, which would already be flowing full.

NRCS also has an interest in the effect the proposed project might have on the existing Spring Canyon Dam.

Corps Response:

NRCS (Mr. Treviño) has a valid point in questioning the ability of the Colorado Drain to adequately provide an outlet for such a large drainage area with multiple detention structures contributing flows to the Drain. The work performed in 2006 on the proposed Spring Canyon Dam determined an outflow of 200 cfs from the structure could be handled by the Drain. This is less than the current capacity of the Drain, approximately 300 cfs. Even when the discharges of the structures Mr. Treviño cites are included, (36 and 13 cfs), we are still under the capacity of 300 cfs. I realize that the current condition of the Drain will require some upgrading of crossing structures along with frequent (at least annually) maintenance to remove vegetation and debris. These activities will be included with the Dam project and the subsequent Operation and Maintenance Manual that will be provided to the Sponsor Agency.

Additionally, our analysis shows that the existing flow in the 100yr event on Spring Canyon will be about 1600 cfs at the headworks of the Colorado Drain. This far exceeds the capacity of the Drain and the 1300 or so cfs that will overtop the Drain proceeds east flooding the Village of Hatch.

Finally, Mr. Trevino mentioned the NRCS has a concern how the proposed Dam will impact the existing Dam located upstream. Our project will not influence the existing Dam in any way. The new structure will perform completely independently of the existing Dam.

8-07 Appendix 1b Tribal Scoping Letter, Mailing List and Responces:

Appendix 1b
Tribal Scoping Letter, Mailing List and Responces

8-08 Tribal Scoping Letter:

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
4101 JEFFERSON PLAZA NE
ALBUQUERQUE NM 87109-3435

February 16, 2007

Planning, Project and Program Management Division
Planning Branch
Environmental Resources Section

Bryan Jones
Cultural Coordinator
Fort Still Apache Tribe
Rt. 2, Box 121
Apache, Oklahoma 73006

Dear Mr. Jones:

The United States Army Corps of Engineers, Albuquerque District, is conducting a series of studies in order to determine if there is sufficient justification for construction of a small earthen flood control dam within the village limits of Hatch, New Mexico. Hatch is very vulnerable to flooding especially during episodes of heavy rainfall. Additionally, the entire village of Hatch is within the 100-year floodplain of the Rio Grande, as is the proposed project. Significant flooding occurred in 1988, 1992, and 2006. The Flood Control Act of 1948, Section 205, authorizes the Secretary of the Army, acting through the Chief of Engineers, to plan and construct small local flood protection projects which have not been specifically authorized by Congress.

The proposed earthen dam would provide 100-year level of protection to Hatch. The storage capacity would be 181 acre-feet, including 30 acre-feet for sediment and 151 acre-feet for water. The dam would be 4,000 feet long, and the maximum height would be 20 feet. The earthen material would come from a borrow area in the proposed reservoir immediately behind the dam. Currently the borrow area contains a large leach field and a waterline, both of which would have to be removed and relocated. A 200-foot long spillway constructed of concrete and rip-rap will carry water to the existing Colorado drain. Factors that will enter into the final decision concerning whether or not a dam would be constructed include the hydrology, the benefit-cost ratio, cultural and environmental concerns, and local support. An existing 1000-foot long spoil-bank levee on the north side of the arroyo coming out of Spring Canyon and emptying into the proposed flood pool will be removed; a 1240-foot long channel will be excavated within that existing arroyo.

As part of the overall investigation, in April, 2006, archaeologists from the Office of Contract Archeology, University of New Mexico, conducted a review of the New Mexico Cultural Resource Information System (NMCRIS) and also an intensive, or complete, inventory survey of the proposed project area that could result from the construction of a flood control dam within the village limits of Hatch. The NMCRIS review of a one-mile radius around the proposed project area found a total of seven known sites, two of which were irrigation canals within the proposed project. The on-the-ground survey included a total of 69.8 acres (28.3 hectares). Four new archaeological sites and nine isolated occurrences (single or small clusters of artifacts) were documented. The records for the two previously recorded canals were updated. Two sites are scatters of historic and recent trash; the other two are prehistoric artifact scatters. The two prehistoric sites were tested to determine if subsurface cultural material were present and very little material was found. None of the four new archaeological sites are considered eligible for the National Register of Historic Places. The two canals, the Rodey Lateral and the Colorado Spur Drain, are irrigation ditches that are part of the Elephant Butte Irrigation District.

A brief description of the sites, isolated occurrences, and a map of the project location is enclosed. The map, a portion of the USGS Quadrangle, shows the proposed project location and the maximum area of the flood pool. We are seeking your input with respect to concerns about any traditional use or gathering areas, traditional cultural properties, or sacred sites.

We would appreciate hearing from you no later than the middle of March, 2007. If you have questions or require additional information please contact John Schelberg at (505) 342-3359. Thank you very much for your attention to this matter.

Sincerely:

Julie A. Hall
Chief, Environmental Resources
Section

Enclosure

Summary Description of Sites and Isolated Occurrences within the proposed flood pool for a dam within the Village of Hatch, New Mexico

Site **LA 152981**, a low-density sherd and lithic artifact scatter associated with the Jornada Mogollon of the Late Formative Period, was used for the rapid production of expedient stone tools probably for use in agricultural fields. While two rock features and lithics were found at **LA 152982**, no diagnostic artifacts were recovered, and its age and cultural affiliation are uncertain. One rock feature, which may have been a room, was essentially destroyed by pot hunters and its function remains a question. The second feature is a concentration of locally available basalt rocks and given its vantage point may have been a hunting blind or a windbreak. A portion of a modern lantern and modern shell casings were scattered around indicating use during the last several decades. The lithics indicate use of the area as a quarry by prehistoric people (Kurota 2006:12-24).

Site **LA 152983** is a concentration of historic-period trash dating from 1912 through 1945. Metal, glass, ceramics, corrugated tin roofing, stove parts, milled lumber, and car parts were among the items recorded. Site **LA 152984** includes similar material in three discrete piles and may indicate individual trash dumps between 1916 and 1930 (Kurota 2006:25-30).

A small portion of the Rodey Lateral, **LA 120285**, abuts the project area for approximately 350 m (1148 feet). It was constructed between 1918 and 1922 and is an earthen unlined irrigation ditch starting as a lateral to the Hatch Canal. It parallels the latter for 4.6 miles of its south side and then re-enters the main canal. The Colorado Spur Drain, **LA 120284** an unlined earthen ditch, begins in the project area for the collection of rain water. An approximately 100-foot (30.5 m) long, four-foot (1.2 m) diameter metal culvert under Rodey Lateral conveys the water in the Colorado Spur Drain. The Spur Drain, which empties into the Hatch Drain, was constructed in 1923 and is 1.7 miles long (Kurota 2006:30-35).

Included in the inventory of the **isolated artifacts** were pieces of metal, glass, china, tin cans, barbed wire, three camps presumably being used by the homeless or migrant workers, and stone artifacts including flakes, a chopper, a knife, and a partially complete Late Archaic projectile point (Kurota 2006:35-36)

8-09 Mailing List for Hatch Tribal Letter:

Dona Ana:
Comanche Indian Tribe
Kiowa Tribe (east half of county)
Mescalero Apache Tribe
Fort Sill Apache Tribe
Isleta Pueblo
Navajo Nation
White Mountain Apache Tribe
Ysleta del Sur Pueblo

8-10 Scoping Comments:

05/04/2007 17:14 5805882133 FORT SILL APACHE TRI PAGE 01

FORT SILL - CHIRICAHUA - WARM SPRINGS - APACHE TRIBE

PHONE: (580) 588-2298 / 2314 • FAX: (580) 588-3133
TOLL FREE: 1-877-826-0726
ROUTE 2, BOX 121 • APACHE, OKLAHOMA 73006

May 4, 2007

Julie Hall
Chief, Environmental Resources Section
Albuquerque District, Corps Of Engineers
4101 Jefferson Plaza NE
Albuquerque, NM
87109-3435

Dear Julie Hall,

Thank you for the information on the proposed small earthen dam in Hatch, NM. The project is located within the area we have identified as Fort Sill Chiricahua/Warm Springs Apache ancestral homelands. After reviewing the information provided, we currently have identified no cultural, historical, or religious concerns within the project area. If you find anything in the course of the project that might relate to Apaches, please let us know.

Please contact me or Michael Darrow at the Fort Sill Apache Tribe if you have any further questions.

We appreciate your contact concerning this matter.

Sincerely,

Bryan Jones
Cultural Coordinator
Fort Sill Apache Tribe
Rt. 2, Box 121
Apache, OK 73006
580-588-2298

MOUNTAIN SPIRIT DANCER

Mountain Spirit Dancer represents the Mountain Spirit Ceremony which is used by the Chiricahua and Warm Springs Apache

COMANCHE TRIBE

NAGPRA

March 12, 2007

Julie Hall, Chief
Department of the Army
Albuquerque District, Corps of Engineers
Planning, Project and Program Management Division
Planning Branch
Environmental Resources Section
4101 Jefferson Plaza NE
Albuquerque, NM 87109-3435

Re: US Army Corps of Engineers, Albuquerque District study to determine sufficient justification for construction of a small earthen flood control dam within the village limits of Hatch, NM

Dear Ms. Hall:

Thank you for your letter of February 15th regarding the above referenced project.

At this time, the Comanche Nation has no immediate concerns or issues regarding this project; however, please keep us informed as your planning proceeds. We look forward to receiving any project reports, archaeological reports or other information that is derived from the planning, preparation, and construction work.

If in the process of the project human remains or archaeological items are discovered, we request that you immediately cease the project work and notify us so that we may discuss appropriate disposition with you and the other Tribal Nations that may be affected by such discoveries.

We look forward to your reports as activities proceed.

Sincerely,

Ruth Toahty

Ruth Toahty, NAGPRA Coordinator

P.O. Box 908 • Lawton, Oklahoma 73502 • Phone: (580) 355-2250 • (580) FAX: 355-2270

8-11 Appendix 2 Fish and Wildlife Coordination Act Letters, Scope of Work and Final Report:

Appendix 2
Fish and Wildlife Coordination Act Letters, Scope of Work and Final Report

8-12 Fish and Wildlife Coordination Act Letters:

Copy

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
4101 JEFFERSON PLAZA NE
ALBUQUERQUE NM 87109-3435

JUL 10 2006

Planning, Project & Program Management Division
Planning Branch
Environmental Resources Section

Benjamin N. Tuggle, Acting Regional Director
Regional Office
U.S. Fish and Wildlife Service
500 Gold Ave. SW
Albuquerque, New Mexico 87102

Dear Mr. Tuggle:

Enclosed is a Scope of Work (SOW) for Fish and Wildlife Coordination Act (FWCA) activities to be performed by the New Mexico Ecological Services Field Office for the City of Hatch Flood Reduction project. Also enclosed is a DD Form 448 for the project's FWCA funding. Funds in the amount of $12,426.29 are available to your agency for this project in Fiscal Year 2006 and 2007. Activities described in the SOW have been coordinated with Mr. David Campbell of the New Mexico Ecological Services Field Office.

Please sign and return the enclosed SOW, retaining a copy for your files. Your financial officer should sign the DD Form 448 on the "Accepted Reimbursable" line and fax a copy to Barbara Bernal, financial point of contact noted on the form. Her facsimile number is (505)342-3193.

If you have any questions, please contact Julie Hall, Supervisory Ecologist, at (505)342-3281 or Danielle Galloway, Biologist, at (505)342-3661. Thank you.

Sincerely,

For Todd Wang
Lieutenant Colonel, U.S. Army
District Engineer

Enclosures

Copy Furnished w/ enclosures:
Mr. David Campbell
U.S Fish and Wildlife Service
Field Office
2105 Osuna Road Northeast
Albuquerque, New Mexico 87113

United States Department of the Interior

FISH AND WILDLIFE SERVICE
P.O. Box 1306
Albuquerque, NM 87103-1306

In Reply Refer To:
R2/ABA-DBF

Lt. Colonel Todd Wang, District Engineer
U.S. Army Engineer District
Management Support Branch
Attn: CESPA-PM-C
4101 Jefferson Plaza N.E.
Albuquerque, NM 87109-3435

Dear Lt. Colonel Wang:

I am pleased to accept the Fiscal Year 2006 funding agreement between our agencies for activities under MIPR #W81G6961815866, dated June 30, 2006. This agreement makes available $12,426.29 to the U.S. Fish and Wildlife Service (USFWS) for Fish and Wildlife Coordination Act activities for the Hatch Flood Reduction project which will be coordinated and conducted by our New Mexico Ecological Services Field Office in Albuquerque, New Mexico.

To consummate this agreement, I have signed an Acceptance of MIPR (DD Form 448-2). The original of DD Form 448-2 and MIPR # W81G6961815866 are enclosed for your records.

USFWS Agreement No. 1448-22420-06-H006 has been assigned to this agreement for internal control purposes. Please refer to this number in any future correspondence regarding this agreement and forward to: Field Supervisor, U.S. Fish and Wildlife Service, New Mexico Ecological Services Field Office, 2105 Osuna, N.E., Albuquerque, New Mexico 87113; telephone number: 505-346-2525.

The Fish and Wildlife Service is pleased to continue its close cooperation with you on matters of mutual concern and benefit.

Sincerely,

Regional Director

Enclosures (as stated)

cc: Acting Field Supervisor, Ecological Services, Albuquerque, NM (Attn: Darlene Montoya)

8-13 Scope of Work:

SCOPE OF WORK
FOR
FISH AND WILDLIFE COORDINATION ACT ACTIVITIES,

CITY OF HATCH FLOOD PROTECTION PROJECT
(Section 205 Program)

The U.S. Army Corps of Engineers, Albuquerque District (Corps), is preparing an Environmental Assessment for the City of Hatch Flood Protection project. The City of Hatch is located in the northwest corner of Doña Ana County, New Mexico, near the Rio Grande. It is approximately 35 miles northwest of Las Cruces, New Mexico at the intersection of US highway 85 and state highway 26. The entire city is in the 100-year floodplain. Significant flooding occurred in 1987 with up to two feet of water in the streets of Hatch. Flow comes from two sources from the west, which travel through the city toward the Rio Grande. Spring Canyon, 7.2 square miles of total drainage area, has an upstream detention dam controlling 5.4 square miles and detention storage areas at its downstream end. As the flow goes overbank it enters Hatch and leaves several smaller ponding areas at Main Street and at the Railroad embankments. The purpose of the project is to provide facilities that would reduce flooding within the project are to protect residents and properties of Hatch and indirect downstream beneficiaries. Specifically, the project would include the construction of an earthen embankment dam with a concrete spillway and an inlet channel from Spring Canyon. Barrow material for the dam would be obtained from the area directly behind the proposed dam. The outlet works would drain water from the reservoir into the Colorado drain. The inlet channel, which would bring water from the Spring Canyon to the dam, would be constructed with gabion and riprap. An additional channel would also be needed on the exterior of the dam to drain the water that collects there currently and direct it into the Colorado drain. To help meet our objectives, funding will be obligated to the Service for the preparation of a Fish and Wildlife Coordination Act Report (CAR), and associated Fish and Wildlife Coordination Act activities related to this project.

Funding was approved for this project under Section 205 of the Flood Control Act of 1948 (Public Law 80-858), as amended. Section 205 provides authority to the Secretary of the Army, acting through the Chief of Engineers, to plan and construct small local flood protection projects which have not already been specifically authorized by Congress. A project is accepted for construction only after detailed investigation clearly shows its engineering feasibility, environmental acceptability, and economic justification.

Tasks to be accomplished by the Service include the following:

1. Perform a biological literature search of studies and other information pertinent to the project area and similar or related communities.

2. On-site biological surveys where available information is inadequate.

3. Describe fish and wildlife resources in the project area.

4. Participate in project team meetings.

5. Provide input to the formulation of project alternatives.

6. Assess any biological effects of project alternatives and recommend measures to avoid, minimize, or compensate for potential significant adverse effects, if any, to fish and wildlife resources.

7. Identify opportunities to enhance fish and wildlife resources and habitat in the project area.

8. Coordinate with the New Mexico Department of Game and Fish and, where appropriate, other agencies to present and solicit project-specific recommendations for the conservation and enhancement of fish and wildlife resources.

9. The Corps will forward a description of the selected preferred alternative to the Service. The Service will comment on the preferred alternative with the purpose of optimizing fish and wildlife benefits. The vehicle for Service comments will be the draft and final CAR. Comments and recommendations in these documents will be addressed by the Corps during the revision/public review period for the EA so that it can be revised appropriately to reflect the Service's concerns.

Date of key milestones and Service personnel requirements for coordination are given below.

MILESTONE	COMPLETION DATE	USFWS BIOLOGIST DAYS	USFWS COSTS ($750.38/day)
1. Corps provides Service with pertinent documents to begin planning process.	Upon Execution of Agreement		--
2. Corps furnishes preliminary array of alternatives and preferred alternative to Service.	Upon Execution of Agreement		---
3. Participation in planning meetings.	August-Sept. 2006	2	1,500.76
4. On site survey (if needed)	July 2006	2	1,500.76
5. Service submits draft CAR	15 Sept. 2006	5	3,751.90
6. Corps responds to draft CAR And selects recommended plan	30 Sept. 2006		--

7. Service submits final CAR	30 October 2006		2,251.14
Subtotal		12	$9,004.56
38% overhead of direct project costs			$3,421.73
Total Cost			**$12,426.29**

The Corps and the Service agree to meet the submitted dates listed above. If the Corps makes a substantial change in the project design or fails to meet a submittal date, the corresponding date for Service submittal of the draft or final supplement to the CAR will be adjusted accordingly. The Corps and the Service will promptly advise and authorize any major project changes or anticipated delays in providing project information so that submittal schedules can be renegotiated.

Ms. Julie Hall (505-342-3281) of the Corps of Engineers, Albuquerque District, and Mr. David Campbell (505-761-4745) of the U.S. Fish and Wildlife Service, New Mexico Ecological Services Field Office, are the responsible persons administering this Scope of Work. This Scope of Work is subject to the availability of funds and execution of DD Form 448 (replacement for Form 2544). Manpower requirements and funding levels are subject to renegotiation based on timely availability of data or changes in overall study requirements. The Service will bill, via the Standard Form 1080, in accordance with the funds as authorized in DD Form 448. Billings will be made quarterly in accordance with the current Nationwide Memorandum of Agreement between the U.S. Fish and Wildlife Service and the Corps of Engineers for funding Fish and Wildlife Coordination Act activities. Transmittal of funds from the Corps to the Service will constitute the Notice to Proceed. All provisions and requirements of the Nationwide Memorandum of Agreement shall apply to this Scope of Work.

The Scope of Work, including major milestones, shall be in effect from the date of signing by both parties to 30 December 2006.

U.S. FISH AND WILDLIFE SERVICE		U.S. ARMY COPRS OF ENGINEERS	
		For [signature]	7/7/06
Benjamin Tuggle	Date	Todd Wang, LTC	Date
Regional Director		District Engineer	
Region 2		Albuquerque District	

8-14 DD Form- Project’s FWCA Funding:

MILITARY INTERDEPARTMENTAL PURCHASE REQUEST PAGE 001

FSC	CONTROL SYMBOL NO.	DATE PREPARED	MIPR NUMBER	REV. MAN	AMEND NO
		30-JUN-2006	W81G6961815866		000

TO: US FISH & WILDLIFE SERVICE
ECOLOGICAL FIELD SERVICES OFFI
2105 OSUNA RD, NE
ALBUQUERQUE ,NM 87113

FROM: CIVIL PROJECT MGMT BRANCH
CESPA-PM-C
4101 JEFFERSON PLAZA, NE
ALBUQUERQUE NM 87109-3435

ITEMS __ ARE __ ARE NOT INCLUDED IN THE INTERSERVICE SUPPLY SUPPORT PROGRAM AND REQUIRED INTERSERVICE SCREENING __ HAS __ HAS NOT BEEN ACCOMPLISHED.

ITEM NO.	DESCRIPTION (Federal stock number, nomenclature, specification and/or drawing No., etc.)	QTY	UNIT	ESTIMATED UNIT PRICE	ESTIMATED TOTAL PRICE
1	103820 HATCH COORDINATION ACT REPORT --- Project No.: 103820	0	LS	.00	$12,426.29

ACCOUNTING CLASSIFICATION 96 X 3122.0000 L4 X 08 2454 176963 2500 4L/2D5 516 S96291 00008736
WORK CAT CODE: 22R0D WORK CAT ELEM CODE: 99999 OBLIG. ADJ.: $.00
GOVERNMENT ORDER NUMBER W81G6961815866
INITIAL ACCOUNTING CLASS 96 X 3122 0000 08 176963

COORDINATION ACT REPORT FOR HATCH $12,426.29
Upon Acceptance of this Government Order the Performing Activity must include the full accounting classification data to include: Department Code, Transfer Department Code, Appropriation Fiscal Year, Appropriation Symbol, Appropriation Limitation, Operating Agency, Allotment Serial Number, Fiscal Station Number, and the account classification amount.
Please have the accepting official sign below and return to the FINANCIAL POC address. EXPIRATION DATE 10 MAY 2007

RA TECHNICAL POC: A. MONICA ZAYAS CESPA-PM-C 505 646-4076
RA FINANCIAL POC: BARBARA J BERNAL CESPA-RM-B 505-342-3238
RA FINANCIAL POC ADDRESS: BUDGET AND MANPOWER BRANCH
4101 JEFFERSON PLAZA, NE

ALBUQUERQUE NM 87109-3435
PA TECHNICAL POC: DAVID CAMPBELL (505-761-4745)
PA FINANCIAL POC: DARLENE MONTOYA (505-761-4722)

ACCEPTED __ REIMBURSABLE ______________________ DATE ____________________ TITLE ____________________

SEE ATTACHED PAGES FOR DELIVERY SCHEDULES, PRESERVATION AND PACKAGING INSTRUCTIONS, SHIPPING INSTRUCTIONS AND INSTRUCTIONS FOR DISTRIBUTION OF CONTRACTS AND RELATED DOCUMENTS.

GRAND TOTAL $12,426.29

TRANSPORTATION ALLOTMENT (Used if FOB Contractor's plant)

MAIL INVOICES TO (Payment will be made by)
USACE FINANCE CENTER
ALBUQUERQUE DISTRICT (L4)
5722 INTEGRITY DRIVE

MILLINGTON TN 38054-5005

FUNDS FOR PROCUREMENT ARE PROPERLY CHARGEABLE TO THE ALLOTMENTS SET FORTH ABOVE, THE AVAILABLE BALANCES OF WHICH ARE SUFFICIENT TO COVERTHE ESTIMATED TOTAL PRICE.

ELECTRONICALLY SIGNED BY
JEFFREY SC LINDEMANN, II
ACCOUNTANT 30-JUN-2006

AUTHORIZING OFFICER	ELECTRONICALLY SIGNED BY	DATE
A. MONICA ZAYAS	A. MONICA ZAYAS	30-JUN-2006
PROGRAM ANALYST		

DD FORM 448

Generated by unregistered txt2pdf v.3.3 © SANFACE Software 2000

8-15 Final Report:

Final Fish and Wildlife Coordination Act Report

for the

City of Hatch Flood Protection Project, Doña Ana County, New Mexico

Photo by Christina S. Linterman, USFWS

U.S. DEPARTMENT OF THE INTERIOR
U.S. Fish and Wildlife Service

Prepared for the U.S. Army Corps of Engineers
By the U.S. Fish and Wildlife Service
New Mexico Ecological Services Field Office
2105 Osuna Road NE
Albuquerque, New Mexico 87113

February 2007

Final Fish and Wildlife Coordination Act Report

for the

City of Hatch Flood Protection Project,
Doña Ana County, New Mexico

Submitted to:
U.S. Army Corps of Engineers
4101 Jefferson Plaza, NE
Albuquerque, New Mexico 87109-3435

Prepared by:
Christina S. Linterman
United States Fish and Wildlife Service
New Mexico Ecological Services Field Office
2105 Osuna Road NE
Albuquerque, New Mexico 87113

February 7, 2007

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APPENDICES

INTRODUCTION

The Flood Control Act of 1948 (Public Law 80-858), Section 205, authorizes the Secretary of the Army, acting through the Chief of Engineers, to plan and construct small local flood protection projects which have not already been specifically authorized by Congress. In July 2006, the U.S. Army Corps of Engineers (USACE) requested the U.S. Fish and Wildlife Service (Service) prepare a Fish and Wildlife Coordination Act Report (CAR) for the proposed City of Hatch Flood Protection Project in Doña Ana County, New Mexico (Proposed Project). This CAR has been prepared under the authority of and in accordance with the requirements of Section 2(b) of the Fish and Wildlife Coordination Act (FWCA; 48 Stat. 401, as amended; 16 USC 661-667e). The FWCA provides for the consideration of fish and wildlife conservation measures identified in a CAR that can be incorporated into water resource development projects such as the Proposed Project. This report describes the fish and wildlife resources existing without the project, potential impacts to those fish and wildlife resources with the project, and recommendations (mitigation) to decrease adverse effects and maximize benefits to fish and wildlife resources.

DESCRIPTION OF THE STUDY AREA

The Proposed Project is located in the northwest corner of Dona Ana County, New Mexico, approximately 35.0 miles [mi] (56.3 kilometers [km]) west of Las Cruces, New Mexico near the intersection of U.S. highway 85 and State highway 26 (Figure 1). The USACE project proposes the construction of an earthen flood control dam north of the Sierra de las Uvas Mountains, southwest of the Village of Hatch (Hatch). The dam would be located just south of the intersection of the Colorado Drain and the Rodey Lateral. The project site is within the 100-year floodplain of the Rio Grande, as is the entire Village of Hatch. During flooding events, water is conveyed through two sources from the southwest, through Hatch into the Rio Grande. One of these two sources of water flow is Spring Canyon, and the other is Placitas Arroyo. The downstream reach of Spring Canyon is located in the southeastern municipal limit of Hatch. For the purposes of this CAR, the Rodey Lateral ditch near the Proposed Project will be referred to as east-west in orientation with banks being on the north and south (Figure 2). The Study Area includes the Rodey Lateral ditch, including the riparian vegetation and local fish and wildlife, wherever the Proposed Project may affect these resources.

Climate and Hydrologic Setting

The Village of Hatch sits east of the Continental Divide within the subdivision of the Mexican Highland Section of the Basin and Range Physiological Province (USACE 2006). This area has gently sloping plains separated by rugged mountain ranges. There are north-south aligned mountain ranges on both the northern and southern ends of the Hatch area, with the Caballo Mountains being north of Hatch and the Sierra de las Uvas Mountains in the south. The Sierra de las Uvas mountains are composed of basalts and ash-flow tuffs. Materials shed from the mountains were carried downstream to be deposited as alluvial fan deposits. Spring Canyon rises in the Sierra de las Uvas Mountains and flows westward through Hatch toward the Rio Grande. Elevations range from almost 6000 feet [ft] (1829 meters [m]) in the Sierra de las Uvas

Mountains to 4030 ft (1228 m) at the confluence with the Rio Grande. Spring Canyon has a total drainage area of 7.2 square miles [mi^2] (18.6 square kilometers [km^2]). There is an existing upstream detention dam controlling 5.4 mi^2 (14.0 km^2) and detention storage areas at its downstream end.

The climate is semi-arid continental, with characteristically low annual precipitation, low humidity, high evaporation, wide temperature variations, and an abundance of clear, sunny days (USDA 2006). Much of the moisture in the eastward circulation from the Pacific Ocean is removed as the air passes over the mountains west of New Mexico (USACE 2006). In the summer, moisture-laden air from the Gulf of New Mexico enters southern New Mexico. Subsequent surface heating and the upslope of the air causes brief and often heavy showers. Precipitation in Hatch averages approximately 9.77 inches [in] (24.82 centimeters [cm]) per year. Precipitation averages range from a low of 0.25 in (.64 cm) in March to a high of 2.08 in (5.28 cm) in August (WRCC 2006). Local, high-intensity thunderstorms of short duration are responsible for most of the rainfall in the area, and contribute to the local flooding problems. Average maximum daily temperatures at Hatch reach an annual low in January of 58.9 degrees Fahrenheit [F] (14.9 degrees Celsius [C]) and an annual high of 95.2 F (35.1 C) in July (WRCC 2006). The average frost-free season is about 200 days.

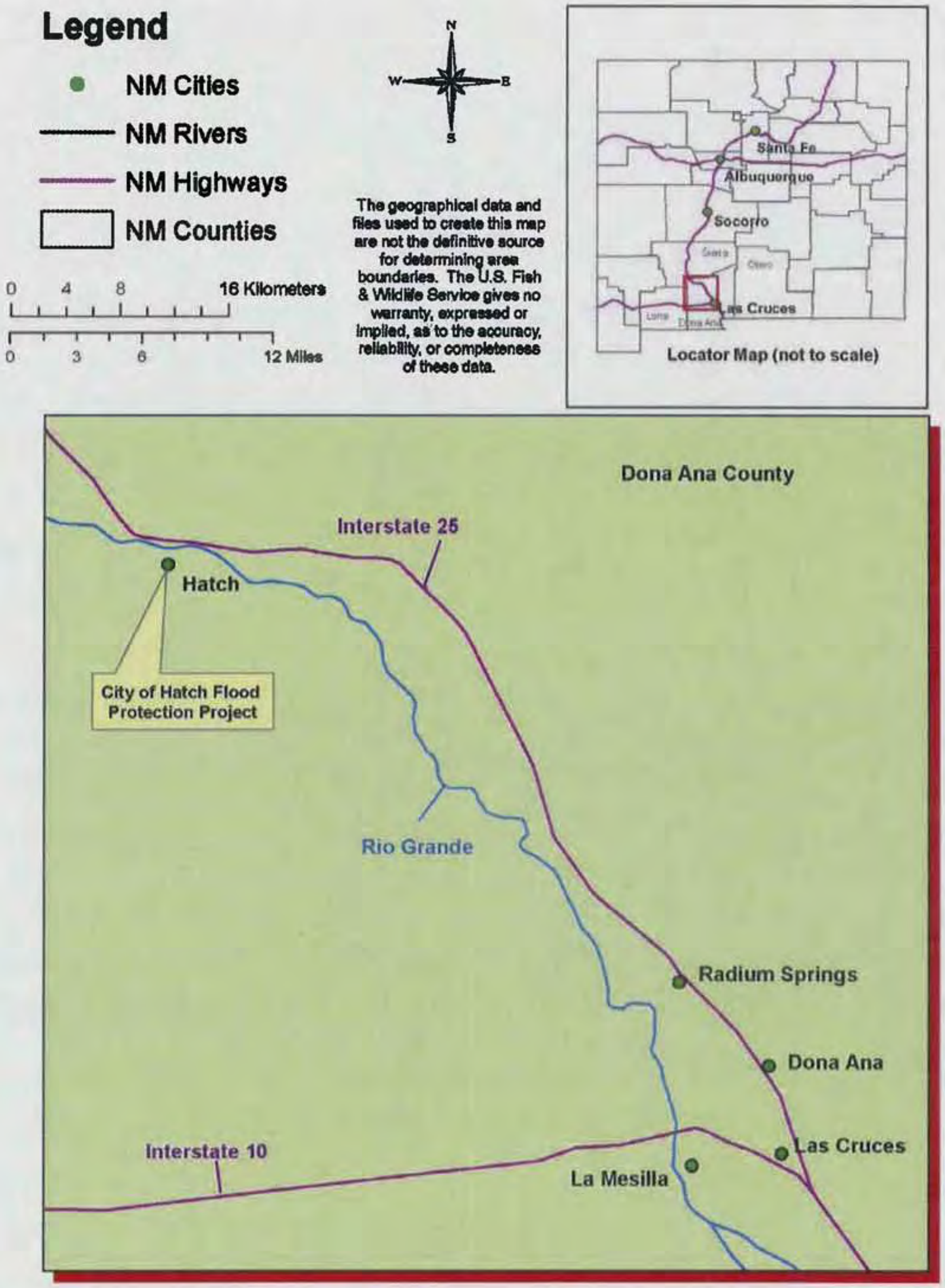

Figure 1. Location of the City of Hatch Flood Protection Project in New Mexico

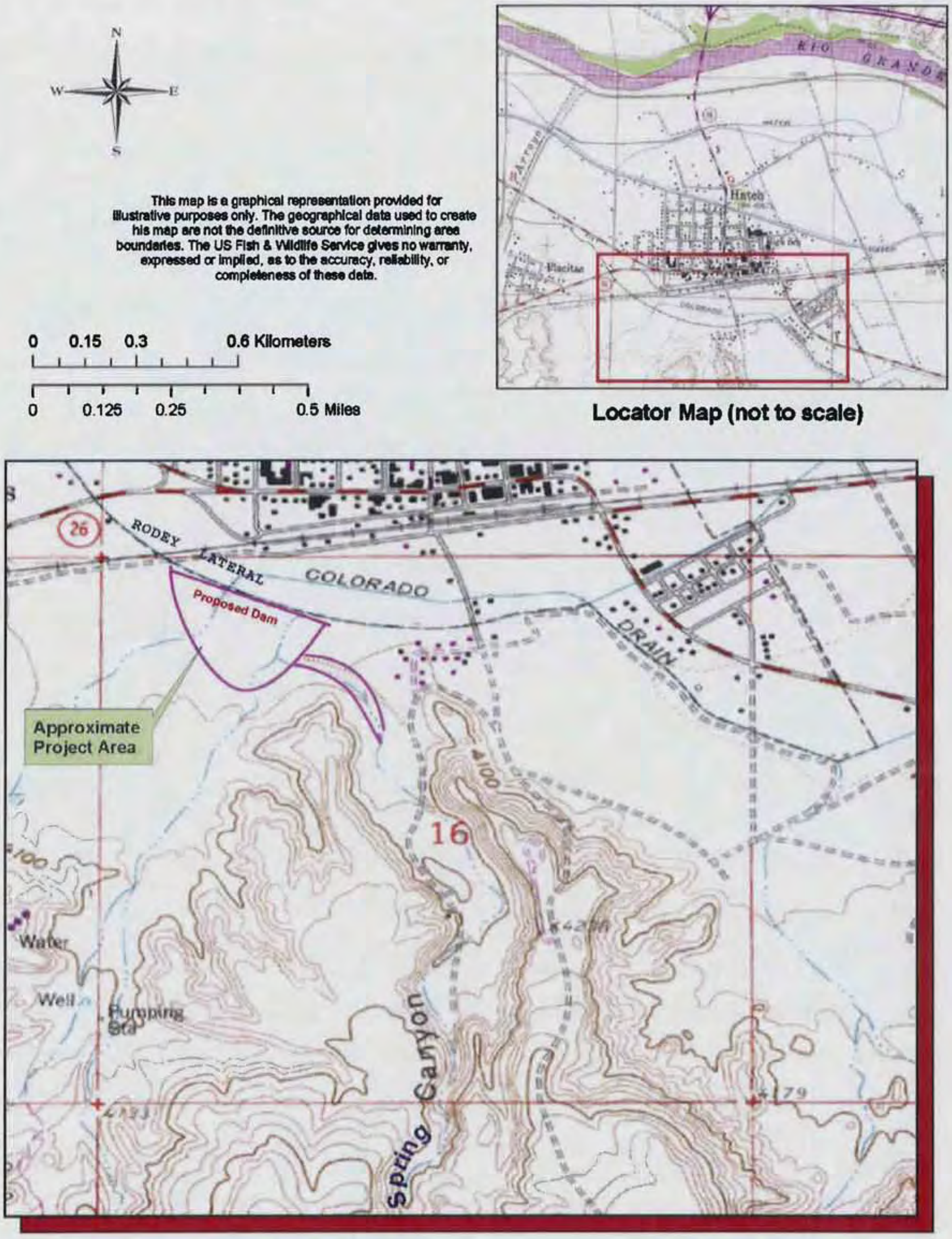

Figure 2. Location of the City of Hatch Flood Protection Project Area

PROJECT DESCRIPTION

The USACE (2006) proposes to construct an earthen dam that will retain a storage capacity of 181 acre-feet (AF). The flood hazard in this area is extensive as the entire Village of Hatch is in the 100-year floodplain. According to USACE (2006), significant flooding occurred in 1988 and 1992 with up to three feet of water in the streets that damaged numerous homes and businesses. Combined flows exceed 2,300 cfs for the 10% annual chance event and 7,000 cfs for the 1% annual chance event. There is no single defined drainage path or river within Hatch, but there are numerous parallel flow paths that travel through the town in a northwest to southeast direction. Since the early 1950's, underground storm drainage systems have been installed in Hatch, but due to the high cost of the systems, they were only designed to handle a five-year design storm and would be of little use in a major flood event (USACE 2006).

An existing dam structure, the Spring Canyon Dam, was constructed in 1939 and was created for flood control and sediment retention (USACE 2006). Spring Canyon Dam has an existing storage capacity of 450 AF at spillway crest. It currently controls 5.4 mi^2 (14.0 km^2) of the 7.2 mi^2 (18.6 km^2) watershed leaving 1.8 mi^2 (4.7 km^2) uncontrolled (USACE 2006). The uncontrolled flows enter a training dike at the mouth of Spring Canyon, where the flow is diverted into a low area behind an embankment of the Rodey Lateral, which acts as a de facto detention basin. A culvert conveys water under the Rodey Lateral into the head of the Colorado Drain, which is intended to provide ground water relief and to convey excess irrigation water to the Rio Grande. The Colorado Drain runs 3.7 mi (6.0 km) to the south where it empties into the river.

The primary objective of the Proposed Project is to provide greater levels of flood protection to flood plain communities and wildlife habitat from flood flows captured in Spring Canyon in Hatch (USACE 2006). A secondary benefit of the Proposed Project would be to provide opportunities for fish and wildlife habitat enhancement measures.

The Proposed Action and Alternatives

The USACE (2006) has proposed one action alternative and a no action alternative. The no action alternative would consist of no improvements to the existing flood control facilities. The existing dam structure at Spring Canyon, flow paths through Hatch, and the Colorado Drain ditch would continue to function and be maintained as they have in the recent past. The action alternative (proposed action) would not affect the existing Spring Canyon dam.

The proposed action would involve construction of a new dam that will provide 100-year level flood protection to Hatch (USACE 2006). The storage capacity of this new dam would be 181 AF which consists of 30 AF of a sediment pool and 151 AF of water behind the new dam. The length of the new dam will be approximately 4000 ft (1219 m) in length and will have a trapezoidal channel that is approximately 1240 ft (378 m) in length that will collect flood waters from Spring Canyon and divert it behind the new dam. At its highest point, the dam height is estimated at 20 ft (6 m). The earthen material for the construction of the new dam will come from borrow material within the reservoir area and will be trucked in as necessary. Two relocations will be performed prior to any borrow excavation. The borrow area consists of: 1) a large leach field and 2) an existing waterline that are both located within the reservoir area. In addition, an existing spoil levee, 1000 ft (305 m) in length, will be removed prior to excavation of a new trapezoidal channel. A spillway 200 ft (61 m) in length will be centered at station 30+00 along the axis of the new dam and will be constructed of riprap and concrete. An outlet works conduit that is approximately 250 ft (76 m) in length will be constructed near station 27+40 that will convey flow into the Colorado Drain. A drainage channel will be constructed over to the outlet works conduit in order to eliminate standing water outside the proposed dam area. Access roads will be built on both sides of the new dam. When the new facility is constructed, new fencing will be placed to enclose the reservoir and access points to the top of the dam.

Alternatives considered and eliminated from further study include flood-proofing, flood-zoning, channelization, and other possible locations for the dam (USACE 2006). Several different heights and configurations of the proposed dam were optimized. Alternatives were considered by USACE in 1990 included levee construction on the bank of Placitas Arroyo, detention structures on arroyos south of Hatch, and a diversion channel to collect and transport water from Spring Canyon to the Rio Grande (USFWS 1991). The alternatives considered in 1990 were found to be infeasible by USACE and were dropped from further analysis at the time.

EVALUATION METHODOLOGY

Field reconnaissance of the study area was initially conducted in May and July of 1990 and feasibility investigation for the project and its alternatives were studied by USACE. The project was found to be infeasible by USACE in late 1990 and dropped from further planning at the time. On July 10, 2006, the USACE, working under a nationwide Memorandum of Agreement with the Service for Fish and Wildlife Coordination Act (FWCA) activities, sent a Scope-of-Work to the Service's New Mexico Ecological Services Field Office. The Scope-of-Work requested that the Service review the Proposed Project and prepare a draft and final Fish and Wildlife Coordination Act Report (CAR) that discussed existing fish and wildlife conditions; any institutionally designated fish and wildlife areas or resources under State, local, or Federal purview; problems, needs, and opportunities relating to fish and wildlife resources; and potential major biological effects of alternative plans. Email and telephone coordination between the USACE and the Service began on August 18, 2006. The USACE provided a preliminary Draft Feasibility Study/Environmental Assessment (FS/EA) for the Hatch Proposed Project on October 3, 2006. Service staff conducted a site visit of the Proposed Project on October 13, 2006. The Draft FS/EA (USACE 2006) was reviewed and selected text was used extensively throughout this CAR. Conversations with representatives from the New Mexico Department of Game and Fish (NMDGF), the USACE, and other area scientists were conducted in October and November 2006 to discuss this report and potential options for wildlife and wetland conservation and habitat mitigation.

FISH AND WILDLIFE RESOURCES WITHOUT THE PROJECT

Aquatic, Riparian and Wetland Resources (this section should be restructured)

Flood flows in excess of the capacity of the current diversion dike, the de facto detention basin, or the Colorado Drain flow directly into Hatch and adjacent agricultural lands. Canal embankments and raised roadways prevent the spread of flood waters so that the floods pond in Hatch until they gradually drain away. A storm with 3.25 in (8.26 cm) of rainfall, or more, in 24 hours, is estimated to occur once every 100 years on average (USACE 2006). This means it has a 1% chance of being equaled, or exceeded, each year. Table 1. shows the current and future-without project instantaneous peak discharges for selected locations (USACE 2006).

Table 1. Without Project Peak Discharges.

Values are in cfs, present conditions/future-without-project-conditions.

Location	Drainage Area (mi^2) [km^2]	10-year Flood (cfs)	50-year Flood (cfs)	100-year Flood (cfs)	500-year Flood (cfs)
Inflow to Spring Canyon Dam	5.4 [14.0]	1200	2000	2500	3500
Outflow from Spring Canyon Dam	5.4 [14.0]	190	200	210	400
Spring Canyon at Rodey Lateral	7.18 [18.6]	800	1300	1600	2200

The USACE (2006) reported that there are no perennial surface water bodies, springs, seeps, or jurisdictional wetlands within the project area. But, within the Study Area lies the Rodey Lateral ditch which has a band of riparian habitat on the south side embankment that leads into the de facto detention basin where the Proposed Project is located. Riparian ecosystems include the ribbon-like (band) mesic vegetative communities occurring between aquatic and more xeric upland sites (Knopf et al. 1988). Willson and Carothers (1972) referred to riparian vegetation as the "aorta of an ecosystem" because of its significance to the perpetuation of water, fish, wildlife, and rangeland and forest resources. It is unlikely that the Rodey Lateral supports many fully aquatic species (i.e. fish) as it is an irrigation ditch with water levels that are highly variable. The riparian band of vegetation that runs along a section of the Rodey Lateral however, may support wildlife dependent on that type of habitat. Johnson et al. (1977) reported that over 50% of all breeding bird species are completely dependent upon riparian vegetation in the southwest.

There is about 1.0 acre [ac] (.4 hectares [ha]) of riparian habitat in the Study Area, along the south side bank of the Rodey Lateral. The habitat along Rodey Lateral was characterized by the USACE (2006) as containing stands of wolfberry, Siberian elm, salt cedar, three leaf sumac, and white mulberry. (See Appendix A for a list of the common and scientific names of local plant species).

Terrestrial and Wildlife Resources

The project area is situated in the Chihuahuan Desert Scrub vegetation community as described by Brown (1982) and Dick-Peddie (1993). Vegetation is scattered throughout the project area; however due to poorly developed soils in the upland areas, the majority of vegetation consists of annual weeds (USACE 2006). Wildlife in the area is typical for New Mexico and the Chihuahuan Desert Scrub community (See Appendices A-D). Several species utilize the area.

The Proposed Project site occurs within Paleargids-Torripsamments-Paleorthids soil association (USDA 2006), 35%, 20%, 15%, respectively (USACE 2006). Soils of this association occupy nearly level to gently sloping or undulating sandy plains and alluvial fans in Doña Ana and Otero counties. Sand dunes and hummocks are prominent features of the landscape, and frequent sandstorms indicate the instability of the surface materials. Strongly calcareous layers are found in the lower part of the profiles. USACE (2006) has identified plant species occurring within the project area. Within the proposed dam area the following plants have been identified: baccharis, common fleabane, creosote bush, four-wing saltbush, honey mesquite, prostrate vervain, salt cedar, Siberian elm, skeleton plant, tansy mustand, wolfberry, and yellow aster. Vegetation within Spring Canyon has been identified as consisting of creosote bush, desert marigold, four-wing saltbush, honey mesquite, and spectacle pod. A list of common and scientific names of plant species discussed in this report is provided in Appendix A.

The USACE (2006) conducted a biological field survey of the project area on January 18, 2006 and the Service conducted a field survey on October 13, 2006. During the USACE field survey the following avian species were observed: ash-throated flycatcher, barn swallow, black-chinned hummingbird, black phoebe, house finch, and mourning dove. Desert cottontail rabbits were also observed by USACE during the field survey. The Chihuahuan Desert Scrub community only has two avian species that are primarily restricted to this type of habitat: scaled quail and white-necked raven (Chihuahuan raven) (Brown 1982). Other avian species that frequent this type of habitat include: black-throated sparrow, cactus wren, curve-billed thrasher, lesser nighthawk, mourning dove, greater roadrunner, and Scott's oriole (Brown 1982). Many avian species use southwestern riparian areas, either all year long, in the winter only, or as a stop during migration (Rappole 2000). A list of common and scientific names of avian species found in the area is provided in Appendix B.

Representative mammal species found in the Chihuahuan Desert Scrub community near Hatch include: fringed myotis, Mexican free-tailed bat, pallid bat, spotted bat, Townsend's big-eared bat, yuma myotis, banner-tailed kangaroo rat, black-tailed jack rabbit, Botta's pocket gopher, cactus mouse, coyote, desert cottontail, desert mule deer, desert pocket gopher, desert pocket mouse, desert shrew, hog-nosed skunk, kit fox, long-tailed weasel, Merriam's kangaroo rat, northern grasshopper mouse, Ord's kangaroo rat, raccoon, rock pocket mouse, silky pocket mouse, southern grasshopper mouse, spotted ground squirrel, striped skunk, Texas antelope squirrel, western spotted skunk, white-footed mouse, and white-throated woodrat. A list of common and scientific names of mammals discussed in this report is provided in Appendix C.

Representative amphibians and reptiles found in the Chihuahuan Desert Scrub community and riparian areas near Hatch include: big bend patch nose snake, black-neck garter snake, black-tailed rattlesnake, bull frog, bull snake, canyon treefrog, checkered garter snake, checkered whiptail, Chihuahuan spotted whiptail, coachwhip, collared lizard, common garter snake, common king snake, corn snake, Couch's spadefoot, desert grassland whiptail, desert spiny lizard, glossy snake, great plains skink, great plains toad, greater earless lizard, green toad, ground snake, leopard lizard, lesser earless lizard, lined snake, little striped whiptail, long nose snake, Lyre snake, Madrean alligator lizard, massasauga, milk snake, New Mexico spadefoot, New Mexico whiptail, night snake, northern leopard frog, ornate box turtle, painted turtle, plain's spadefoot, plains black-headed snake, plains leopard frog, prairie lizard, red spotted toad, ringneck snake, rock rattlesnake, roundtail horned lizard, side-blotched lizard, spiny softshell, striped whip snake, Texas blind snake, Texas horned lizard, trans-Pecos rat snake, tree lizard, western blind snake, western diamondback, western hognose snake, western hooknose snake, western rattlesnake, western whiptail, Woodhouse's toad, and yellow mud turtle. A list of common and scientific names of amphibians and reptiles found in the area is provided in Appendix D.

Threatened and Endangered Species

The quality and quantity of the fish and wildlife habitat within the Hatch area has decreased over time from habitat alteration and urban development. When flows occur, large amounts of sediment are moved down Spring Canyon, and continued soil erosion contributes to degradation of surface water quality (USACE 2006). The urban development in the upstream areas continues to increase the stream flows in the existing narrow channels and enhances the likelihood of future flooding (USACE 2006). Seven species native to Doña Ana County have been listed as Federally endangered or threatened under the Endangered Species Act (ESA). One species is listed as a candidate for Federally listing as endangered or threatened under the ESA, and several species are listed as "Species of Concern" that occur in Doña Ana County (USFWS 2006). None of the seven Federally endangered or threatened species are expected to occur in the project area. These listed species are: bald eagle, least tern, Mexican spotted owl, northern aplomado falcon, Rio Grande silvery minnow, Sneed pincushion cactus, and southwestern willow flycatcher.

Bald Eagle (*Haliaeetus leucocephalus*)

The project area is within the known and historic range of the bald eagle. The Service reclassified the bald eagle from endangered to threatened on July 12, 1995 (60 FR: 36000-36010). Adults of this species are easily recognized by their white heads and dark bodies. Wintering bald eagles frequent all major river systems in New Mexico from November through March. Bald eagles prefer to roost and perch in large trees near water. Bald eagle prey includes fish, waterfowl, and small mammals. No suitable habitat exists within or near the project area, therefore the Proposed Project will not affect bald eagles or their habitat (USACE 2006).

Least Tern (*Sterna antillarum*)

The project area is within the known and historic range of the least tern. The Service listed the least tern as endangered May 28, 1985 (50 FR: 21784-21792). Suitable habitat for this species consists of bare or sparsely vegetated sand, shell, and gravel beaches, sandbars, islands, and salt flats associated with rivers and reservoirs. No suitable habitat exists within or near the project area, therefore the Proposed Project will not affect the least tern or their habitat (USACE 2006).

Mexican Spotted Owl (*Strix occidentalis lucida*)

The project area is within the known and historic range of the Mexican spotted owl. The Service listed the Mexican spotted owl (MSO) as threatened on March 16, 1993 (58 FR: 14248-14271). Suitable habitat consists of caves, cliff ledges, witches' broom, and stick nests of other species in mature and old growth forests associated with steep canyons. Suitable habitat sometimes consists of mixed conifers or pinon-juniper, pine-oak, and ponderosa pine. Designated critical habitat does not exist within or near the Proposed Project area. The USACE (2006) determined that there was no suitable habitat for the MSO in the project area, therefore the Proposed Project will not affect the MSO or its habitat.

Northern Aplomado Falcon (*Falco femoralis septentrionalis*)

The project area is within the known and historic range of the northern Aplomado falcon (falcon). The Service listed the northern falcon as endangered on February 25, 1986 (51 FR: 6686-6690). Suitable habitat for the falcon consists of grassy plains interspersed with mesquite, cactus, and yucca, preferably with scattered trees, low ground cover, and a good supply of nesting platforms. The USACE (2006) determined that there was no suitable habitat for the falcon in the project action area, therefore the Proposed Project will not affect the falcon or its habitat.

Rio Grande Silvery Minnow (*Hybognathus amarus*)

The project area is within the known and historic range of the Rio Grande silvery minnow (RGSM). The Service listed the RGSM as endangered July 20, 1994 (59 FR 36988-36995). Designated critical habitat does not exist within or near the project area. There is no suitable aquatic habitat within or near the project area, therefore the Proposed Project will not affect RGSM or their habitat.

Sneed Pincushion Cactus (*Coryphantha sneedii var. sneedii*)

The project area is within the known and historic range of the Sneed pincushion cactus. The Service listed the Sneed pincushion cactus (cactus) as endangered on November 7, 1979 (44 FR: 64741-64743). It lives in grasslands or lechuguilla-sotol shrublands on limestone outcrops and rocky slopes of mountains within the Chihuahuan Desert. This cactus blooms from April through September, producing fruit that ripens from June through November. However, the Proposed Project would not affect habitat at the locations where the cactus are known.

Southwestern Willow Flycatcher (*Empidonax traillii extimus*)

The project area is within the known and historic range of the southwestern willow flycather. The Service listed the southwestern willow flycatcher (SWWF) as endangered on February 27, 1995 (60 FR: 10694-10715). The flycatcher is a riparian obligate bird and it nests in riparian thickets associated with streams and other wetlands where dense growths of willow, cottonwood, buttonbush, box elder, Russian olive, salt cedar and other plants grow. Available habitat and overall numbers have declined statewide in conjunction with modification of wetlands and riparian habitat (62 FR: 39129-39147). Flycatchers begin arriving in New Mexico in late April and May to nest, and the young fledge in early summer. Flycatchers nest in thickets of trees and shrubs approximately 6.5 - 23 ft (1.9 – 7.0 m) in height or taller, with a densely vegetated understory from ground or water surface level to 13 ft (4.0 m) or more in height. Surface water or saturated soil is usually present beneath or next to occupied thickets (Phillips et al. 1964, Muiznieks et al. 1994). Designated critical habitat does not exist within or near the project area. Although some of the above vegetation exists within the project area, it is not dense in growth, and therefore the USACE (2006) determined that there was no suitable habitat for the flycatcher in the project action area.

FISH AND WILDLIFE RESOURCES WITH THE PROJECT

Impacts to Flood Plains and Wetland Habitat

No additional development of the flood plain would result from the proposed action and there are no wetlands in the area of the Proposed Project.

Impacts to Riparian Habitat

Riparian areas are among the most threatened environments in New Mexico (U.S. Environmental Protection Agency 1991) and the piecemeal losses of riparian habitats have an adverse cumulative impact on wildlife utilizing these areas. According to the USACE (2006), the proposed action will not impact the riparian vegetation that is located along the Rodey Lateral near the project area. The larger trees and shrubs in the riparian area may be adversely affected by soil compaction from equipment operation.

Impacts to Terrestrial Habitat and Wildlife

Construction of the dam, inlet channels, and access roads for the proposed action would result in minor impacts to terrestrial vegetation. Staging of equipment and use of borrow material would result in temporary impacts to 5.0 ac (2.0 ha) of terrestrial habitat (USACE 2006). Permanent disturbance from the proposed action would result in 2.5 ac (1.0 ha) of impacts to this terrestrial habitat. The USACE (2006) has indicated that following the proposed construction, the excavated surfaces behind the dam would be seeded with certified weed-free native vegetation to provide wildlife habitat and to reduce wind erosion.

Short-term impacts to wildlife may occur from noise, dust, and the presence of workers and machinery during project construction. Equipment with water sprinklers would be used during construction to minimize dust (USACE 2006). Long-term adverse impacts may occur from the loss of terrestrial vegetation from construction of permanent structures, soil erosion, new access roads, staging areas, and compaction of soils. The USACE (2006) proposes to mitigate for the loss of these areas.

Impacts to Threatened and Endangered Species

The USACE (2006) determined that the Proposed Project will have no effect on Federally or State listed as endangered or threatened species.

DISCUSSION

Construction projects that result in adverse impacts to fish and wildlife resources require the development of mitigation plans. These plans should consider the value of fish and wildlife habitat affected. The Service has an established mitigation policy used as guidance in recommending mitigation (USFWS 1981). This policy states that the degree of mitigation should correspond to the value and scarcity of the fish and wildlife habitat at risk. Four resource categories in decreasing order of importance are identified.

Resource Category No. 1 Habitats of high value for the species being evaluated that are unique and irreplaceable on a national basis or in the ecoregion. No loss of existing habitat value should occur.

Resource Category No. 2 Habitats of high value that are relatively scarce or becoming scarce on a national basis or in an Ecoregion. No net loss of in-kind habitat value should occur.

Resource Category No. 3 Habitats of high to medium value that are relatively abundant on a national basis. No net loss of habitat value should occur and loss of in-kind habitat should be minimized.

Resource Category No. 4 Habitats of medium to low value. Loss of habitat value should be minimized.

The proposed alternative would result in a direct loss of terrestrial vegetation (2.5 ac [1.0 ha]) that provides life stage support for amphibians, reptiles, mammals and migratory birds. The riparian habitat found in the Hatch project area provides food, habitat and ecological services (e.g. water quality purification, nutrient and chemical transformation, cover) for macroinvertebrates, algae, aquatic plants, amphibians, reptiles, mammals, and migratory birds. Due to the decreasing amount of riparian habitat and the terrestrial habitat located next to it, the loss of these resources will require mitigation as it is classified as a Resource Category No. 2. While most naturally occurring riparian habitats in the southwest are often considered Resource Category No. 1, the riparian habitat quality of the Hatch project likely provides fewer services and benefits given its small size and its function as a constructed ditch and embankment. There is also some loss of aquatic resources to agricultural fields during irrigation. Therefore, while this riparian and terrestrial habitat is of high value, in its current condition and operation it is considered as a Resource Category No. 2.

The proposed action would construct a new dam and outlet works conduit to more efficiently direct flood flows and reduce flooding and damage within Hatch, however maintenance to the dam and outlet will continue to some extent into the foreseeable future. Long-term impacts should be avoided by limiting all permanent project features to the minimum area required, using existing access routes when possible, and selecting less sensitive or previously disturbed areas for any new facilities. Loss of, or disturbance to, riparian habitat should be kept to a minimum.

The following mitigation will be necessary for the loss of 2.5 ac (1.0 ha) of terrestrial habitat that is adjacent to riparian habitat. Dense planting of coyote willow or New Mexico olive whips or poles, and cottonwood poles should be established where adequate amounts of water would be available to ensure successful mitigation. Mitigation should cover the direct removal of vegetation during the construction phase of the project, as well as induced mortality that may occur in future years due to any construction or maintenance impacts. The Service recommends replacing all mature standing trees or shrubs at a 1:1 ratio. The Service recommends planting native shrubs to create habitat for wildlife (at least 2.5 ac [1.0 ha]) in the area to mitigate for the lost habitat near the riparian area. We also recommend removal of nonnative riparian species (Russian olive, salt cedar) within or close to the riparian area or watershed and to provide mitigation trees as part of any replanting efforts within five years, so as to create more suitable habitat for the native wildlife. These plantings and removal would comply with the Service mitigation policy of Resource Category No. 2 (i.e., no net loss of in-kind habitat value should occur). The USACE shall coordinate these mitigation activities with other agencies.

RECOMMENDATIONS

To prevent and reduce project impacts to fish and wildlife resources, the Service recommends the following measures:

1. If impacts are unavoidable, mitigate the loss of terrestrial and riparian habitats and monitor the project and mitigation area to evaluate growth and success of revegetated areas for a minimum of 3 years. Implement corrective actions, as necessary.

2. Work with others in the Hatch area to maximize the value of the mitigation and help restore local wetlands, riparian vegetation, terrestrial and aquatic habitat.

3. Ensure that the best management practices identified in the Draft FS/EA are implemented.

4. Scarify compacted soils or replace topsoils and re-vegetate all disturbed sites with a suitable mixture of native plants.

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(USFWS) U.S. Fish and Wildlife Service. 2006. Endangered Species List: Dona Aña County, New Mexico. http://ifw2es.fws.gov/endangeredspecies/lists/

Willson, M.F. and S.W. Carothers. 1979. Avifauna of habitat islands in the Grand Canyon. Southwestern Naturalist 24:563-576.

(WRCC) Western Regional Climate Center. 2006. Period of Record Monthly Climate Summary, Hatch, NM. http://www.wrcc.dri.edu/

For use in Appendix A-D:

[a] **Endangered Species Act (ESA) status** (U.S. Fish and Wildlife Service):
Federally Threatened and Endangered species are protected by the ESA.

- **E**= Endangered: any species that is in danger of extinction throughout all or a significant portion of its range.
- **T**= Threatened: any species that is likely to become and endangered species within the foreseeable future throughout all or a significant portion of its range.
- **C**= Candidate: taxa for which the Service has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened species.
- **SC**= Species of Concern: taxa for which information now in the possession of the Service indicates that proposing to list as endangered or threatened is possibly appropriate, but for which sufficient data on biological vulnerability and threat are not currently available to support proposed rules.
- **CH**= Critical Habitat: Critical Habitat, as Federally designated by the Service.
- **P**= Proposed for listing in the identified category listed above.

[b] **State of New Mexico status** (New Mexico Department of Game and Fish or New Mexico Rare Plant Technical Council):

- **E**= Endangered animal species whose prospects of survival or recruitment within the state are in jeopardy.
- **T**= Threatened animal species whose prospects of survival or recruitment within the state are likely to become jeopardized in the foreseeable future.
- **ST**= Sensitive taxa
- **R**= Rare

Appendix A. Common and scientific name of plant species potentially occurring within the project area, Dona Aña County, New Mexico (Dick-Peddie 1993).

Common Name	Scientific Name	Federal Status[a]	State of New Mexico Status[b]
Plants			
grayish-white giant hyssop	*Agastache cana*	---	R
Castetter's milkvetch	*Astragalus castetteri*	---	R
Sandberg pincushion cactus	*Escobaria sandbergii*	---	R
Sneed pincushion cactus	*Escobaria sneedii var. sneedii*	E	R
Vasey's bitterweed	*Hymenoxys vaseyi*	---	R
Alamo beardtongue	*Penstemon alamosensis*	SC	R
nodding rock-daisy	*Perityle cernua*	SC	R
New Mexico rock daisy	*Perityle staurophylla var. staurophylla*	---	R
Mescalero milkwort	*Polygala rimulicola var. mescalerorum*	SC	R
supreme sage	*Salvia summa*	---	R
Plank's campion	*Silene plankii*	---	R

whitethorn	*Acacia constricta*		
------------------	*Acacia neovernicosa*		
lechugilla	*Agave lechuguilla*		
spicebush	*Aloysia wrightii*		
coldenia	*Coldenia* spp.		
squawbush	*Condalia spathulata*		
pincushion cactus	*Coryphantha micormeris*		
purple ballcactus	*Coryphanthan vivipara var. aggregata*		
feather peabush	*Dalea formosa*		
smoothleaf stool	*Dasylirion leiophylla*		
wheeler stool	*Dasylirion wheeleri*		
hedgehog cactus	*Echinocactus horizonthalonius*		
------------------	*Echinocereus chloranthus*		
------------------	*Echinocereus pectinatus*		
longleaf jointfir	*Ephedra trifurca*		
------------------	*Epithelantha micromeris*		
barrel cactus	*Ferocactus wislizenii*		
tarbush	*Flourensia cernua*		
ocotillo	*Fouquieria spledens*		
broom snakeweed	*Gutierrezia sarothrae*		
------------------	*Gutierrezia microcephala*		
althorn	*Koeberlinia spinosa*		
range ratany	*Krameria glanulosa*		
creosotebush	*Larrea tridentate*		
------------------	*Mammillaria meiacantha*		
sacahuista	*Nolina microcarpa*		
tree cholla	*Opuntia imbricate*		
Klein cholla	*Opuntia kleiniae*		
christmas cactus	*Opuntia leptocaulis*		
purple pricklypear	*Opuntia macrocentra*		
mariola	*Parthenium incanum*		
honey mesquite	*Prosopis gladulosa*		
resinbush	*Viguiera stenoloba*		
banana yucca	*Yucca baccata*		
soaptree yucca	*Yucca elata*		
Torrey yucca	*Yuccatorreyi*		
graythorn	*Zizyphus obtusifolia*		
black grama	*Bouteloua eriopoda*		
saltgrass	*Distichlis stricta*		
fluffgrass	*Erioneuron pulchellum*		
alkali sacaton	*Sporobolus airoides*		
spike dropseed	*Sporobolus contractus*		
field bahia	*Bahia absinthifolia*		
	Boerhaavia spp.		

spiderling	*Cassia bauthunioides*		
twinleaf	*Dyssodia acerosa*		
dogweed	*Drymaria pachphylla*		
thickleaf drymary	*Pectis papposa*		
lemonweed	*Perezia nana*		
desert holly	*Elaeagus angustifolia*		
Russian olive	*Tamarix* spp.		
salt cedar	*Ulmus pumila*		
Siberian elm	*Atriplex canescens*		
fourwing saltbush			

Appendix B. Common and scientific name of avian species potentially occurring within the project area, Dona Aña County, New Mexico (Rappole 2000).

Common Name	Scientific Name	Federal Status[a]	State of New Mexico Status[b]
Avians			
acorn woodpecker	*Melanerpes uropygialis*		
American avocet	*Recurvirostra americana*		
American coot	*Fulica americana*		
American goldfinch	*Carduelis tristis*		
American kestrel	*Falco sparverius*		
American peregrine falcon	*Falco peregrinus anatum*	SC	T
American pipet	*Anthus rubuscens*		
American robin	*Turdid migratorius*		
American wigeon	*Anas americana*		
Aplomado falcon	*Falco femoralis septentrionalis*	E	E
ash-throated flycatcher	*Myiarchus cinerascens*		
Baird's sparrow	*Ammodramus bairdii*	SC	T
bald eagle	*Haliaeetus leucocephalus*	T	T
barn owl	*Tyto alba*		
barn swallow	*Hirundo rustica*		
Bell's vireo	*Vireo bellii arizonae*	SC	T
belted kingfisher	*Ceryle alcyon*		
Bewick's wren	*Thryomanes bewickii*		
black crowned night heron	*Nycticorax nycticorax*		
black neck stilt	*Himantopus mexicanus*		
black phoebe	*Sayornis nigricans*		
black tailed gnatcatcher	*Polioptila melanura*		
black tern	*Chlidonias niger*	SC	---
black throated sparrow	*Amphispiza bilineata*		
black-chinned hummingbird	*Archilochus alexandri*		
black-headed grosbeak	*Pheucticus melanocephalus*		
black-throated gray warbler	*Dendroica nigrescens*		
blue grosbeak	*Guiraca caerulea*		
blue winged teal	*Anas discors*		
blue-gray gnatcatcher	*Polioptila caerulea*		

Brewer's blackbird	*Euphagus cyanocephalus*		
Brewer's sparrow	*Spizella breweri*		
broad-billed hummingbird	*Cyanthus latirostris*	---	T
broad-tailed hummingbird	*Selasphorus platycerus*		
brown-headed cowbird	*Molothrus ater*		
bufflehead	*Bucephala albeola*		
Bullock's oriole	*Icterus bullockii*		
burrowing owl	*Athene cunicularia*		
bushtit	*Psaltriparus minimus*		
cactus wren	*Campylorhynchus brunneicapillus*		
Canada goose	*Branta canadensis*		
canvasback	*Aythya valisineria*		
canyon towhee	*Pipilo fuscus*		
canyon wren	*Catherpes mexicanus*		
Cassin's finch	*Carpodacus cassini*		
Cassin's kingbird	*Tyrannus vociferans*		
Cassin's sparrow	*Aimophila cassinii*		
cattle egret	*Bubulcus ibis*		
cedar waxwing	*Bombycilla cedrorum*		
chestnut-collared longspur	*Calcarius ornatus*		
Chihuahuan raven	*Corvus cryptoleucus*		
chipping sparrow	*Spizella passerina*		
cinnamon teal	*Anas cyanoptera*		
Clark's grebe	*Aechmophorus clarkia*		
cliff swallow	*Petrochelidon pyrrhonta*		
common black-hawk	*Buteogallus anthracinus anthracinus*	SC	T
common goldeneye	*Bucephala clangula*		
common grackle	*Quiscalus quiscalua*		
common merganser	*Mergus merganser*		
common moorhen	*Gallinula chloropus*		
common nighthawk	*Chordeiles minor*		
common poorwill	*Phalaenoptilus nuttallii*		
common raven	*Corvus corax*		
common snipe	*Gallinago gallinago*		
common yellowthroat	*Geothypis trichas*		
Cooper's hawk	*Accipiter cooperii*		
Costa's hummingbird	*Calypte costae*	---	T
crissal thrasher	*Toxostoma crissale*		
curve-billed thrasher	*Toxostoma curvirostre*		

dark eyed junco	*Junco hymalis*		
eastern bluebird	*Sialia sialis*		
eastern meadowlark	*Sturnella magna*		
elf owl	*Micrathene whitneyi*		
European starling	*Sturnus vulgaris*		
evening grosbeak	*Coccothraustes vespertinus*		
ferruginous hawk	*Buteo regalis*		
flammulated owl	*Otus flammeolus*		
gadwall	*Anas strepera*		
Gambel's quail	*Callipepla gambelii*		
gold-crowned kinglet	*Regulus satrapa*		
golden eagle	*Aquila chrysaetos*		
Grace's warbler	*Dendroica graciae*		
gray vireo	*Vireo vicinior*	---	T
great blue heron	*Ardea Herodias*		
great egret	*Ardea alba*		
great horned owl	*Bubo virginianus*		
greater roadrunner	*Geococcyx californicus*		
greater white fronted goose	*Anser albifrons*		
greater yellowlegs	*Tringa melanoleuca*		
great-tailed grackle	*Quiscalus mexicanus*		
green heron	*Butorides virescens*		
green tailed towhee	*Pipilo chlorurus*		
green winged teal	*Anas crecca*		
hairy woodpecker	*Picoides villosus*		
Harris's sparrow	*Zonotrichia querula*		
hepatic tanager	*Piranga flava*		
hermit thrush	*Catharus guttatus*		
hooded merganser	*Lophodytes cucullatus*		
hooded oriole	*Icterus cucullatus*		
horned lark	*Eremophila alpestris*		
house finch	*Carpodacus mexicanus*		
house sparrow	*Passer domesticus*		
indigo bunting	*Passerine cyana*		
juniper titmouse	*Baeolophus griseus*		
killdeer	*Charadrius vociferus*		
ladder-backed woodpecker	*Picoides scalaris*		
lark bunting	*Calamospiza melanocorys*		

least sandpiper	*Calidris minutilla*		
least tern	*Sterna antillarum*	E	E
lesser goldfinch	*Carduelis psaltria*		
lesser nighthawk	*Chordeiles acutipennis*		
lesser scaup	*Anthya affinis*		
Lincoln's sparrow	*Melospiza lincolnii*		
loggerhead shrike	*Lanius ludovicianus*		
long billed dowitcher	*Limnodromus scolopaceus*		
long eared owl	*Asio otus*		
mallard	*Anas playrhynchos*		
marsh wren	*Cistothorus palustris*		
McCown's longspur	*Calcarius mccownii*		
merlin	*Falco columbarius*		
Mexican spotted owl	*Strix occidentalis lucida*	T/CH	ST
Mississippi kite	*Ictinia mississippiensis*		
mountain bluebird	*Sialia currucoides*		
mountain chickadee	*Poecile gambeli*		
mourning dove	*Zenaida macroura*		
neotropic cormorant	*Phalacocorax brasilianus*	---	T
northern flicker	*Colaptes auratus*		
northern harrier	*Circuc cyaneus*		
northern mockingbird	*Mimus polyglottos*		
northern pintail	*Anas acuta*		
northern pygmy owl	*Glaucidium gnoma*		
northern rough-winged swallow	*Stelgidopteryx serripennis*		
northern shoveler	*Anas clypeata*		
phainopepla	*Phainopepla nitens*		
pine siskin	*Carduelis pinus*		
plumbeous vireao	*Vireo plumbeus*		
prairie falcon	*Falco mexicanus*		
pyrrhuloxia	*Cardinalis sinuaus*		
red breasted nuthatch	*Sitta canadensis*		
red-breasted merganser	*Mergus serrator*		
redhead	*Anthya americana*		
red-tailed hawk	*Buteo jamaicensis*		
red-winged blackbird	*Agelaius phoeniceus*		
ring billed gull	*Larus delawarensis*		
ring neck pheasant	*Phasianus colchicus*		
ring-neck duck	*Anthya collaris*		

rock dove	*Columba livia*		
rock wren	*Salpinctes obsoletus*		
rough-legged hawk	*Buteo lagopus*		
ruby-crowned kinglet	*Regulus calendula*		
ruddy duck	*Oxyura jamaicensis*		
rufous-crowned sparrow	*Aimophila ruficeps*		
sage sparrow	*Amphispiza belli*		
sage thrasher	*Oreoscoptes montanus*		
sandhill crane	*Grus canadensis*		
savannah sparrow	*Passerculus sandwichensis*		
Say's phoebe	*Sayornis saya*		
scaled quail	*Callipepla squamata*		
Scott's oriole	*Icterus parisorum*		
sharp-shinned hawk	*Accipiter striatus*		
short eared owl	*Asio flammeus*		
snow goose	*Chen caerulescens*		
snowy egret	*Egretta thula*		
song sparrow	*Melospiza melodia*		
sora	*Porzana carolina*		
southwestern willow flycatcher	*Empidonax traillii extimus*	E/CH	E
spotted sandpiper	*Actitis macularia*		
spotted towhee	*Pipilo maculates*		
Stellar's jay	*Cyanocitta stelleri*		
summer tanager	*Piranga rubra*		
Swainson's hawk	*Buteo swainsoni*		
swamp sparrow	*Melospiza georgiana*		
Townsend's solitaire	*Myadestes townsendi*		
turkey vulture	*Cathartes aura*		
varied bunting	*Passerine versicolor*	----	T
verdin	*Auriparus flaviceps*		
vermilion flycatcher	*Pyrocephalus rubinus*		
vesper sparrow	*Pooecetes gramineus*		
violet-crowned hummingbird	*Amazilia violiceps ellioti*	---	T
violet green swallow	*Tachycineta thalassina*		
Virginia rail	*Rallus limicola*		
Virginia's warbler	*Vermivora virginiae*		
warbling vireo	*Vireo gilvus*		
western bluebird	*Sialia mexicana*		

western burrowing owl	*Athene cunicularia hypugae*	SC	---
western grebe	*Aechmophorus occidentalis*		
western meadowlark	*Sturnella neglecta*		
western screech owl	*Otus kennicottii*		
western scrub jay	*Aphelocoma californica*		
western tanager	*Piranga ludoviciana*		
western wood pewee	*Contopus sordidulus*		
white breasted nuthatch	*Sita carolinensis*		
white crowned sparrow	*Zonotrichia leucophrys*		
white throated swift	*Aeronautes saxatalis*		
white faced ibis	*Plegadis chihi*		
white-throated sparrow	*Zonotrichia albicollis*		
white-winged dove	*Zenaida asiatica*		
wild turkey	*Meleagris gallopavo*		
wood duck	*Aix sponsa*		
yellow breasted chat	*Icteria virens*		
yellow rumped warbler	*Dendroica coronata*		
yellow warbler	*Dendroica petechia*		
yellow-billed cuckoo	*Coccyzus americanus*	C	E
yellow-headed blackbird	*Xanthocephalus xanthocephalus*		
zone tailed hawk	*Buteo albonotatus*		

Appendix C. Common and scientific name of mammal species potentially occurring within the project area, Dona Aña County, New Mexico (Findley *et al.* 1975 and Brown 1982).

Common Name	Scientific Name	Federal Status[a]	State of New Mexico Status[b]
Mammals			
banner-tailed kangaroo rat	*Dipodomys spectabilis*		
black-tailed jack rabbit	*Lepus californicus*		
Botta's pocket gopher	*Thomomys bottae*		
cactus mouse	*Peromyscus eremicus*		
coyote	*Canis latrans*		
desert cottontail rabbit	*Sylvilagus audubonii*		
desert mule deer	*Odocoileus hemionus*		
desert pocket gopher	*Geomys arenarius*	SC	---
desert pocket mouse	*Chaetodipus penicillatus*		
desert shrew	*Notiosorex crawfordi*		
fringed myotis	*Myotis thysanodes*	---	ST
hog-nosed skunk	*Conepatus mesoleucus*	---	ST
kit fox	*Vulpes macrotis*		
long-tailed weasel	*Mustela frenata*		
Merriam's kangaroo rat	*Dipodomys merriami*		
Mexican free-tailed bat	*Tadarida brasiliensis*		
northern grasshopper mouse	*Onychomys leucogaster*		
Ord's kangaroo rat	*Dipodomys ordii*		
pallid bat	*Antrozous pallidus*		
Pecos River muskrat	*Ondatra zibethicus ripensis*	SC	ST
raccoon	*Procyon lotor*		
rock pocket mouse	*Chaetidapus intermedius*	---	ST
silky pocket mouse	*Peregnathus flavus*		
southern grasshopper mouse	*Onychonys torridus*		
spotted bat	*Euderma maculatum*	---	T
spotted ground squirrel	*Spermophilus spilosoma*		
striped skunk	*Mephitis mephitis*		
Texas antelope squirrel	*Ammospermophilus interpres*		
Townsend's big eared bat	*Corynorhinus townsendii*	SC	ST
western red bat	*Lasiurus blossvillii*	SC	ST
western spotted skunk	*Neotoma albigula*		ST
white-footed mouse	*Peromyscus leucopus*		
white-throated woodrat	*Neotoma albigula*		
Yuma myotis	*Myotis yumanensis*	SC	ST

Appendix D. Common and scientific name of reptile and amphibian species potentially occurring within the project area, Dona Aña County, New Mexico (Degenhardt *et al.*1996).

Common Name	Scientific Name	Federal Status[a]	State of New Mexico Status[b]
Reptiles & Amphibians			
big bend patch nose snake	*Salvador deserticola*		
black-neck garter snake	*Thamnophis cyrtopsis*		
blacktailed rattlesnake	*Crotalus molossus*		
bull frog	*Rana catesbiana*		
bull snake	*Pituophis melanoleucus*		
checkered garter snake	*Thamnophis marcianus*		
canyon treefrog	*Hyla arenicolor*		
checkered whiptail	*Cnemidophorus grahamii*		
Chihuahuan spotted whiptail	*Cnemidophorus exanguis*		
coachwhip	*Masticophus flagellum*		
collared lizard	*Crotaphytus collaris*		
common garter snake	*Thamnophis sirtalis*		
common king snake	*Lampropeltis getula*		
Couch's spadefoot	*Scaphiopus couchii*		
corn snake	*Elaphe guttata*		
desert grassland whiptail	*Cnemidophorus uniparens*		
desert spiny lizard	*Sceloporus magister*		
glossy snake	*Arizona elegans*		
great plains skink	*Eumeces obsoletus*		
greater earless lizard	*Cophosaurus texanus*		
great plains toad	*Bufo cognatus*		
green toad	*Bufo deblis*		
ground snake	*Senora semiannulata*		
leopard lizard	*Gambelia wislizenii*		
lesser earless lizard	*Holbrookia maculata*		
lined snake	*Tripidoclonion lineatum*		
little striped whiptail	*Cnemidophorus inornatus*		
long nose snake	*Rhinocheilus lecontei*		
Lyre snake	*Trimorphodon biscutatus*		
Madrean alligator lizard	*Elgaria kingii*		
massasauga	*Sistrurus catenatus*		
milk snake	*Lampropeltis triangulum*		
New Mexico spadefoot	*Spea multiplicata*		
New Mexico whiptail	*Cnemidophorus neomexicanus*		
night snake	*Hypseglena torquata*		

northern leopard frog	*Rana pipiens*		
ornate box turtle	*Terrapene ornata*		
painted turtle	*Chrysemys picta*		
plain's spadefoot	*Spea bombifrons*		
plains black-headed snake	*Tantilla nigriceps*		
plains leopard frog	*Rana blairi*		
prairie lizard	*Sceloporus undulatus*		
red spotted toad	*Bufo Punctatus*		
rock rattlesnake	*Diadophis punctatus*		
ringneck snake	*Crotalus Lepidus*		
roundtail horned lizard	*Phrynosoma modestum*		
side-blotched lizard	*Uta stansburiana*		
spiny softshell	*Trionyx spiniferus*		
striped whip snake	*Masticophus taeniatus*		
Texas blind snake	*Leptotyphlops dulcis*		
Texas horned lizard	*Phrynosoma cornutum*		
trans-Pecos rat snake	*Bogertophis subocularis*		
tree lizard	*Urosaurus ornatus*		
western blind snake	*Leptotyphlops humilis*		
western diamondback	*Crotalus atrox*		
western hognose snake	*Heterodon nasicus*		
western hooknose snake	*Gyalopian canum*		
western rattlesnake	*Crotalus viridus*		
western whiptail	Cnemidophorus tigris		
Woodhouse's toad	*Bufo woodhousii*		
yellow mud turtle	*Kinosternon flavescens*		

8-16 Appendix 3- Clean Water Act Section 404 Compliance Review:

Appendix 3
Clean Water Act Section 404 Compliance Review

US Army Corps of Engineers®
Albuquerque District

Nationwide Permit Summary

NATIONWIDE PERMIT 43
Stormwater Management Facilities
Effective Date: March 19, 2012
Expiration Date: March 18, 2017
(NWP Final Notice, 77 FR 10279, para. 43)

Stormwater Management Facilities. Discharges of dredged or fill material into non-tidal waters of the United States for the construction of stormwater management facilities, including stormwater detention basins and retention basins and other stormwater management facilities; the construction of water control structures, outfall structures and emergency spillways; and the construction of low impact development integrated management features such as bioretention facilities (e.g., rain gardens), vegetated filter strips, grassed swales, and infiltration trenches. This NWP also authorizes, to the extent that a section 404 permit is required, discharges of dredged or fill material into non-tidal waters of the United States for the maintenance of stormwater management facilities. Note that stormwater management facilities that are determined to be waste treatment systems under 33 CFR 328.3(a)(8) are not waters of the United States, and maintenance of these waste treatment systems generally does not require a section 404 permit.

The discharge must not cause the loss of greater than 1/2-acre of non-tidal waters of the United States, including the loss of no more than 300 linear feet of stream bed, unless for intermittent and ephemeral stream beds the district engineer waives the 300 linear foot limit by making a written determination concluding that the discharge will result in minimal adverse effects. This NWP does not authorize discharges into non-tidal wetlands adjacent to tidal waters. This NWP does not authorize discharges of dredged or fill material for the construction of new stormwater management facilities in perennial streams.

Notification: For the construction of new stormwater management facilities, or the expansion of existing stormwater management facilities, the permittee must submit a pre-construction notification to the district engineer prior to commencing the activity. (See general condition 31.) Maintenance activities do not require pre-construction notification if they are limited to restoring the original design capacities of the stormwater management facility. (Section 404)

NATIONWIDE PERMIT GENERAL CONDITIONS

General Conditions: The following general conditions must be followed in order for any authorization by a NWP to be valid:

1. **Navigation.** (a) No activity may cause more than a minimal adverse effect on navigation.

(b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.

(c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

2. **Aquatic Life Movements.** No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species.

3. **Spawning Areas.** Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

4. **Migratory Bird Breeding Areas.** Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

5. **Shellfish Beds.** No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.

6. **Suitable Material.** No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

7. **Water Supply Intakes.** No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

8. **Adverse Effects from Impoundments.** If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

9. **Management of Water Flows.** To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization and storm water management activities, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).

10. **Fills Within 100–Year Floodplains.** The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

11. **Equipment.** Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

12. **Soil Erosion and Sediment Controls.** Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow.

13. **Removal of Temporary Fills.** Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

14. **Proper Maintenance.** Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

15. **Single and Complete Project.** The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

16. **Wild and Scenic Rivers.** No activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system while the river is in an official study status, unless the appropriate federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service).

17. **Tribal Rights.** No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

18. **Endangered Species.** (a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which "may affect" a listed species or critical habitat, unless Section 7 consultation addressing the effects of the proposed activity has been completed.

(b) Federal agencies should follow their own procedures for complying with the requirements of the ESA. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address ESA compliance for the NWP activity, or whether additional ESA consultation is necessary.

(c) Non-federal permittees must submit a pre-construction notification to the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect federally-listed endangered or threatened species or designated critical habitat, the pre-construction notification must include the name(s) of the endangered or threatened species that might be affected by the proposed work or that utilize the designated critical habitat that might be affected by the proposed work. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non-federal applicant of the Corps' determination within 45 days of receipt of a complete pre-construction notification. In cases where the non-federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the project, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification the proposed activities will have "no effect" on listed species or critical habitat, or until Section 7 consultation has been completed. If the non-federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

(d) As a result of formal or informal consultation with the FWS or NMFS the district engineer may add species-specific regional endangered species conditions to the NWPs.

(e) Authorization of an activity by a NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the U.S. FWS or the NMFS, The Endangered Species Act prohibits any person subject to the jurisdiction of the United States to take a listed species, where "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word "harm" in the definition of "take" means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.

(f) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the U.S. FWS and NMFS or their world wide web pages at *http://www.fws.gov/*, or *http://www.fws.gov/ipac* and *http://www.noaa.gov/fisheries.html*, respectively.

19. **Migratory Birds and Bald and Golden Eagles.** The permittee is responsible for obtaining any "take" permits required under the U.S. Fish and Wildlife Service's regulations governing compliance with the Migratory Bird Treaty Act or the Bald and Golden Eagle Protection Act. The permittee should contact the appropriate local office of the U.S. Fish and Wildlife Service to determine if such "take" permits are required for a particular activity.

20. **Historic Properties.** (a) In cases where the district engineer determines that the activity may affect properties listed, or eligible for listing, in the National Register of Historic Places, the activity is not authorized, until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.

(b) Federal permittees should follow their own procedures for complying with the requirements of Section 106 of the National Historic Preservation Act. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address section 106 compliance for the NWP activity, or whether additional section 106 consultation is necessary.

(c) Non-federal permittees must submit a pre-construction notification to the district engineer if the authorized activity may have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties may be affected by the proposed work or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of or potential for the presence of historic resources can be sought from the State Historic Preservation Officer or Tribal Historic Preservation Officer, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of Section 106 of the National Historic Preservation Act. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample field investigation, and field survey. Based on the information submitted and these efforts, the district engineer shall determine whether the proposed activity has the potential to cause an effect on the historic properties. Where the non-federal applicant has identified historic properties on which the activity may have the potential to cause effects and so notified the Corps, the non-federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects or that consultation under Section 106 of the NHPA has been completed.

(d) The district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA Section 106 consultation is required. Section 106 consultation is not required when the Corps determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR 800.3(a)). If NHPA section 106 consultation is required and will occur, the district engineer will notify the non-federal applicant that he or she cannot begin work until Section 106 consultation is completed. If the non-federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

(e) Prospective permittees should be aware that section 110k of the NHPA (16 U.S.C. 470h–2(k)) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of Section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.

21. **Discovery of Previously Unknown Remains and Artifacts.** If you discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity authorized by this permit, you must immediately notify the district engineer of what you have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The district engineer will initiate the federal, Tribal and state coordination required to determine if the items or remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

22. **Designated Critical Resource Waters.** Critical resource waters include NOAA-managed marine sanctuaries and marine monuments, and National Estuarine Research Reserves. The district engineer may designate, after notice and opportunity for public comment, additional waters officially designated by a state as having particular environmental or ecological significance, such as outstanding national resource waters or state natural heritage sites. The district engineer may also designate additional critical resource waters after notice and opportunity for public comment.

(a) Discharges of dredged or fill material into waters of the United States are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, 50, 51, and 52 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.

(b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38, notification is required in accordance with general condition 31, for any activity proposed in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after it is determined that the impacts to the critical resource waters will be no more than minimal.

23. **Mitigation.** The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that adverse effects on the aquatic environment are minimal:

(a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (i.e., on site).

(b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating for resource losses) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.

(c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1⁄10-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse effects of the proposed activity are minimal, and provides a project-specific waiver of this requirement. For wetland losses of 1⁄10-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in minimal adverse effects on the aquatic environment. Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332.

(1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity results in minimal adverse effects on the aquatic environment.

(2) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, wetland restoration should be the first compensatory mitigation option considered.

(3) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2)–(14) must be approved by the district engineer before the permittee begins work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)).

(4) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan only needs to address the baseline conditions at the impact site and the number of credits to be provided.

(5) Compensatory mitigation requirements (e.g., resource type and amount to be provided as compensatory mitigation, site protection, ecological performance standards, monitoring requirements)

may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan.

(d) For losses of streams or other open waters that require pre-construction notification, the district engineer may require compensatory mitigation, such as stream rehabilitation, enhancement, or preservation, to ensure that the activity results in minimal adverse effects on the aquatic environment.

(e) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of 1⁄2-acre, it cannot be used to authorize any project resulting in the loss of greater than 1⁄2 -acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that a project already meeting the established acreage limits also satisfies the minimal impact requirement associated with the NWPs.

(f) Compensatory mitigation plans for projects in or near streams or other open waters will normally include a requirement for the restoration or establishment, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, riparian areas may be the only compensatory mitigation required. Riparian areas should consist of native species. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. If it is not possible to establish a riparian area on both sides of a stream, or if the waterbody is a lake or coastal waters, then restoring or establishing a riparian area along a single bank or shoreline may be sufficient. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

(g) Permittees may propose the use of mitigation banks, in-lieu fee programs, or separate permittee-responsible mitigation. For activities resulting in the loss of marine or estuarine resources, permittee-responsible compensatory mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management.

(h) Where certain functions and services of waters of the United States are permanently adversely affected, such as the conversion of a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse effects of the project to the minimal level.

24. **Safety of Impoundment Structures.** To ensure that all impoundment structures are safely designed, the district engineer may require non-federal applicants to demonstrate that the structures comply with established state dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has been independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

25. **Water Quality.** Where States and authorized Tribes, or EPA where applicable, have not previously certified compliance of an NWP with CWA Section 401, individual 401 Water Quality Certification must be obtained or waived (see 33 CFR 330.4(c)). The district engineer or State or Tribe may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

26. **Coastal Zone Management.** In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). The district engineer or a State may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

27. **Regional and Case-By-Case Conditions.** The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

28. **Use of Multiple Nationwide Permits.** The use of more than one NWP for a single and complete project is prohibited, except when the acreage loss of waters of the United States authorized by the NWPs does not exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1⁄3-acre.

29. **Transfer of Nationwide Permit Verifications.** If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature: "When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below."

(Transferee)

(Date)

30. **Compliance Certification.** Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and any required compensatory mitigation. The success of any required permittee-responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include:

(a) A statement that the authorized work was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions;

(b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the certification must include the documentation required by 33 CFR 332.3(l)(3) to confirm that the permittee secured the appropriate number and resource type of credits; and

(c) The signature of the permittee certifying the completion of the work and mitigation.

31. **Pre-Construction Notification.** (a) Timing. Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. The request must specify the information needed to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:

(1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or

(2) 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or in the vicinity of the project, or to notify the Corps pursuant to general condition 20 that the activity may have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is "no effect" on listed species or "no potential to cause effects" on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or Section 106 of the National Historic Preservation (see 33 CFR 330.4(g)) has been completed. Also, work cannot begin under NWPs 21, 49, or 50 until the permittee has received written approval from the Corps. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).

(b) Contents of Pre-Construction Notification: The PCN must be in writing and include the following information:

(1) Name, address and telephone numbers of the prospective permittee;

(2) Location of the proposed project;

(3) A description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause, including the anticipated amount of loss of water of the United States expected to result from the NWP activity, in acres, linear feet, or other appropriate unit of measure; any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity. The description should be sufficiently detailed to allow the district engineer to determine that the adverse effects of the project will be minimal and to determine the need for compensatory mitigation. Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the project and when provided results in a quicker decision. Sketches should contain sufficient detail to provide an illustrative description of the proposed activity (e.g., a conceptual plan), but do not need to be detailed engineering plans);

(4) The PCN must include a delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial, intermittent, and ephemeral streams, on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many waters of the United States. Furthermore, the 45-day period will not start until the delineation has been submitted to or completed by the Corps, as appropriate;

(5) If the proposed activity will result in the loss of greater than 1⁄10-acre of wetlands and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied, or explaining why the adverse effects are minimal and why compensatory mitigation should not be required. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.

(6) If any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, for non-federal applicants the PCN must include the name(s) of those endangered or threatened species that might be affected by the proposed work or utilize the designated critical habitat that may be affected by the proposed work. federal applicants must provide documentation demonstrating compliance with the Endangered Species Act; and

(7) For an activity that may affect a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, for non-federal applicants the PCN must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic property. Federal applicants must provide documentation demonstrating compliance with Section 106 of the National Historic Preservation Act.

(c) Form of Pre-Construction Notification: The standard individual permit application form (Form ENG 4345) may be used, but the completed application form must clearly indicate that it is a PCN and must include all of the information required in paragraphs(b)(1) through (7) of this general condition. A letter containing the required information may also be used.

(d) Agency Coordination: (1) The district engineer will consider any comments from federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the project's adverse environmental effects to a minimal level.

(2) For all NWP activities that require pre-construction notification and result in the loss of greater than 1⁄2-acre of waters of the United States, for NWP 21, 29, 39, 40, 42, 43, 44, 50, 51, and 52 activities that require pre-construction notification and will result in the loss of greater than 300 linear feet of intermittent and ephemeral stream bed, and for all NWP 48 activities that require pre-construction notification, the district engineer will immediately provide (e.g., via email, facsimile transmission, overnight mail, or other expeditious manner) a copy of the complete PCN to the appropriate federal or state offices (U.S. FWS, state natural resource or water quality agency, EPA, State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Office (THPO), and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will have 10 calendar days from the date the material is transmitted to telephone or fax the district engineer notice that they intend to provide substantive, site-specific comments. The comments must explain why the agency believes the adverse effects will be more than minimal. If so contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the pre-construction notification. The district engineer will fully consider agency comments received within the specified time frame concerning the proposed activity's compliance with the terms and conditions of the NWPs, including the need for mitigation to ensure the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The district engineer will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each pre-construction notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.

(3) In cases of where the prospective permittee is not a federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.

(4) Applicants are encouraged to provide the Corps with either electronic files or multiple copies of pre-construction notifications to expedite agency coordination.

D. District Engineer's Decision

1. In reviewing the PCN for the proposed activity, the district engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. For a linear project, this determination will include an evaluation of the individual crossings to determine whether they individually satisfy the terms and conditions of the NWP(s), as well as the cumulative effects caused by all of the crossings authorized by NWP. If an applicant requests a waiver of the 300 linear foot limit on impacts to intermittent or ephemeral streams or of an otherwise applicable limit, as provided for in NWPs 13, 21, 29, 36, 39, 40, 42, 43, 44, 50, 51 or 52, the district engineer will only grant the waiver upon a written determination that the NWP activity will result in minimal adverse effects. When making minimal effects determinations the district engineer will consider the direct and indirect effects caused by the NWP activity. The district engineer will also consider site specific factors, such as the environmental setting in the vicinity of the NWP activity, the type of resource that will be affected by the NWP activity, the functions provided by the aquatic resources that will be affected by the NWP activity, the degree or magnitude to which the aquatic resources perform those functions, the extent that aquatic resource functions will be lost as a result of the NWP activity (e.g., partial or complete loss), the duration of the permanent), the importance of the aquatic resource functions to the region (e.g., watershed or ecoregion), and mitigation required by the district engineer. If an appropriate functional assessment method is available and practicable to use, that assessment method may be used by the district engineer to assist in the minimal adverse effects

determination. The district engineer may add case-specific special conditions to the NWP authorization to address site-specific environmental concerns.

2. If the proposed activity requires a PCN and will result in a loss of greater than 1⁄10-acre of wetlands, the prospective permittee should submit a mitigation proposal with the PCN. Applicants may also propose compensatory mitigation for projects with smaller impacts. The district engineer will consider any proposed compensatory mitigation the applicant has included in the proposal in determining whether the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The compensatory mitigation proposal may be either conceptual or detailed. If the district engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse effects on the aquatic environment are minimal, after considering mitigation, the district engineer will notify the permittee and include any activity-specific conditions in the NWP verification the district engineer deems necessary. Conditions for compensatory mitigation requirements must comply with the appropriate provisions at 33 CFR 332.3(k). The district engineer must approve the final mitigation plan before the permittee commences work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the district engineer will expeditiously review the proposed compensatory mitigation plan. The district engineer must review the proposed compensatory mitigation plan within 45 calendar days of receiving a complete PCN and determine whether the proposed mitigation would ensure no more than minimal adverse effects on the aquatic environment. If the net adverse effects of the project on the aquatic environment (after consideration of the compensatory mitigation proposal) are determined by the district engineer to be minimal, the district engineer will provide a timely written response to the applicant. The response will state that the project can proceed under the terms and conditions of the NWP, including any activity-specific conditions added to the NWP authorization by the district engineer.

3. If the district engineer determines that the adverse effects of the proposed work are more than minimal, then the district engineer will notify the applicant either: (a) That the project does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an individual permit; (b) that the project is authorized under the NWP subject to the applicant's submission of a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level; or (c) that the project is authorized under the NWP with specific modifications or conditions. Where the district engineer determines that mitigation is required to ensure no more than minimal adverse effects occur to the aquatic environment, the activity will be authorized within the 45-day PCN period, with activity-specific conditions that state the mitigation requirements. The authorization will include the necessary conceptual or detailed mitigation or a requirement that the applicant submit a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level. When mitigation is required, no work in waters of the United States may occur until the district engineer has approved a specific mitigation plan or has determined that prior approval of a final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation.

E. Further Information

1. District Engineers have authority to determine if an activity complies with the terms and conditions of an NWP.

2. NWPs do not obviate the need to obtain other federal, state, or local permits, approvals, or authorizations required by law.

3. NWPs do not grant any property rights or exclusive privileges.

4. NWPs do not authorize any injury to the property or rights of others.

5. NWPs do not authorize interference with any existing or proposed federal project.

F. Definitions

Best management practices (BMPs): Policies, practices, procedures, or structures implemented to mitigate the adverse environmental effects on surface water quality resulting from development. BMPs are categorized as structural or non-structural.

Compensatory mitigation: The restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.

Currently serviceable: Useable as is or with some maintenance, but not so degraded as to essentially require reconstruction.

Direct effects: Effects that are caused by the activity and occur at the same time and place.

Discharge: The term “discharge” means any discharge of dredged or fill material.

Enhancement: The manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s), but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area.

Ephemeral stream: An ephemeral stream has flowing water only during, and for a short duration after, precipitation events in a typical year. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from rainfall is the primary source of water for stream flow.

Establishment (creation): The manipulation of the physical, chemical, or biological characteristics present to develop an aquatic resource that did not previously exist at an upland site. Establishment results in a gain in aquatic resource area.

High Tide Line: The line of intersection of the land with the water’s surface at the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The line encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds such as those accompanying a hurricane or other intense storm.

Historic Property: Any prehistoric or historic district, site (including archaeological site), building, structure, or other object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria (36 CFR part 60).

Independent utility: A test to determine what constitutes a single and complete non-linear project in the Corps regulatory program. A project is considered to have independent utility if it would be constructed absent the construction of other projects in the project area. Portions of a multi-phase project that depend upon other phases of the project do not have independent utility. Phases of a project that would be constructed even if the other phases were not built can be considered as separate single and complete projects with independent utility.

Indirect effects: Effects that are caused by the activity and are later in time or farther removed in distance, but are still reasonably foreseeable.

Intermittent stream: An intermittent stream has flowing water during certain times of the year, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for stream flow.

Loss of waters of the United States: Waters of the United States that are permanently adversely affected by filling, flooding, excavation, or drainage because of the regulated activity. Permanent adverse effects include permanent discharges of dredged or fill material that change an aquatic area to dry land, increase the bottom elevation of a waterbody, or change the use of a waterbody. The acreage of loss of waters of the United States is a threshold measurement of the impact to jurisdictional waters for determining whether a project may qualify for an NWP; it is not a net threshold that is calculated after considering compensatory mitigation that may be used to offset losses of aquatic functions and services. The loss of stream bed includes the linear feet of stream bed that is filled or excavated. Waters of the United States temporarily filled, flooded, excavated, or drained, but restored to pre-construction contours and elevations after construction, are not included in the measurement of loss of waters of the United States. Impacts resulting from activities eligible for exemptions under Section 404(f) of the Clean Water Act are not considered when calculating the loss of waters of the United States.

Non-tidal wetland: A non-tidal wetland is a wetland that is not subject to the ebb and flow of tidal waters. The definition of a wetland can be found at 33 CFR 328.3(b). Non-tidal wetlands contiguous to tidal waters are located landward of the high tide line (i.e., spring high tide line).

Open water: For purposes of the NWPs, an open water is any area that in a year with normal patterns of precipitation has water flowing or standing above ground to the extent that an ordinary high water mark can be determined. Aquatic vegetation within the area of standing or flowing water is either non-emergent, sparse, or absent. Vegetated shallows are considered to be open waters. Examples of "open waters" include rivers, streams, lakes, and ponds.

Ordinary High Water Mark: An ordinary high water mark is a line on the shore established by the fluctuations of water and indicated by physical characteristics, or by other appropriate means that consider the characteristics of the surrounding areas (see 33 CFR 328.3(e)).

Perennial stream: A perennial stream has flowing water year-round during a typical year. The water table is located above the stream bed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow.

Practicable: Available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

Pre-construction notification: A request submitted by the project proponent to the Corps for confirmation that a particular activity is authorized by nationwide permit. The request may be a permit application, letter, or similar document that includes information about the proposed work and its anticipated environmental effects. Pre-construction notification may be required by the terms and conditions of a nationwide permit, or by regional conditions. A pre-construction notification may be voluntarily submitted in cases where pre-construction notification is not required and the project proponent wants confirmation that the activity is authorized by nationwide permit.

Preservation: The removal of a threat to, or preventing the decline of, aquatic resources by an action in or near those aquatic resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms. Preservation does not result in a gain of aquatic resource area or functions.

Re-establishment: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Reestablishment results in rebuilding a former aquatic resource and results in a gain in aquatic resource area and functions.

Rehabilitation: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function, but does not result in a gain in aquatic resource area.

Restoration: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. For the purpose of tracking net gains in aquatic resource area, restoration is divided into two categories: reestablishment and rehabilitation.

Riffle and pool complex: Riffle and pool complexes are special aquatic sites under the 404(b)(1) Guidelines. Riffle and pool complexes sometimes characterize steep gradient sections of streams. Such stream sections are recognizable by their hydraulic characteristics. The rapid movement of water over a course substrate in riffles results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. A slower stream velocity, a streaming flow, a smooth surface, and a finer substrate characterize pools.

Riparian areas: Riparian areas are lands adjacent to streams, lakes, and estuarine-marine shorelines. Riparian areas are transitional between terrestrial and aquatic ecosystems, through which surface and subsurface hydrology connects riverine, lacustrine, estuarine, and marine waters with their adjacent wetlands, non-wetland waters, or uplands. Riparian areas provide a variety of ecological functions and services and help improve or maintain local water quality. (See general condition 23.)

Shellfish seeding: The placement of shellfish seed and/or suitable substrate to increase shellfish production. Shellfish seed consists of immature individual shellfish or individual shellfish attached to shells or shell fragments (i.e., spat on shell). Suitable substrate may consist of shellfish shells, shell fragments, or other appropriate materials placed into waters for shellfish habitat.

Single and complete linear project: A linear project is a project constructed for the purpose of getting people, goods, or services from a point of origin to a terminal point, which often involves multiple crossings of one or more waterbodies at separate and distant locations. The term “single and complete project” is defined as that portion of the total linear project proposed or accomplished by one owner/developer or partnership or other association of owners/developers that includes all crossings of a single water of the United States (i.e., a single waterbody) at a specific location. For linear projects crossing a single or multiple waterbodies several times at separate and distant locations, each crossing is considered a single and complete project for purposes of NWP authorization. However, individual channels in a braided stream or river, or individual arms of a large, irregularly shaped wetland or lake, etc., are not separate waterbodies, and crossings of such features cannot be considered separately.

Single and complete non-linear project: For non-linear projects, the term “single and complete project” is defined at 33 CFR 330.2(i) as the total project proposed or accomplished by one owner/developer or partnership or other association of owners/developers. A single and complete non-linear project must have independent utility (see definition of “independent utility”). Single and complete non-linear projects may not be “piecemealed” to avoid the limits in an NWP authorization.

Stormwater management: Stormwater management is the mechanism for controlling stormwater runoff for the purposes of reducing downstream erosion, water quality degradation, and flooding and mitigating the adverse effects of changes in land use on the aquatic environment.

Stormwater management facilities: Stormwater management facilities are those facilities, including but not limited to, stormwater retention and detention ponds and best management practices, which retain water for a period of time to control runoff and/or improve the quality (i.e., by reducing the concentration of nutrients, sediments, hazardous substances and other pollutants) of stormwater runoff.

Stream bed: The substrate of the stream channel between the ordinary high water marks. The substrate may be bedrock or inorganic particles that range in size from clay to boulders. Wetlands contiguous to the stream bed, but outside of the ordinary high water marks, are not considered part of the stream bed.

Stream channelization: The manipulation of a stream’s course, condition, capacity, or location that causes more than minimal interruption of normal stream processes. A channelized stream remains a water of the United States.

Structure: An object that is arranged in a definite pattern of organization. Examples of structures include, without limitation, any pier, boat dock, boat ramp, wharf, dolphin, weir, boom, breakwater, bulkhead, revetment, riprap, jetty, artificial island, artificial reef, permanent mooring structure, power transmission line, permanently moored floating vessel, piling, aid to navigation, or any other manmade obstacle or obstruction.

Tidal wetland: A tidal wetland is a wetland (i.e., water of the United States) that is inundated by tidal waters. The definitions of a wetland and tidal waters can be found at 33 CFR 328.3(b) and 33 CFR 328.3(f), respectively. Tidal waters rise and fall in a predictable and measurable rhythm or cycle due to the gravitational pulls of the moon and sun. Tidal waters end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking by other waters, wind, or other effects. Tidal wetlands are located channelward of the high tide line, which is defined at 33 CFR 328.3(d).

Vegetated shallows: Vegetated shallows are special aquatic sites under the 404(b)(1) Guidelines. They are areas that are permanently inundated and under normal circumstances have rooted aquatic vegetation, such as seagrasses in marine and estuarine systems and a variety of vascular rooted plants in freshwater systems.

Waterbody: For purposes of the NWPs, a waterbody is a jurisdictional water of the United States. If a jurisdictional wetland is adjacent—meaning bordering, contiguous, or neighboring—to a waterbody determined to be a water of the United States under 33 CFR 328.3(a)(1)–(6), that waterbody and its adjacent wetlands are considered together as a single aquatic unit (see 33 CFR 328.4(c)(2)). Examples of “waterbodies” include streams, rivers, lakes, ponds, and wetlands.

ADDITIONAL INFORMATION

For additional information concerning the nationwide permits or for a written determination regarding a specific project, please contact the office below:

In New Mexico:

Chief, Regulatory Division
Albuquerque District, US Army Corps of Engineers
4101 Jefferson Plaza, NE
Albuquerque, NM 87109-3435
Telephone: (505) 342-3282

In Southeastern Colorado:

Southern Colorado Regulatory Office
200 S. Santa Fe Avenue, Suite 301
Pueblo, CO 81003
Telephone: (719) 543-9459

In Southern New Mexico and Western Texas:

Las Cruses Regulatory Office
505 S. Main St., Suite 142
Las Cruces, NM 88001
Telephone: (575) 556-9939

In Northwestern New Mexico and within the San Luis Valley of Colorado:

Durango Regulatory Office
1970 E. 3rd Avenue, Suite 109
Durango, CO 81301
Telephone: (970) 259-1582

Information about the U.S. Army Corps of Engineers regulatory program, including nationwide permits, may also be accessed on our Internet page: http://www.spa.usace.army.mil/reg/

This nationwide permit is effective March 19, 2012, and expires on March 18, 2017.

Summary Version: March 19, 2012

ARCHEOLOGICAL SURVEY AND TESTING FOR PROPOSED HATCH DAM AND FLOOD POOL CONSTRUCTION, DOÑA ANA COUNTY, NEW MEXICO

Alexander Kurota

Office of Contract Archeology
University of New Mexico

The University of New Mexico

US Army Corps
of Engineers

ARCHEOLOGICAL SURVEY AND TESTING FOR PROPOSED HATCH DAM AND FLOOD POOL CONSTRUCTION, DONA ANA COUNTY, NEW MEXICO

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OCA/UNM Report No. OCA-185-892

NMCRIS No. 99460
November 2006

ABSTRACT

This report presents the results of an archeological survey by the University of New Mexico's Office of Contract Archeology (OCA/UNM) within the town limits of Hatch, New Mexico. The project was conducted at the request of Mr. Jorge R. Colberg of the United States Army Corps of Engineers office in Albuquerque to perform a Class III survey of roughly 70 acres of land proposed for a flood control dam construction with a resulting flood pool in Hatch, Dona Ana county, New Mexico. The planned project involves building an earthen dam whose outlet will feed into the existing Colorado Spur Drain. In addition, the project will also involve the removal of an existing spoil bank levee along an arroyo that will feed into the pool. The survey area, therefore, included the proposed flood control dam and the resulting flood-pool.

The project area is a state-owned parcel located in the northwestern quarter of Section 16, Township19 South, Range 3 West, of Hatch USGS 7.5' quadrangle (1959). OCA archeologists performed the fieldwork between April 24 and 28, 2006. Four new sites, two previously documented canals and nine isolated occurrences were documented during this undertaking. Two sites were also tested for buried cultural deposits. The results of the fieldwork suggest that none of the four new sites are eligible for the inclusion in the National Register of Historic Places (NRHP). However, the northern part of the proposed construction intersects with the Colorado Spur Drain (LA 120284) and Rodey Lateral (LA 120285), which already have been determined as eligible for the NRHP under criterion "a".

ACKNOWLEDGEMENTS

The author of this report would like to thank the Department of the Army's Mr. Jorge Colberg and Mr. Don Luna for funding and coordination of this project and Mr. Paul Duggie, Executive Director for the Doña Ana Flood Control Authority, who provided rights of entry to the survey crew.

A special thanks goes to Mrs. Valerie Beversdorf, a GIS Specialist at the Elephant Butte Irrigation District office in Las Cruces. During our brief visit to the office, Mrs. Beversdorf showed us the extent of two irrigation canals next to the project area. Mrs. Beversdorf also presented us with 1930s maps showing irrigation canals in Hatch and informed us about the general EBID operations. Many thanks also goes to Dedie Snow, of the Archaeological Records Management System, who promptly sent us copies of requested LA site forms and other pertinent research material.

I would also like to extend my appreciation to Mr. Bill Lockhart of the New Mexico State University who shared his extensive knowledge and decades of experience in dating and typing historic bottles of southern New Mexico with the participants of the New Mexico Archaeological Council workshop in November 2005. Mr. Lockhart's presentation, as well as his on-line books on glass articles in southern New Mexico, have provided an invaluable source of reference. Another thank you goes to Mr. David Whitten for his website with a guide to the nationally produced historic glass articles.

As always, the OCA staff provided a professional team effort to bring this research project into its final reporting phase. Adrienne Actis served as an experienced colleague archeologist in the field and digitized site maps and profile drawings. Ron Stauber did his artwork using Adobe Photoshop, produced the cover page and added a final touch to all figures. Rebecca Melsheimer produced the artifact tables using the OCA's access database developed by Dorothy Larson. OCA's computer programmer Adel Saad recently upgraded our computers and, whenever needed, provided a fast and reliable computer service. Lou Romero, the office's Laboratory Manager, produced our new excavation screens, secured our field supplies and a reliable transportation. Bill Brown typed the single animal bone recovered during the testing phase. Barbara Daniels employed her extensive editing skills and Donna K. Lasusky facilitated the report production. Patrick Hogan, the project's Principal Investigator, offered experienced advice and guidance. I also extend my appreciation to the other OCA's senior staff Dick Chapman and Peggy Gerow for their advice and support.

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INTRODUCTION

This report presents the results of an archeological survey and testing project conducted by the University of New Mexico's Office of Contract Archeology (OCA) within the town limits of Hatch, Doña Ana County, New Mexico. The work was performed for the U.S. Army Corps of Engineers, Albuquerque District Office (COE) under Contract No. W912PP-06-D-0001, Delivery Order 0003. The COE plans to construct a flood control dam, and the objective of the survey was to identify and evaluate any cultural resources that might be affected by the construction. The proposed construction involves building an earthen dam with an outlet feeding into the existing Colorado Spur Drain and the removal of an existing spoil bank levee along an arroyo that will feed into the pool. The survey area encompasses the proposed dam and flood-pool, a total area of 69.82 acres (28.25 hectares).

This state-owned parcel is in the northwestern quarter of Section 16, Township19 South, Range 3 West, Hatch USGS 7.5' quadrangle (Figure 1). OCA archeologists Alexander Kurota and Adrienne Actis completed the fieldwork between April 24 and 28, 2006. Four new sites, two previously recorded canals and nine isolated occurrences (IOs) were documented during this undertaking. The two previously recorded irrigation ditches are Rodey Lateral (LA 120285) and Colorado Spur Drain (LA 120284), both of which are part of the Elephant Butte Irrigation District (EBID). Two of the four new sites, LA 152983 and LA 152984, are historical trash dumps. The other two sites are prehistoric artifact scatters, and these were tested for possible buried cultural deposits.

The results of the fieldwork suggest that none of the four new sites are eligible for the inclusion in the National Register of Historic Places (NRHP). However, the northern part of the proposed construction intersects with the Colorado Spur Drain (LA 120284) and Rodey Lateral (LA 120285), which have been determined as eligible for the National Register of Historic Places under criterion "a" of 36CFR60.4.

The project (OCA project No. 185-892, NMCRIS No. 99460) was performed under New Mexico State Cultural Resources survey permit No. NM-06-017-S. Patrick Hogan served as OCA's Principal Investigator, Mr. John Schelberg was the contact person for the COE, and Mr. Paul Duggie of the Doña Ana Flood Control Authority coordinated the rights of entry.

ENVIRONMENTAL BACKGROUND

The project area is located in the southwest Basin and Range province. It is situated between the low-lying basin deserts and the riparian habitats of the Rio Grande Valley to the north, east, and southeast; the volcanic Sierra de las Uvas which extend to the south of the project area; and the uplands of the Black Range to the northwest. The town of Hatch is spread over the area between the Rio Grande and the survey parcel. State Road 26 runs through Hatch about 200 m to the north of the project area. The highway crosses dissected Quaternary- and Tertiary-age gravel deposits associated with the ancestral and recent Rio Grande Valley (Doleman and Treadwell 1997:23).

Several north-trending drainages flow into the Rio Grande in the vicinity of the project area. Placitas Arroyo, located about 0.5 mi to the east, is a major tributary and flows into the Rincon portion of the Rio Grande Valley. A smaller arroyo enters the southeast corner of the project area and delivers runoff water from Spring Canyon.

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Besides the underlying Quaternary-Tertiary gravels and occasional alluvial deposits, surface deposition on the ridges consists of medium to fine eolian sand. In particular, this was observed in the southern portion of the project area during the survey and testing at LA 152892. However, these sediments appeared not as contiguous layers but rather as isolated micro dunes under the larger vegetation species, such as creosotes and mesquite bushes. The vast majority of the project area is typified by soft alluvial deposits.

Soils

Three types of soil are present in or near the project area. The first one, Anthony-Vinton clay loam, is located in the lowest portion of the survey area, which is almost level and currently used as irrigated cropland. These soils are commonly protected from floodwaters of Rio Grande by dams and levees. The Anthony soils have formed in alluvium and are usually deep and well drained. These soils make up about 55% of the soil unit. The Vinton soils are formed in mixed alluvium and are also deep and well drained. These soils make up about 30% of the main soil unit (Bulloch, Jr. and Neher 1980:15–16).

The second soil is the Nickel-Badland Complex, which consists of undulating to moderately rolling soils This complex can be found from 4,000 to 5,200 feet of elevation (Bulloch, Jr. and Neher 1980:33) and is well represented in the gravel terraces south of the project area.

The third soil unit is the Canutio and Arizo gravelly sandy loam and is commonly found on fans, terraces, valley floors and wide arroyos at elevations ranging from 3,800 to 4,400 feet. Such soil units can be found to the east, slightly downstream from the project area (Bulloch, Jr. and Neher 1980:24).

Climate

The climatic conditions in the project area are characteristic for the southern Rio Grande Valley, which are classified as arid (Tuan et al. 1973:187, Figure 78). Half of the annual precipitation is received during the summer months of July through September (Tuan et al. 1973:190). Average annual precipitation is roughly 18-20 cm (7–8 inches) and average daily temperatures range from 57 ºF in January to 94 ºF in July. Temporal and spatial variability in weather patterns in this part of New Mexico vary considerably which often translates into unpredictable seasonal productivity. As a result, local vegetation experiences two blooming seasons, one taking place in the spring dependent on the winter precipitation, and the other in a late summer/early fall, dependent of the summer monsoon (Doleman and Treadwell 1997).

Vegetation

The survey area is located in the northern portion of the Chihuahuan biogeographic province (Brown and Lowe 1994:13, Figure 3). Chihuahuan Desert Scrub is the only biome represented in the study area. Within this biome, the local vegetation is diversified based on the elevation and relief. In the project area, creosote bush, mesquite, snakeweed, saltbush, old cedar brush have commonly been observed (Figure 2). Additionally, some cacti species, including prickly pear and hedgehog cactus, were noticed in small quantities. Non-local species, such as the tamarisk tree, were found growing in abundance in the areas around moisture-rich drainages within the floodplain of the study area.

Figure 2 Overview of project area, view looking northwest.

Fauna

During the course of survey, various animal species were observed in or near the project area. The mammalian species include cottontail, jackrabbit, coyote, raccoon, and various unidentified rodents. Additionally, several small lizards were noticed throughout the project area. Frogs were also found swimming in the water of Rodey Lateral. Of the avian species, a large number of sparrows, one roadrunner along with a handful of ravens were noticed in the project area and in the town of Hatch. Several different species of ducks and cranes were noticed in or near the Rio Grande. Noteworthy of mention is one other mammalian species. A colony of roughly 70 bats were found to have established a home in the campground of the nearby Leasburg State Park.

CULTURE HISTORY

Three major periods of human occupation in the region are relevant to the data collected during the survey. These include the Archaic period (ca. 6000 BC–AD 200), the Formative period (ca. AD 200–1400) and the Historic period (AD 1540–1956).

The Archaic Period

Two main chronological sequences have been developed for the Archaic period in southern New Mexico. The first to be defined was the Cochise culture (Sayles and Antevs 1941). Because it was the first Southwestern Archaic sequence to be defined, the Cochise sequence has been widely applied across the Southwest, although it now appears relevant primarily to southeastern Arizona and to the uplands of the southern Colorado Plateau Province (Datil Section) in west-central New Mexico. As most recently described by Sayles (1983), the Cochise culture is divided into four temporal stages: Sulphur Springs (10,500–9000 BC), Cazador (9000–6000 BC), Chiricahua (6000–1500 BC), and San Pedro (1500 BC–AD 1). These date ranges appear inconsistent with the available chronometric evidence, though, leading some researchers to question the validity of the Cochise culture concept (Berry and Berry 1986; Wills 1988).

The early dates suggested for the Sulphur Springs stage were based on Antev's geologic dating of the Double Adobe site and on the apparent association of Sulphur Springs artifacts with the bones of extinct fauna. Radiocarbon dates from the strata containing Sulphur Springs artifacts (Waters 1986) indicate a date range of 8000–6000 BC for these materials, however. Further, Waters argues that the bones of extinct fauna found in association with Sulphur Springs artifacts at Double Adobe were eroded from older deposits and reworked into younger deposits with the artifacts. Waters' (1986) assessment of the geoarchaeology of Whitewater Draw also indicates that Cazador artifacts identified by Sayles (1983) appear to have come from a mixture of Sulphur Springs age and younger deposits, raising serious doubt about the validity of the Cazador stage. Thus there remains a significant gap in the Cochise sequence between the Sulphur Springs and Chiricahua stages, particularly since the projectile point styles associated with the Chiricahua stage now appear to date between about 3000 and 1500 BC (Hogan 1998). Given this gap, there is no evidence for cultural continuity between the Sulphur Springs and later Cochise stages. In fact, San Pedro is the only well-documented Cochise stage. Recent work in southeastern Arizona (Huckell 1995) has led to some refinement of this late end of the Cochise chronology. Huckell divides his “Early Agricultural Period” into two phases – the San Pedro phase (1500/1000–500 BC) and the Cienega phase (500 BC–AD 100/200).

The second Archaic sequence relates to the "Chihuahua Tradition" as defined by MacNeish and Beckett (1987) based on research in the Rio Grande valley and adjacent Tularosa Basin in south-central New Mexico. As such, it is probably more directly applicable to the Hatch area than the Cochise sequence, although the boundaries between the two Archaic traditions are poorly defined. As described by MacNeish (1993), the Chihuahua tradition is divided into four phases: Gardner Springs (6000–4300 BC), Keystone (4300–2600 BC), Fresnal (2600–900 BC), and Hueco (900 BC–AD 200). The definition of the Gardner Springs phase is based on minimal evidence, but MacNeish sees similarities with the Sulphur Springs and San Dieguito materials, and speculates that the complex was intrusive into the region from the west. The Keystone phase is somewhat better dated but also represented by relatively few components. The two later phases are better defined, and apparently mark a significant increase in the regional population coincident with the introduction of cultigens. The Chihuahua sequence has not received the scrutiny given to the Cochise sequence, however, so the phases are best viewed as a preliminary chronological construct.

In general, the Archaic subsistence strategy is characterized as a hunting and gathering adaptation utilizing a variety of wild plant and animal resources. For northwestern New Mexico, Elyea and Hogan (1983) have proposed a “serial foragers” model, which describes Archaic groups as highly mobile bands moving seasonally from one environment to another. As applied to south-central New Mexico by Doleman and Chapman (1997:11), this model envisions Archaic groups utilizing lowland and riparian resources during the spring, summer and fall and aggregating into larger residential bases during the short winter.

Archaic settlement patterns in the region are poorly defined, but appear broadly consistent with this model. Numerous low-density lithic scatters with ground stone have been found in lower basin settings, most of which apparently date to the late Archaic. These sites are believed to have been procurement and processing loci for mesquite and annual seed plants (Brethauer 1978; Carmichael 1981). Excavated Archaic sites along the lower part of Placitas Arroyo, about one mile west of the Hatch survey area, also evidence intensive plant processing along the floodplain margins of the Rio Grande valley (Doleman 1997). Agave gathering camps, which probably date to the late Archaic, are found in the foothills of the Sacramento and Franklin Mountains (Anyon 1985; Beckes 1977; O'Laughlin 1980), while the mountains themselves appear to have been used primarily for hunting (O'Laughlin 1977). Seasonal basecamps evidencing early use of cultigens have been documented in dry caves in the southern Organ Mountains (Johnson and Upham 1988), and the Keystone Dam site in the Rio Grande valley is believed to be a winter settlement (O'Laughlin 1980).

The Formative Period

Two Formative period sequences apply to the interpretation of the sites in the project area, those for the Mimbres and Jornada Branches of the Mogollon Culture (Haury 1936). The Rio Grande is generally considered the dividing line between the two branches, with the Jornada to the east and Mimbres to the west. Jornada sites predominate on both sides of the river within the Rio Grande valley, however (Wegener 2002, Doleman 1997).

The Jornada Branch Mogollon was defined by Lehmer (1948) based on excavations at Los Tules, La Cueva, and the Bradfield Site, and limited surveys in the area between Alamogordo and Las Cruces. The occupation was divided into four phases – Hueco (before AD 900), Mesilla (AD 900–1100), Doña Ana (AD 1100–1200), and El Paso (AD 1200–1400). The Hueco phase is now considered part of the Archaic sequence, and the beginning date for the Mesilla phase has been pushed back to AD 200 based on more recent research. Given the long time period now encompassed by the Mesilla phase, most researchers have informally divided it into early and late subphases. The validity of the Doña Ana phase has also been questioned and, because Doña Ana phase sites cannot be consistently distinguished on survey, a number of researchers have dropped it from the sequence. Typical of the revisions to Jornada chronology is Anyon’s (1985:5–6) sequence which divides the Formative into Early Mesilla (AD 200–750), Late Mesilla (AD 750–1150), and El Paso (AD 1150–1400) phases.

Early and Late Mesilla settlements consist of pithouses and/or less formal structures and shelters. The two phases are distinguished on the basis of their ceramic assemblages, primarily the absence (early) or presence (late) of Mimbres black-on-white. The beginning of the El Paso phase is marked by the introduction of El Paso Polychrome pottery and above ground, adobe-walled architecture.

The chronology for the Mimbres Mogollon is similarly divided into three periods: Early Pithouse, Late Pithouse, and Pueblo. The Early Pithouse period or Cumbre phase is dated from AD 200 to 550. The succeeding Georgetown phase (AD 550–650) is the first of the three phases defined for the Late Pithouse period (Anyon et al. 1981). These two early Mimbres phases are often hard to distinguish since their ceramic assemblages consist only of plain brownwares and redwares. The second Late Pithouse phase, San Francisco (AD 650–750), is easier to define due to the appearance of the first painted pottery, Mogollon Red-on-brown. New ceramics types, including Mimbres Boldface Black-on-white and Three Circle Red-on-white, mark the beginning of the third late pithouse phase, Three Circle (AD 750–1000).

The Pueblo period of the Mimbres Mogollon has also been referred to as the Classic Mimbres. Hegmon et al. (1999:147) offer a synthesis of the latest research in the Mimbres area and sub-divide the Pueblo period into four phases. The earliest of these is the Classic Mimbres phase (AD 1000–1130) which is characterized by cobble masonry architecture. Mimbres Black-on-white and corrugated ceramics were produced during this phase. The Terminal Classic Mimbres (late 1000s–1130) reflects later occupations of the Mimbres villages. The ceramics are the same as in the previous phase with the addition of El Paso Polychrome, Chupadero Black-on-white, Chihuahuan and Tularosa Corrugated and Playas Red Incised. The third Pueblo period phase is Post-Mimbres (AD 1150–1200s), and common sites are small masonry hamlets. The pottery assemblages include the same types as the previous phase with the addition of St. Johns Poychrome. Finally, the Black Mountain phase is marked by adobe pueblos often associated with small plazas and the appearance of Ramos Polychrome.

The chronological sequence in the Mimbres region is further characterized by a gradual shift from residential villages in upland settings during the early Pithouse period to increasingly utilization of drainage valleys as year-round residences during the late Pithouse and Pueblo periods (LeBlanc and Whalen 1980:112). Jornada Mogollon land use differs from this pattern in that earlier village sites can be found throughout the landscape. Only later, as groups became more dependent on agriculture, did people began to live closer to the river valleys (Doleman and Chapman 1997:13). A shift from pithouse architecture to above ground adobe structures is a major feature reflecting the change in residential patterns through time. While there are many parallels which can be observed in the chronological sequences of the Jornada and Mimbres Mogollon, perhaps the most interesting differences are the varying importance of agriculture and subsequently different settlement patterns, architecture community, and regional organization (Doleman and Chapman 1997:13).

The Historical Period

The Historical period in New Mexico is dated from AD 1540, the initial Spanish exploration of the region by the Francisco Vasquez de Coronado expedition, or alternatively from the Spanish colonization of northern New Mexico in 1598. The Rio Grande valley in the vicinity of Hatch was not settled by Euro-Americans until the mid-nineteenth century, however. Consequently, for most of the historical period the lower Rio Grande valley served primarily as a transportation corridor. During the seventeenth and eighteenth centuries, the Camino Real or Chihuahua Trail, which crosses the edge of the Jornada del Muerto east of Hatch, was the major supply and trade route linking the colony in New Mexico with Spanish settlements in El Paso and the Chihuahua mining district. When New Mexico came under Mexican control in 1821, trade restrictions with the United State were eased and the Santa Fe Trail was opened. The resulting increase in trade further enhanced the importance of the Camino Real, extending its network from Santa Fe to Independence, Missouri and the industrial centers of the eastern United States.

Following the Mexican War, the United States Army moved to exert control over the newly-designated New Mexico Territory. Securing transportation routes was a priority, and several forts and military posts were established in present-day Doña Ana County to protect the Camino Real and California Trail from outlaws and Apache raids. Fort Thorn was established near the sporadically occupied village of Santa Barbara in 1853. The fort was badly sited, and it was closed in 1859. It was eventually replaced by Fort Selden, which was built north of Doña Ana in 1865 (Wilson et al. 1989:24–25). The village of Santa Barbara was again abandoned after the closure of Fort Thorn, and it was not reoccupied until 1875. At that time, the village was renamed Hatch in honor of General Edward Hatch, Fort Thorn’s former commander (Julyan 1996:162).

The military presence and subsequent subjugation of the Apaches opened the lower Rio Grande valley to Hispanic and Anglo settlers. The area developed as an agricultural center initially centering on the Mesilla Valley but gradually expanding northward into the Rincon valley. By 1881, the Atchison, Topeka, and Santa Fe Railroad had extended its line southward to Rincon and, in March 1881, the Southern Pacific and AT&SF railroads joined at Deming to form a second transcontinental railroad (Wilson et al. 1989:30). By the 1890s, Hatch became a stop on the AT&SF diagonal line between Rincon and Deming and was emerging as the mercantile center for the Hatch-Rincon valley.

The arrival of the railroad brought a new influx of settlers and a demand for additional irrigation water. The Rio Grande Dam and Irrigation Company was incorporated in 1893 to build a dam and reservoir at Elephant Butte to provide irrigation water and flood control for the Mesilla Valley. These plans conflicted with those of farmers in El Paso and Ciudad Juarez, but an agreement was negotiated through the U.S. Reclamation Service stipulating that the federal government would construct a large dam near Elephant Butte to provide water to all three areas. Once the Elephant Butte Dam was completed in 1916, construction began almost immediately on the Percha Diversion Dam, designed to provide irrigation water for the Rincon Valley. That dam was completed in 1918 and the first water delivery systems in the Rincon Valley were excavated between 1916 and 1919 (Ackerly 1996:75, Table 10). By 1935, the irrigation system in and around the Hatch was well developed, with individual canal segments privately owned and maintained by many local farmers (1935 map, Elephant Butte Irrigation District office archives, Las Cruces, NM).

Because a number of historical period trash dumps were found in the project area, it is also relevant to note that the 19th and early 20th century region of southern New Mexico saw a boom in soft drink and milk production. Companies producing soda in various flavors and milk in different bottle shapes were operating in Alamogordo as well as in El Paso, Texas (Lockhart 2000, 2001a, 2001b).

PREVIOUS RESEARCH AND PREFIELD RECORDS CHECK

On April 17, 2006, the New Mexico Cultural Resource Information System (NMCRIS) database was examined to identify previous archaeological surveys conducted in the vicinity of the current project area, and previously recorded sites located within a one-mile radius around the survey parcel. Records were found for seven previously-documented sites (Table 1), only two of which fall within the project area. The COE’s maps indicate that the proposed dam will feed water into the existing culvert, which leads into the Colorado Spur Drain (LA 120284), and the planned construction of the earthen dam abuts the Rodey Lateral (LA 120285). The other five previously recorded sites include two prehistoric sites, two historical sites, and one multi-component site. LA 1663 is a Jornada Mogollon ceramic and lithic scatter probably dating to the Doña Ana and El Paso phase (AD 1100–1400). LA 124497 is a lithic scatter of indeterminate age (9500 BC–AD 1930). LA 72336 designates the village of Hatch from the New Mexico Statehood – World War II period (AD 1912–1945), and LA 143587 is an adobe structure of probable Hispanic origin dating to an unspecific historic period (AD 1500–1930). LA 2783 has both the prehistoric and historic components, an ash stain and Jornada Mogollon lithic and ceramic scatter (AD 750–1100), and an adobe wall with historical ceramics that dates to the Post-Revolt-New Mexico Statehood-World War II period (AD 1800–1930). Previous archaeological surveys in the vicinity of the project area were mostly linear surveys conducted in conjunction with road widening and flood control dam construction or other urban development (Table 2).

Table 1 Previously recorded sites within one mile radius around project area (Data collected from NMCRIS Database).

LA Number/ Name	Occupation Period	Cultural Affiliation	Description	Recording Agency/ Recording Year	NMCRIS DOE Status
1663	(1) Early Pueblo IV (Jornada) AD 1100–1175 (Doña Ana phase) (2) Late Pueblo (Jornada) AD 1175–1400 (El Paso phase)	(1) Mogollon (2) Mogollon	(1) Prehistoric ceramics (2) Prehistoric ceramics	Laboratory of Anthropology, Museum of New Mexico (1934)	Not entered
2783	(1) Late Pithouse (Jornada) AD 750–1100 (Mesilla phase) (2) Post-Revolt to NM Statehood-WWII, AD1800–1930	(1) Mogollon (2) Hispanic	(1) ash stain, chipped stone tools, diagnostic ceramics (2) adobe wall, historic ceramics, faunal remains	TRC Mariah Associates, Inc. (2004)	Not entered
72336 “Town of Hatch”	NM Statehood-WWII, AD 1912–1945	Anglo/Euro-American	House extant	-NM State Highway and Transportation Dept. (1988) -Archaeological Services (no date)	Not entered
120284 “Colorado Drain”	NM Statehood-WWII, AD 1912–1925	Anglo/Euro-American	Irrigation ditch; earth-banked drain	Archaeological Services (1997)	Eligible, criteria A
120285 “Rodey Lateral”	NM Statehood-WWII, AD 1912–1925	Anglo/Euro-American	Irrigation ditch; earth-banked lateral	Archaeological Services (1997)	Eligible, criteria A
124497	Unspecific Prehistoric, 9500 BC – AD 1550	Unknown	100s of lithics consisting mostly of primary reduction flakes and cores	Archaeological Services (1998)	Not determined
143587	Unspecific Historic AD 1500–1930	Hispanic	Structure extant, corner of adobe structure, walls eroded	TRC Mariah Associates, Inc. (2004)	Not entered

Several excavation projects have also been conducted in the region. Among these are the 1976 excavations by North Texas State University at six sites in the upper Placitas Arroyo area (Morenon and Hays 1984), about 2 miles west of the current project area. The excavated sites were closely positioned to the Placitas Arroyo and were associated primarily with the early Formative period of the Jornada Mogollon. Morenon and Hays argue that the prehistoric Mogollon may have procured and processed wild plant food in ways similar to those of the Apaches. Groundstone was used for the initial food processing, and mescal and yucca were roasted in heated earthen pits filled with cobbles (1984:6.1–6.14). The project also successfully incorporated the use of a magnetometer for the discovery of pit structures and other buried features, a cutting edge technology of the period.

In 1993, OCA completed a data recovery project along State Road 26, about one mile west of the project area (Doleman 1997). This project excavated four sites dating to the late Archaic to early Formative period. These loci (LA 37450, LA 37451, LA 87917, and LA 98669) are characterized by moderate to high density lithic scatters with associated with fire pits and concentrations of fire-cracked rock. Numerous ground stone fragments were also recovered during the excavations.

Table 2 Previous surveys conducted in the vicinity of the project area (data collected from NMCRIS database).

NMCRIS Activity No.	Type of Survey	Area Surveyed (acres)	No. of Docum. Sites	Performing Agency/ Survey Year
24596	Linear and block units,	34.5	1	NM State Highway and Transportation Dept. (1988)
37444	Linear	Not entered	0	BLM Las Cruces District (1979)
37452	Linear	10.15	1	BLM Las Cruces District (1979)
39823	Linear	57.2	3	NM State Highway and Transportation Dept. (1992)
41927	Block units	69.2	2	Archaeological Services by Laura Michalik (1992)
42865	Linear and block units	274.45	2	Archaeological Services by Laura Michalik (1993)
45681	Linear and block units	41.34	0	Archaeological Services by Laura Michalik (1994)
47825	Block units	209.7	1	TRC Mariah Associates, Inc. (1994)
58739	Linear	231.4	18	Archaeological Services by Laura Michalik (1997)
62249	Linear	1.39	0	Archaeological Services by Laura Michalik (1998)
62302	Linear	1.24	0	Archaeological Services by Laura Michalik (1998)
75075	Linear	169.1	3	Lone Mountain Archeological Services (2001)
75586	Linear	78.88	0	Lone Mountain Archeological Services (2001)
87821	Block units	80	4	TRC Mariah Associates, Inc. (2004)
88490	Block units	0.8	0	Applied Ecosystem Management, Inc. (2004)
89955	Linear	11.3	1	Archaeological Services by Laura Michalik (2004)

The Museum of New Mexico completed salvage excavations at the Hatch Site (LA 3135) in 1964. The Hatch Site is a multicomponent village site located on a gravel terrace overlooking the Rio Grande floodplain. It consists of nine pit houses along with an adobe surface structure, all dating to the Mesilla – Doña Ana phase (Early to Late Mesilla phase) of the Jornada Mogollon. The site also had an earlier, Archaic, component consisting of a cluster of hearths, fire-cracked rock and a numerous lithic artifacts (Schaafsma 1964:2). The Hatch Site is significant for two reasons. It is one of the few Doña Ana (Late Mesilla) phase residential sites with above ground architecture. The site occupation also suggests a possible shift in the cultural influence affecting the local population of the Rio Grande valley. During early occupations at the site the presence of ceramics affiliated with the western (Mimbres) Mogollon suggest influence from the west, while in the later occupation the ceramics suggest the emergence of distinctive Jornada Branch cultural traits.

More recently, Statistical Research, Inc. excavated LA 106780, an Early to Late Mesilla phase site located on the grounds of the Leasburg State Park (Wegener 2002). With the aid of the magnetometer and the resistivity meter, Wegener discovered three pit structures indicating the presence of a multicomponent habitation locus placed on the east bank of the Rio Grande Valley. The presence of this habitation locus near the Rio Grande confirms the prevailing view that the prehistoric Jornada Mogollon commonly occupied territories further west of the Tularosa Basin.

SURVEY METHODS

Prior to the fieldwork, the outline of the project area was downloaded into a Garmin GPSmap 76C Ground Positioning System (GPS) unit with accuracy <10 m (20–30 ft), 95% typical to aid the field crew in locating the survey area. The survey started in the southeastern corner of the project area and proceeded westward, with the two archeologists walking 15 m apart, in east-to-west and west-to-east running transects.

Isolated occurrences, single artifacts or small clusters presumably reflecting non-localized, low intensity use of the landscape, were recorded and analyzed individually. The artifact were described using the same variables used for in-field analysis of site artifact assemblages, the location was recorded on the GPS receiver, and topographic setting and vegetation association were noted.

When sites were encountered, features were identified and all surface artifacts were marked with pin flags. A permanent site datum was established and marked with a 12" rebar and an aluminum cap pre-stamped with "OCA-UNM" and then marked with the site's field number (for example 892-1). UTM coordinates for the datum were recorded in the GPS receiver. Sites were recorded on Laboratory of Anthropology Site Record Forms. Photographs were made at all sites, and included a site overview and the views of features or diagnostic artifacts. Diagnostic attributes, such as embossed bottle bases, were also sketched on paper. Each site was mapped using a Silva compass and a measuring tape. The map was produced by plotting its features, topography and its important components on graph paper.

A representative sample of artifacts at each site was analyzed in the field. Variables recorded for lithic artifacts include artifact type, raw material, condition or completeness, percentage of dorsal cortex, type of striking platform, and the length, width, and thickness of each complete item to the nearest millimeter. Only thickness was measured for fragmentary artifacts. Variable recorded for ceramics were ware, type, and vessel form. Variables recorded for historical artifacts varied depending on the kind of materials present.

Prior to surveying the two irrigation ditches, the archeologists visited the office of the Elephant Butte Irrigation District in Las Cruces to gather information on the history of the use of these water delivery systems. Mrs. Valerie Beversdorf provided us with a map showing the extent of the two ditches within the limits of Hatch. In addition, maps showing past ownership rights to individual segments of the two acequias were reviewed and photographed. A site update form was filled out for the two previously recorded irrigation canals. Also, those components of Rodey Lateral that were in close proximity to the project area were documented and photographed. A cross-sectional drawing of each of the two irrigation ditches was also made in the field.

SURVEY RESULTS

The archeological survey of the proposed dam and flood pool led to the documentation of four new sites and the records for two previously recorded sites – the Rodey Lateral (LA 120285) and Colorado Spur Drain (LA 120284) – were updated. Two of the newly recorded sites, LA 152983 and LA 152984, are historical trash dumps, and two are prehistoric, LA 152981 and LA 152982. Nine isolated occurrences (IOs) were also found, primarily in the southern-southeastern and northern portion of the project area.

LA 152981 (OCA/UNM 892-1)

LA 152981 is a low-density sherd and lithic artifact scatter dispersed over a wide area of open floodplain (Figure 3). Diagnostic ceramics indicate that the site is affiliated with the Jornada Mogollon and probably dates to the Doña Ana (Late Mesilla) or El Paso phase (AD 1100–1400). The site measures 160 m by 35 m with its long axis running southwest to northeast. It is located near the western boundary of the flood pool in an area of soft alluvial sediments. Local vegetation consists primarily of mesquite sometimes mixed with creosotes, with occasional cedar bush and prickly pear cactus. Clusters of tamarisks extend along the southern boundary of the site. A narrow 2-track road cuts through the site roughly in a north-south direction, causing localized disturbance, and the site area has been trampled by grazing cattle.

Forty-five surface artifacts, 34 lithic artifacts and 11 sherds, were analyzed in the field. Three additional redware sherds and one possible flake fragment were recovered from test excavations. The lithic assemblage (Table 3) consists primarily of debitage (23 flakes and 3 angular debris fragments) but also includes 3 irregular cores, 1 scraper/adze (Figure 4a), 2 choppers (Figure 4b), 1 utilized core fragment, 1 retouched flake, and a one-hand mano. The most common lithic raw materials are basalt (*n*=11), gray and lavender chert (*n*=11), fine grain rhyolite (*n*=6). Chalcedony, granite, and andesite were also found in small quantities.

The large number of complete flakes, high percentage of dorsal cortex, rudimentary platform preparation, and unpatterned core reduction all suggest that core reduction was directed toward the production of flakes for use as expedient tools. This lithic reduction strategy is typical of Formative period sites. The tools were produced with minimal shaping of the use edge. The tool forms, particularly the scraper/adze and choppers, suggest heavy use for digging or wood working, behaviors expected at agricultural field locations where wooden agricultural implements would need to be refurbished periodically during use.

The ceramic assemblage from LA 152981 consists of 14 sherds (Table 4). Based on differences in ware/type and vessel form, at least five vessels are represented – four jars and one bowl. The predominance of jars and relatively small number of vessels suggests that LA 152981 might have been a field location, and that the vessels were used by farmers to carry food or water during periodic day-long visits to the site.

The only temporally diagnostic ceramics are one Chupadero Black-on-white jar body sherd and one El Paso Plain Brown jar rim sherd. The Chupadero Black-on-white sherd had a hard gray paste with the exterior surface polished and painted black-on-white, while the interior was scored and unfinished (Mera 1931). The El Paso Plain Brown rim sherd had a light brown paste tempered with sand. The rim top was slightly curving outward, indicating possible Late Mesilla to El Paso phase vessel morphology (Seaman and Mills 1988:180, Figure 13.8).

The remaining 12 sherds are of fragmentary nature and could only be classified by ware. The seven redware sherds might be San Francisco Red or Playas Red type, but all of the sherds from LA 152981 have somewhat eroded surfaces which precludes typological designation. The three redware sherds inspected at the OCA laboratory were all tempered with river sand. All redware jar sherds had their slip applied on the exterior surface of the vessel, while the single bowl sherd fragment was slipped red on the interior surface.

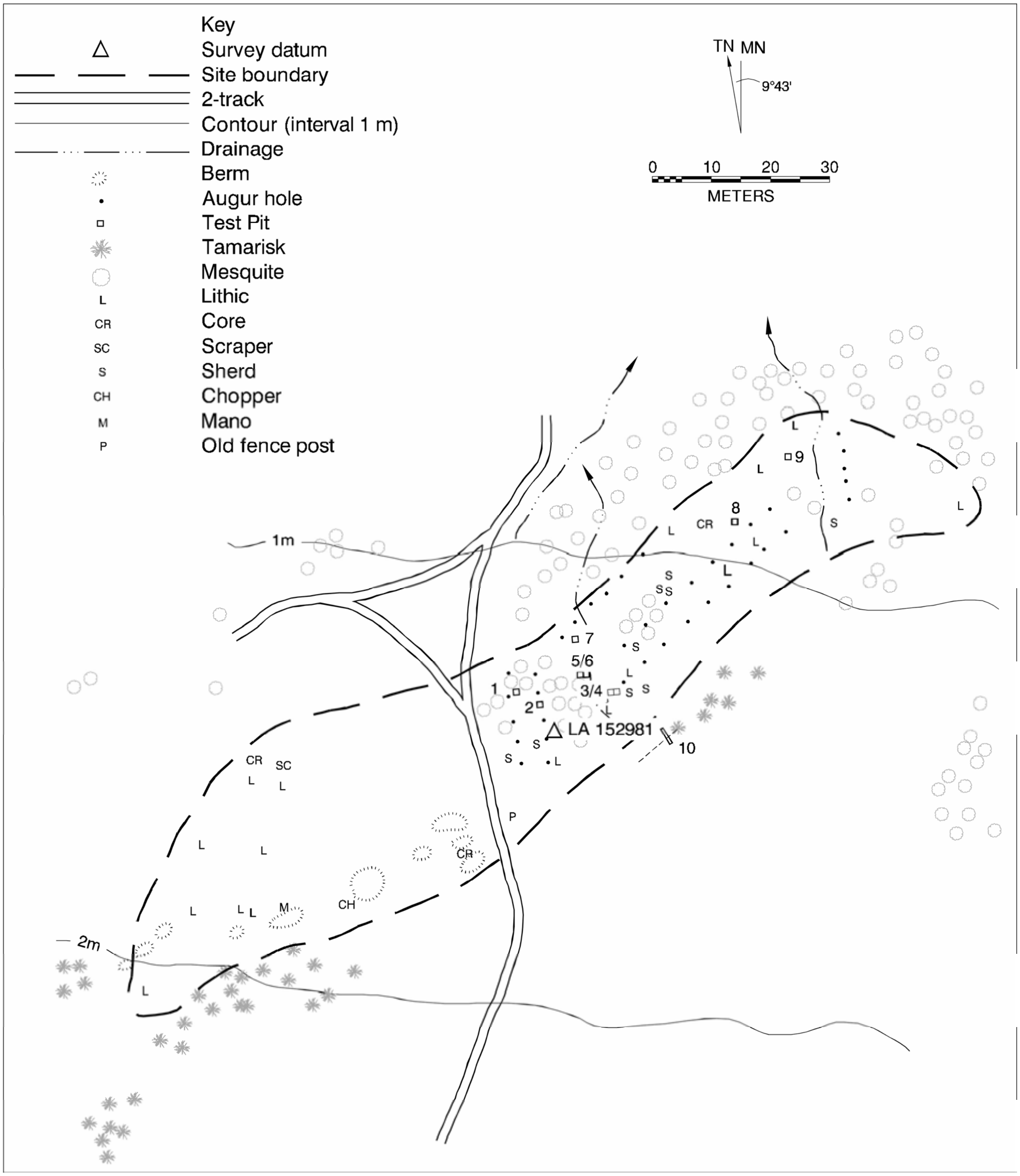


Figure 3 Map of LA 152981.

Three of the unspecific brownware sherds have smoothed exterior surfaces, indicating they are from jars. These sherds may be from an El Paso Plain Brown vessel, although this assessment cannot be made without the presence of rim. The fourth unspecific brownware sherd might be Three Rivers Corrugated given its orange-brown exterior paste color, and what may be corrugations on its exterior surface. The origin of the single plain gray ceramic is unclear. This sherd has a light gray paste color with a slightly polished exterior and smooth interior surface.

Table 3 Lithic artifacts analyzed in the field at LA 152981 (All dimensions in millimeters).

LITHIC TYPE	CONDITION	MATERIAL	CORTEX	LENGTH	WIDTH	THICK	PLATFORM
Flake	Complete	Rhyolite, fine grain	10%	47	33	12	Single facet
Flake	Complete	Chert, gray	30%	47	45	16	Single facet
Flake	Lateral	Chalcedony, black & red	0	28	-	7	Collapsed
Flake	Complete	Rhyolite, fine grain	0	22	15	2	Collapsed
Utilized Core Fragment	Complete	Rhyolite, fine grain	20%	81	74	43	
Flake	Proximal	Rhyolite, fine grain	0	-	43	13	Collapsed
Flake	Proximal	Chert, lavender	0	-	6	1	Single facet
Angular Debris	Unknown	Andesite	0	-	-	25	
Flake	Complete	Chert, purple	40%	28	32	6	Single facet
Scraper	Complete	Chert, purple	0	55	41	20	
Flake	Lateral	Basalt	0	-	30	13	Single facet
Mano, One-Hand	Complete	Granite	100%	110	90	45	
Flake	Complete	Basalt	0	17	32	6	Cortical
Core, Irregular	Complete	Chert, lavender	40%	40	36	29	
Angular Debris	Unknown	Chert, lavender	0	-	-	17	
Flake	Complete	Basalt	90%	26	33	14	Collapsed
Chopper, Unifacial	Complete	Basalt	30%	120	110	50	
Flake	Complete	Basalt	0	22	17	4	Single facet
Flake	Distal	Basalt	40%	-	24	13	
Flake, Retouched	Complete	Chert, lavender	20%	57	46	39	Retouched
Angular Debris	Unknown	Chalcedony, clear	40%	-	-	15	
Flake	Complete	Basalt	100%	43	56	15	Cortical
Core, Irregular	Complete	Rhyolite, fine grain	20%	40	35	30	
Flake	Complete	Chert, gray	20%	29	21	7	Cortical
Flake	Complete	Basalt	0	48	33	10	Multi-facet
Flake	Complete	Chert, lavender	10%	43	41	23	Collapsed
Flake	Complete	Basalt	40%	50	31	8	Single facet
Flake	Proximal	Chert, purple	60%	-	41	17	Single facet/ground
Flake	Distal	Silicified wood	70%	-	42	19	
Flake	Complete	Chert, purple	20%	50	44	8	Single facet
Flake	Proximal	Chalcedony, clear	0	-	11	2	Single facet
Core, Irregular	Complete	Basalt	40%	92	74	36	
Flake	Medical	Basalt, vesicular	0	-	-	5	
Flake	Complete	Rhyolite, fine grain	60%	38	31	12	Single facet

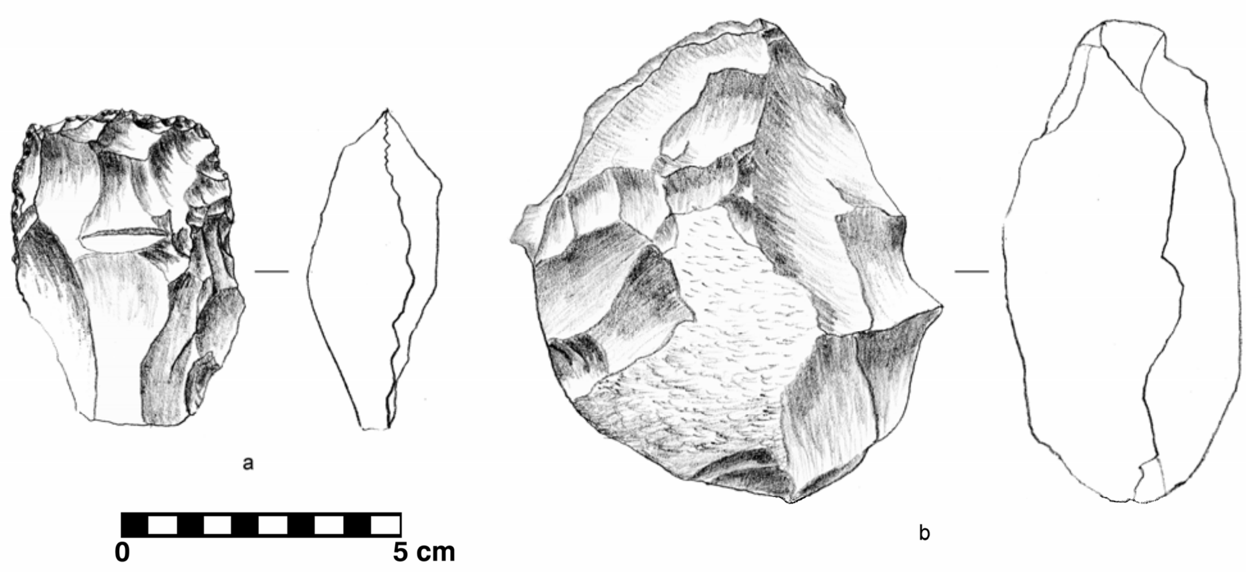


Figure 4 Lithic tools found on surface of LA 152981: (a) scraper, (b) bifacial chopper.

Table 4 Ceramics from surface and excavated test pits at LA 152981.

Ceramic Type	Vessel Form	Context	Count
Unknown redware	Jar	Surface	4
		Test Pit 3	2
	bowl	Test Pit 2	1
Chupadero Black-on-white	Jar	Surface	1
El Paso Plain Brown rim	Jar	Surface	1
Unspecific brownware	Jar	Surface	4
Plain Gray	Jar	Surface	1
Total			14

Auger Tests

Limited test excavations were completed at LA 152981 to determine if subsurface cultural deposits or buried features were present. Only the eastern half of the site, the area east of the two-track road, falls within the flood pool and could be impacted by the proposed undertaking. Consequently, testing was limited to that part of the site.

Auger test pits were used for the initial phase of testing to determine the site stratigraphy and to probe for buried features. The soil augers used for these tests were 170 cm-long augers with 15 cm-long buckets. Auger holes were bored in 15 cm deep increments, and the sediment in the bucket was screened through a 1/8" mesh hardware cloth. Thirty-nine auger tests were dug in six transects (Figure 3). Two parallel north-south transects were positioned 5 m apart in the central part of the site, and two other parallel transects were run southwest to northeast through the major artifact concentration. The fifth transect was placed along the northern site boundary, and the sixth was positioned near the eastern site boundary. Individual auger holes in each transect were spaced 3–5 m apart.

A possible flake fragment of gray siltstone was found in one of the early auger tests bored east of the two-track road at a depth of 70 cm below modern ground surface. Consequently, all but four of the tests were taken down to at least that depth (Table 5). Stage 1 carbonate development was observed in sediments starting about 10–20 cm below the ground surface in auger holes near the two-track road and extending to depths of 45–50 cm in the auger holes further to the east. One or two soil horizons were noted beneath the calcium carbonate horizon at depths of 30–60 cm. A thick layer of sand was encountered below these horizons at depths of 45–60 cm and extending to 150–160 cm in some of the deeper auger holes bored near the two-track road. This massive sandy stratum probably reflects an old flood episode that took place in the region well before the occupation of LA 152981. Except for the possible flake fragment, no artifacts were found in the matrix removed from auger holes, and no charcoal/ash stained sediments or other cultural deposits were observed in the tests.

Table 5 Data showing depth of each auger hole excavated in the eastern half of the site. Boring with augers ended upon the encounter of a thick sand lens.

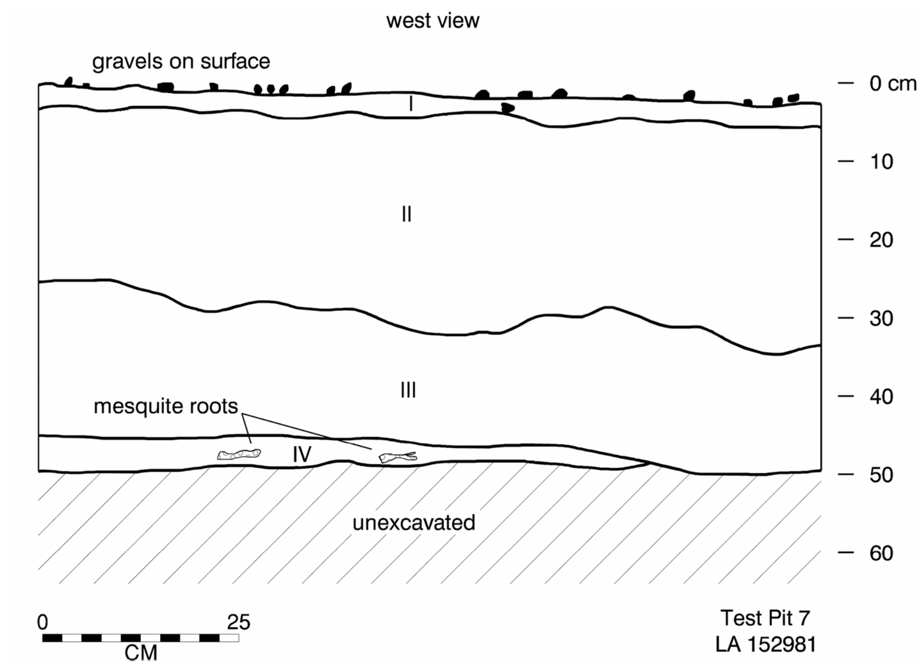
Auger Hole Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
End depth (cm)	170	150	150	150	135	165	135	145	80	100	110	90	100
Auger Hole Number	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
End depth (cm)	100	95	120	90	105	105	105	120	90	105	90	90	90
Auger Hole Number	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
End Depth (cm)	90	105	90	85	40	75	45	100	105	60	90	65	70

Test Pits

Although auger testing is an efficient method for locating buried features, it is not effective in determining if subsurface artifacts are present. Nine 1 x 1 m test pits were therefore excavated to supplement the auger tests. Since no discrete artifact concentrations were discernable at the site, the test pits (TP) were excavated in areas where there appeared to be some clustering of materials (Figure 3). The test pits were dug to a depth of 30–50 cm, with at least one 10 cm excavated into the calcium carbonate horizon. All sediments excavated from these pits was screened through 1/8 in hardware cloth.

Test Pit 1 was positioned adjacent to the auger test from which a possible flake fragment was recovered from 70 cm below ground surface. Excavation of this test pit indicated that root penetration from a nearby mesquite had churned the sediments, which suggests that the artifact had been displaced downward by bioturbation. Test Pit 2 was placed about 8 m east of the 2-track and 4 m northwest of the site datum. This area had a diffuse surface scatter of sherds and flakes. Test Pit 3 was placed within a light scatter of surface artifacts about 10 m northeast of the datum. The surface sediments in these test pits consisted of a 5–10 cm thick layer of poorly consolidated light brown loam to sandy loam with no visible structure. Three artifacts were recovered from this stratum, one sherd from TP 2 and two sherds from TP 3. The loose surface sediments overlay a consolidated sandy loam with blocky structure that exhibited the initial stage of $CaCO_3$ development. Excavation of an additional 10 cm level into this matrix revealed an increase in calcium carbonates formation but no additional artifacts were recovered. As no charcoal or other cultural material was found, the excavation in these units was halted, and the pits were backfilled. Additional units (TP 4–6) were excavated near TP 2 and TP 3 to further probe the area. The units were excavated into the caliche layer but no artifacts or features were found.

Test pits 7, 8, and 9 were excavated the more eastern portions of the site. Although the calcium carbonate layer in these units was encountered in the deeper levels (30–50 cm below ground surface), no additional artifacts were recovered, and no subsurface features were observed. Test Pit 7 was the deepest 1 x 1 m unit excavated at LA 152981 and it best illustrates the site stratigraphy (Figure 5).



I (0-4cm)	Unconsolidated pale brown sandy loam of no structure, contains artifatcs, small gravels and decomposing organic matter, rests on top of Stratum II with an abrupt boundary.
II (4-25cm)	Consolidated brown sandy loam of blocky structure, peds are weakly developed and range from 1-2cm in diameter, visible redding of the soil, boundary between II and III is gradual.
III (25-45cm)	Well consolidated loam of pronounced blocky structure, peds range from 2-4cm in diameter, contains fine roots and rootlets, rests on top of Stratum IV with a clear boundary
IV (45cm-?)	Compacted dark brown clay loam of pronounced blocky structure, peds range from 3-5cm in diameter, Stage I calcium-carbonate development, this is the root zone for mesquite bushes.

Figure 5 West wall profile drawing of Test Pit 7 showing soil stratigraphy at LA 152981.

The upper 4 cm of sediments in TP 7 is Stratum I, an unconsolidated pale brown sandy loam of no structure. This weakly developed A horizon is the matrix from which artifacts were recovered elsewhere at the site. Small, pebble-size gravel, decomposing organic matter and modern trash are mixed within this horizon. Stratum I is separated from the underlying Stratum II by an abrupt boundary. Stratum II is a consolidated brown sandy loam with a blocky structure. The sediments have weakly developed peds, ranging from 1 to 2 cm in diameter. The stratum is visibly reddened and extends to a depth of up to 25 cm of depth where a gradual boundary separates it from Stratum III, a well consolidated loam with a pronounced blocky structure. Individual soil peds in this stratum range from 2 to 4 cm in diameter and are intermixed with fine roots and rootlets. This older B horizon extends to a depth of up to 45 cm below modern ground surface, and there is a clear boundary separating it from the underlying Stratum IV. Stratum IV is a compact, dark brown clay loam with a pronounced blocky structure; the peds range from 3 to 5 cm in diameter. An initial (Stage I) calcium carbonate development is observable in this unit and gradually develops into Stage I+ with increasing depth. This is the main root zone for the local vegetation. Excavation of TP 7 ceased at the caliche layer but nearby auger tests indicate that Stratum IV extends to a depth of 45 to 60 cm and overlies Stratum V, the massive sand stratum already described as the basal unit found in the auger tests.

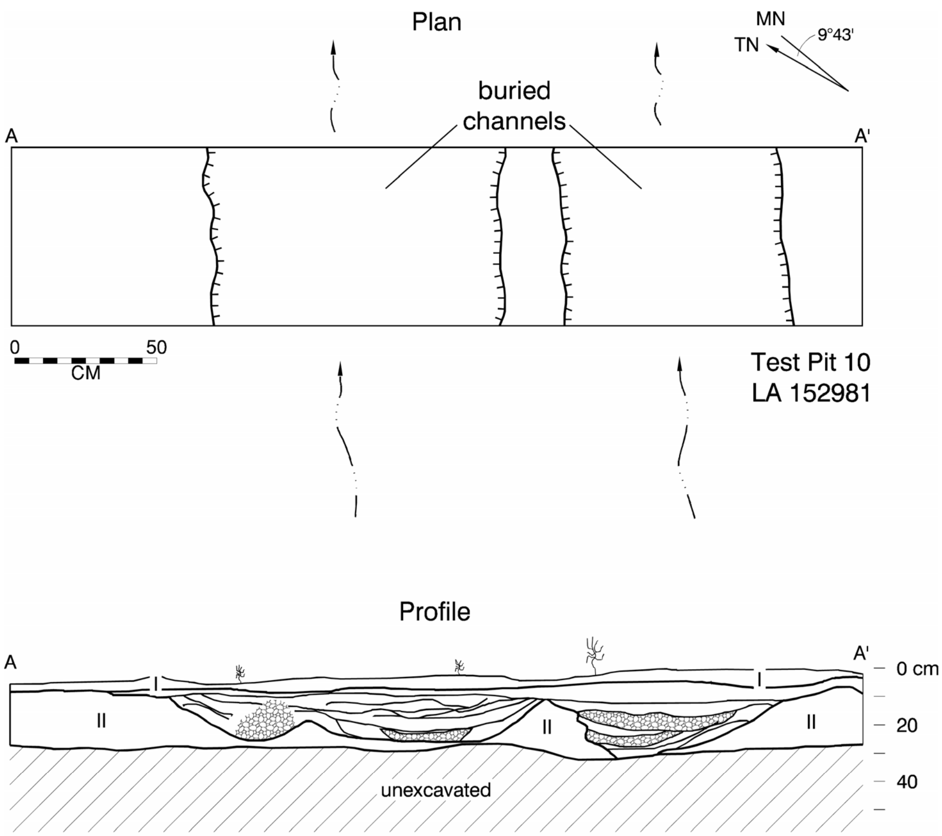
The occurrence of clusters of tamarisk in a southwest-to-northeast alignment suggested the possible presence of a buried channel running along the southeastern edge of the site. TP 10, a trench 3 m long and 50 cm wide, was dug perpendicular to the tamarisk alignment to test that hypothesis. As shown in Figure 6, a shallow braided channel was uncovered about 5 cm below modern ground surface. The channel segments are no more than 15 cm deep, and are filled with laminated sands. During heavy rainfall, runoff in the channel would flow naturally into the area of LA 152981 or could have been intentionally diverted (Figure 7). In either case, the presence of the channel marks the site as a potential location for an agricultural field.

Summary and Eligibility Recommendation

LA 152981 is a sparse and discontinuous sherd and lithic scatter situated on the floodplain at the western edge of the proposed flood pool. The site setting, small number and dispersed distribution of the artifacts, limited variety of lithic tool types, and the nature of the ceramic assemblage all suggest that the site was most likely a prehistoric farm field cultivated by Jornada Mogollon farmers sometime between AD 1100 and 1400. No evidence of subsurface cultural deposits or features was found in the 39 auger holes and 10 test pits excavated at the site, which suggests that the scatter is probably surficial. These negative results are consistent with the soil development observed at the site, which indicates that the floodplain surface has been stable for at least several hundred years. The site therefore appears to have limited information potential. Since basic data relevant to the significant research issues currently identified for the Formative occupation of south-central New Mexico were collected from the site as part of the survey documentation and subsurface testing effort, LA 152981 does not appear eligible for nomination to the National Register of Historic Places.

LA 152982 (OCA/UNM 892-2)

LA 152982 consists of two rock features and a lithic scatter located on a low gravel knoll in the southern portion of the project area. No diagnostic artifacts were found at the site, so its age and cultural affiliation are uncertain. Based on the extent of artifacts, the site measures 30 m by 15 m with its long axis running in a southwest-northeast direction. Natural cobbles and gravels cover the entire site surface and most of the adjoining ridge. The gravel deposit is part of a substantial Pleistocene formation, which extends to the south. The site overlooks a broad flood plain valley to the north and east. Vegetation in the site area consists of a moderate cover of creosote mixed with some mesquite.



I Unconsolidated pale brown sandy loam of no structure, contains artifacts, small gravels and decomposing organic matter, rests on top of Stratum II with an abrupt boundary.

II Consolidated brown sandy loam of blocky structure, peds are weakly developed and range from 1-2 cm in diameter, visible redding of soil, boundary between II and III is gradual.

Gravels

Laminations

Figure 6 Plan view and profile of a buried channel discovered based on the alignment of tramarisk trees immediately south of LA 152981.

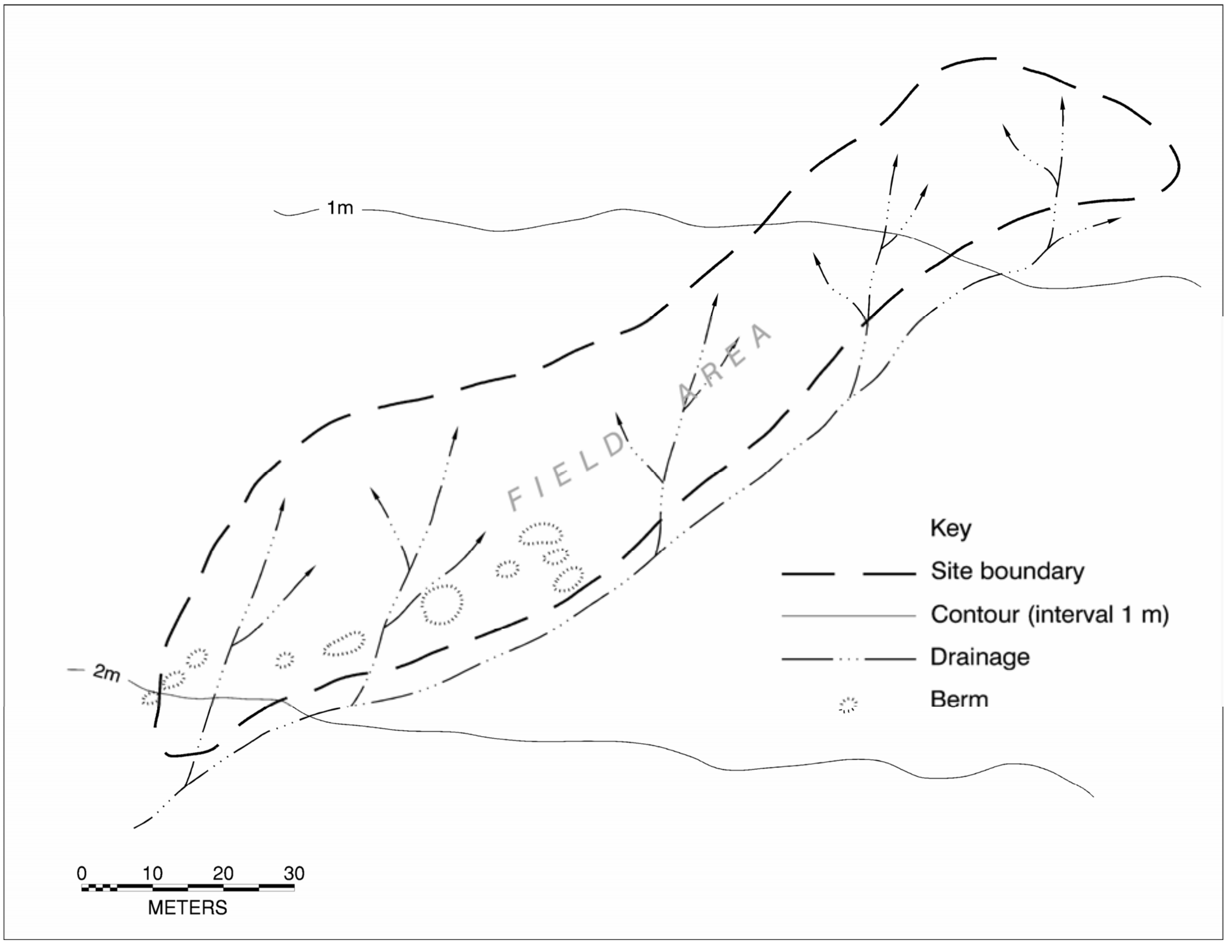


Figure 7 Stylized drawing of model showing possible use of floodplain for farming. Water from channel buried under modern sediment may have been diverted into inferred field area.

The two rock features are located roughly in the central part of the site (Figure 8). Feature 1 was first noted as an 80 cm deep, 2.5 m by 3.5 m pit dug into the top of the knoll (Figure 9). A 4-m long rock alignment is visible in the southwestern wall of this pit, and facing of the pit wall along this alignment suggests that it was intentionally left *in situ*. The northwestern end of the rock alignment makes a 90° angle to the northeast, which suggests that the pit may have been dug into the cobble foundation of a surface structure. Backdirt from the excavation is scattered around the perimeter of the pit, making it difficult to determine the size and shape of the structure. The backdirt consists primarily of natural cobbles and gravels, and what may be the screened sediment matrix. Three lithic artifact were found in this backdirt on the eastern edge of the pit, and there was one flake in the northwestern wall of the pit, about 10 cm below modern ground surface that appeared in place. These artifacts provide tenuous evidence that Feature 1 dates to the prehistoric period. If Feature 1 is the remanant of a masonry surface room, then excavation of the pit has removed the bulk of any cultural fill that may once have been present. Only a small shelf of what may be intact fill remains along the northern pit wall.

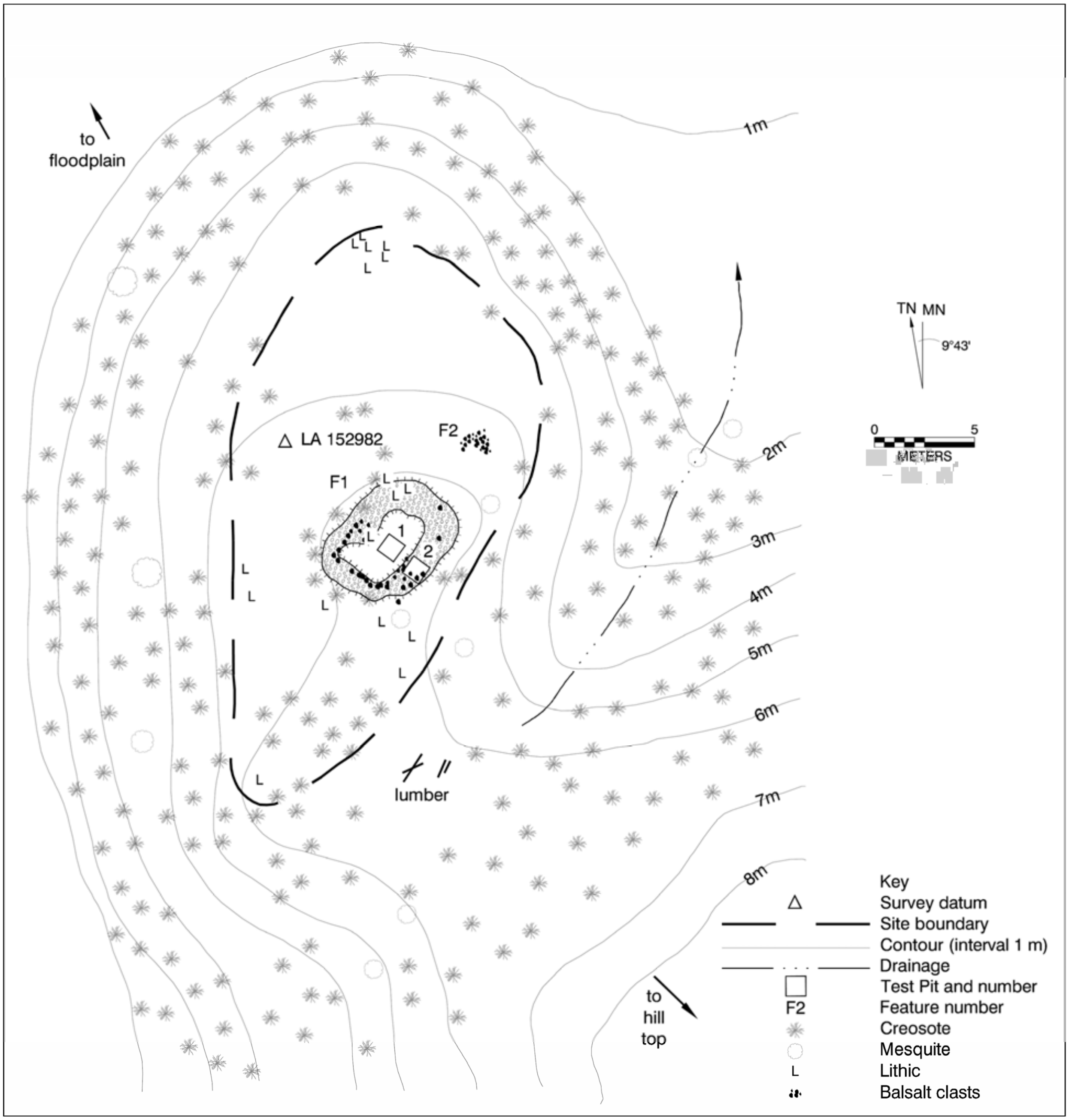


Figure 8 Map of site LA 152982 showing location of two rock features and extent of disturbance.

Feature 2 is located about four meters northeast of Feature 1. It consists of a concentration of natural basalt clasts of about 1.5 m in diameter. At least 45 rocks constitute the feature extent of which some are stacked on top of each other. None of the rocks are buried in the sediment. It seems that the original feature was a rock wall, which stood low to the ground, perhaps 30 to 40 cm tall. The wall was no more than 1.2 m long and was aligned in a southeast-northwest direction. The feature is located in the northeastern part of the site with a good view of the entire floodplain to the north. It is possible that the rock wall served as an ephemeral hunting blind or windbreak. A rusted lid from an old lantern is within the southern limits of the feature and probably is of modern age. It is possible that the hunting blind was used in the past two or three decades as modern shell casings are scattered near the feature and throughout the entire gravel terrace.

Figure 9 LA 152982 site overview with large pit excavated inside Feature 1, view looking west.

The surface artifact assemblage from the site consisted of 21 lithic artifacts, all of which were analyzed in the field (Table 6). The assemblage consists largely of core flakes (*n*=17), but also includes two retouched flakes, one irregular core, and one angular debris fragment. About two-thirds of the flakes have little or no dorsal cortex, and one third of the flakes have cortex covering 50% or more of their dorsal surfaces. This patterning is consistent with non-intensive reduction of cobble or nodular cores. Cherts (*n*=11) of lavender, green, tan, gray, and brown color are the most common material types, followed by fine grain rhyolite (*n*=6), chalcedony (*n*=3), and basalt (*n*=1). Most of these raw materials can be found locally in the Pleistocene gravel deposits outcropping on the ridge. In fact, there is an extensive, diffuse scatter of flakes, tested nodules, and cores covering the surface of the ridge outside of the project area. This scatter indicates that the ridge was utilized as a lithic procurement area by local aboriginal groups. It also raises the possibility that the lithic artifacts at LA 152982 might not be directly associated with the rock features.

Table 6 Lithic artifacts analyzed in the field at LA 152982 (All dimensions in millimeters).

LITHIC TYPE	CONDITION	MATERIAL	CORTEX	LENGTH	WIDTH	THICK	PLATFORM
Flake	Complete	Chert, lavender	10%	34	32	10	Single facet
Flake, Retouched	Complete	Chert, green/purple	0	34	41	10	Multi-facet
Flake	Lateral	Chalcedony, black inclusive	0	40	-	4	Single facet
Flake	Complete	Chert, lavender	0	32	38	12	Single facet
Flake, Retouched	Distal	Chalcedony, black inclusive	0	-	46	14	
Flake	Distal	Chalcedony, opaque	0	-	16	1	
Flake	Complete	Chert, lavender	80%	44	31	5	Multi-facet
Flake	Distal	Chert, tan	0	-	41	-	Retouched
Flake	Complete	Rhyolite, fine grain	0	51	27	18	Single facet
Flake	Complete	Chert, green/purple	0	28	22	10	Single facet
Core, Irregular	Complete	Rhyolite, fine grain	10%	95	45	45	
Flake	Complete	Chert, brown	0	18	10	6	Single facet
Flake	Complete	Chert, gray	80%	42	50	14	Single facet
Angular Debris	Unknown	Chert, brown	10%			15	
Flake	Distal	Chert, brown	0	-	15	4	
Flake	Complete	Rhyolite, fine grain	100%	26	38	12	Cortical
Flake	Complete	Basalt	10%	36	33	8	Cortical
Flake	Complete	Rhyolite, fine grain	50%	42	33	7	Single facet
Flake	Complete	Rhyolite, fine grain	100%	33	41	9	Single facet
Flake	Complete	Chert, gray	0	46	31	7	Single facet
Flake	Complete	Rhyolite, fine grain	100%	56	27	11	Single facet

Test Pits

Two test pits were excavated in Feature 1 to determine if the rock alignments exposed in the pit were remnants of a surface structure, and if possible to determine the age and cultural affiliation of the feature. Test Pit 1 was placed in the center the pit to determine if there were any remnants of a structure floor. Although the bottom of the pit is below the suspected foundation alignments, semi-subterranean surface rooms have been documented at early Mogollon sites (e.g., Schutt et al. 1994). Up to 25 cm of soft sediments were removed from TP 1. In profile, these sediments exhibited thin laminations, indicating that they had been washed into the pit during periodic rainstorms. Two possible flakes were recovered from these sediments but, because deposition of the sediments postdates excavation of the pit, they are clearly in a secondary context. The laminated sediment overlay a gravel deposit in the bottom of the pit. The presence of caliche coating on all sides of the cobbles indicated that the gravels were in place and that they predate any human occupation of the site area. No evidence of floor level was noted during the excavation of TP 1, and it appears that the large pit was dug through any floor that may once have been present.

Test Pit 2, was placed in the southeastern part of the Feature 1 to determine if an unexcavated wall segment was present at that location. The sediments in TP 2 consisted of brown sandy loam mixed with a large volume of pebbles and cobbles with maximum dimensions ranging from 3–40 cm. Nine lithic artifacts, some of which may be natural, and an unburned left jackrabbit pelvis bone were recovered from these sediments. After removing about 16 to 18 cm of sediments, a flat platform was uncovered in the northern part of TP2. In the southern part of the test pit, a rock alignment was exposed running in a southwest-northeast direction, parallel to the feature's suspected northwestern wall alignment. The exposed alignment consists of two parallel lines of basalt clasts roughly 15 cm apart. The space between these alignments was filled with additional rocks and sediment (Figure 10). Small basalt elements and gravels were also noticed in spaces between the large "wall" rocks, indicating their possible function as chinking material. No vertical stacking of rock was observed on the exposed alignment, yet, all rocks were found resting on the flat platform exposed to the northwest. Based on the evidence from TP 2, it appears that Feature 1 is probably the foundation of a rectangular surface room measuring roughly 4 by 5 m, with its long axis running in a southwest-northeast direction.

Summary and Eligibility Recommendations

Our best guess is that Feature 1 at LA 152982 is the masonry foundation of a surface structure. From the architectural details revealed by our limited test excavations, it most likely dates to the Formative period. The dearth of artifacts, absence of any ceramics, and lack of any culturally stained sediments seems inconsistent with this interpretation, however, and there is some question about whether the lithic artifacts found at the site are associated with the structure or with the widespread lithic procurement activities evident in the general vicinity of the site. Assuming that the structure is prehistoric, then the most likely explanation for the dearth of cultural debris is that the structure served as a field shelter used sporadically by farmers working in agricultural plots in the nearby floodplain. We cannot categorically rule out the possibility that the structure was built during the historical period, however. In any case, the structure appears to have been excavated, probably by pothunters, which has destroyed any information potential the feature might once have had. As Feature 2 appears modern, and basic information about the lithic assemblage was collected as part of the site documentation process, LA 152982 is not recommended as eligible for nomination to the National Register of Historic Places.

Figure 10 Possible 50 cm-thick rock wall exposed in the southern portion of Test Pit 2 within Feature 1.

LA 152983 (OCA/UNM 892-3)

This site is a historical artifact scatter representing a probable trash damp covering of an area of 80 by 50 m (Figure 11). Diagnostic artifacts found on the site surface suggest the scatter dates to the New Mexico Statehood-World War II period (AD 1912–1945). The site is located at the base of a steep-sloping gravel ridge to the south-southeast with open floodplain extending to the north and northwest. Local vegetation consists of low-to-the-ground mesquite bushes growing in the flat areas and creosotes covering the steep slopes of the ridge to the south. The area north of the site is relatively flat with soft alluvial sediments and little or no vegetation. A cluster of tamarisk trees is visible about 90 m northwest of the site. Occasional prickly pear cactus and cedar brush grow at isolated instances.

No cultural features were found in association with the historic artifacts but a very dense artifact concentration is located roughly in the west-central part of the site, and there is a 2 m diameter clinker pile mixed with charcoal just north of the artifact concentration (Figure 12). The artifact concentration covers an 18 by 7 m area, and consists of over a thousand fragments of glass and metal. Other debris including fragments of historical china, car parts, stove parts, corrugated tin sheets for roofing, 2 x 4" boards, and chicken wire are scattered throughout the limits of the site. Diagnostics (Figure 13) include the attached letters "AB" (AD 1905–1916) embossed on the base of a clear soda bottle fragment; an "O" within a square (AD 1911–1919) embossed on the bottom of a small clear glass jar (probably used to hold medicine); and "I" within a diamond (AD 1916–1929) embossed on the bottom of a clear liquor bottle,

Figure 11 LA 152983 overview with historic artifacts scattered on the surface, view looking southwest.

and “Ficaro Chemical Co., Dallas Texas” (unknown date) embossed on a clear bottle base. A perforated metal tag embossed with “FRANCE” was also found within the artifact concentration. This item may have been attached to a French wine or champagne bottle. The range of artifacts (Table 7) indicates that the area was used for trash dumping, and the overall artifact distribution indicates that there were several dumping episodes.

LA 152983 has a very limited potential to yield information relevant to significant historical issues relating to the Statehood-World War II period in New Mexico. The scatter is surficial and, given the limited range of materials present, the information recorded during the survey is adequate to characterize the assemblage. For these reasons, LA 152983 is not recommended as eligible for the inclusion in the National Register of Historic Places.

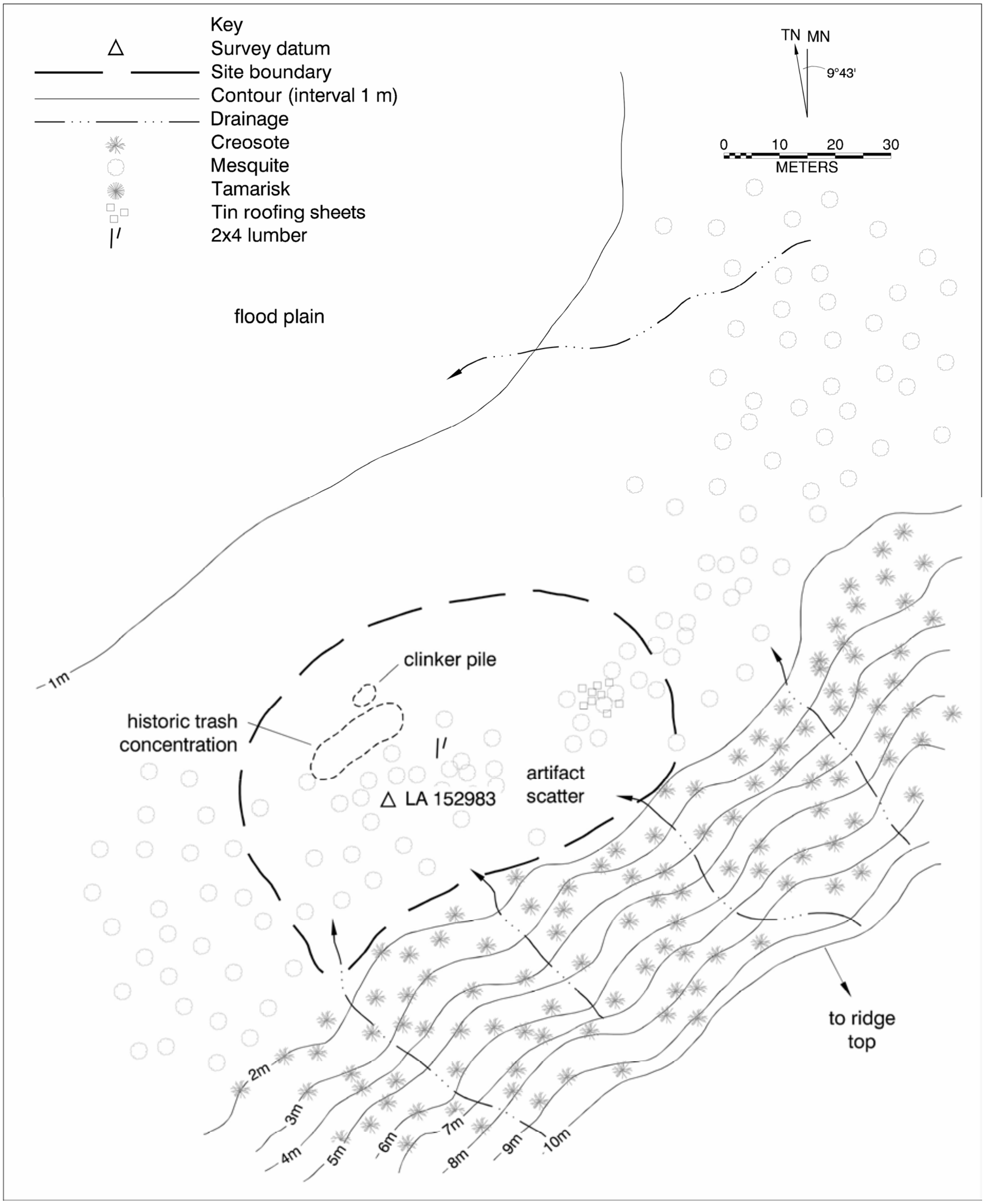


Figure 12 Map of LA 152983.

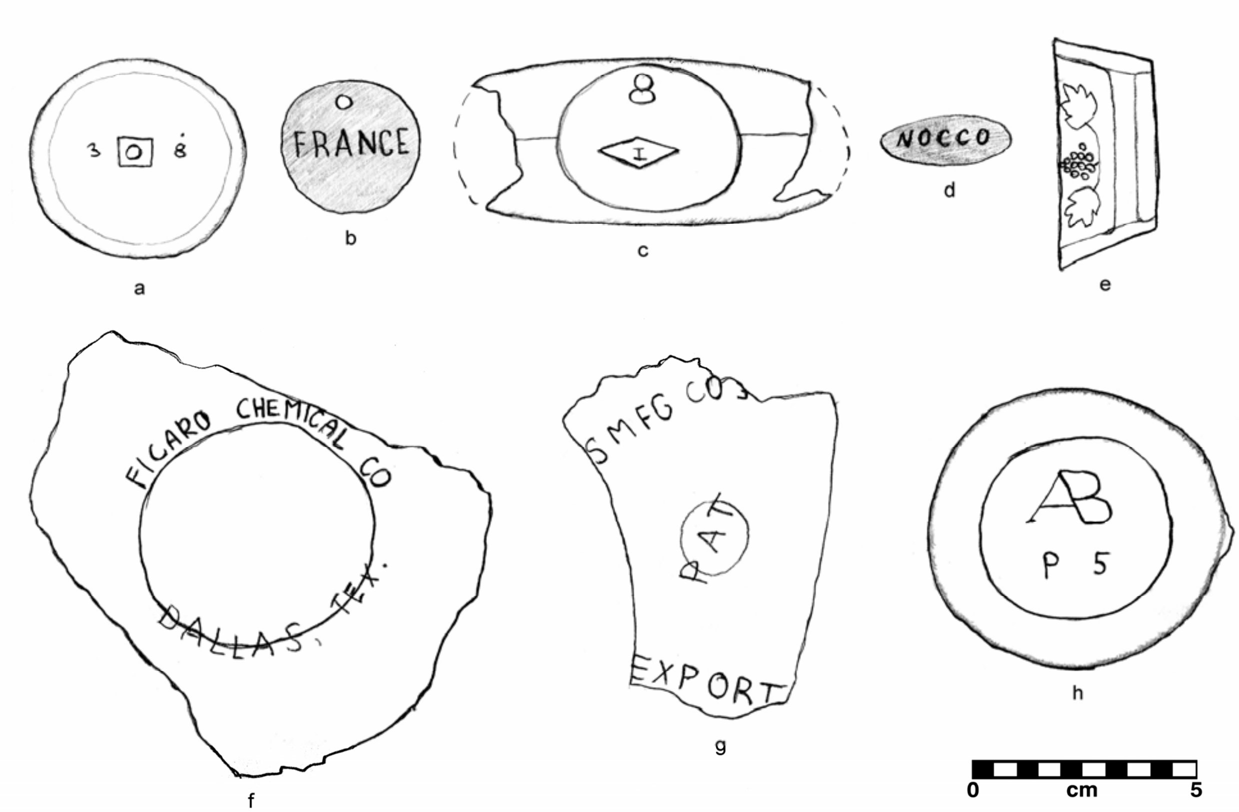


Figure 13 Embossed glass and metal artifacts found on surface of LA 152983: (a) “O in a square” mark on the base of an Owens Bottle Company bottle base, (b) perforated metal tag embossed with “FRANCE”, (c) “I within a diamond” mark on the base of an Illinois Glass Company liquor bottle, (d) “NOCCO” mark on the base of a sanitary can, (e) sideway sketch of a shallow purple glass container (base is on the left side), (f) “Ficaro Chemical Col, Dallas, Tex” mark embossed on the base of a clear bottle, possibly used for milk, (g) clear bottle base probably from a Kerr Glass Manufacturing Company, (h) “AB (letters attached)” dipthong embossed on an aqua glass base of American Bottle Company soda bottle.

LA 152984 (OCA/UNM 892-4)

LA 152984 consists of three proveniences, each representing a discrete historical trash dump, encompassed by an oval site area measuring 60 by 45 m (Figure 14). Diagnostic glass and metal artifacts suggest the site dates to the New Mexico Statehood-World War II period (AD 1912–1945). All three proveniences are situated in a broad, northwest-trending arroyo. One of the smaller segments of this arroyo clips the western boundary of the site while another one cuts through its northeastern portion. The northeastern edge of the site borders with a 2.5 m tall erosion control berm, which runs in a southeast-northwest direction. A private house residence is located behind the earthen berm. The site area is on a low gravel bar covered with creosotes and mesquite bushes. A pronounced Pleistocene gravel ridge, located about 90 m to the west, is the highest geographical feature in the vicinity of LA 152984 (Figure 15).

Table 7 Historic artifacts and other material recorded at LA 152983.

Count	Item
100s	Unknown metal fragments
1	Metal pail (shot with shotgun)
2	Chicken wire
1	1 clinker pile (2 m diameter)
1	Wine jug (2 m in diameter)
1	Mobil Oils can, smashed
20+	Plain white china/ceramic: plate and mug fragment
	Crockery fragments
1	½ bottle base: ketchup
10+	3-hinge tobacco tins
10+	Lard budkets
25	Sanitary food cans (opened with can opener)
1000+	Glass: clear, purple, green, aqua, milk, cobalt
10	Match-stick vent hole cans (condensed milk)
100+	Barrel hoops
10+	Bottle bases
7	Tin roofing
1	"AB Dipthong" embossing on an aqua
1	"I in a diamond" embossing on an aqua bottle base
1	"O in a square" embossing on a clear bottle base

Measuring 30 by 10 m, Provenience 1 is located in the northwestern portion of the site and covers the largest area of the three proveniences. Hundreds of metal, glass, ceramic, charcoal and clinker fragments are scattered throughout this area. Diagnostic items (Figure 16a, b, c, d, f, g) include lard buckets, AB Co. bottle base (AD 1905–1916), a "T" in an inverted triangle (AD 1905–1930) embossed on a clear soda (?) bottle base, milk bottle mouth, aqua glass bottle base with the pawn chess piece logo (AD 1918–1938) of the Capstan Glass Co., and numerous fragments of clear, green, purple, aqua and brown bottle glass.

Provenience 2 is positioned on a southwest-facing slope of the erosion control berm, about 12 m east of Provenience 1. This 10 m-wide locus has a considerably lower artifact density than that of Provenience 1. The total amount of artifacts is 100 to 150. Diagnostics in this provenience include: an aqua glass bottle with blake-shaped base and the "O" in a square embossing (AD 1911–1919) of the Owens Bottle Company, and a clear glass polygonal bottle base with Hazel Atlas Company logo (AD 1923–1964) (Figure 16e, i, l).

Provenience 3 is located about 30 m south of Provenience 2. Artifacts from this locus are scattered over the low gravel bar in an area of 12 by 8 m. Several hundred fragments of glass and metal are scattered throughout Provenience 3. Diagnostics from this locus include a clear glass bottle base (probably for milk) with "Kerr Glass" Pat. Aug 31 1915/Sand Springs Okla" embossing, terracotta ware sherds, dark blue stone ware, aqua glass soda bottle base with "VICTORY BOTTLING WORKS EL PASO, TEXAS" (AD 1923–1931) embossing on the side and "M.Q." embossing on the base (Figure 16h, j, k, l).

A wealth of information is offered on the presence of numerous diagnostic attributes and maker's marks of several artifacts (Table 8). The three spatially tight artifact concentrations (Provenience 1, 2, and 3) seem to reflect individual episodes of trash dumping. It is reasonable to assume that the objects may have been used for a short period of time prior to their disposal. Therefore, the dumping may have taken place between AD 1916 and 1930.

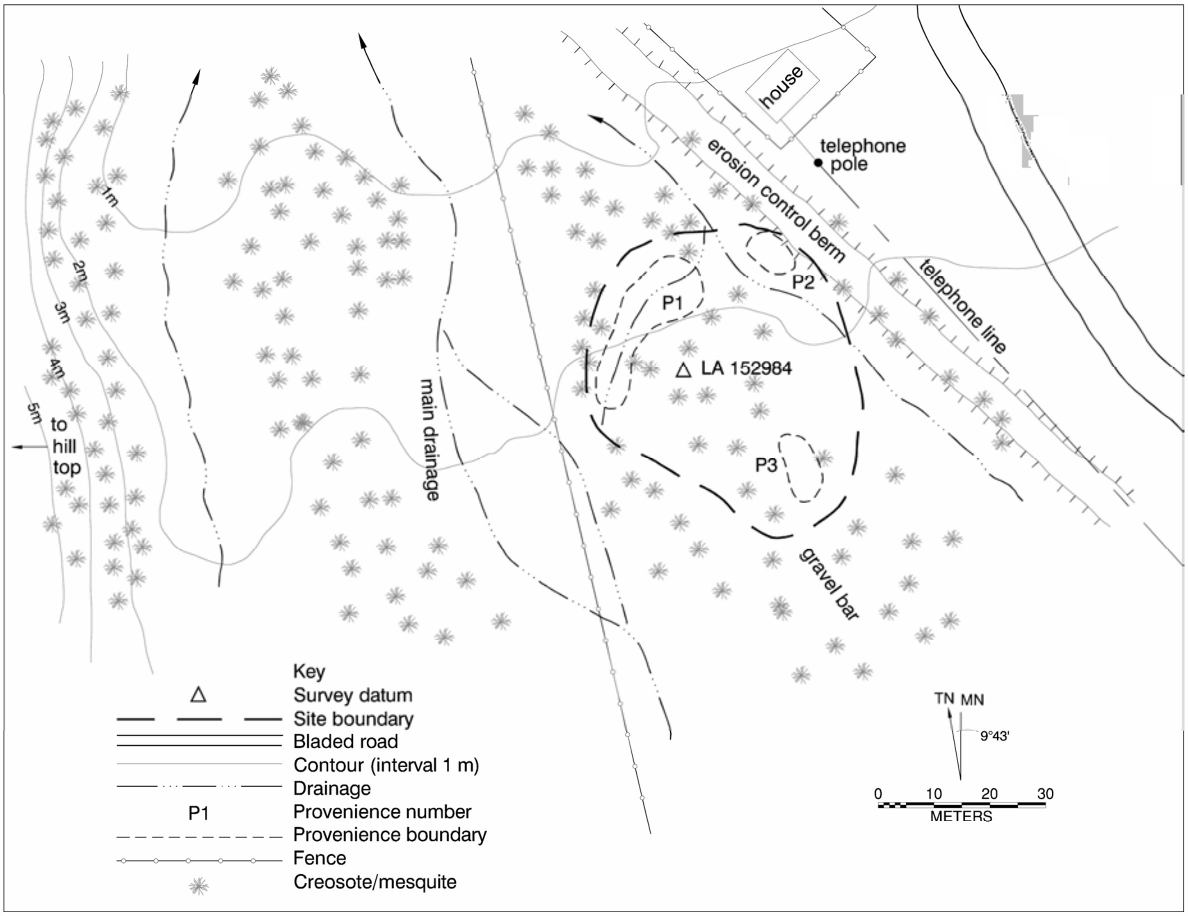


Figure 14 Map of LA 152984 showing location of its three proveniences.

No features or evidence for buried cultural deposits was observed during the visit to the site. For this reason, the site has limited research potential and does not appear eligible for the inclusion in the National Register of Historic Places.

Previously Recorded Canals

Two canals, the Rodey Lateral and Colorado Spur Drain, are located at the northern boundary of the project area. These canals are part of the Elephant Butte Irrigation District, which has been determined eligible for the National Register of Historic Places under criterion "a" (Phillips 1997).

Rodey Lateral, LA 120285 (OCA/UNM 892-5)

The Rodey Lateral was first documented as an archeological site (LA 120285) by the Archaeological Services of Laura Michalik (Martin 1997). The water of this linear feature runs to the southeast through the town of Hatch with a small portion of the system abutting the current project area.

Figure 15 Surface artifacts in Provenience 1 of LA 152984, view looking south.

Phillips (1997:5, 7) states that Rodey Lateral was built during the year 1918 and 1922. It starts as a lateral ditch from the Hatch Canal and parallels it for 4.6 miles on its south side before it re-enters the main canal. This is an unlined irrigation ditch with earthen banks on both of its sides. Its average width is 6.1 m (20 feet) wide and 1.7 m (5.6 feet) deep (Figure 17). Only about 350 m of the canal abuts the northern boundary of the project area. The berms in this part of the acequia are flat and have been used as dirt roads by the ditch maintenance crews and other traffic (Figure 18). Each berm is about 15 feet wide.

Two crossing points were noticed within the ditch segment abutting the project area. The first one is a railroad crossing at the northern-most point of the survey parcel. About 35 m downstream along the acequia is the second crossing point, a concrete culvert and concrete bridge.

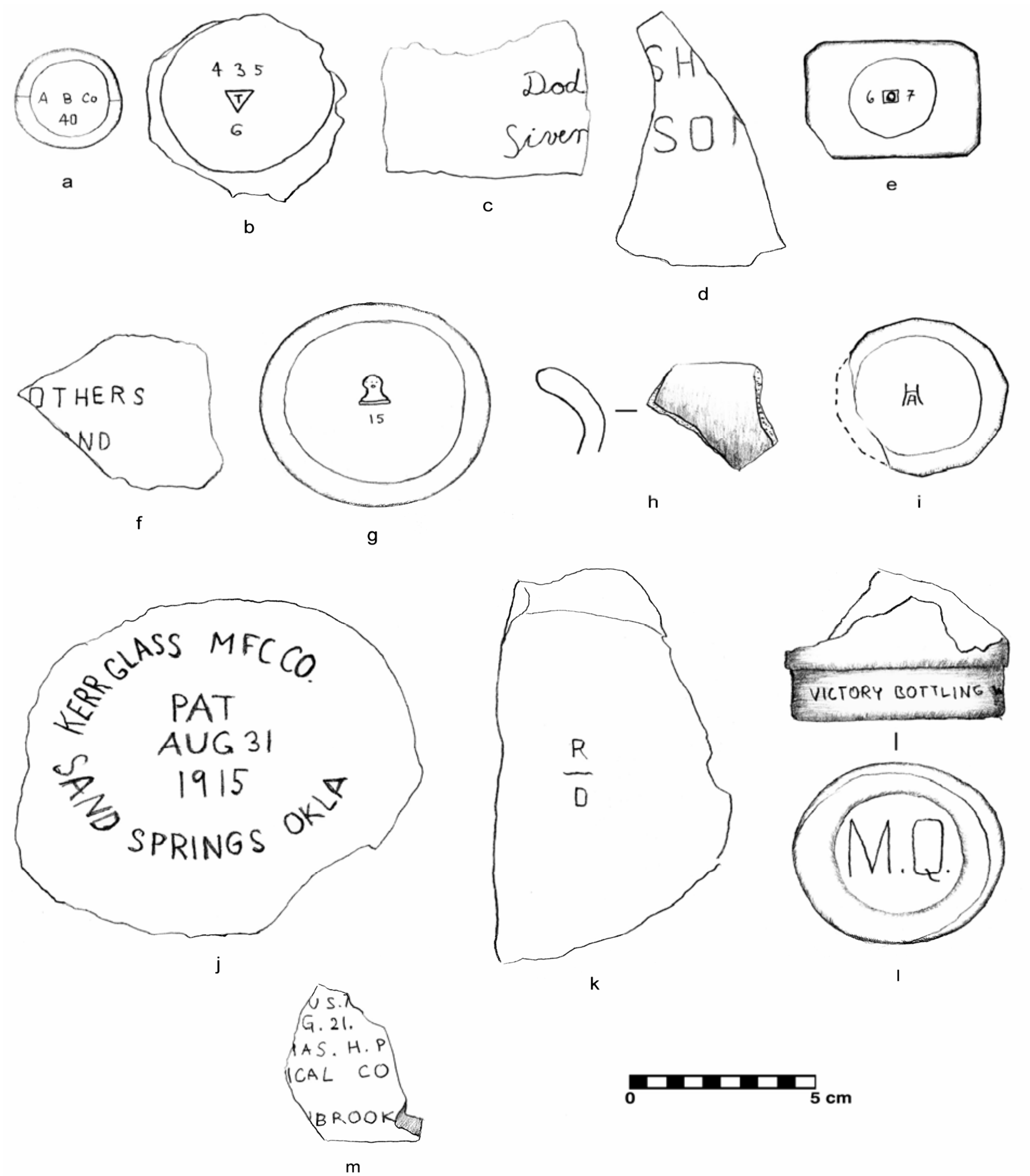
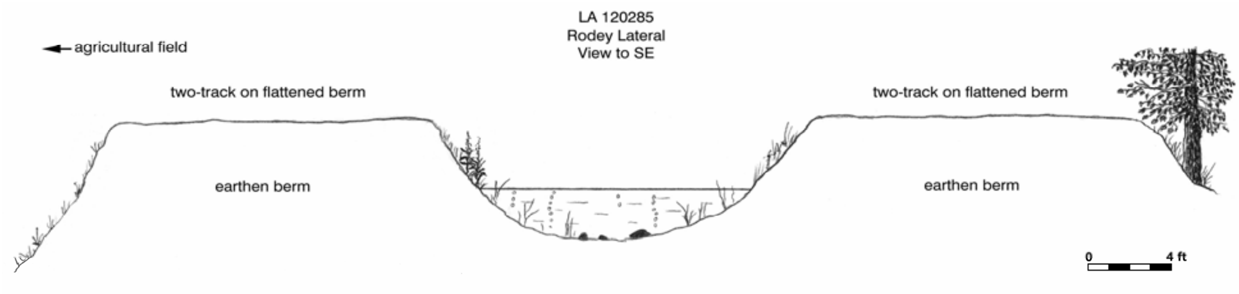


Figure 16 Historic artifacts found on surface at LA 152984: (a) "AB Co." mark embossed on clear American Bottle Company jar possibly used to hold medicine, (b) "T in an inverted triangle" mark on a clear Turner Brothers Glass Company bottle of indeterminate function, (c), (d), (f), (m) indeterminate marks embossed on side walls of aqua glass bottles, (e) "O in a square" mark on the polygonal base of an Owens Bottle Company aqua glass bottle, (g) "pawn chess piece" mark embossed on the base of a Capstan Glass Company aqua glass soda bottle, (h) terracotta ware jar rim sherd, (i) "H over an A" mark embossed on the polygonal base of a Hazel-Atlas Glass Company aqua glass bottle, (j) clear glass bottle base made by Kerr Glass Bottle Company, (k) unknown "R/D" or "R/O" mark embossed on a clear glass bottle base possibly used to hold milk, (l) "Victory Bottling Works, El Paso, Texas" mark embossed at the heel and the "M.Q." mark on the base of an aqua glass soda bottle (The M.Q." stands for the initials of Mauro Quevedo).

Table 8 Historic artifacts recorded at three proveniences at LA 152984.

Provenience 1	Provenience 2	Provenience 3
5 match-stick vent hole cans	10+ terracotta planter fragments	20+ sanitary food cans (can-opener opened)
10+ metal parts: car and/or stove	1 clear square bottle base: Owens Bottle Co. 1911-1929	dark blue stone ware
1 clear bottle base "ABCo 40"	Exhaust pipe (deteriorating)	oil cans or syrup? No markings with screw cap
stone ware: blue with dot/line pattern Crockery (tan)	Unknown metal fragments	partially clear bottle base
china/ceramics: white with various patterns	10+ plain white china/white with small blue flower print	5+ 3 hinge tobacco cans
6 lard buckets (with and without handles)	1 bottle base, clear glass	metal plate? "NOCCO"
"435" bottle base, clear with “T in triangle” embossing	60+ glass fragments: clear, green, purple, cobalt, brown	car/machine/stove parts?
Coal/clinker, ashy dump	Polygonal bottle base (probably from soda drink) with Hazel Atlas Glass Company logo	bottle base fragment
Glass: clear, green, purple, aqua, brown		base "Kerr Glass NFOCO/Pat Aug. 31 1915/Sand Springs OKLA"
1 double ring mouth bottle fragment, clear		barrel hoops
1 milk bottle mouth		10+ meat tins
coffee cans		10+ side strip opened cans (4 in diameter)
“pawn” symbol on Capstan Glass Co. bottle base		20+ match-stick vent hole cans
		white china/ceramic with pink rose pattern
		tan crockery fragments
		Glass: clear, green, brown, aqua (100s)
		Terracotta ware, 2 jar rims
		smashed tin pail with wire handle
		aqua glass soda bottle base with “VICTORY BOTTLINGWORKS EL PASO, TEXAS” embossing on side and “M.Q.” on the base



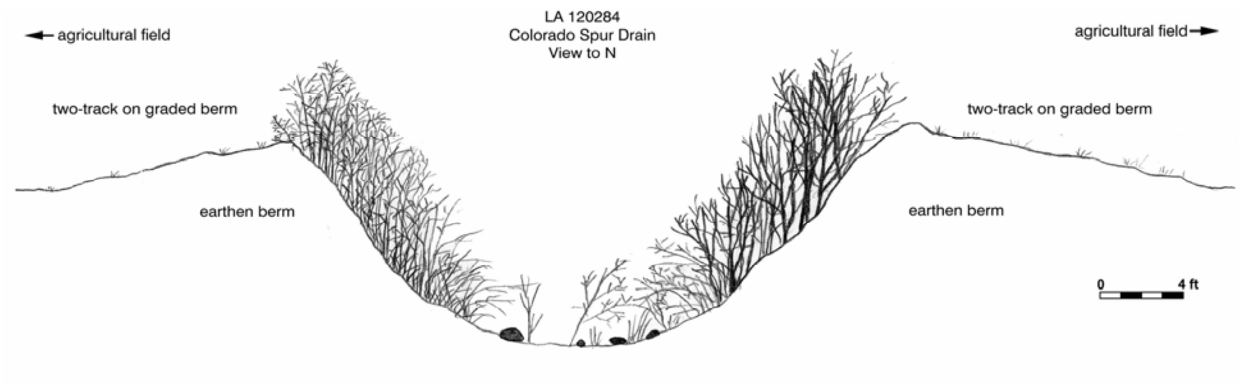


Figure 17 Profile drawings of (a) Rodey Lateral and (b) Colorado Spur Drain. Water up to 2 to 2.5 feet high ran down Rodey Lateral on the day of documenting the two ditches. NOTE: Rodey Lateral has its berms flattened for maintenance and other vehicular traffic while berms of Colorado Spur Drain gradually fade into the irrigated fields.

The area south of the irrigation canal is the proposed flood pool zone, and it is separated from the ditch by an earthen berms and wire fence. The area north of the canal has been divided into several farm fields. Water is diverted into these fields from Rodey Lateral through a metal gate with a metal screw lift system located roughly 100 m downstream of the project area. The water is diverted into a smaller, concrete-lined lateral ditch, which distributes it into earthen ditches in the fields.

Colorado Spur Drain, LA 120284 (OCA/UNM 892-6)

The Colorado Spur Drain was first recorded as an archeological site (LA 120284) in 1997 by the Archaeological Services of Laura Michalik (Martin 1997). This unlined earthen ditch starts in the northern part of the survey area where it collects rain water from the surface of the proposed flood pool zone. A roughly 100 feet (30.5 m) long, 4 feet (1.2 m) diameter metal culvert is located under Rodey Lateral and feeds the water into Colorado Spur Drain in a north-northeast direction. Phillips (1997:4) states that drain was built in 1923, it is 1.7 miles long and culminates into the Hatch Drain.

Figure 18 EBID maintenance truck spraying banks of Rodey Lateral with poison, view looking southeast.

Only the beginning point (near the culvert) of Colorado Spur Drain was documented since this is the single point of the drain's intersection with the current survey area. At the point of water intake from the culvert, the ditch is 12 feet (3.7 m) deep and 30 feet (9.1 m) wide (Figure 17). Its earthen berms are gradually leveled into irrigated fields located on both sides of the ditch. The inner banks of the ditch are thickly overgrown with weeds, grasses, shrubs, and trees (Figure 19).

Isolated Occurrences

Nine isolated occurrences (IOs) were documented during the course of fieldwork. Four of the IOs are historical artifact scatters (Table 9), and three of those appear to be single-episode trash dumps. Unlike the trash scatters recorded as sites, these trash dumps are small with a low density of artifacts. Diagnostics artifacts from these scatters include "ROOT" (AD 1901–1932) embossing on the base of a clear soda bottle, Kerr clear milk bottle base with August 31, 1915 date embossed, and a rectangular (side-opened) tea metal can lid embossed with "Lipton's Tea / The most Delicious the World Produces" (Figure 20a, b, c).

Isolated lithic artifacts were found at three locations (Table 10). IO 3 included a complete knife made from light brown siltstone (Figure 20d) and IO 5 had an almost complete Late Archaic projectile point made of dark gray to black chalcedony (Figure 20e). All of the lithic IOs are clustered around the northern slopes of a pronounced gravel ridge in the southeastern portion of the project area. It is possible that the gravel ridge was used as lithic procurement source during the prehistoric times.

Figure 19 Colorado Spur Drain thickly overgrown with vegetation, view looking north.

The remaining three isolated occurrences are currently occupied camps, presumably occupied by migrant workers (Table 9). IO 7 is located in the area of dense growth of tamarisks in the northern part of the project area. The shelter consists of several features the most prominent of which are a brush structure with a large earthen pit excavated in front of its entry. The structure is about 2 m tall and 3 m in diameter and it is fully enclosed with brush walls, which meet at the top to form a partial roof (Figure 21). The earthen pit is of triangular shape, about 75 cm deep and its longest axis is 5 m long. An earthen hearth is pedestalled in the center of the pit. IO 8 is located just south of the fence line next to Rodey Lateral in the northern part of the project area. The shelter consists of a couch with a cobble-lined hearth and a number of household items. IO 9 is at the southern edge of the project area. This locus consists of a shallow depression covered with blue tarp and a rock and brush wall around its perimeter.

Discussion of Historic Artifacts

Because of the volume and the variety of bottle glass fragments found at the various trash dumps recorded in the survey area, an internet search was performed to answer questions about the origin of the manufactured glass containers, several of which displayed diagnostic logos embossed on their bases or sidewalls. Websites of David Whitten and Bill Lockhart, who are viewed as primary sources of reference in this field provided useful background information about some of the recorded artifacts. The following passage is an adapted from David Whitten's website (http://myinsulators.com/glass-factories/bottlemarks.html).

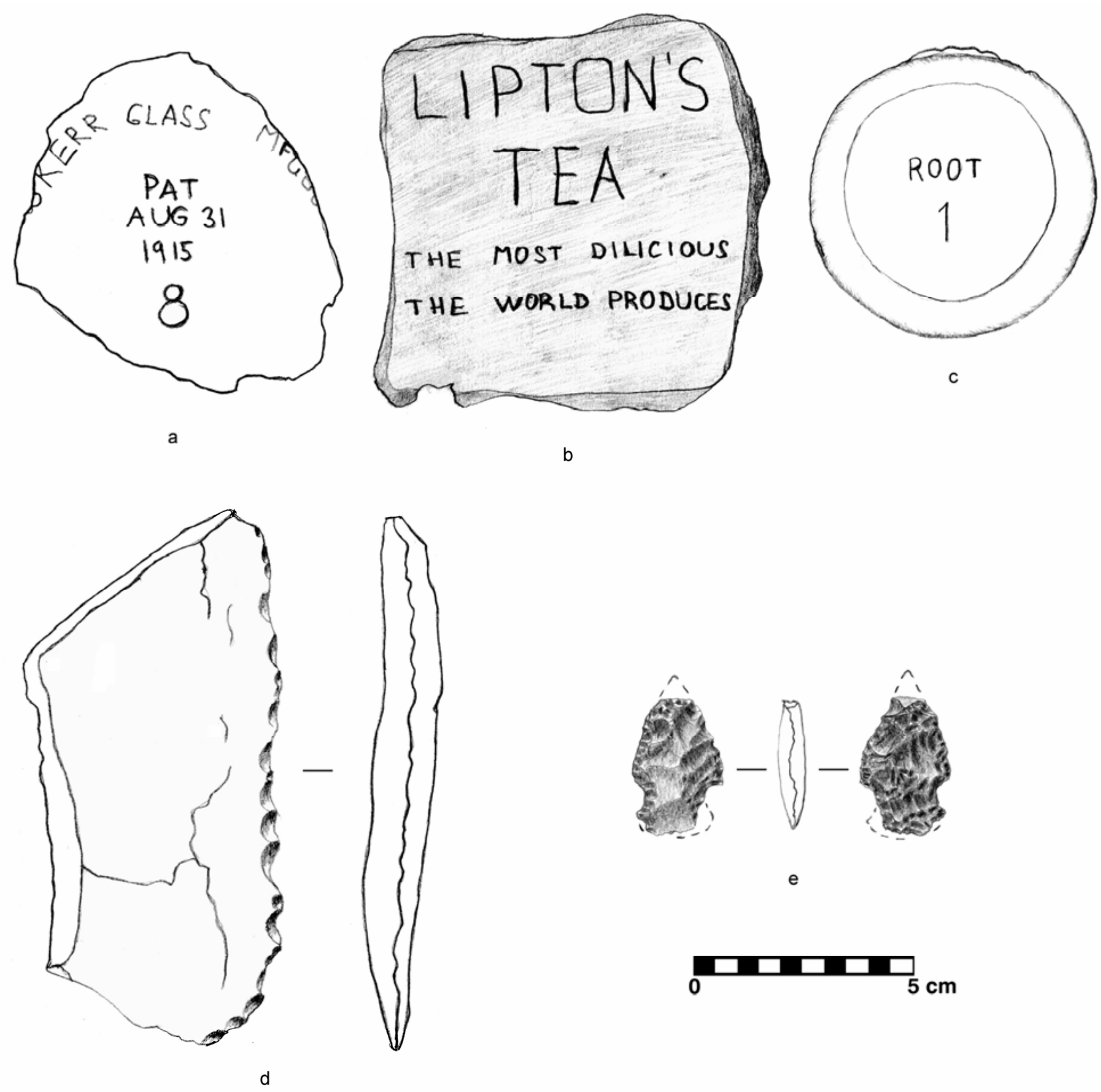


Figure 20 Isolated occurrences represented by historic and prehistoric artifacts: (a) clear glass bottle base made by Kerr Glass Bottle Company (IO 1), (b) embossed metal lid of a Lipton’s Tea can (IO 1), (c) “ROOT” logo on the base of a Root Glass Company aqua soda bottle (IO 4), (d) siltstone knife (IO 3), (e) Late Archaic projectile point made of dark gray to black chalcedony (IO 5).

The Capstan logo, which resembles the “pawn chess piece” (Figure 16g), was used by the Capstan Glass Company of Connesville, Pennsylvania. The company started its operation in 1918 but, in 1938, was bought by Anchor Hocking Glass Company. The Capstan logo commonly appears on different flint glass bottles and on commercial packer’s jars, such as jelly glasses or small “tumblers” for cheese spread, mayonnaise, peanut butter, jam, etc.

Table 9 Isolated occurrences represented by historic artifacts and in-use human shelters.

IO No	Description	Count	Comments
1	1915 bottle base (clear)	1	3 x 4 m area trash dump, probable single event, artifacts are on an arroyo bank and gradually are being re-deposited downslope by rain water
	Glass: clear, green aqua		
	china/ceramic: plain white		
	crockery (cream and tan)		
	"Lipton's Tea the most delicious the world produces", square metal lid, side-opened	1	
	3 hinge tobacco tins	10+	
	sanitary food cans (small and medium) can-opener opened	30+	
	lard buckets	3	
	many unknown metal fragments and car/stove parts		
	mason jar lids	2	
	Clear glass/metal fragments	200+	
2	metal/can fragments	10	1 x 2 m trash dump, single event
	bottle base (clear) fragment, no markings	1	
	can lids (side opened)	5	
	clear glass fragments	15+	
4	glass: clear, aqua, brown (1880-1920)	50+	2 x 3 m trash dump, single event
	unmarked bottle bases (photo)	4	
	bottle base "ROOT1" (1901-1932)	1	
	Milk bottle mouth fragment	1	
	meat tins (Spam like)	2	
	can and lid fragments (sanitary food cans)	20+	
	barbed wire 2x strand/flat single twist	1	
5	brown bottle base fragment, no marking (1880-present)	1	
	cream china with paired pink/green flowers	2	
7	Human shelter	1	House structure made of branches and mud, pit (triangular shaped) about 75 cm deep. 5x4x4 m with fire pit in center and 2 step entrances in the north and south.
8	Human Shelter	1	Couch with tarp, fire pit, hanging radio in tree, 2 dead animals on fence.
9	Human Shelter	1	Depression covered with blue tarp on 7x4m large clearing surrounded by rock berm and brush wall

The “AB (letters attached)” (Figure 13h) was one of the early logos of the American Bottle Company which operated from 1905 to 1929, first in Chicago, and later in Toledo, Ohio. The company was purchased by Owens Bottle Machine Company in 1916. Most bottles with “AB (letters attached)” and “AB (letters attached) Co.” logos therefore probably date to 1905-1916.

The “H over an A” logo (Figure 16h) was used by the Hazel-Atlas Glass Company which operated in Pennsylvania, West Virginia, Oklahoma, and California between 1902 and 1964. Whitten reports that the earliest date for the logo is 1923 and last time it was used was in 1964. Hazel-Atlas is known for its “depression” pressed glass ware which was made between 1920s and 1940s.

“I within a diamond” (Figure 13c) was one of the logos used by the Illinois Glass Company of Alton, which operated from 1873 to 1929. According to Whitten, this mark was used between 1915 and 1929 and is shown only on bottles made through the automatic bottle machine production.

Table 10. Lithic Isolated Occurrences

IO	Description	Cortex (%)	Length (mm)	Width (mm)	Thickness (mm)	Platform
3	Tan chert flake (complete)	0	42	25	7	single facet
	Fine-grain rhyolite flake (complete)	0	55	43	19	multi-facet
	Fine-grain rhyolite anvil/chopper (complete)	20%	80	75	63	
	Siltstone knife (complete)	0	125	60	9	
5	Fine-grain rhyolite flake (complete	0	25	34	19	single facet
	Basalt flake (complete)	20%	60	55	11	multi-facet
	Fine-grain rhyolite flake (complete)	0	21	12	4	single facet
	Fine-grain rhyolite utilized flake (complete)	30%	33	56	9	single facet
	Dark gray to black chalcedony Late Archaic projectile point (complete)	0	31	21	6	
6	Gray chert flake (complete)	0	32	17	3	single facet

Figure 21 In-use brush shelter, IO 7, found in dense growth of tamarisks, view looking south.

The “Kerr” logo (Figure 20a) was introduced by the Kerr Glass Manufacturing Company which began the production of its own bottles in 1909 in Altona, Kansas. The company became a corporation in 1927 and its production continued in plants throughout the United States. In 1992 it was sold to Ball Corporation.

The “O in a square” (Figures 13a and 116e) was a well-known logo of the Owens Bottle Company which operated from 1903 to 1929 in Ohio and West Virginia. According to Whitten, this logo was first used sometime between 1911 and 1919.

The “ROOT” logo (Figure 20c) belonged to the Root Glass Company of Terre Haute, Indiana (1901-1932). This logo is often found on a variety of soda, mineral water and beer bottles.

The “T in an inverted triangle” (Figure 16b) was a logo used by the Turner Bros. Glass Co. of Terre Haute, Indiana, which operated from ca. 1905 to 1930.

The above-listed logos indicate that most of the historical glass bottles discovered during the survey were produced outside New Mexico during the first quarter of the 20th century. Some items might be locally manufactured but this is often hard to prove (Bill Lockhart, BLM Historic Artifact Workshop, Santa Fe, November 2005). According to Lockhart, there were numerous small, short-lived glass bottle manufacturing companies in Alamogordo, Las Cruces, and El Paso. The records of the manufactured glass products of companies with short period of operation are often hard to trace, but at least one example of locally manufactured glass was found at LA 152984. The heel fragment of a soda bottle showed an embossing “VICTORY BOTTLING WORKS, EL PASO, TEXAS” (Figure 16l). Lockhart’s research (2000) shows that this company was in operation from 1923 to 1931 under E.M. Seggerson and Mauro Quevedo. The aqua glass bottle fragment has two large capital letters “M.Q.” embossed on the base which evidently stand for Quevedo’s initials (Lockhart 2000). The presence of this bottle demonstrates the use of regionally produced items in the Hatch area.

SUMMARY AND RECOMMENDATIONS

Four newly discovered archeological sites, two previously recorded irrigation canals, and nine isolated occurrences were documented during the survey. Two of the newly discovered sites are prehistoric. LA 152981 is a diffuse sherd and lithic scatter probably dating to the Doña Ana (Late Mesilla) or El Paso phase of the Jornada Mogollon. Given the range of artifacts present and the site setting, the scatter is probably a prehistoric agricultural field. Based on the soil profile and limited subsurface testing, the scatter appears to be surficial. The site has limited data potential, and most of the basic information relevant to major research issues relating to the prehistory of south-central New Mexico was collected as part of the survey documentation. LA 152981 therefore does not appear eligible for nomination to the National Register of Historic Places. LA 152982 encompasses two rock features and a prehistoric lithic artifact scatter. One of the rock features may be modern, and the other may be the remnants of a Formative masonry structure. A large pit, possibly dug by pothunters, has completely destroyed the interior of this feature. The lithic scatter is part of a much larger scatter covering most of the gravel-capped ridge, so it is not certain that the lithics and features at the site are associated. LA 152981 has little potential of yielding any significant information beyond that documented during the survey, and it is not recommended as eligible for nomination to the National Register of Historic Places.

The other two newly recorded sites, LA 152983 and LA 152984, are dense scatters of historical debris representing repeated episodes of trash dumping. Diagnostic artifacts from these scatters indicate that they date to the early 20th century, the New Mexico Statehood – World War II era. Again, these sites are surficial and have limited data potential. LA 152983 and LA 152984 therefore do not appear to meet the eligibility criteria under 36 CFR 60.4 and they are recommended as ineligible for the National Register.

The two previously recorded sites, the Rodey Lateral (LA 120285) and Colorado Spur Drain (LA 120284) have been deemed eligible for the National Register. Proposed construction of the flood control dam may impact one or both of these features, and consultations with the New Mexico SHPO are recommended to assess the effects of the proposed undertaking and, if necessary, to develop mitigation measures. These canals are part of the Elephant Butte Irrigation District (EBID). In conducting background research at the EBID office, the field crew was informed that the EBID had not been notified of the proposed construction. It is suggested that the COE contact the EBID prior to construction. Our contact at that office was Valerie Beversdorf, Resource Engineer Specialist/GIS Manager (phone: 505-526-6671; email: vbeversd@ebid-nm.org).

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NMCRIS No.: 121028

NMCRIS INVESTIGATION ABSTRACT FORM (NIAF)

1. NMCRIS Activity No.: 121028

2a. Lead Agency: US Army Corps of Engineers Albuquerque District

2b. Other Agency(ies):

3. Lead Agency Report No.: USACE-ABQ; 2011-004

4. Title of Report:

A 12.95-Acre Supplemental Cultural Resource Inventory for the Proposed Hatch Dam, Dona Ana County, New Mexico

5. Type of Report

- [x] Negative
- [ ] Positive

Author(s)

Jeremy T. Decker

6. Investigation Type

- [ ] Research Design
- [x] Archaeological Survey/Inventory
- [ ] Architectural Survey/Inventory
- [ ] Test Excavation
- [ ] Excavation
- [ ] Collections/Non-Field Study
- [ ] Compliance Decision Based on Previous Inventory
- [ ] Overview/Lit Review
- [ ] Monitoring
- [ ] Ethnographic Study
- [ ] Site/Property Specific Visit
- [ ] Historic Structures Report
- [ ] Other

7. Description of Undertaking (what does the project entail?):

The Corps is conducting a series of studies in order to determine if there is sufficient justification for construction of a small earthen flood control dam within the village limits of Hatch, New Mexico. At this time no construction is planned.

[x] Continuation

8. Dates of Investigation: from: 01-Jun-2011 to: 01-Jun-2011

9. Report Date: 27-Jun-2011

10. Performing Agency/Consultant: US Army Corps of Engineers Albuquerque District

Principal Investigator: Jeremy Decker

Field Supervisor: Jeremy Decker

Field Personnel Names: Gregory Everhart

Historian / Other:

11. Performing Agency/Consultant Report No.:

USACE-ABQ-2011-004

12. Applicable Cultural Resource Permit No(s):

NM-11-193

NMCRIS No.: 121028

13. Client/Customer (project proponent):

Dona Ana County

Contact: Paul Dugie, P.E., Dona Ana County Flood Commission Director

Address: County Government Center
845 N. Motel Blvd, Rm 1-250
Las Cruces, NM 88007

Phone: 575-525-5558

14. Client/Customer Project No.:

15. Land Ownership Status (must be indicated on project map):

Land Owner (By Agency)	Acres Surveyed	Acres in APE
State of New Mexico	12.95	12.95
TOTALS	12.95	12.95

16. Records Search(es):

Date(s) of HPD/ARMS File Review: May 2011	Name of Reviewer(s): Jeremy Decker	
Date(s) of Other Agency File Review: May 2011	Name of Reviewer(s): Jeremy Decker	Agency: Us Army Corps of Engineers

17. Survey Data:

a. Source Graphics [ ] **NAD 27** [x] **NAD 83** **Note: NAD 83 is the NMCRIS standard.**

☑ **USGS 7.5' (1:24,000) topo map** ☐ **Other topo map, Scale:**

☑ **GPS Unit** **Accuracy** ☑ **<1.0m** ☐ **1-10m** ☐ **10-100m** ☐ **>100m** ☑ **Aerial Photo(s)**

Other Source Graphic(s):

b. USGS 7.5' Topographic Map Name	USGS Quad Code
Hatch, NM	32107-F2

c. County(ies): DONA ANA

d. Nearest City or Town: Hatch, NM

e. Legal Description:

Township (N/S)	Range (E/W)	Section
19S	3W	16

Projected legal description? [ ] **Yes** [ ] **No** [ ] **Unplatted**

f. Other Description (e.g. well pad footages, mile markers, plats, land grant name, etc.):

[ ] **Continuation**

18. Survey Field Methods:

Intensity: ☑ 100% coverage ☐ <100% coverage

Configuration: ☑ block survey units ☐ linear survey units (l x w):

NMCRIS No.: 121028

☐ other survey units (specify):

Scope: ☑ non-selective (all sites/properties recorded) ☐ selective/thematic (selected sites/properties recorded)

Coverage Method: ☑ systematic pedestrian coverage

☐ other method (describe)

Survey Interval (m): 15 **Crew Size:** 2 **Fieldwork Dates:** from: 01-Jun-2011 to: 01-Jun-2011

Survey Person Hours: 6.00 **Recording Person Hours:** 0.00 **Total Hours:** 6.00

Additional Narrative:

Survey consisted of walking 15m-spaced compass-directed transects in the two largest survey blocks, and by zig-zagging across the smallest survey area until the entire block had been examined. All isolates encountered were recorded. One section of LA152984 extended into the survey area. The site was examined and no changes were noted from the 2006 OCA survey, so the site was not updated, and the area within the site boundary was not formally resurveyed.

[ ] Continuation

19. Environmental Setting (NRCS soil designation; vegetative community; elevation; etc.):

Taken directly from Kuroda 2006:

The project area is located in the southwest Basin and Range province. It is situated between the lowlying basin deserts and the riparian habitats of the Rio Grande Valley to the north, east, and southeast; the volcanic Sierra de las Uvas which extend to the south of the project area; and the uplands of the Black Range to the northwest. The town of Hatch is spread over the area between the Rio Grande and the survey parcel. State Road 26 runs through Hatch about 200 m to the north of the project area. The highway crosses dissected Quaternary- and Tertiary-age gravel deposits associated with the ancestral and recent Rio Grande Valley (Doleman and Treadwell 1997:23).

[x] Continuation

20.a. Percent Ground Visibility: 76-99% **b. Condition of Survey Area (grazed, bladed, undistributed, etc.):**

The two largest survey areas are located in the active arroyo floodplain. The area is 100% disturbed by recent fluvial activity. The small survey block heavily utilized by local residents, and is covered in old furniture, broken glass, and modern trash.

[ ] Continuation

21. CULTURAL RESOURCE FINDINGS ☐ **Yes, see next report section** ☑ **No, discuss why:**

Two isolated finds located. The isolates are considered out of context because the area is heavily disturbed due to its location within an active floodplain.

[ ] Continuation

22. Attachments (check all appropriate boxes):

[x] USGS 7.5 Topographic Map with sites, isolates, and survey area clearly drawn (required)

[x] Copy of NMCRIS Map Check (required)

[ ] LA Site Forms - new sites (with sketch map & topographic map) if applicable

[ ] LA Site Forms (update) - previously recorded & un-relocated sites (first 2 pages minimum)

[ ] Historic Cultural Property Inventory Forms, if applicable

[x] List and Description of Isolates, if applicable

[ ] List and Description of Collections, if applicable

23. Other Attachments:

[ ] Photographs and Log

[ ] Other Attachments (Describe):

NMCRIS No.: 121028

24. I certify the information provided above is correct and accurate and meets all applicable agency standards.

Principal Investigator/Qualified Supervisor: **Printed Name:** Jeremy Decker

Signature: Jeremy Decker **Date:** 6/28/2011 **Title:** Archaeologist

25. Reviewing Agency		**26. SHPO**
Reviewer's Name/Date:		**Reviewer's Name/Date:**
Accepted [ ]	**Rejected [ ]**	**HPD Log #:**
		Date sent to ARMS:

CULTURAL RESOURCE FINDINGS

[fill in appropriate section(s)]

SURVEY RESULTS:

The survey located two isolated occurrences and found no new historic properties. LA152984 is located on the northern edge of the easternmost survey block. The sites boundary was verified, but the site was not included in the current survey, and thus, was not updated with this recording.

Archaeological Sites discovered and registered: 0

Archaeological Sites discovered and NOT registered: 0

Previously recorded archaeological sites revisited (site update form required): 0

Previously recorded archaeological sites not relocated (site update form required): 0

TOTAL ARCHAEOLOGICAL SITES (visited & recorded): 0

Total isolates recorded: 2 ✓ **Non-selective isolate recording?**

HCPI properties discovered and registered: 0

HCPI properties discovered and NOT registered: 0

Previously recorded HCPI properties revisited: 0

Previously recorded HCPI properties not relocated: 0

TOTAL HCPI PROPERTIES (visited & recorded, including acequias): 0

MANAGEMENT SUMMARY:

The information potential of the two isolated finds documented on survey is considered exhausted with recordation. The isolates are considered ineligible for inclusion in the NRHP.

[ ] Continuation

IF REPORT IS NEGATIVE, YOU ARE DONE AT THIS POINT.

NMCRIS No.: 121028

SURVEY LA/HCPI NUMBER LOG

Sites/Properties Discovered:

LA/HCPI No.	Field/Agency No.	Eligible? (Y/N/U, applicable criteria)

Previously recorded revisited sites/HCPI properties:

LA/HCPI No.	Field/Agency No.	Eligible? (Y/N/U, applicable criteria)

MONITORING LA NUMBER LOG (site form required)

Sites Discovered (site form required):

LA No.	Field/Agency No.

Previously recorded sites (site update form required):

LA No.	Field/Agency No.

Areas outside known nearby site boundaries monitored? [ ] Yes [ ] No, Explain why:

TESTING & EXCAVATION LA NUMBER LOG (site form required)

Tested LA number(s)

Excavated LA number(s)

---

7. (Continued from page 1)

Hatch is very vulnerable to flooding especially during episodes of heavy rainfall. Additionally, the entire village of Hatch is within the 100-year floodplain of the Rio Grande, as is the proposed project. Significant flooding occurred in 1988, 1992, and 2006. The Flood Control Act of 1948, Section 205, authorizes the Secretary of the Army, acting through the Chief of Engineers, to plan and construct small local flood protection projects which have not been specifically authorized by Congress.

The proposed earthen dam would provide 100-year level of protection to Hatch. The storage capacity would be 181 acre-feet, including 30 acre-feet for sediment and 151 acre-feet for water. The dam would be approximately 4,000 feet long, and the maximum height would be 20 feet. The earthen material would come from a borrow area in the proposed reservoir immediately behind the dam. Currently the borrow area contains a large leach field and a waterline, both of which would have to be removed and relocated. A 200-foot long spillway constructed of concrete and rip-rap will carry water to the existing Colorado drain. Factors that will enter into the final decision concerning whether or not a dam would be constructed include the hydrology, the benefit-cost ratio, cultural and environmental concerns, and local support. An existing 1000-foot long spoil-bank levee on the north side of the arroyo coming out of Spring Canyon and emptying into the proposed flood pool will be removed; a 1240-foot long channel will be excavated within that existing arroyo.

19. Continued from Page 3:

Several north-trending drainages flow into the Rio Grande in the vicinity of the project area. Placitas Arroyo, located about 0.5 mi to the east, is a major tributary and flows into the Rincon portion of the Rio Grande Valley. A smaller arroyo enters the southeast corner of the project area and delivers runoff water from Spring Canyon.

Besides the underlying Quaternary-Tertiary gravels and occasional alluvial deposits, surface deposition on the ridges consists of medium to fine eolian sand. In particular, this was observed in the southern portion of the project area during the survey and testing at LA 152892. However, these sediments appeared not as contiguous layers but rather as isolated micro dunes under the larger vegetation species, such as creosotes and mesquite bushes. The vast majority of the project area is typified by soft alluvial deposits.

Soils

Three types of soil are present in or near the project area. The first one, Anthony-Vinton clay loam, is located in the lowest portion of the survey area, which is almost level and currently used as irrigated cropland. These soils are commonly protected from floodwaters of Rio Grande by dams and levees. The Anthony soils have formed in alluvium and are usually deep and well drained. These soils make up about 55% of the soil unit. The Vinton soils are formed in mixed alluvium and are also deep and well drained. These soils make up about 30% of the main soil unit (Bulloch, Jr. and Neher 1980:15–16).
The second soil is the Nickel-Badland Complex, which consists of undulating to moderately rolling soils. This complex can be found from 4,000 to 5,200 feet of elevation (Bulloch, Jr. and Neher 1980:33) and is well represented in the gravel terraces south of the project area.
The third soil unit is the Canutio and Arizo gravelly sandy loam and is commonly found on fans, terraces, valley floors and wide arroyos at elevations ranging from 3,800 to 4,400 feet. Such soil units can be found to the east, slightly downstream from the project area (Bulloch, Jr. and Neher 1980:24).

Climate

The climatic conditions in the project area are characteristic for the southern Rio Grande Valley, which are classified as arid (Tuan et al. 1973:187, Figure 78). Half of the annual precipitation is received during the summer months of July through September (Tuan et al. 1973:190). Average annual precipitation is roughly 18–20 cm (7–8 inches) and average daily temperatures range from 57 °F in January to 94 °F in July. Temporal and spatial variability in weather patterns in this part of New Mexico vary considerably which often translates into unpredictable seasonal productivity. As a result, local vegetation experiences two blooming seasons, one taking place in the spring dependent on the winter precipitation, and the other in a late summer/early fall, dependent of the summer monsoon (Doleman and Treadwell 1997).

Vegetation

The survey area is located in the northern portion of the Chihuahuan biogeographic province (Brown and Lowe 1994:13). Chihuahuan Desert Scrub is the only biome represented in the study area.
Within this biome, the local vegetation is diversified based on the elevation and relief. In the project area, creosote bush, mesquite, snakeweed, saltbush, old cedar brush have commonly been observed. Additionally, some cacti species, including prickly pear and hedgehog cactus, were noticed in small quantities. Non-local species, such as the tamarisk tree, were found growing in abundance in the areas around moisture-rich drainages within the floodplain of the study area.

References Cited:

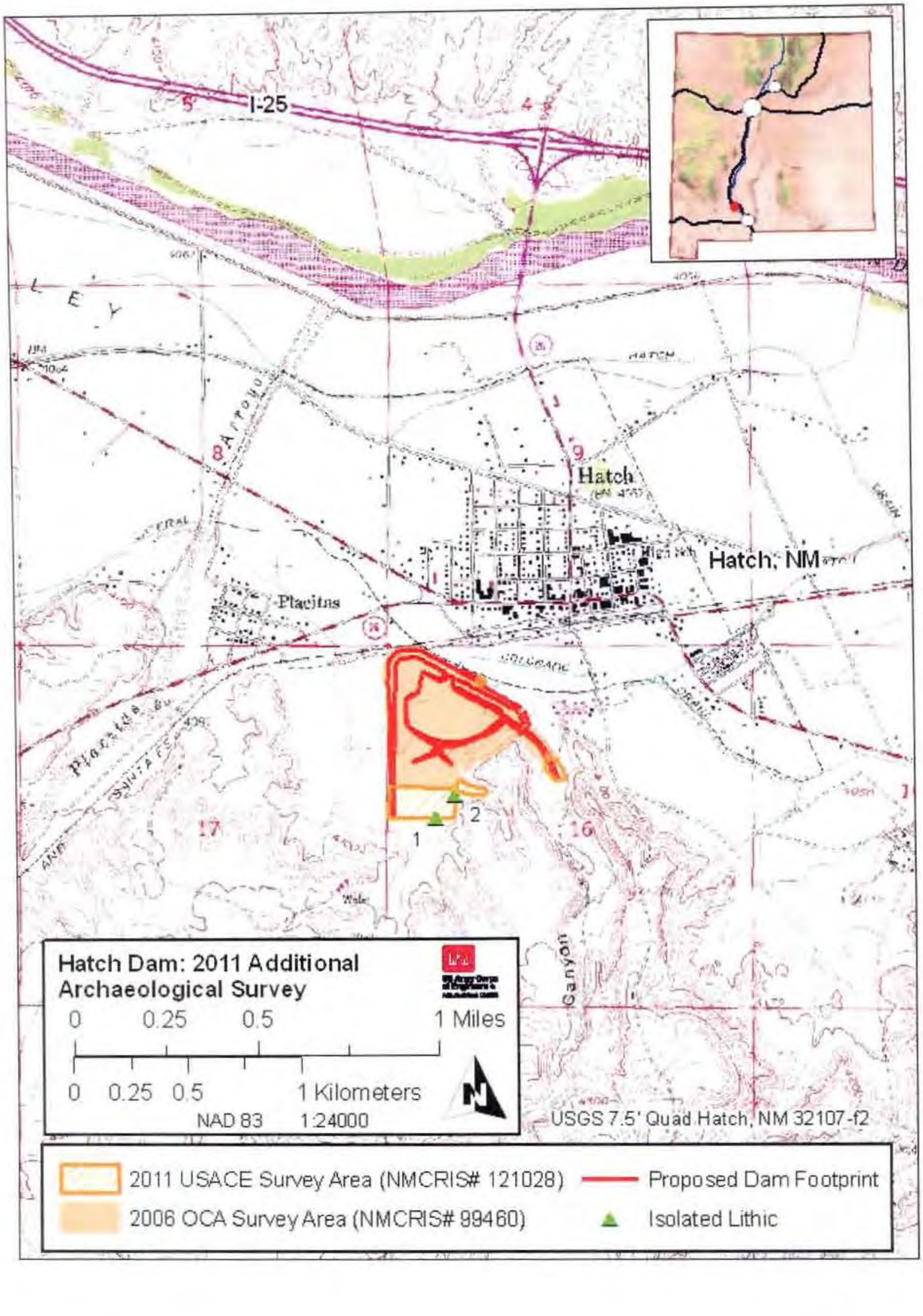
Brown, David E., and Charles H. Lowe
1994 *Biotic Communities of the Southwest.* University of Utah Press, Salt Lake City, Utah.

Bulloch, Jr., H. Edward, and Raymond E. Neher
1980 Soil Survey of Doña Ana County Area, New Mexico. Soil Conservation Service and United States Department of Agriculture.

Doleman, William H., and Carol J. Treadwell
1997 Environment, Geomorphology, and Geology. In *Prehistoric Occupations near the Lower Placitas Arroyo: Excavations along State Road 26 West of Hatch, NM*, edited by William H. Doleman, pp. 23–38. OCA/UNM Report No. 185-511. Office of Contract Archeology, University of New Mexico, Albuquerque.

Kuroda, Alexander
2006 Archaeological Survey and Testing for Proposed Hatch Dam and Flood Pool Construction, Dona Ana County, New Mexico. OCA/UNM Report No. 185-892. Office of Contract Archeology, University of New Mexico, Albuquerque.

Tuan, Yi-Fu, Cyril E. Edward, Jerold G. Widdison, and Iven V. Bennett
1973 *The Climate of New Mexico, revised edition*. State Planning Office, Santa Fe.

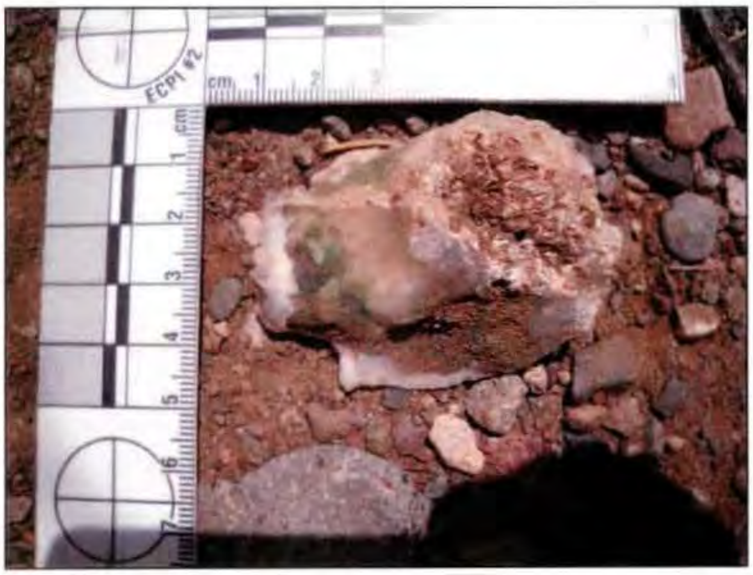


I-25
Hatch
Hatch, NM
Placitas
Canyon
1
2
Hatch Dam: 2011 Additional Archaeological Survey
0 0.25 0.5 1 Miles
0 0.25 0.5 1 Kilometers
NAD 83 1:24000
USGS 7.5' Quad Hatch, NM 32107-f2
2011 USACE Survey Area (NMCRIS# 121028)
Proposed Dam Footprint
2006 OCA Survey Area (NMCRIS# 99460)
Isolated Lithic

Summary of Isolated Occurrences

Isolate 1: Complete chert flake with a plain platform, cortex present, and a utilized edge. Measures 3-4cm.

Isolate 2: Chalcedony shatter with cortex present. Measures 5-6cm. See photo below.



Isolate 2: Chalcedony debitage with primary cortex.

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
4101 JEFFERSON PLAZA NE
ALBUQUERQUE NM 87109-3435

February 16, 2007

Planning, Project and Program Management Division
Planning Branch
Environmental Resources Section

Honorable Ronnie Lupe
Chairman
White Mountain Apache Tribal Council
Post Office Box 700
Whiteriver, Arizona 85941

Dear Chairman Lupe:

The United States Army Corps of Engineers, Albuquerque District, is conducting a series of studies in order to determine if there is sufficient justification for construction of a small earthen flood control dam within the village limits of Hatch, New Mexico. Hatch is very vulnerable to flooding especially during episodes of heavy rainfall. Additionally, the entire village of Hatch is within the 100-year floodplain of the Rio Grande, as is the proposed project. Significant flooding occurred in 1988, 1992, and 2006. The Flood Control Act of 1948, Section 205, authorizes the Secretary of the Army, acting through the Chief of Engineers, to plan and construct small local flood protection projects which have not been specifically authorized by Congress.

The proposed earthen dam would provide 100-year level of protection to Hatch. The storage capacity would be 181 acre-feet, including 30 acre-feet for sediment and 151 acre-feet for water. The dam would be 4,000 feet long, and the maximum height would be 20 feet. The earthen material would come from a borrow area in the proposed reservoir immediately behind the dam. Currently the borrow area contains a large leach field and a waterline, both of which would have to be removed and relocated. A 200-foot long spillway constructed of concrete and rip-rap will carry water to the existing Colorado drain. Factors that will enter into the final decision concerning whether or not a dam would be constructed include the hydrology, the benefit-cost ratio, cultural and environmental concerns, and local support. An existing 1000-foot long spoil-bank levee on the north side of the arroyo coming out of Spring Canyon and emptying into the proposed flood pool will be removed; a 1240-foot long channel will be excavated within that existing arroyo.

As part of the overall investigation, in April, 2006, archaeologists from the Office of Contract Archeology, University of New Mexico, conducted a review of the New Mexico Cultural Resource Information System (NMCRIS) and also an intensive, or complete, inventory survey of the proposed project area that could result from the construction of a flood control dam within the village limits of Hatch. The NMCRIS review of a one-mile radius around the proposed project area found a total of seven known sites, two of which were irrigation canals within the proposed project. The on-the-ground survey included a total of 69.8 acres (28.3 hectares). Four new archaeological sites and nine isolated occurrences (single or small clusters of artifacts) were documented. The records for the two previously recorded canals were updated. Two sites are scatters of historic and recent trash; the other two are prehistoric artifact scatters. The two prehistoric sites were tested to determine if subsurface cultural material were present and very little material was found. None of the four new archaeological sites are considered eligible for the National Register of Historic Places. The two canals, the Rodey Lateral and the Colorado Spur Drain, are irrigation ditches that are part of the Elephant Butte Irrigation District.

A brief description of the sites, isolated occurrences, and a map of the project location is enclosed. The map, a portion of the USGS Quadrangle, shows the proposed project location and the maximum area of the flood pool. We are seeking your input with respect to concerns about any traditional use or gathering areas, traditional cultural properties, or sacred sites.

We would appreciate hearing from you by late March, 2007. If you have questions or require additional information please contact John Schelberg at (505) 342-3359. Thank you very much for your attention to this matter. For your convenience, we have included an acknowledgement letter (Enclosure 1).

Sincerely,

Andrea Hummel

for Julie Hall,
Chief, Environmental Resources Section

Enclosures

ENCLOSURE 1: Acknowledgement Letter

HATCH DAM PROJECT

If you have any questions or require additional information, please contact Danielle Galloway, biologist at (505) 342-3661, John D. Schelberg, archaeologist at (505) 342-3359, or Julie Hall, Chief of Environmental Resources Section, at (505) 342-3281.

ACKNOWLEDGEMENT:

As a representative for the White Mountain Apache Tribal Council, the undersigned acknowledges receipt of this request for comment, and having reviewed the project summary information, have:

[ ] NO CONCERNS [ ] CONCERNS (please write below, attach letter or call)

Concerns: ____

____

____

____

Signature: ______________________

Date: ______________________

Printed Name: ______________________

Title: ______________________

*** please mail or fax (505-342-3668) this form to the Corps ***

You received this request for comments because you are listed with the New Mexico Historic Preservation Division as having interest in activities undertaken in the project county(ies).

For future contact we would appreciate if you would make any appropriate changes to the following information:

Honorable Ronnie Lupe
Chairman
White Mountain Apache Tribal Council
Post Office Box 700
Whiteriver, Arizona 85941
Telephone: 928-338-4346
Fax: 928-338-1514

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
4101 JEFFERSON PLAZA NE
ALBUQUERQUE NM 87109-3435

October 31, 2007

082820

RECEIVED
NOV - 2 2007
HISTORIC PRESERVATION DIVISION

Planning, Project and Program Management Division
Planning Branch
Environmental Resources Section

Ms. Katherine Slick
State Historic Preservation Officer
Historic Preservation Division
Bataan Memorial Building
407 Galisteo Street, Suite 236
Santa Fe, New Mexico 87501

Dear Ms. Slick:

Pursuant to 36 CFR Part 800, the U.S. Army Corps of Engineers, Albuquerque District, (Corps) is seeking your concurrence with our determination that the four recently recorded archaeological sites and nine isolated occurrences within the proposed pool of a flood control dam within the village limits of Hatch, New Mexico, are not eligible for the National Register of Historic Places. A copy of the survey report, site forms, and tribal correspondence are enclosed for your review. Consistent with the Department of Defense's American Indian and Alaska Native Policy of 1998, tribal letters were sent on February 16, 2007, to tribes with concerns for projects in Doña Ana County. Responses were received from the Comanche Tribe and the Fort Sill, Chiricahua, Warm Springs Apache. Neither tribe has concerns with activity at this location.

The Corps, is conducting a series of studies in order to determine if there is sufficient justification for construction of a small earthen flood control dam within the village limits of Hatch, New Mexico. At this time no construction is planned. Hatch is very vulnerable to flooding especially during episodes of heavy rainfall. Additionally, the entire village of Hatch is within the 100-year floodplain of the Rio Grande, as is the proposed project. Significant flooding occurred in 1988, 1992, and 2006. The Flood Control Act of 1948, Section 205, authorizes the Secretary of the Army, acting through the Chief of Engineers, to plan and construct small local flood protection projects which have not been specifically authorized by Congress.

The proposed earthen dam would provide 100-year level of protection to Hatch. The storage capacity would be 181 acre-feet, including 30 acre-feet for sediment and 151 acre-feet for water. The dam would be 4,000 feet long, and the maximum height would be 20 feet. The earthen material would come from a borrow area in the proposed reservoir immediately behind the dam. Currently the borrow area contains a large leach field and a waterline, both of which would have to be removed and relocated. A 200-foot long spillway constructed of concrete and rip-rap will carry water to the existing Colorado drain. Factors that will enter into the final decision concerning whether or not a dam would be constructed include the hydrology, the benefit-cost ratio, cultural and environmental concerns, and local support. An existing 1000-foot long spoil-bank levee on the north side of the arroyo coming out of Spring Canyon and emptying into the proposed flood pool will be removed; a 1240-foot long channel will be excavated within that existing arroyo.

As part of the overall investigation, in April, 2006, archaeologists from the Office of Contract Archeology, University of New Mexico, conducted a review of the New Mexico Cultural Resource Information System (NMCRIS) and also an intensive, inventory survey of the proposed project area that could result if the construction of a flood control dam were to occur. The report is entitled *Archeological Survey and Testing for Proposed Hatch Dam and Flood Pool Construction, Doña Ana County, New Mexico* by Alexander Kurota. The NMCRIS review of a one-mile radius around the proposed project area found a total of seven known sites, two of which were irrigation canals within the proposed project. The on-the-ground survey included a total of 69.8 acres (28.3 hectares). Four new archaeological sites and nine isolated occurrences were documented. The records for the two previously recorded canals were updated. The two canals, the Rodey Lateral and the Colorado Spur Drain, are irrigation ditches that are part of the Elephant Butte Irrigation District, and they were previously determined eligible for the National Register of Historic Places (NRHP) under criterion "a".

Two sites, LA 152283 and LA 152284, are scatters of early historic (1912) through recent trash. The other two, LA 152981 and LA 152982, are prehistoric artifact scatters. The two prehistoric sites were tested to determine if subsurface cultural material were present and very little material was found. None of the four archaeological sites are considered eligible for the NRHP. The nine isolated occurrences are not considered eligible to the NRHP by virtue of the data recorded during the survey and their limited potential for additional NRHP information.

A brief description of the sites, isolated occurrences, a copy of the final report, and the site survey and other forms are enclosed. At this time no construction is planned. In the event that a flood control project at this location within the village limits of Hatch, New Mexico, comes to fruition, the Corps will initiate consultation with your office and provide information to the tribes.

If you need additional information or have question please concerning the study of the proposed flood control location in Hatch, New Mexico, please call John Schelberg at (505) 342-3359. Thank you very much for your attention to this matter.

Sincerely,

Julie Alcon
Chief, Environmental Resources
Section

12/5/07
Date

I concur
For Katherine Slick
New Mexico State Historic
Preservation Officer

Enclosures

Copy furnished (w/o enclosures):

Don Klima, Director
Office of Federal Agency Programs
Advisory Council on Historic Preservation
1100 Pennsylvania Avenue, NW Suite 809
Washington, D.C. 20004

92445

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
4101 JEFFERSON PLAZA NE
ALBUQUERQUE NM 87109-3435

June 30, 2011

Planning, Project and Program Management Division
Planning Branch
Environmental Resources Section

RECEIVED
JUL 5 2011
Bob
HISTORIC PRESERVATION DIVISION

Ms. Jan Biella
Interim State Historic Preservation Officer
New Mexico Department of Cultural Affairs
Historic Preservation Division
Bataan Memorial Building
407 Galisteo Street, Suite 236
Santa Fe, New Mexico 87501

Dear Ms. Biella:

Pursuant to 36 CFR Part 800, the U.S. Army Corps of Engineers, Albuquerque District, (Corps) is seeking your concurrence with our determination that the two isolated occurrences located within the revised survey area in the proposed pool of a flood control dam within the village limits of Hatch, New Mexico, are not eligible for the National Register of Historic Places. A copy of the negative survey report (Enclosure 1; Corps report no. USACE-2011-004, NMCRIS# 121028) is enclosed for your review. This report serves as an addendum to the original survey of the proposed pool conducted by the University of New Mexico Office of Contact Archaeology (OCA) in 2006 entitled *Archeological Survey and Testing for Proposed Hatch Dam and Flood Pool Construction, Doña Ana County, New Mexico* by Alexander Kurota (NMCRIS# 99460).

The Corps is conducting a series of studies in order to determine if there is sufficient justification for construction of a small earthen flood control dam within the village limits of Hatch, New Mexico. At this time no construction is planned. Hatch is very vulnerable to flooding especially during episodes of heavy rainfall. Additionally, the entire village of Hatch is within the 100-year floodplain of the Rio Grande, as is the proposed project. Significant flooding occurred in 1988, 1992, and 2006. The Flood Control Act of 1948, Section 205, authorizes the Secretary of the Army, acting through the Chief of Engineers, to plan and construct small local flood protection projects which have not been specifically authorized by Congress.

The proposed earthen dam would provide 100-year level of protection to Hatch. The storage capacity would be 181 acre-feet, including 30 acre-feet for sediment and 151 acre-feet for water. The dam would be approximately 4,000 feet long, and the maximum height would be 20 feet. The earthen material would come from a borrow area in the proposed reservoir immediately behind the dam. Currently the borrow area contains a large leach field and a waterline, both of which would have to be removed and relocated. A 200-foot long spillway constructed of concrete and rip-rap will carry water to the existing Colorado drain. Factors that will enter into the final decision concerning whether or not a dam would be constructed include the hydrology, the benefit-cost ratio, cultural and environmental concerns, and local support. An existing 1000-foot long spoil-bank levee on the north side of the arroyo coming out of Spring Canyon and emptying into the proposed flood pool will be removed; a 1240-foot long channel will be excavated within that existing arroyo.

As part of the overall investigation, in April, 2006, archaeologists from the Office of Contract Archeology, University of New Mexico, conducted an intensive cultural resources survey of the proposed project area that could result if the construction of a flood control dam were to occur. The report is entitled *Archeological Survey and Testing for Proposed Hatch Dam and Flood Pool Construction, Doña Ana County, New Mexico* by Alexander Kurota. The survey included a total of 69.8 acres (28.3 hectares), and four new archaeological sites and nine isolated occurrences were documented. The Corps consulted with the New Mexico State Historic Preservation Officer (NMSHPO) in 2007, and your office concurred with the Corps' eligibility determinations on December 5, 2007 (HPD no. 082820).

In 2011, a review of the drawings for the proposed dam construction footprint showed that three areas fell outside of the 2006 OCA survey area. In response, Corps archaeologists conducted a cultural resources survey on June 1, 2011 to cover the additional areas. Corps archaeologists Jeremy Decker and Gregory Everhart surveyed a total of 12.95 acres, locating two isolated occurrences (Enclosure 2). No new or previously recorded sites were located. The isolates include one utilized chert flake, and a large piece of chalcedony shatter (Enclosure 3). Both were found within an active arroyo flood channel and no longer contain any contextual information. It is the opinion of the Corps that the information potential of these isolates is exhausted with recording, and the isolates are considered "not eligible" for inclusion in the National Register of Historic Places.

Consistent with the Department of Defense's American Indian and Alaska Native Policy of 1998, tribal letters were sent as part of the original survey project on February 16, 2007, to tribes with concerns for projects in Doña Ana County. Responses were received from the

Comanche Tribe and the Fort Sill, Chiricahua, Warm Springs Apache. No tribal concerns were raised at that time. No additional consultation was conducted as part of the 2011 survey, as the proposed undertaking has not changed and the footprint of the survey is small and only slightly extending the boundaries of the original survey area.

A copy of the final negative survey report, a brief description of the isolated occurrences, and project area maps are included with this letter. At this time no construction is planned. In the event that a flood control project at this location within the village limits of Hatch, New Mexico, comes to fruition, the Corps will initiate consultation with your office and provide information to the tribes.

In sum, we seek your concurrence in our eligibility determinations for the two isolated occurrences located in the current project. It is the opinion of the Corps that the information potential of the two isolated finds has been exhausted with recording, thus the artifacts are ineligible for inclusion in the National Register of Historic Places. If you need additional information or have question please concerning the study of the proposed flood control location in Hatch, New Mexico, please call Jeremy Decker at (505) 342-3671. Thank you very much for your attention to this matter.

Sincerely,

Gregory D Everhart

Acting for Julie Alcon
Chief, Environmental Resources Section

5 Jul 2011 — Date

I concur

Jan Biella
Interim New Mexico State Historic Preservation Officer

Enclosures

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
4101 JEFFERSON PLAZA NE
ALBUQUERQUE, NM 87109-3435

100814

February 5, 2015

Planning, Project and Program Management Division
Planning Branch
Environmental Resources Section

RECEIVED
Bob
HISTORIC PRESERVATION DIVISION

Dr. Jeff Pappas
State Historic Preservation Officer
Historic Preservation Division
Bataan Memorial Building
407 Galisteo Street, Suite 236
Santa Fe, New Mexico 87501

Dear Dr. Pappas:

Pursuant to 36 CFR Part 800, the U.S. Army Corps of Engineers (Corps), Albuquerque District, is seeking your concurrence with our determination that the construction of a flood control dam within the village limits of Hatch, New Mexico, will result in "no adverse effect to historic properties". The Corps is proposing to construct a small earthen flood control dam within the village limits of Hatch, New Mexico (Enclosure 1). Hatch is very vulnerable to flooding especially during episodes of heavy rainfall. Significant flooding occurred in 1988, 1992, and 2006. The Flood Control Act of 1948, Section 205, authorizes the Secretary of the Army, acting through the Chief of Engineers, to plan and construct small local flood protection projects which have not been specifically authorized by Congress.

The proposed earthen dam would provide 100-year level of protection to Hatch. The storage capacity would be 305 acre-feet. The dam would be 4,191 feet long, and the maximum height would be 22.6 feet. The earthen material would come from a borrow area in the proposed reservoir immediately behind the dam. A 350-foot wide spillway constructed of roller-compacted concrete will carry water to the existing Colorado Spur Drain and Rodey Lateral in the event that the dam is overtopped; however, a gated outlet structure will release flows from the dam into Colorado Drain in a controlled fashion for most flows. The outlet structure will require burying a rectangular, concrete outlet works conduit under the existing Rodey Lateral, and placing approximately 60 feet of wire-wrapped rip rap within the channel of the Colorado Drain in order to protect the channel as flows are released. A 1319-foot long rip rap-lined channel will be excavated within Spring Arroyo which flows along the east side of the project area in order to direct flood flows from the arroyo into the flood pool. Enclosure 2 shows the complete layout of the dam within the project area.

Two previous archaeological investigations have taken place that, in aggregate, cover the entire project area. In April of 2006, archaeologists from the Office of Contract Archeology, University of New Mexico (OCA), conducted an intensive cultural resources survey of the majority of the proposed project area. The results of the survey were documented in a report titled, *Archeological Survey and Testing for Proposed Hatch Dam and Flood Pool Construction, Doña Ana County, New Mexico* by Alexander Kurota (NMCRIS # 99460). The survey included a total of 69.8 acres, and four new archaeological sites (LA 152981, LA 152982, LA 152983 and LA 152984) and nine isolated occurrences were documented. The Corps consulted with the New Mexico State Historic Preservation Officer (SHPO) in 2007, and your office concurred with the Corps' determination that the four newly recorded sites and nine isolated occurrences are not eligible for listing in the National Register of Historic Places (NRHP) on December 5, 2007 (HPD no. 082820; Enclosure 3). OCA also documented the historic Rodey Lateral (LA 120285) and Colorado Spur Drain (LA 120284). These sites were originally recorded in 1997 by the Archaeological Services of Laura Michalik. Both of these ditches are historic, earth-lined irrigation ditches (See Kuroda 2006 for cross section drawings and photographs; see also Enclosure 4), and both have the potential to be impacted by the project as designed. In addition to the OCA survey, the Corps returned to the project area in 2011 to survey an additional 12.95 acres. This survey was documented in a report by Jeremy T. Decker titled, *A 12.95-Acre Supplemental Cultural Resource Inventory for the Proposed Hatch Dam, Dona Ana County, New Mexico* (NMCRIS # 121028). This survey located two isolated occurrences which were determined to be ineligible for listing in the NRHP. The Corps consulted with your office in 2011, and your office concurred with the Corps' eligibility determination on July 5, 2011 (HPD no. 92445; Enclosure 3).

Consistent with the Department of Defense's American Indian and Alaska Native Policy of 1998, tribal letters were sent as part of the original survey project on February 16, 2007, to tribes with concerns for projects in Doña Ana County. Responses were received from the Comanche Tribe and the Fort Sill Apache Tribe. No tribal concerns were raised at that time. No additional consultation was conducted as the proposed undertaking has not changed except for minor design changes.

The project has the potential to affect both the Rodey Lateral and the Colorado Spur Drain. Both of these historic properties are owned and operated by the Elephant Butte Irrigation District (EBID), and both are listed in the NRHP as contributing elements to the EBID (NR# 97000822). EBID is being consulted as a stakeholder and supports the project. The impact will occur at the junction between the two ditches directly below the dam to the north. At present, water from the proposed flood pool drains through a culvert under Rodey Lateral and into the Colorado Spur Drain. The Corps is proposing to retain this overall structure and function and use this point for the outlet structure of the dam. Work in this area would include modifying the existing culvert under the Rodey Lateral into a similar concrete outlet works conduit that would carry water from the flood pool, under the dam and the Rodey Lateral and release it into the Colorado

Spur Drain (Enclosure 5). Because this work will be completely buried under the Rodey Lateral and the ditch will be returned to its present, earth-lined form; and because the function, alignment and character of the Rodey Lateral will not change as a result of the project, the Corps is of the opinion that the project will result in "no adverse effect" to the Rodey Lateral. Within the Colorado Spur Drain, an approximately 60-foot section of wire-wrapped rip rap will be necessary in order to protect the ditch from erosion at the point at which flows area released through the outlet works into the ditch (Enclosure 5). Currently this outlet point is unlined and requires extensive maintenance due to erosion during high flows. The existing concrete headwall and apron will also need to be replaced where the pipe daylights into the ditch. Replacement of the concrete headwall and apron will be in kind and will not alter the appearance, function or character of the ditch. While these modifications do alter a small portion of the Colorado Spur Drain, the impact is minimal as only 60 of the 9,000-foot length of the ditch will be impacted, amounting to less than one percent of the total length. In addition, the construction of the dam will allow flood flows into these historic ditches to be regulated. Currently these flows can back up against the Rodey Lateral and run unchecked into the Colorado Spur Drain causing significant damage and requiring the ditches to be repaired. With the dam in place, flows will be captured and released into the Colorado Spur Drain at levels the ditch can handle without causing damage. For this reason, the Corps believes the project will have a beneficial effect for both the Rodey Lateral and Colorado Spur Drain and the Corps determines that the project will result in "no adverse effect" to either the Rodey Lateral or the Colorado Spur Drain.

In sum, we seek your concurrence in our determination of effect for the proposed dam construction project. If you need additional information or have questions concerning the proposed construction of a flood control dam in Hatch, New Mexico, please call Jeremy Decker at (505) 342-3671. Thank you very much for your attention to this matter.

Sincerely,

Julie Alcon
Chief, Environmental Resources Section

Enclosures

March 9, 2015 Concur for
Date Dr. Jeff Pappas
State Historic Preservation Officer

Small Flood Risk Management Project Hatch, NM

Appendix E

Environmental Engineering

February 2015

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Albuquerque District

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Executive Summary

In 2006 an initial Phase 1 Environment Site Assessment (Phase 1 ESA) was conducted at the site to determine whether there were any known environmental negative impacts. The Albuquerque District of the United States Army Corps of Engineers (USACE) retained Cornerstone Consulting Associates, LLC, to perform the Phase I ESA.

The ESA was prepared according to the American Society for Testing and Materials (ASTM), *Standard Practice for Environmental Site Assessments, Phase I Environmental Site Assessment Process* (Designation E1527-00); the Comprehensive Environmental Response, Compensation, and Liability Act Section 120(h); the USACE *Hazardous, Toxic, and Radioactive Waste (HTRW) Guidance for Civil Works Projects* (ER 1165-2-132); as well as standard industry methodology.

Information obtained through records review, interviews, and Site observations revealed no specific evidence of disposal or release of hazardous, toxic, radiological wastes (HTRW) or substances, including petroleum products or derivatives.

In 2010, USACE Environmental Engineering and Geotechnical Engineering staff made a site visit in preparation of developing an addendum to the initial Phase I ESA. USACE staff met with Mr. Paul Dugie of the Doňa Ana County Flood Commissioner's office. Of particular interest at the dam site, was a sewage leach field. The leach field is located in an area that will be directly beneath the western embankment of the dam. Since the publication of the original Phase I ESA, Doňa Ana County purchased the land where the leach field is located. Mr. Dugie informed USACE that the leach field is no longer in service and all the houses that it served are now on individual septic systems or converted to the Hatch sewer system. When the Hatch Dam project is authorized, Doňa Ana County Flood Commission will remove the leach field.

In 2014, USACE prepared an addendum to the initial 2006 Phase I ESA. The addendum comprises a summary of the initial Phase I ESA, a 2010 property inventory/records search and a 2014 property inventory/records search to identify any potential negative environmental impacts. The initial records search presented in the 2006 Phase I ESA was compared to the 2010 and 2014 records to identify any changes or new listings. Information obtained through these records revealed no specific evidence of disposal or release of HTRW or substances, including petroleum products or derivatives. The location of the proposed dam is free of any known negative environmental impacts

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Small Flood Risk Management Project Hatch, NM

APPENDIX E-3

PHASE I ENVIRONMENTAL ASSESSMENT ADDENDUM

for the

NORTH SPRING CANYON DAM SITE

HATCH, NEW MEXICO

February 2015

DRAFT

US Army Corps
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Albuquerque District

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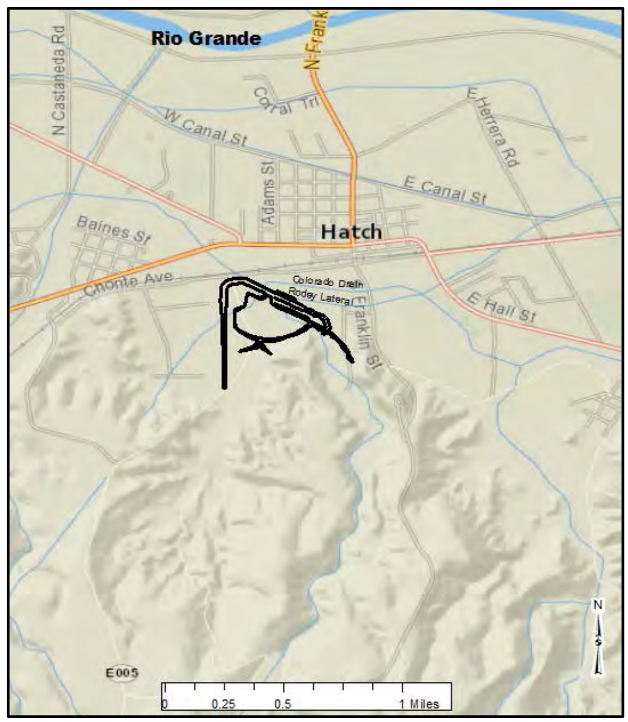
1 - INTRODUCTION

The purpose of this addendum is to verify the status of facilities surrounding the proposed North Spring Dam site. In November 2006, the Final Report for the Phase I Environmental Site Assessment (Phase I ESA) was completed (Cornerstone 2006). The findings of the Phase I ESA was that no hazardous substances or wastes, including petroleum products and derivatives, were stored, released, or disposed of on this property. However, Recognized Environmental Conditions (REC) were identified. These RECs included debris, stagnant standing water, and a septic system leach field. This addendum verifies conditions at and near the proposed Hatch North Spring Dam site as of November 2014 (Cornerstone 2006).

2 - SITE LOCATION

The proposed dam is located approximately 1/2 –mile southwest of the village of Hatch center in Doña Ana County New Mexico (*Figures 1 and 2*). The proposed dam site will be an earthen dam whose outlet will flow into the Carlsbad Irrigation District's Colorado Drain to convey flood water to the Rio Grande.

Figure 1: Hatch Geographic Location



3 - SITE RECONNOITER

On 3 June 2010, the U.S. Army Corps of Engineers (USACE) conducted a site reconnoiter, and met with Mr Paul Duggie, the current property owner representative (Henry 2010). Dana Anna County Flood Control Commission currently owns the land (Henry 2010). The primary purpose of the site visit was to observe conditions of the dam impoundment area where an abandoned

Figure 2: Dam Locati0n and Approximate Footprint

septic system leach field is located (referred to as the leach field) and where standing water was observed during the original Phase I ESA (Cornerstone 2006). No standing water was noted within the area of the leach field area. However, standing water was noted on the east side the proposed impoundment area.

The leach field is located within the foot print of the dam. Since the publication of the original Phase I ESA, Dana Anna County has purchased the property and is responsible for the septic system and leach field (Henry 2010). The septic system and its appartenances are currently not in use and will be removed by the current landowner before construction of the dam (Henry 2010).

No other RECs were noted, and there was no evidence of hazardous substance and/or wastes. No hazardous products and/0r derivatives have been released in the past, or currently being released, stored, or disposed of within the boundaries of the proposed dam and impoundment area. However, there was standing water noted on the east side of the proposed impoundment area. There were markers indicating that a water main was buried beneath the proposed water impoundment area (Figure 3). It appeared at the time that the water main had been leaking for a prolonged period (Figure 4). Geographic Positioning System (GSP) coordinates were taken at three water line markers. These water line markers were directly in line with a municipal water tank approximately 3,690 feet to the southwest. The water main and leach field were the only notable aspects of the site recon. The water line and standing water are shown in Figure 3 and 4, respectively.

Figure 3: Suspected Water Main Location

Figure 4: Water Line Marker and Standing Water

4 - RECORDS REVIEW

Since the original Phase I ESA, two reports were ordered and received from Environmental Data Resources, Inc. (EDR 2010, EDR 2014). One report was ordered in June of 2010 and the other was order and received in November 2014. A side-by-side comparison was performed for each EDR and to the original Phase I ESA records search package to determine if new environmental concerns appeared in the new data sets. To the best of our knowledge, no REC are located with a 1-mile radius of the site. The EDR reports are in Appendix A of this addendum. The original Phase I ESA documents three Underground Storage Tanks (UST) that were removed from the Hatch Conoco station, two removed USTs from the Webb home, two removed USTs from Hatch Auto Electric, one removed UST from the Village of Hatch (with a no further action [NFA] status), 6 USTs at the Pic Quick 34 (3 removed and 3 in use) with a NFA on a LUST (leaking UST). Additionally, the original Phase I ESA documents five LUST cleanup sites at Halsells Grocery, Hatch Exxon (B&M), Hillger Oil, the Webb Home, the Village of Hatch, and at Pic Quick 234. In 2010, the EDR report documents one site in the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS), three USTs, one Above-Ground Storage Tank (AST), and six LUSTs within one mile of the proposed dam site. The 2014 EDR documents the same CERCLIS facility, the same six LUSTs, only two USTs, and one AST. The table below is a comparison of the three records searches and the current status of each of the listed facilities. All the sites documented in Table 1 are down gradient of the proposed dam and not considered a REC. These sites are documented in federal and state records. To the best of our knowledge, there are no groundwater plumes associated with these identified facilities. The proposed dam site is free of any known environmental hazards, as defined by RCRA, CERCLA, UST Programs, Lust Programs, programs that fall under the jurisdiction of Toxic Substance Control Act (TSCA).

Table 1: Facilities within a 1-Mile Radius of the Proposed Dam Site

SITE NAME	ADDRESS	SITE TYPE	RELATIVE ELEVATION	DIRECTION	DISTANCE (MILE)	2006 PHASE 1 ESA	2010 EDR	2014 EDR	CURRENT STATUS
Hatch Exxon(B&M)	410 W Hall	LUST/AST	Down Gradient	NNW	1/8 to 1/4	X	X	X	Removed and In Use
Hatch Exxon	410 W Hall	UST, AST	Down Gradient	NNW	1/8 to 1/4	X	X	X	Removed and In Use
Hatch Conoco	430 W Hall	UST	Down Gradient	NNW	1/8 to 1/4	X	X	X	Removed/NR
Hillger Oil	430 W Hall	LUST	Down Gradient	NNW	1/8 to 1/4	X	X	X	Unknown
Hatch Conoco	515 West Hall Street	LUST	Down Gradient	NNW	1/8 to 1/4		X	X	Removed/ NFA
Halsells Grocery	101 School Rd	LUST, UST	Down Gradient	NNE	1/8 to 1/4	X	X	X	Removed/NR
Village Market	101 School Rd	Dry Cleaner	Down Gradient	NNE	1/8 to 1/4		X		Unknown
Halsell's Grocery	112 School Street	LUST	Down Gradient	NNE	1/8 to 1/4	X			Removed/NR
Webb Home	104 Wilson	LUST	Down Gradient	NE	1/8 to 1/4	X	X	X	Removed/ NFA
Village Hatch	112 Franklin	LUST	Down Gradient	ENE	1/8 to 1/4	X	X	X	Removed/ NFA
Pic Quik #234	202 Franklin	LUST	Down Gradient	NE	1/8 to 1/4	X	X	X	Removed/ NFA

SITE NAME	ADDRESS	SITE TYPE	RELATIVE ELEVATION	DIRECTION	DISTANCE (MILE)	2006 PHASE 1 ESA	2010 EDR	2014 EDR	CURRENT STATUS
Pic Quick 234	205 North Franklin S	LUST	Down Gradient	NE	1/8 to 1/4	X	X	X	Removed/ NFA
El Paso Electric Co.	607 Franklin	SCS/CERLIS	Down Gradient	NNE	1/2 to 1		X	X	Soil Excavation/ Closed
BN&SF Railroad	100 Railroad Avenue	RCRA-SQG	Down Gradient	NW	1/4	X			NV
Hatch Auto Electric	104 W Hall	UST	Down Gradient	NNW	1/8 to 1/4	X			Removed

UST – Underground Storage Tank
AST – Aboveground Storage Tank
LUST – Leaking Underground Storage Tanks
NR – No Further Action Date Not Reported
NFA – No Further Action
NV – No Violations
RCRA – Resource Conservation and Recovery Act
SQC – Small Quantity Generator
SCS – State Cleanup Site – CERCLIS Equivalent
X – Documented In This Report

5 - INTERVIEWS

According to Mr. Paul Duggie, the houses that were serviced by this septic system have been disconnected. Mr. Paul Duggie stated that Dona Anna County will remove the septic system, leach field, and all appartenances before construction the Hatch North Spring Dam (Henry 2010).

6 - CONCLUSION

In 2006, the original Phase I ESA was conducted by Cornerstone Consulting Associates, LLC on behalf of USACE. In 2010, USACE ordered an EDR report to determine if site condition changed. Additionally, USACE conducted a site reconnoiter and met with the current land owner of the land where the dam will be constructed. A trip report of the reconnoiter is in Appendix A-2, titled *Hatch Dam Site Visit*. In November of 2014, USACE ordered an additional ERD report and performed a desktop review and wrote this addendum to the original Phase I ESA. For this addendum, a review of the EDR report was conducted to determine if addition significant-negative, moderate-negative, or low- to negligible-negative recognized environmental conditions developed between November 2006 and November 2014. The appendix to this addendum contains EDR Radius Map™ Report with GeoCheck® and historical aerial photographs. To the best of our knowledge no significant-negative, moderate-negative, low- to negligible-negative, or recognized environmental conditions developed between November 2006 and November 2014 other than what is documented in the original Phase I ESA.

7 - REFERENCES

ASTM, 2000 American Society for Testing and Materials. Standard E1527-00 - Standard Practice for Environmental Site Assessments. 2000.

Cornerstone, 2006 Cornerstone Consulting Services, Final Report Phase I Environmental Site Assessment for the North Spring Dam, November 2006.

Henry, 2010, Hatch Dam/ Placitas Arroyo Site Visit Trip Report, U.S. Amry Corps of Engineers, Albuquerque District, June 2010.

EDR, 2010 Environmental Data Resources, Inc, Radius Maps Report with GeoCheck for Hatch Spring Dam, Inquiry Number 2798822.2s, July, 2010.

EDR, 2014 Environmental Data Resources, Inc, Aerial Photo Decade Package for Hatch Spring Dam, Inquiry Number 4140193.5, November 2014.

EDR, 2014 Environmental Data Resources, Inc, The EDR-City Directory Image Report for Hatch Spring Dam, 4140193.6, November 2014.

EDR, 2014 Environmental Data Resources, Inc (EDR), 2014 Radius Maps Report with GeoCheck for Hatch Spring Dam, Inquiry Number: 4140193.2s, November 2014.

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APPENDIX A

Small Flood Risk Management Project Hatch, NM

APPENDIX E-2

2010 Hatch Dam/ Placitas Arroyo Site Visit Trip Report

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Albuquerque District

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Hatch Dam/ Placitas Arroyo Site Visit
Geotech and Environmental Engineering
Date: June 3, 2010

USACE Representatives: David Henry and Bruce Jordan

We arrived in Hatch at approximately 1030 and meet with Mr. Paul Dugie of the Doňa Ana County Flood Commissioner's office. We (USACE) were escorted by Mr Dugie to the two drainage areas (Placitas Arroyo and Glen Springs Arroyo). We first visited the County Rd 314 (Canal Road) Bridge that crosses the Placitas Arroyo. The old, concrete culvert, bridge is still in place. However, Mr Dugie informed us that the bridge will be replaced by a low-water crossing. This will alleviate the debris build-up that occurs at this location during high water/flow events in the Placitas Arroyo. The exact schedule for replacing the bridge was not provided, but the plan is approved and awaiting funds.

We then visited the Highway NM 187 that crosses the Placitas Arroyo. This bridge is new that replaced an old wooden trestle. As with the proposed low-water crossing, the new bridge will restrict less surface water flow during high water/flow events.

We also viewed the repaired "levee" that breached during the 2006 flood. We noted that the "levees" on the Placitas are not FEMA certified structures. The breach has been repaired, though. Mr. Dugie also informed us that the surrounding surface elevation of farmland is generally lower than the surface elevation of the Placitas Arroyo channel. Mr. Dugie also pointed out that an automated flow meter had been installed on the bank of the Placitas Arroyo, upstream of the Deming Highway crossing. This was installed by the Elephant Butte Irrigation District.

According to Mr. Dugie, the two aforementioned bridges contributed significantly to the flooding that occurred in 2006. The replacement bridge on NM 187 and the planned low-water crossing on Canal Rd will alleviate restrictions at these two crossings, and allow surface water to flow downstream during significant high water/flow events and will also allow for more frequent maintenance within the channel.

After walking the Placitas Arroyo, we visited the Hatch Dam Site. The primary purpose for the trip was to update the Phase I Environmental Assessment conducted in November 2006. Of particular interest at the dam site, is the sewage leach field. The leach field is located in an area that will be directly beneath the western embankment of the dam. Since the publication of the original Phase I, Doňa Ana County has purchased the land where the leach field is located. Mr. Dugie told us that the leach field is no longer in service and all the houses that it served are now on individual septic systems or converted to the Hatch sewer system. When the Hatch Dam project is authorized, Doňa Ana County Flood Commission will remove the leach field. There were no hazardous waste issues noted during the site visit, and there was no standing water near the leach field. An addendum to the Phase 1 will be prepared for the Hatch Dam Project after a review of a new environmental data base search, in accordance with ATSM E1527-00.

APPENDIX E-1

FINAL REPORT
PHASE I ENVIRONMENTAL SITE ASSESSMENT
for the
NORTH SPRING DAM SITE
HATCH, NEW MEXICO

Contract No. WP912PP-06-P0112
November 2006

Prepared for:
U.S. Army Corps of Engineers
Albuquerque District
4101 Jefferson Plaza, NE
Albuquerque, New Mexico 87109

Prepared by:
Cornerstone Consulting Associates, LLC
36 Sierra Blanca Road
Cedar Crest, New Mexico 87008

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EXECUTIVE SUMMARY

The Albuquerque District of the United States Army Corps of Engineers (USACE) retained Cornerstone Consulting Associates, LLC, to perform a Phase I Environmental Site Assessment (ESA) on a parcel of property proposed for the construction of the North Spring Dam. The North Spring Dam Site (the Site) is located just south of the Village of Hatch within Doña Ana County New Mexico.

The ESA was prepared according to the American Society for Testing and Materials (ASTM), *Standard Practice for Environmental Site Assessments, Phase I Environmental Site Assessment Process* (Designation E1527-00); the Comprehensive Environmental Response, Compensation, and Liability Act Section 120(h); the USACE *Hazardous, Toxic, and Radioactive Waste (HTRW) Guidance for Civil Works Projects* (ER 1165-2-132); as well as standard industry methodology.

Information obtained through records review, interviews, and Site observations revealed no specific evidence of disposal or release of HTRW substances, including petroleum products or derivatives. However, the following recognized environmental conditions were identified:

- A domestic wastewater leach field system is located on the Site. State officials indicated that the leach field has overflowed causing mosquito and health problems. Wastewater samples were collected in the vicinity of the leach field (the exact location not documented) in late August 2004, and were analyzed for volatile organic compounds (VOCs), metals, and inorganic compounds. The analyses detected trace concentrations of 2-butanone (methyl-ethyl-ketone), toluene, tetra-hydro-furan, ammonia, and organic nitrogen. None of the chemical concentrations detected exceeded New Mexico Ground Water Quality Control Commission standards for groundwater.
- The Site reconnaissance identified a dump and debris area just west of the Site. The pile consisted of wooden pallets, tires, concrete, and some household trash. No evidence of HTRW, including petroleum products was observed during the Site reconnaissance.
- The exact locations of the septic tanks and leach fields in El Milagro could not be located and may be present on the Site.

The Site property encompasses approximately 100 acres in area and is described as the northwest quarter of Section 16, Township 19 South, Range 3 West, New Mexico Principal Meridian. The Site is undeveloped with the exception of irrigation works. The irrigation works include underground water pipeline that transports water between the Colorado Drain-Rodey Lateral and two above ground water storage tanks located southwest of the Site. No buildings or other utilities are located on the property. Ranching (cattle grazing) is the only former use of the property identified.

The domestic wastewater leach field system is located along the western portion of the Site, extending into the central portion of the Site. The system serves the neighboring subdivision of El Milagro to the south. According to the New Mexico Environment Department, the wastewater system overflows and ponds, causing mosquito problems and health concerns.

During the Site reconnaissance, a large area of standing water was observed in the northwestern corner and northwest of the Site. The water had a greenish color, possibly from algae and other vegetation, and emitted a strong septic odor. The recent heavy rainfall and flooding in the area likely contributed to the standing water. However, overflowing leach lines from septic tanks have been reported in the area and may have contributed to the standing water and odor.

Observations during the Site reconnaissance found no evidence of stained soil, stressed vegetation, or chemical films on water. Note that the Site was not entirely visible due to the thick vegetation cover, standing water, and mud due to recent flooding in the area.

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1.0 INTRODUCTION

The Albuquerque District of the United States Army Corps of Engineers (USACE) retained Cornerstone Consulting Associates, LLC to perform a Phase I Environmental Site Assessment (ESA) for the parcel of property considered in the North Spring Dam Feasibility Study. Information obtained through records review, interviews, and Site observations are presented in Sections 2.0 through 7.0. Section 8.0 provides the conclusions of the ESA. Section 9.0 lists the references cited in the report.

Phase I ESAs, such as the one performed for this Site, are of limited scope, are non-invasive, and cannot eliminate the potential that hazardous, toxic, or radioactive substances have been released at the Site. There may be additional information, not readily available, that documents environmental conditions not revealed during preparation of this report. New or subsequent facts including evolving knowledge of Site conditions and chemical effects on the environment and health may change the information and conclusions provided in this Report. Upon request, we will advise the USACE of additional research or assessment options that may be available to reduce the uncertainty of the presence and associated costs.

1.1 Site Description

The North Spring Dam Project Site (herein referred to as the Site) is located just south of the Village of Hatch within Doña Ana County New Mexico (*Figures 1 and 2*). The USACE is proposing to improve the Site with an earthen dam whose outlet will flow into the Carlsbad Irrigation District's Colorado Drain to convey flood water to the nearby Rio Grande (*Figure 3*). The Site improvements include removal of a spoil bank levee adjacent to a small arroyo that feeds into a proposed flood pool.

The Site property is described as the northwest quarter of Section 16, Township 19 South, Range 3 West, New Mexico Principal Meridian. The Site is approximately 100 acres and is presently undeveloped with the exception of earthen berms and irrigation works. The irrigation works include underground water pipeline that transports water between the Colorado Drain-Rodey Lateral and two above ground water storage tanks located southwest of the Site. No buildings or other utilities are located on the property.

1.2 Scope of Services

This ESA was performed according to the Scope of Work included in USACE Contract No. WP912PP-06-P-0112 dated July 18, 2006. The Scope of Work specifies that the ESA be prepared according to the American Society for Testing and Materials (ASTM) Standard E1527-00 - *Standard Practice for Environmental Site Assessments (ASTM, 2000)*; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 120(h) – *Property Transferred by Federal Agencies (CERCLA, 2002)*; the USACE Environmental Regulation (ER) 1165-2-132 - *Hazardous, Toxic, and Radioactive Waste (HTRW) Guidance for Civil Works Projects (USACE, 1992)*; and standard industry methodology.

The purpose of this ESA is to assist the USACE in developing information to identify *recognized environmental conditions* (RECs) in connection with the Site (*ASTM, 2000*). The information was developed through a regulatory database review, historical and physical records review, interviews including local government inquiries as applicable, and a visual non-invasive reconnaissance of the Site and adjoining properties.

1.3 Standard of Care

This ESA was performed in accordance with generally accepted practices of the environmental assessment profession. We have endeavored to meet the standard of care recommended in ASTM E1527-00, but are limited by time constraints and Site conditions.

1.4 Additional Scope Limitations and ASTM Exceptions

Based upon the agreed-on scope of services, this ESA did not include subsurface or other invasive assessments, business environmental risk evaluations, or other services. Reasonable attempts were made to obtain information within the scope and time constraints set forth by the Contract; however, in some instances, information requested was not received by the issuance date of the report.

Information obtained for this ESA was received from several sources that we believe to be reliable; nonetheless, the authenticity or reliability of these sources cannot be ensured. Purchase price data, specialized knowledge or experience, activities and land use limitations, and environmental lien information were not provided by the USACE for evaluation.

The majority of the Site was inaccessible during the Site reconnaissance due to the presence of standing water, mud, and dense vegetation. Many weeks of heavy precipitation and local area flooding preceded the Site reconnaissance.

1.5 Reliance

This ESA report has been prepared for the exclusive use and reliance of the USACE for studying the feasibility of the North Spring Dam. Reliance by any other party is prohibited without the written authorization of the USACE.

Findings in this report are based upon the Site's current condition. Certain indicators of the presence of hazardous substances may be latent, inaccessible, un-observable or not present during the Site reconnaissance and may become observable after Site development.

2.0 PHYSICAL SETTING

The following table summarizes the physical setting of the Site and surrounding area. The general physical conditions of the Site are depicted in Figures 1 and 2.

Table 1. Physical Setting

FEATURE	DESCRIPTION	Reference
Site Elevation	Approximately 4,050 to 4,060 feet above mean sea level (amsl)	USGS, 1978
Surface Runoff/ Topographic Gradient	North	
Closest Surface Water	River – The Rio Grande is approximately 1 mile to the north.	
Flood Plains		
Zone	Site is in 100-year flood zone	EDR, 2006b FEMA, 2006
Description	Site is inundated by 100-year flood, no base flood elevations determined.	
Soil Characteristics		
Formations	Majority of Site composed of Nickel, Canutio, Glendale, Pajarito, Armijo, and Anthony soil formations from the surface to five feet depth.	EDR, 2006b
Descriptions	The above soil formations consist of gravels, silty gravels, clayey gravels, sands, silty sands, silts, and clays. The soil textures range from gravelly-sandy loam to clay loam. The soils have moderate infiltration rates, with the exception of the Armijo soils, which have very slow infiltration rates. All of the soils are well drained.	
Geology/Hydrogeology		
Physiographic and Geologic Description	The Site and the Village of Hatch lie within the floodplain of the Rio Grande. The Rio Grande is located approximately one mile north of the Site. The floodplain ranges between approximately 4,050 and 4,060 feet amsl. The floodplain is bordered on the north and south by mountain ranges: the Rincon Hills and Caballo Mountains to the north and the Sierra de los Uvas to the south. The elevations in the mountain ranges are from 4,060 to greater than 5,400 feet amsl. The floodplain of the Rio Grande is composed of late Quaternary fluvial deposits, which include gravels, sands, silts, and clays. These deposits fill the channel cut into the Tertiary-age Rincon Valley Formation, part of the Santa Fe Group. The Rincon Valley Formation is composed of fanglomerate deposits and basin-floor red beds (reddish colored sedimentary rocks).	Figure 1 (FEMA, 2006; USGS, 1978)
Depth to First Occurrence of Groundwater	Estimated to be 18 feet below ground surface (bgs) based on installation of water wells to the east of the Site. Groundwater elevation in Hatch ranges from approximately 8 feet bgs to approximately 12 feet bgs, depending on the height of water in the Rio Grande. During heavy precipitation, groundwater elevations may be higher.	See Section 4.2 (EDR, 2006b; BEI, 2006)
Groundwater Gradient*	North	See Figure 1
Site Water Source	None	

*The groundwater flow direction and the depth to shallow groundwater, if present, would likely vary depending upon seasonal variations in rainfall and the depth to the soil/bedrock interface. Without the benefit of on-Site groundwater monitoring wells surveyed to a datum, groundwater depth and flow direction beneath the Site cannot be ascertained.

3.0 HISTORICAL USE INFORMATION

The following paragraphs describe the readily available information used to evaluate the past use of the Site. The information includes topographic maps, aerial photographs, and interviews. None of the historical use information evaluated for this ESA documented a release or use of HTRW on the Site. However, RECs were identified.

3.1 Historical Topographic Maps

U.S. Geological Survey (USGS) historical topographic maps were obtained from Environmental Data Resources, Inc. (EDR), a contract information services company. The maps were reviewed to assist in identification of RECs in connection with the Site. The historical topographic maps and interpretation are summarized in the following table and are included in Appendix A (*EDR, 2006a*).

Table 2. Topographic Map Review Summary

USGS Map/Date	Direction	Description
Hatch, NM 1959 Scale: 1:24,000	Site	Colorado Drain and Rodey Lateral present in northeastern portion of Site. Few drainages present.
	North	Atchison Topeka and Santa Fe (A.T.S.F.) Railroad and western portion of Village of Hatch. Eastern portion of Village of Hatch to northeast. Community of Placitas to northwest.
	South	Undeveloped and Sierra de los Uvas. Six structures labeled “water” (likely above ground water storage tanks) to the southwest.
	East	Few structures, likely homes, present in future Amery Powers subdivision.
	West	Undeveloped.
Hatch, NM 1978 Scale: 1:24,000	Site	Colorado Drain and Rodey Lateral present in northeastern portion of Site. Few drainages present.
	North	A.T.S.F. Railroad and western portion of Village of Hatch. Eastern portion of Village of Hatch to northeast. Community of Placitas to northwest.
	South	Undeveloped and Sierra de los Uvas. Three structures labeled, “water tanks,” to the southwest.
	East	Many more structures present – appears to be what is now called the Amery Powers subdivision.
	West	Undeveloped.
Hatch, NM 1996 Scale: 1:24,000	Site	Colorado Drain and Rodey Lateral present in northeastern portion of Site. A structure is present in east-central portion of Site along trail running north-south through Site. Aqueduct running northeast-southwest in eastern and southern portion of Site, from Rodey Lateral to water storage tanks. Few drainages present.
	North	A.T.S.F. Railroad and western portion of Village of Hatch. Eastern portion of Village of Hatch to northeast. Community of Placitas to northwest.
	South	Undeveloped and Sierra de los Uvas. Two structures labeled, “water tanks,” to the southwest.
	East	Several more structures present in the Amery Powers Subdivision. More structures south of the subdivision, southeast of the Site, with expanded roads/trails.

	West	El Milagro housing community appears to be present, with many structures along roads/trails.

Based on review of historical topographic maps, the Colorado Drain and Rodey Lateral were present in the northern portion of the Site as far back as 1959. In 1996, an unknown structure appears to be present in the east-central portion of the Site. It should be noted that no similar structure was observed on the Site during the September 2006 Site reconnaissance. An aqueduct linking the Rodey Lateral and the area of the water storage tanks southeast of the Site appears to be present on the Site by 1996. This feature was not observed during the September 2006 Site reconnaissance. According to communications with Mr. Robert Avalos, who is the Survey Party Chief for the Doña Ana County Flood Commission, there is no conveyance channel on the Site, just the underground piping linking the water storage tanks to the Rodey Lateral and Colorado Drain.

The Atchison, Topeka, and Santa Fe (A.T.S.F.) Railroad and the Village of Hatch, located north of the Site, are present in 1959. The Amery Powers subdivision currently present east of the Site does not appear to have been developed prior to 1978; however, a few structures (presumably houses) were present east of the Site in 1959 in the area of the future subdivision. The El Milagro housing community currently present just west of the Site does not appear to have been developed until 1978; the community is present in the 1996 topographic map. The two water storage tanks currently present southwest of the Site did not appear to be present in their current position until after 1978. In the 1959 and 1978 topographic maps, several structures are present in the general area of the current water storage tanks. The area south of the Site appears to have been undeveloped in all of the topographic maps reviewed.

3.2 Historical Aerial Photographs

Available historical aerial photographs were obtained from the University of New Mexico (UNM) Earth Data Analysis Center (EDAC) and the Doña Ana County Flood Commission. The photographs were reviewed to identify potential RECs associated with the Site. Photographic quality and scale limit evaluation of these photographs. The aerial photograph review is summarized in the following table. The aerial photographs are provided in Appendix C.

Table 3. Aerial Photograph Review Summary

Date & Scale	Direction	Description
1935 Scale:1:31,680	Site	Colorado Drain and Rodey Lateral present in northeastern portion. Faint trail in west-central portion. Trees/vegetation in southwestern portion. Drainages in eastern portion with small berm. Linear feature in southwestern portion. Sierra de las Uvas in southeastern portion. Evidence of agricultural development in northeastern portion.
	North	Evidence of agricultural development, A.T.S.F. Railroad, and few structures/roads. Village of Hatch present northeast of Site. Community of Placitas to northwest.

Table 3. Aerial Photograph Review Summary

Date & Scale	Direction	Description
	South	Drainages, trees/vegetation, and the Sierra de las Uvas.
	East	Drainages, trees/vegetation, few roads/trails, and agricultural development.
	West	Trees/vegetation, the Sierra de las Uvas, and a linear feature.
December 8, 1953 Scale: 1:54,000	Site	Colorado Drain and Rodey Lateral present in northeastern portion. Faint trail in west-central portion (less defined). Trees/vegetation in north-central and western portions. Drainages in eastern portion with more developed berm. Linear feature (less defined) in southwestern portion. Sierra de las Uvas in southeastern portion. Evidence of agricultural development in northeastern portion.
	North	Village of Hatch and A.T.S.F. Railroad, as well as evidence of agricultural development. Community of Placitas to northwest.
	South	Drainages, trees/vegetation, and the Sierra de las Uvas.
	East	Drainages, trees/vegetation, few structures and roads/trails, and agricultural development.
	West	Trees/vegetation, the Sierra de las Uvas, and a linear feature (less defined).
October 4, 1976 Scale: 1:80,000	Site	Colorado Drain and Rodey Lateral present in northeastern portion. Faint trail in west-central portion. Trees/vegetation in southwestern portion. Drainages and berm in eastern portion. Linear feature (less defined) in southwestern portion. Sierra de las Uvas in southeastern portion. Evidence of agricultural development in northeastern portion.
	North	Village of Hatch and A.T.S.F. Railroad, as well as evidence of agricultural development. Community of Placitas to northwest.
	South	Drainages, trees/vegetation, and the Sierra de las Uvas.
	East	Structures (subdivision), roads/trails, and some trees/vegetation, one agricultural development.
	West	Trees/vegetation, the Sierra de las Uvas, and a linear feature (less defined).
May 10, 1983 1:,200	Site	Colorado Drain and Rodey Lateral present in northeastern portion. Faint trail in west-central portion. Trees/vegetation in western portion of Site. Drainages and berm in eastern portion. Sierra de las Uvas in southeastern portion. Evidence of agricultural development in northeastern portion.
	North	Village of Hatch and A.T.S.F. Railroad, as well as evidence of agricultural development. Community of Placitas to northwest.
	South	Drainages, trees/vegetation, and the Sierra de las Uvas.
	East	Structures (subdivision), roads/trails, and some trees/vegetation. Some agricultural development.
	West	Trees/vegetation and the Sierra de las Uvas.

Table 3. Aerial Photograph Review Summary		
Date & Scale	**Direction**	**Description**
2005 1 meter resolution	Site	Colorado Drain and Rodey Lateral present in northeastern portion. Very faint trail in west-central portion. Faint trail in south-central portion (location correlates with that of aqueduct from 1996 topographic map). Dark area in northwest corner of Site. Trees/vegetation in north-central and southwestern portion. Drainages and berm in eastern portion. Sierra de las Uvas in southeastern portion. Evidence of agricultural development in northeastern corner.
	North	Village of Hatch and A.T.S.F. Railroad, as well as evidence of agricultural development.
	South	Faint trail (in location of aqueduct), drainages, trees/vegetation, and the Sierra de las Uvas. Structures to southeast and southwest.
	East	Structures (subdivision), roads/trails, and some trees/vegetation. Some agricultural development.
	West	Structures (El Milagro), roads/trails, and some trees/vegetation.

Review of aerial photographs revealed the following general development and use history of the Site:

- The aqueduct appears to have been developed on the property sometime between 1983 and 2005, but may have been present as far back as 1935. The aqueduct was not visible during the September 2006 Site reconnaissance.
- A trail feature that appears very faint in the 2005 photograph appears to have been present back to at least 1935.
- A dark area in the northwest corner of the Site appeared sometime between 1983 and 2005. This area appears to be the location of stagnant water observed during the September 2006 Site reconnaissance.
- The Colorado Drain and Rodey Lateral appear to be present back to at least 1935. The berm that is present in the eastern portion of the Site seems to have been partially developed by 1935, and appears to have been more fully developed sometime between 1935 and 1953. The northeastern portion of the property appears to have been developed for agricultural use sometime prior to 1935.
- The western portion of the Village of Hatch, north of the Site, appears to have been developed between 1935 and 1953; in 1935, the property to the north contained only a few structures and roads. The property north of the Site appears to have been developed for agricultural use prior to 1935. The eastern portion of the Village of Hatch

located northeast of the Site, and the community of Placitas located northwest of the Site, both appear to have been developed prior to 1935.

- Property south of the Site appears to have been undeveloped from 1935 to 2005 with the exception of the aqueduct discussed above. Property southeast and southwest of the Site appears to have been developed between 1983 and 2005.
- With the exception of a few roads and trails on the property east of the Site in 1935, the property appears to have been partially improved between 1935 and 1953, when a few structures appeared. The subdivision appears to have been developed between 1953 and 1976.
- Property west of the Site appears to have been developed sometime between 1983 and 2005.

3.3 City Directories

Since no physical address identifies the Site, city directories could not be searched for this ESA.

3.4 Historical Fire Insurance Maps

Sanborn Maps are used to identify construction materials of structures and gasoline storage tank locations. Based on the review by EDR (*Appendix A, EDR, 2006b*), Sanborn Maps were not available for the Site area.

3.5 Ownership Information

Based on information obtained from the Doña Ana County Flood Commission the Village of Hatch; Border Waterworks, LLC; the State of New Mexico; and Peter and Rosa Atencio are the owners of the Site (*Figure 4*). Prior owners of the site were not identified.

3.6 Historical Interviews

Mr. Robert Avalos (Survey Party Chief for the Doña Ana County Flood Commission) was interviewed during the Site reconnaissance. Mr. Avalos confirmed that a leach field is currently present on the Site. The leach field was usually dry, but due to the recent heavy rains some standing water was present in the leach field area as observed during the Site reconnaissance. Mr. Avalos believes the leach field lines run east and west, and that the area will be excavated for construction of the dam. A valve cover marked “Water Valve” (*See photograph 9 in Appendix D*) may be a septic cleanout, according to Mr. Avalos. Mr. Avalos was not aware of the date the leach field was installed. He also believed the previous owners of the Border Waterworks, LLC property were private landowners. To Mr. Avalos’ knowledge, no underground utilities are present on the Site.

The aqueduct that appears on the 1996 topographic map and aerial photographs is, according to Mr. Avalos, underground piping that connects the water storage tanks located southwest of the Site with the Rodey Lateral and Colorado Drain. The earth berm present just south of the Rodey Lateral is reportedly man-made.

Mr. Avalos indicated that the structure appearing in the 1996 topographic map, in the central portion of the Site, could have been a stock tank or feeding station. The Site was formerly used for cattle grazing. A road that was observed on the Site in topographic maps and aerial photographs was a ranch road that ran through the Site. The road is presently a narrow trail.

According to Mr. Avalos, the housing community west of the Site is called El Milagro, and the community utilizes septic tanks for wastewater disposal. The housing community to the east of the Site is reportedly called the Amery Powers subdivision, and is connected to the city sewer system. Mr. Avalos stated that the berm that runs southwest of the subdivision is man-made and diverts water away from the subdivision towards the Colorado Drain. The running water visible during the Site reconnaissance just south of the intersection of the Rodey Lateral and the Colorado Drain was part of the path of the water from the diversion dike (*See photograph 3 in Appendix D*).

Mr. Sasha Earl, President of Border Waterworks, LLC, was contacted regarding the septic system on their property (*BEI, 2006a*). Mr. Earl confirmed that the septic tank and drain field is currently on the Site, and approximately four to five homes are connected to it. The system was reportedly designed for the entire community of El Milagro, but, with the small number of homes actually connected, he believes that the system is well within it's capacity. The septic system was already constructed when he joined the company in 2000. The date on the engineering drawings provided by Mr. Earl is March 1998, so the system was likely constructed in 1998 or 1999 (*Naugles, 1998*).

According to Mr. Earl, the Village of Hatch is designing a force main to connect the residences of El Milagro to the village's wastewater plant. Once the force main is constructed, the current septic system on the Site will be abandoned. According to Mr. Earl, wastewater from the homes connected to the system is transferred by poly-vinyl chloride (PVC) piping to an approximately 2,000 to 3,000-gallon underground fiberglass tank. The location of the tank is in the area of standpipes observed during the Site reconnaissance (*See Section 5.2.1*). There is reportedly approximately 150 feet of leach chamber as well. Mr. Earl provided engineering plans for the septic system (*Naugles, 1998*). Mr. Earl indicated that the septic system was only used for domestic wastewater, and no commercial wastewater. Mr. Earl stated that only a "trickle" of wastewater is currently passing through the system.

Border Waterworks, LLC has never tested the wastewater in the system. According to Mr. Earl, wastewater has not surfaced from the system (*See Section 4.2*). Mr. Earl is not aware of any environmental liens or issues associated with his property, and he was unaware of any environmental contamination on his property. According to Mr. Earl, the septic system is the only structure on the Site and the property has never had, to his knowledge, any underground or above ground storage tanks.

He was not aware of the date Border Waterworks, LLC purchased the property, although he believes it may have been in 1998. He had no knowledge of previous landowners.

3.7 Prior Report Review

No previous historical environmental reports for the Site were located for review.

4.0 REGULATORY RECORDS REVIEW

Regulatory records were reviewed to identify RECs within the vicinity of the Site. The records search results were provided by EDR (*EDR, 2006*). EDR accessed the database information from the United States Environmental Protection Agency (USEPA) and the State of New Mexico. The information is subject to the accuracy of the input data provided by the regulatory agencies, as well as the date at which the information is updated.

4.1 Federal and State Databases

Listed below are the names and numbers of the facilities identified on readily available federal and state databases within the indicated search radius.

Search radii recommended by ASTM E1527 were increased by one-quarter mile to ensure the required distances extended from the property boundary of the Site. EDR's Radius Map Report, which includes database definitions, descriptions, and the database search report, is located in Appendix A.

Table 4. Federal and State Database Review Summary

Database	Description	Radius (Miles)	Facilities
	Federal		
NPL	The National Priority List (NPL) is the USEPA's database of uncontrolled or abandoned hazardous waste facilities that have been listed for priority remedial actions under the Superfund Program.	1.25	0
CERCLIS/ NFRAP	The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) database is a compilation of facilities that the USEPA has investigated or is currently investigating for a release or threatened release of hazardous substances pursuant to the CERCLA of 1980. No Further Remedial Action Planned (NFRAP) refers to facilities that have been removed and archived from its inventory of CERCLA sites.	0.75	0
RCRA CORRACTS/ TSD	The USEPA maintains a database of Resource Conservation and Recovery Act (RCRA) facilities associated with treatment, storage, and disposal (TSD) of hazardous materials that are undergoing "corrective action". A "corrective action" order is issued when there has been a release of hazardous waste or constituents into the environment from a RCRA facility.	1.25	0
RCRA Non-CORRACTS/ TSD	The RCRA Non-Corrective Action Report (Non-CORRACTS)/TSD Database is a compilation by the USEPA of facilities that report storage, transportation, treatment, or disposal of hazardous waste. Unlike the RCRA CORRACTS/TSD database, this database does not include RCRA facilities where corrective action is required.	0.75	0

Table 4. Federal and State Database Review Summary			
Database	**Description**	**Radius (Miles)**	**Facilities**
RCRA Generators	The RCRA Generators database, maintained by the USEPA, lists facilities that generate hazardous waste as part of their normal business practices. Generators are listed as large, small, or conditionally exempt. Large quantity generators (LQG) produce over 1000 kilograms (kg)/month of non-acutely hazardous waste or over one kg/month of acutely hazardous waste. Small quantity generators (SQG) produce 100-1000 kg/month of non-acutely hazardous waste. Conditionally exempt small quantity generators (CESQG) generate less than 100 kg/month of non-acutely hazardous waste or less than one kg/month of acutely hazardous waste.	0.5	1
ERNS	The Emergency Response Notification System (ERNS) is a listing compiled by the USEPA of reported releases of oil and hazardous substances to the air, soil, and/or water.	0.25	0
	State		
SWF/LF	The NMED maintains a database of Solid Waste Facilities/Landfill Sites (SWF/LF) located within New Mexico. The database information may include the facility name, class, operation type, area, estimated operational life, and owner.	0.75	0
LUST/LAST	The NMED provides databases of Leaking Underground Storage Tanks (LUSTs) and Leaking Aboveground Storage Tanks (LASTs) in the State of New Mexico.	0.75	6
UST/AST	The NMED has compiled databases of registered underground storage tanks (USTs), and above ground storage tanks (ASTs) that have been inspected by the State Fire Marshal in the State of New Mexico.	0.5	8

The following table summarizes the Site information provided by the EDR report (*Appendix A*) for facilities within the search radii listed above.

Table 5. Listed Facilities Surrounding the Site		
Facility Name and Location	**Estimated Distance, Direction, and Topographic Position**	**Database Listings and Status**
Halsells Grocery 101 School Road	1/8-1/4 Mile, North, Down	LUST, UST; Cleanup, State Lead
Hatch Exxon 410 West Hall	1/8-1/4 Mile, North, Down	UST, AST; 3 USTs Removed, 5 ASTs (Unleaded Gasoline and Diesel) Currently in Use
Hatch Exxon (B&M) 410 West Hall	1/8-1/4 Mile, North, Down	LUST; Cleanup, State Lead
Hillger Oil 430 West Hall	1/8-1/4 Mile, North, Down	LUST; Investigation, State Lead
Hatch Conoco 430 West Hall	1/8-1/4 Mile, North, Down	UST; 3 USTs Removed
Webb Ann 104 Wilson	1/8-1/4 Mile, North, Down	UST; 2 USTs Removed
Webb Home 104 Wilson	1/8-1/4 Mile, North, Down	LUST; No Further Action Required

Table 5. Listed Facilities Surrounding the Site		
Facility Name and Location	**Estimated Distance, Direction, and Topographic Position**	**Database Listings and Status**
Hatch Auto Electric 104 West Hall	1/8-1/4 Mile, North-Northeast, Down	UST; 2 USTs Removed
Village of Hatch 112 Franklin	1/8-1/4 Mile, North-Northeast, Down	UST; 1 UST Removed
Village of Hatch 112 Franklin	1/8-1/4 Mile, North-Northeast, Down	LUST; No Further Action Required
Pic Quick 234 202 Franklin	1/8-1/4 Mile, North-Northeast, Down	UST; 3 USTs Removed, 3 USTs Currently in Use
Pic Quick 234 202 Franklin	1/8-1/4 Mile, North-Northeast, Down	LUST; No Further Action Required
Burlington Northern and Santa Fe 100 Railroad Avenue	1/4 Mile, Northeast, Down	RCRA-SQG; No Violations Found

Only three LUST sites listed above appear to be currently active. All three of these sites are located north of the Site and across the railroad tracks. The three sites are topographically down gradient of the Site and thus, not considered to constitute a REC.

In addition to the above listed sites, 18 facilities were identified in the EDR that do not contain adequate address or location information to map these facilities in relation to the Site (*See Appendix A, pg. 15 of EDR Radius Map section*). Based on the general location information provided and observations during the Site reconnaissance, none of the facilities appear to be located on or adjacent to the Site. However, the facilities may be within the search radii.

4.2 Local Agency Inquiries

The Doña Ana County Fire Prevention Department, based in Las Cruces, New Mexico, was contacted to identify RECs for the Site (*BEI, 2006c*). Captain Daniel Kolson indicated that he was not aware of any historical hazardous substance spills at the Site. Due to the lack of a known street address for the Site, Capt. Kolson could not determine if fires or other incidences had occurred at the Site.

The Hatch Police Department was contacted regarding incidence responses on the Site (*BEI, 2006d*). Police Officer Dale Harrison, was not aware of any hazardous substance spills, fires, or any other incidences that had occurred in the vicinity of the Site.

The Doña Ana County Planning Department was contacted regarding the zoning of the Site (*BEI, 2006e*). According to the Department, the community of Rodey (one-mile east-southeast of the Site) is the only area surrounding the Village of Hatch that has been zoned.

Mr. Michael Castillo, Utilities Director for the Village of Hatch, was contacted regarding his knowledge of plans for the El Milagro subdivision to be connected to the Village's sewer system (*BEI, 2006f*). Mr. Castillo stated that they are in the process of acquiring a grant to connect the

El Milagro to the Village of Hatch sewer system. Mr. Castillo had no knowledge of the septic system on Border Waterworks, LLC's property or of any leach fields in that area.

Ms. Sylvia Sierra, Director for the Doña Ana County Health and Human Services Department, was contacted regarding the septic system for El Milagro (*BEI, 2006g*). According to Ms. Sierra, the county is working with the Colonias Initiative to connect El Milagro with the Village of Hatch sewer system. Ms. Sierra also confirmed that the present septic system was installed by Border Waterworks, LLC. Ms. Sierra provided contact information for Ms. Lorenzo Dorado, whose husband worked on the installation of the septic system, and Ms. Sue Padilla, Utilities Director for Doña Ana County.

Mr. Michael Montoya, Liquid Waste Specialist with the NMED was contacted (*BEI, 2006h*). Mr. Montoya believed that the leach field on the Site was abandoned. Other interviews and information indicate that the system is still in use. Mr. Montoya confirmed that Border Waterworks, LLC designed and installed the wastewater system for El Milagro. Only half a dozen homes were ever connected to the septic system due to problems with the system. Mr. Montoya stated that there was a mosquito and health problem caused by the septic system approximately one and a half to two years ago. He believed that this system was sampled as described below. The wastewater sampling location was reportedly located approximately 30 feet north of the PVC standpipes observed during the Site reconnaissance (*See Section 5.2.1*), in an area where wastewater was bubbling up. Due to continuous failing of the system, there was a plan to remove homes from the system and discharge wastewater to individual septic tanks. Mr. Montoya did not know if the plan took effect. He confirmed that El Milagro will be connected to the Village of Hatch sewer system if funding can be obtained.

Mr. Ray Montes, Geoscientist with the NMED Ground Water Quality Bureau (GWQB) in Las Cruces, New Mexico, was contacted regarding his knowledge of the geology and hydrogeology of the area, as well as any potential environmental contamination present on the property (*BEI, 2006i*). Mr. Montes also stated that septic tanks and leach lines in El Milagro have overflowed in the past. He indicated that there has been ponding in the area in the past caused by overflowing leach lines. He also reported that four homes are connected to the septic system/leach lines that were overflowing.

Mr. Montes stated that on August 31, 2004, he collected samples of wastewater from the ponded water caused by overflowing leach lines. Mr. Montes did not know the exact locations where the samples were collected. Mr. Montoya and Ms. Martha Jimenez, the president of the El Milagro Colonia, were reportedly present during the sampling event. Mr. Montoya stated that Ms. Jimenez has blueprints of the septic system; however, this contact information could not be obtained. The wastewater samples were analyzed for volatile organic compounds, metals, and inorganics. Mr. Montes provided the laboratory analytical results, which are included in Appendix B. Mr. Montes stated that groundwater in the area flows generally toward the Rio Grande. He suggested contacting the NMED PSTB for further information on groundwater quality and geology.

Mr. John Kovacs of the NMED PSTB in Santa Fe, New Mexico, was contacted regarding the geology and depth to water in the area, as well as his knowledge of any potential LUST facilities in the Site vicinity (*BEI, 2006b*). Based on the approximate location of the Site provided on a map to Mr. Kovacs, he is not aware of any active LUST facilities in the area of the Site. According to Mr. Kovacs, there are some active LUST facilities within the Village of Hatch, most of which are situated along Hall Street. Most of the LUST facilities have been closed in the area. He stated that the depth to water in downtown Hatch, based on data collected from the LUST facilities, is reportedly approximately eight feet bgs. Mr. Kovacs stated that depending on the height of water in the Rio Grande, the groundwater ranges in depth from approximately five feet to 12 feet bgs. The geology in the area, according to Mr. Kovacs, is mostly sand river deposits.

An attempt was made to contact Ms. Dorado regarding the current septic system on the site. As of the date of this report, no contact was made with Ms. Dorado. Also, an attempt was made to contact Ms. Padilla regarding the current septic system on the site and the plans for connecting El Milagro to the Village sewer system. As of the date of this report, no contact was made with Ms. Padilla.

5.0 SITE RECONNAISSANCE

This Section describes the Site reconnaissance conducted on September 7, 2006. Figure 5 depicts the area traversed during the Site reconnaissance. Most of the project Site was inaccessible due to standing water, mud, and dense vegetation. The Site visit consisted mostly of a perimeter survey with a limited walk-over at the western side of the project (*Figure 5*). Photographs of the Site taken during the Site reconnaissance are provided in Appendix D.

5.1 General Site Information

The Site reconnaissance commenced at 10:45 am along the levee road on the north side of the Site starting at the outlet to the Colorado drain (*Photographs 1, 2, and 3*). Mr. Robert Avalos, the Survey Party Chief of Doña Ana County Flood Commission conducted the visit. The weather was partly cloudy, humid, and warm (approximately 80^{o}F). The Site visit adjourned at 12:30 pm.

5.2 Summary of Observations

The Site is surrounded by small residential subdivisions (known as *Colonias*) and agricultural properties. Railroad operation facilities and the town of Hatch are located north of the Site (*Photograph 4, 5, 11, and 12*).

No evidence of petroleum storage tanks, hazardous chemicals, solid waste disposal or other RECs were observed on the Site. No soil staining or chemical sheens on standing water were observed in the accessible areas of the Site.

The following table is a check-list that summarizes Site observations. Affirmative responses are noted and discussed further in the sections that follow.

Table 6. Site Observation Summary		
Category	**Item or Feature**	**Observation**
Aboveground Chemical or Waste Storage	Evidence of above ground storage tanks	None observed
	Drums, barrels and/or containers ≥ 5 gallons	None observed
Underground Chemical or Waste Storage, Drainage or Collection Systems	Evidence of USTs or ancillary UST equipment	None observed
	Sumps, cisterns, catch basins and/or dry wells	None observed
	Septic tanks and/or leach fields	Leach field
	Pipeline markers	None observed
Electrical Transformers	Pad or pole mounted transformers	None observed
Evidence of Releases or Potential Releases	Stressed vegetation	None observed
	Stained soil	None observed
	Stained pavement or similar surface	None observed
	Trash, debris and/or other waste materials	Yes
	Dumping or disposal areas	None observed
	Construction/demolition debris and/or dumped fill dirt	Yes
	Surface water discoloration, odor, sheen, and/or free floating product	None observed
	Strong, pungent or noxious odors	Septic Odor
Other Notable Site Features	Surface water bodies	Yes
	Quarries or pits	None observed
	Wells	None observed

5.2.1. Specific Observations

Septic Tanks and/or Leach Fields

During the Site reconnaissance, multiple PVC standpipes were observed in the Site area (*Photographs 9, 10, and 11*). Located along the western portion and extending into the central portion of the Site is a septic system designed and installed for use by the community of El Milagro. Based on engineering plans and communication with Mr. Earl, the septic system is described as consisting of an approximately 1,500-gallon underground fiberglass septic tank with associated PVC piping (*BEI, 2006a; Naugles, 1998*). The leach field is oriented from west to east and includes approximately 300 feet of dosed and vented infiltrators.

No stained soil or stressed vegetation was observed in the vicinity of the septic tank or leach field during the Site reconnaissance. It should be noted that stained soil, if present, was not visible due to thick vegetation cover, mud, and standing water.

Trash/Debris Piles

The Site reconnaissance identified a dump and debris area (*Photograph 7*) just west of the Site boundary. The pile consisted of wooden pallets, tires, concrete, and some household trash. No evidence of hazardous materials were observed

Construction/Demolition Debris and/or Dumped Fill Dirt

Man-made earth berms are located in the northern and southeastern portions of the property (*See communication with Mr. Avalos in Section 3.6*). The berm to the southeast is currently a diversion dike but will be converted to an inlet channel. It is possible that fill material was imported to the Site to create the berms. Imported fill material from unknown sources can contain hazardous substances unless precautions were made to assess the material prior to delivery. The source of the fill for the berms was not documented in the readily available information. There was no evidence of chemical stains or stressed vegetation on or around the berms.

Surface Water Bodies

A large area of standing water was observed during the Site reconnaissance in the northwest corner portion of the leach field area and just northwest of the Site (*Photograph 8*). The water had a greenish color that appeared to be from an algal bloom. A strong septic odor was present. No evidence of stressed vegetation near the pond was observed. Site conditions prevented further observation for chemical films.

5.2.2. Interviews Conducted During Visual Reconnaissance

Mr. Avalos was interviewed during the Site reconnaissance (*See Section 3.6*).

6.0 ADJOINING/SURROUNDING PROPERTY RECONNAISSANCE

The properties adjoining and surrounding the Site were observed during the Site reconnaissance. These areas were observed from Site boundaries and accessible public areas.

The Site is bounded by the community of El Milagro on the west (Photographs 4 and 6), the Amery Powers subdivision on the east (*Photograph 5*), and the Rodey Lateral, Colorado Drain, and A.T.S.F. Railroad to the north (*Photographs 1 and 2*). The reconnaissance observations for the adjoining and surrounding properties are summarized below.

Table 7. Adjacent/Surrounding Properties Observation Summary

Direction	Description
North	A.T.S.F. Railroad and the Village of Hatch (Photograph 1).
South	Sierra de las Uvas (Photograph 12). To the southwest is the southern portion of El Milagro, as well as above ground water storage tanks for the Village of Hatch (Photograph 6).
East	Amery Powers subdivision, a community of homes and trailers (Photograph 5).

Table 7. Adjacent/Surrounding Properties Observation Summary	
Direction	**Description**
West	El Milagro, a community of homes and trailers, is adjacent to the Site (Photographs 4 and 6). Within El Milagro, just west of the standpipes for the 1,500-gallon septic tank, was a dump/debris area filled with wooden pallets, tires, concrete, and some household trash (Photograph 7). No evidence of hazardous materials were observed within the dump/debris area during the Site reconnaissance.

7.0 ADDITIONAL SERVICES

No additional services were provided.

8.0 CONCLUSIONS

This Phase I ESA was performed in conformance with the scope and limitations of ASTM Practice E1527 with consideration for USACE ER 1165-2-32 and CERCLA 120(h). Based on information derived from a Site reconnaissance, a review of applicable available regulatory records and files, and discussions with knowledgeable individuals, the following was determined. Some specific details are not discussed in this section and are found elsewhere in the report.

This ESA has revealed no evidence of disposal, or release, of HTRW substances, including petroleum products or derivatives. However, the following RECs were identified:

- A domestic wastewater leach field system is located on the Site. State officials indicated that the leach field has overflowed causing mosquito and health problems. Wastewater samples were collected in late August 2004 and were analyzed for volatile organic compounds (VOCs), metals, and inorganic compounds. The analyses detected trace VOCs including 2-butanone (methyl-ethyl-ketone), toluene, tetra-hydro-furan, ammonia, and organic nitrogen. None of the concentrations of these VOCs exceeded New Mexico Ground Water Quality Control Commission standards for groundwater.
- The Site reconnaissance identified a dump and debris area just west of the Site. The pile consisted of wooden pallets, tires, concrete, and some household trash. No evidence of HTRW including petroleum products was observed.
- A large area of stagnant water was observed near the northwestern corner of the Site during the Site reconnaissance. The water had a greenish color, likely from an algae or other vegetation, and emitted a septic odor. The recent heavy rainfall and flooding in the area have contributed to the ponded water. However, overflowing leach lines from septic tanks in the area may have contributed to the water.
- The locations of the El Milagro individual septic tanks and leach fields could not be identified and may be present on the Site.

These RECs require investigation by geophysical methods, soil sampling, and groundwater sampling to determine the presence of absence of hazardous substances and petroleum products.

Government regulatory database search of records did not identify listed facilities within the Site. The regulatory review did identify LUST, UST, AST, and RCRA facilities within the specified search radii. However, these facilities are all located north of the Site across the A.T.S.F. railroad tracks, and are situated topographically lower than the Site. Based on regional topography, these facilities appear to be hydrologically down gradient of the Site. None of the facilities listed are considered an REC.

9.0 REFERENCES

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BEI, 2006d	Brown Environmental, Inc. Personal Communication with Officer Dale Harrison, Hatch Police Department. September 2006.
BEI, 2006e	Brown Environmental, Inc. Personal Communication with The Doña Ana County Planning Department. September 2006.
BEI, 2006f	Brown Environmental, Inc. Personal Communication with Ms. Sylvia Sierra, Director for the Doña Ana County Health and Human Services Department. September 2006.
BEI, 2006g	Brown Environmental, Inc. Personal Communication with Mr. Michael Castillo, Utilities Director for the Village of Hatch. September 2006.
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Small Flood Risk Management Project Hatch, NM

Appendix F

Geotechnical Engineering

U. S. Army Corps of Engineers

Albuquerque District

December 2016

US Army Corps of Engineers
Albuquerque District

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EXHIBIT C – HATCH DAM GEOTECHNICAL ANALYSIS

1.0 INTRODUCTION

This appendix (*Appendix F-Geotechnical Engineering*) provides a summary of the geotechnical information and methods of analysis used to characterize conditions at the proposed dam site, and make preliminary recommendations regarding design specifications and construction standards.

The proposed Hatch Dam is a horseshoe-shaped earthen embankment dam to be located southwest of the village of Hatch, NM. The purpose of the proposed dam is to provide short-term impoundment of floodwaters from typically dry arroyos. The proposed dam site is downstream from the mouth of Water Canyon, and will capture flow from Spring Canyon, adjacent to Water Canyon on the east, by means of a diversion channel.

The right (east) dam abutment will extend southeast to intercept high ground on the west side of Spring Canyon. A diversion channel will continue beyond the right abutment into Spring Canyon intercepting any flows within the canyon and diverting the flow to the dam. The left (west) abutment similarly extends south to intercept high ground on the west side of Water Canyon.

A reinforced concrete conduit will serve as the outlet works and will extend through the earthen embankment. A roller compacted concrete (RCC) overflow spillway is provided to pass the Probable Maximum Flood (PMF). A plan for the dam is in *Appendix J, EXHIBIT A – DAM FEASIBILITY DRAWINGS, SITE PLAN, C-102*.

2.0 SITE CONDITIONS

2.1 Site Geology

The project site lies at the boundary between the modern floodplain of the Rio Grande and the dissected highlands of the Rincon Hills to the south of Hatch. Most of the footprint of the proposed dam sits atop Rio Grande fluvial deposits which consist of roughly 5 ft to 10 ft of silts and clay underlain by sands. The high ground at the left and right dam abutments is comprised of older, partly cemented alluvial deposits.

2.2 Subsurface Investigation

The subsurface investigation consisted of two subsurface studies (*Figure F1*). The first study was conducted in 2000 by Resource Technology Inc. (RTI) and included 10 boreholes within the project site. Drilling was done using a 4-in. inside-diameter hollow stem auger. In-situ soil samples were collected using either a 2-in. diameter split-spoon sampler, or a 3-in. diameter California sampler. Samples were collected at 2.5 ft below ground surface (BGS), and then at 5 ft intervals to the total depth of the hole. All of the RTI borings were drilled to depths of between 10.0 ft and 16.5 ft except for boring No. 11, which was drilled to 50.5 ft. Standard penetration test (SPT) blow counts for soils in the project area are generally consistent with the mean uncorrected SPT N-value of 10.1 with a standard deviation of +/-7.40, indicating that in-situ soils are typically of loose to medium density where sandy and medium to stiff where clayey. Up to 10 ft of loose fill was encountered in the RTI boreholes drilled along the existing Rodey Lateral ditch. Groundwater was encountered in all RTI borings at between 5.0 ft and 13.5 ft bgs. Soil samples were described in the field according to American Society for Testing and Materials (ASTM) method D2488. Boring logs are included as *Exhibit B* in this appendix.

A second drilling study was conducted in 2011 by Licon Engineering Co. (Licon) and included 16 boreholes within the project site. Drilling was done using a 6-in. inside-diameter hollow stem auger. In-situ soil samples were collected using a 2-in. split-spoon sampler. Samples were collected at 2.5 ft intervals beginning at the ground surface and continuing to the total depth of the hole or 20 ft; below 20 ft bgs samples were collected at 5 ft intervals. The Licon borings were drilled to depths of between 10.0 ft and 40.0 ft. Uncorrected SPT N-values were 8.11 with a standard deviation of +/-4.07, indicating that in-situ soils are typically of loose to medium density where sandy and medium to stiff where clayey. Groundwater was encountered at between 10.5 ft and 24.0 ft bgs. Boring logs are included as *Exhibit A* in this appendix.

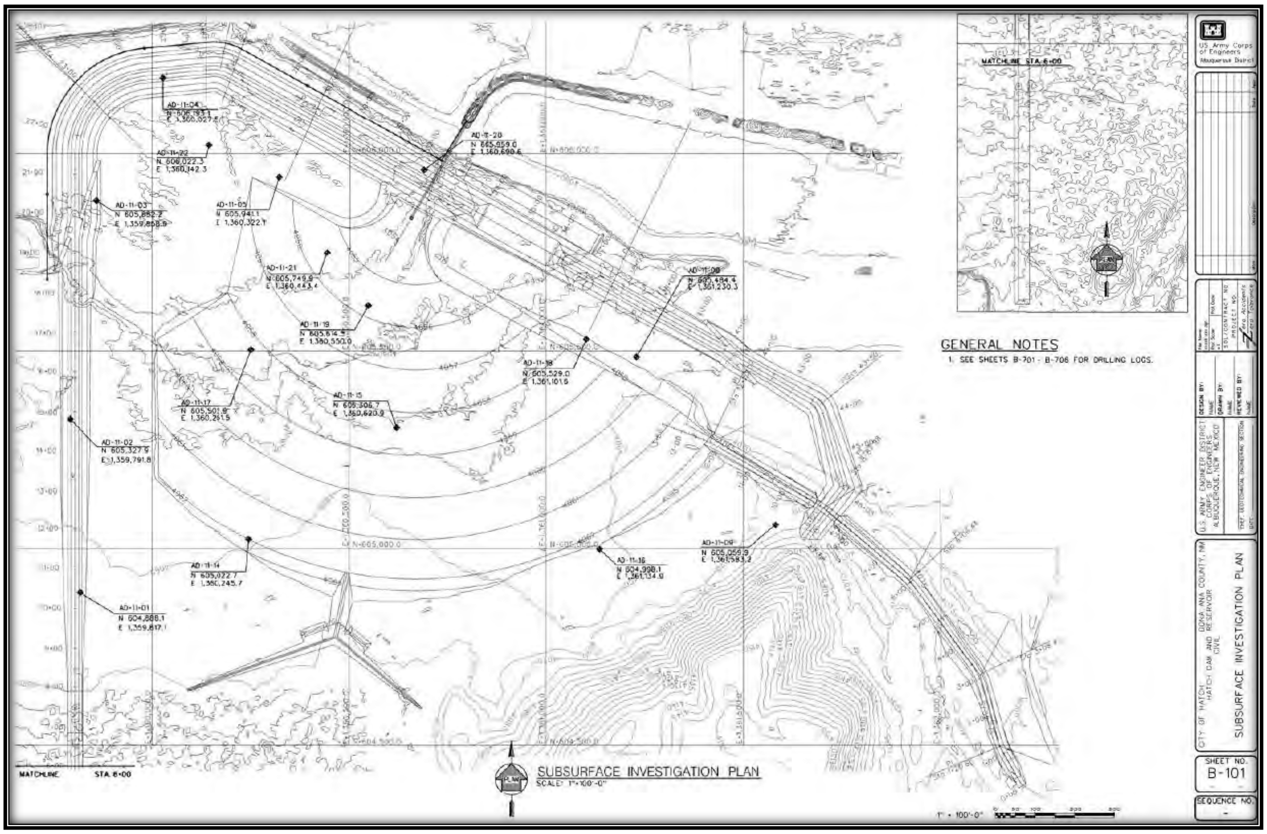

Figure F1: Site Plan showing 2011 borehole locations and proposed dam.

During both the 2000 and 2011 subsurface investigations, there was a leaking waterline in the vicinity of the project that is suspected to have artificially raised groundwater elevations in the surrounding area. The waterline has since been repaired and it is expected that the groundwater level has dropped in response. The ground water level will also be affected by the time of drilling due to the presence of seasonal irrigation flows in the Rodey Lateral.

Additional subsurface exploration will be necessary during development of the Detailed Design Documents in order to verify estimated shear strengths, insitu permeabilities, seismic hazards, and groundwater elevations used in the model and to verify extents of allowable over-excavation in the reservoir area.

2.3 Laboratory Testing

Soil samples collected during the subsurface investigations were classified by soil type according to the Unified Soil Classification System (USCS) using ASTM D2487 for laboratory identification of soils. The size distribution of coarse soils was determined by grain size analysis (ASTM D422) and the plasticity of fine soils was determined by Atterberg limits (ASTM D4318).

Fine grained soils are predominantly in the upper 5-10 ft and comprise mostly lean clay (CL), fat clay (CH), and silty sands (SM).

Coarse grained soils typically underlie the upper clay layer and comprise mostly poorly graded sand (SP).

2.4 Seismic Hazards

There are no known active faults in the vicinity of the dam site, however, there are numerous faults of Quaternary and Tertiary age in the general vicinity of the proposed dam that are most likely associated with the Rio Grande rift, many of which there is little information.

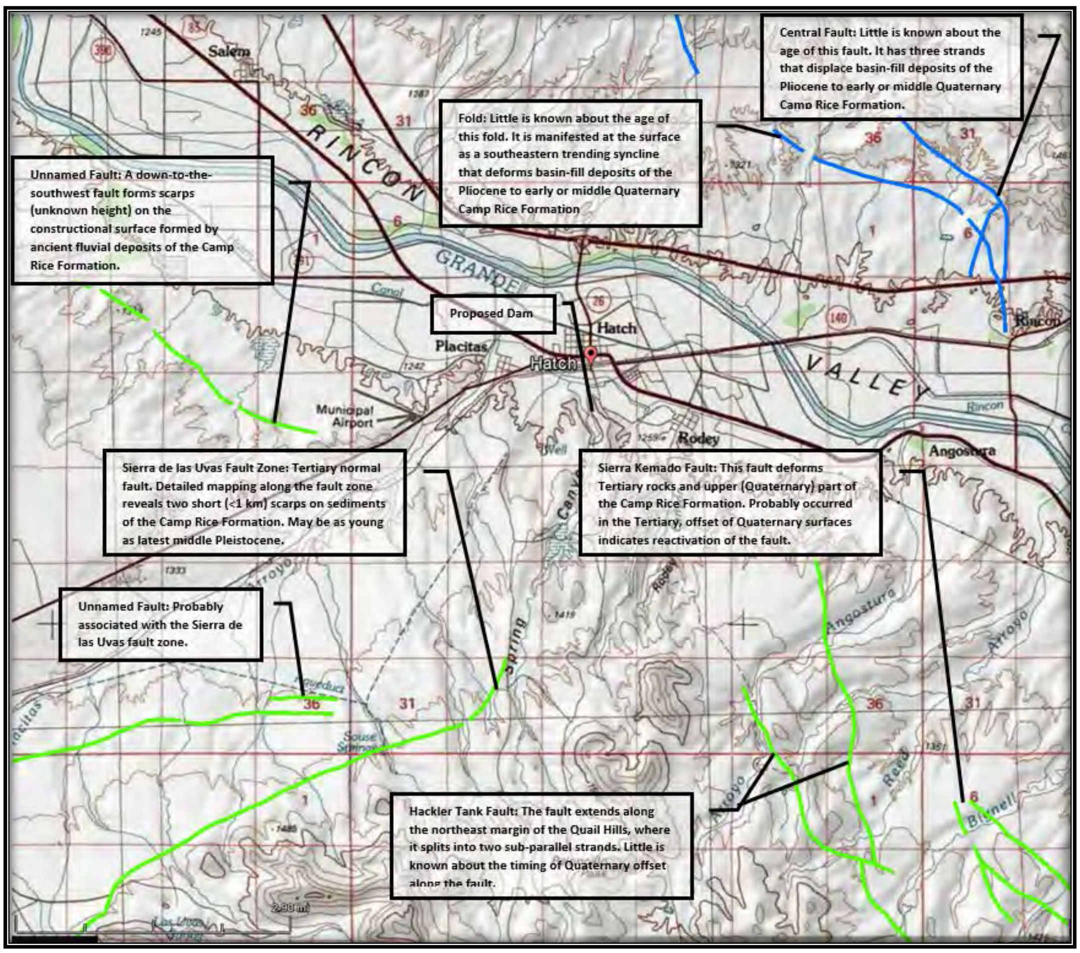

Figure F2: Quaternary and Tertiary Faults in Vicinity of the Project Site.

Source: USGS, Earthquake Hazards Program 2014, http://geohazards.usgs.gov

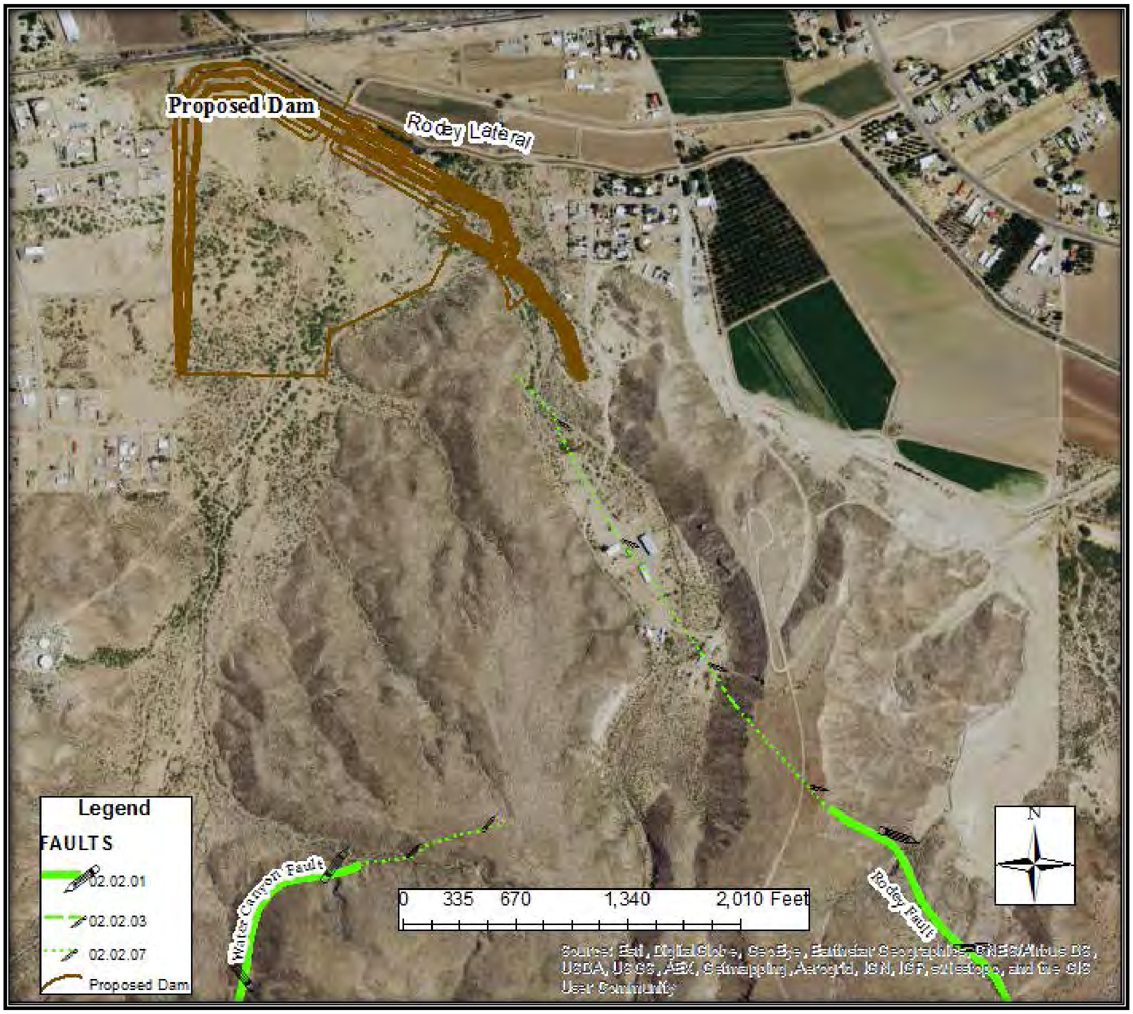

Figure F3: Local Faults within the vicinity of the proposed dam.

Source: New Mexico Bureau of Geology and Mineral Resources Open-file Geologic Map 213, http://geoinfo.nm.edu.

USACE design guidelines utilize an operating basis earthquake (OBE) and a maximum design earthquake (MDE). The probabilistically determined OBE is considered to be an earthquake that has a 50-percent PE in 100 years (i.e., 144-year return period) and is estimated from a probabilistic seismic hazard analysis (PSHA). The MDE is the maximum level of ground motion for which a structure is designed or evaluated.

For "critical" structures which are part of a high hazard project and whose failure will result in loss of life, the MDE represents the expected ground motions that could be produced by the maximum credible earthquake (MCE). The MCE is defined as the greatest earthquake magnitude that can reasonably be expected to be generated by a specific seismic source. The MCE determination includes both the expected maximum magnitude and the source-to-site distance. The MCE is an informed judgment based on seismological and geological evidence from a deterministic seismic hazard analysis (DSHA). The expected ground motion from the MCE may be produced either by an individual seismic source or by a composite of several seismic sources that could produce different shaking levels for different ground motion frequencies. The MCE is typically associated with the 84th percentile expected ground motion for major active faults and may be associated with the median (50th percentile) expected ground motion for potentially active faults (with slip rates of ~0.1 mm/yr or less). By definition, it is not possible to assign a return period to the ground motions produced by the MCE. However, the results of a PSHA are commonly used to estimate the approximate return period of the MCE. For structures that are part of a significant hazard project and whose failure will not result in loss of life, the probabilistically determined MDE is generally an earthquake that has a 10 percent probability of exceedance in 100 years (i.e., 950-year return period).

A local (site specific) probabilistic seismic hazard analyses (PSHA) has not been performed for this project. The mean seismic hazard curve for peak horizontal ground acceleration was generated using the regional (USGS 2014) PSHA as shown in *Figure F4* There is considerable uncertainty for annual exceedance probabilities less than 1/10,000. The extrapolation of the mean hazard curve is shown as a dashed line in this figure. The peak ground accelerations corresponding to selected common values of return periods were interpolated from this mean hazard curve and are shown in *Table F1*.

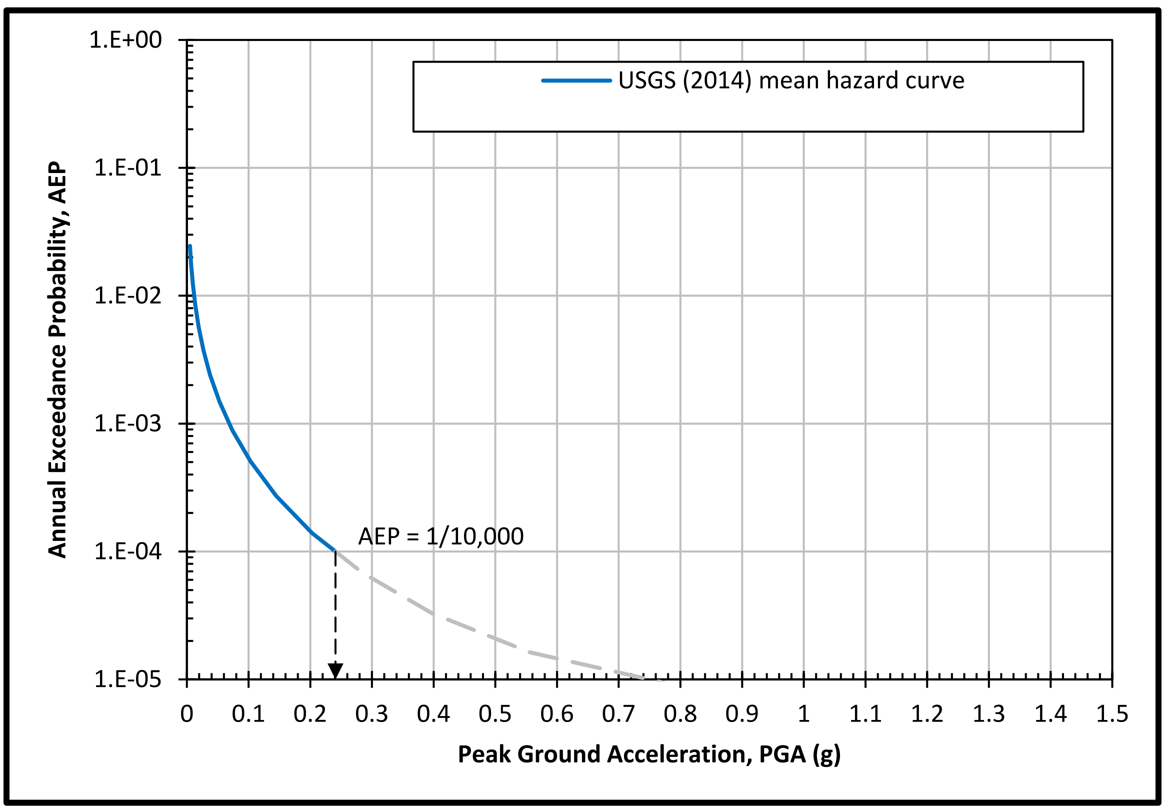

Figure F4: Seismic hazard curve for PGA.

Source: USGS, Earthquake Hazards Program, 2014, http://geohazards.usgs.gov

Table F1: Peak Horizontal Ground Acceleration Summary

Source: USGS 2014

Earthquake	Return Period (years)	PGA (g)
Operating Basis Earthquake (OBE)	144	0.016
Maximum Design Earthquake (MDE) for non-critical structures	950	0.067
IBC Maximum Considered Earthquake	2,475	0.118
Intermediate earthquake	4,950	0.171
Reasonable limit suggested by ICOLD Bulletin 72 (2010)	10,000	0.242

3.0 DAM FOUNDATION

The length of the dam will be primarily founded on the poorly graded sands found at a depth of 5 ft to 10 ft below existing ground surface. Soils at the site are predominantly fluvial and consist of an upper layer roughly 5 ft to 10 ft thick of mostly clay and silty sands, underlain by mostly poorly graded sands. Standard Penetration Tests (SPT) indicate in-situ soils are typically of loose to medium density where sandy and medium to stiff where clayey. Near the right (east) abutment, alluvial arroyo and fan deposits derived from Spring Canyon are expected and the clay layer present elsewhere at the site may be absent. Arroyo and fan deposits will likely consist of loose sand and gravel.

3.1 Discussion and Recommendations

3.1.1 Subgrade Preparation

The foundation exploration shows a surface layer of predominantly clay and silty sands underlain by mostly poorly graded sand. The clayey surface materials have a tendency to swell and consolidate and are not suitable for foundation materials. These materials must be excavated to a depth of 10 ft bgs and the underlying material must be proof-rolled by at least twice the number of compaction roller passes specified for the embankment. Material excavated during subgrade preparation is suitable for use as embankment fill and should be prepared as described in *Section 4.0 Dam Embankment*.

3.1.2 Partial Cutoff Wall

The subgrade over-excavation must be filled with suitable embankment fill and compacted as described in *Section 4.0 Dam Embankment*. A partial cutoff wall of semi-pervious material must be constructed for seepage control. The cutoff wall is an inverted trapezoid in section and must be continuous with the overlying embankment core. Preliminary cutoff wall dimensions are 20 ft wide at the base of the embankment (grade), tapering to 10 ft wide at the bottom of the wall at a depth of 5 ft.

3.1.3 Drainage Blanket and Toe Drain

Loose, sandy foundation materials will likely contribute to high foundation seepage volumes, and potentially contribute to higher exit gradients at the downstream toe of the embankment. However, limited allowable storage time and low embankment height are anticipated to limit the volume of seepage through the foundation.

Preliminary analysis of the seepage through the embankment and foundation was conducted using permeability coefficients estimated from the USCS soil types. The results indicate that a drainage blanket is needed at the base of the downstream embankment to control the seepage gradient within the embankment. A 3 ft thick drainage blanket, located from the downstream toe of the semi-pervious core to the downstream toe of the embankment, will collect embankment and foundation seepage and direct it to a toe drain (*Exhibit C - Hatch Dam Geotechnical Analysis*). The internal drainage features are not expected to function during regular operation due to the limited storage time; instead the drainage features ensure that seepage control is maintained even if the outlet works are obstructed or unforeseen circumstances prevent water from exiting the structure.

4.0 DAM EMBANKMENT

Preliminary dam design calls for a zoned earthen embankment 4,191 ft long with a 20 ft wide crest and 1V:3H upstream and downstream slopes. The dam consists of upstream and downstream random fill shells surrounding a trapezoidal, semi-pervious core. The semi-pervious core will cut off seepage through much of the embankment; the random fill shells provide sufficient structure to support the core

The downstream embankment face has a 6 in. gravel cover to reduce runoff erosion and incursions by plants and burrowing animals. The upstream face is armored by a soil-cement cap for erosion protection; the soil-cement will be laid in 9.5-ft-wide, 0.5-ft-thick lifts.

The elevation of the dam crest was determined by hydrologic consideration for passing the Probable Maximum Flood (PMF) at the emergency spillway, plus an additional 3 ft of freeboard. The crest elevation is 4,075.60 ft (NAVD 88), making the dam 22.6 ft above ground surface at its highest point. The 20 ft crest width was chosen to provide adequate and uniform depth for the spillway crest and discharge chute. Traffic will not be allowed on the crest, but there are two vehicle ramps incorporated into the design for maintenance. See *Appendix J - Civil Engineering*.

4.1 Discussion and Recommendations

4.1.1 Embankment Material

Embankments will consist of random fill shells surrounding an inner core. Embankment fill material will consist of blended fine and coarse grained soils excavated from the dam foundation and the reservoir area. Fat clays (CH) excavated from borrow areas will not be used as embankment (random) fill.

Semi-pervious embankment core material will consist of coarse-grained soils blended with a minimum of 20%, by weight, of fine-grained soils (i.e. passing the #200 sieve). Fat clays (CH) excavated from borrow areas will not be used as semi-pervious core fill.

Drainage blanket material will consist of coarse sands and gravels; and will be graded as a filter material in accordance with filter design (pending). Borrow areas are not expected to contain material of sufficient quality and quantity for construction of the drainage blanket and this material will have to be imported from local sources. Alternatively, additional drilling may be performed prior to detailed design specifically to seek an on-site source for coarse sand and gravel for drainage blanket filter material and concrete aggregate. If available, on-site coarse sands and gravels will reduce the cost of importing aggregate.

The results of the subsurface investigations indicated that most of the material in the borrow area will be suitable for both semi-pervious and embankment (random) fill sections, after stripping to remove vegetation and topsoil. Thickness of fill layers before compaction will not be more than 9 in. for tamping roller or more than 12 in. for rubber-tired roller. Moisture content of random fill and semi-pervious fill during compaction will be between optimum and 2% dry of optimum moisture content, based on standard proctor testing to be completed prior to final plans and specifications. Eight complete passes of a tamping roller or four complete passes of a rubber-tired roller will be required for each lift of random and semi-pervious fill. A minimum of 95 % of maximum density, as determined by ASTM D698, is required in all random and semi-pervious fill sections.

The borrow area for construction is located upstream of the dam in the reservoir basin and will serve as the primary source of material for the dam. Six of the RTI boreholes, AD-11-14 through AD-11-19, were drilled to sample potential borrow materials. Borrow area materials consist of mostly lean clays (CL), fat clays (CH), poorly graded sands (SP), and silty sands (SM). It is anticipated that blending materials from the reservoir borrow area (excluding fat clays) will produce an adequate volume of random and semi-pervious fill materials of desirable gradation and porosity for the construction of the dam embankment.

4.1.2 Embankment Settlement and Horizontal Movement

Settlement of foundation materials under embankment loading is estimated to be small with total settlement of about 0.4 ft. Post construction volume changes under applied loads are expected to be minor due to the relatively small size of the structure.

Settlement under full-pool conditions is expected to result in negligible additional settlement at the crest and a maximum of 0.15 ft additional settlement on the upstream slope. Horizontal movement under full-pool conditions is expected to be minor (about 0.1 ft). Note, however, the additional settlement under full-pool conditions is considered unlikely due to the limited storage time and consequent limited embankment saturation. See **Exhibit C - Hatch Dam Geotechnical Analysis**.

4.1.3 Embankment Slope Stability

The proposed dam design has a low risk of embankment failure due to the low dam height and relatively shallow 1V:3H embankment slopes. The analysis of the selected embankment section resulted in an acceptable factor of safety (FS) for all slope stability cases analyzed.

The geotechnical slope stability analysis examined all loading conditions with the inclusion and exclusion of the interior drainage blanket, toe drain, the upstream and downstream erosion protection, and coarse and fine grained foundation conditions, in order to determine the necessity of features and the effects of the varying possible foundation conditions.

Shear strength and density of embankment materials were estimated based on assumptions about blended fill materials assumed to be used in construction. Shear strength and density of foundation materials were estimated from USCS soil types and SPT blow counts. See *Exhibit C – Hatch Dam Geotechnical Analysis*.

The slope stability models used the same dam design but employed a probabilistic approach to account for variability in dam materials. The models simulated the following loading conditions: end-of-construction, steady-state seepage, and rapid drawdown of the pool (*Table F2*).

Table F2: Summary of Slope Stability Factors of Safety

Case 1	**End-of-Construction**	Failure of either embankment slope
Calculated	FS = 2.02	
Minimum	FS = 1.30	*Per Table 3-1, USACE EM 1110-2-1902*
Case 2	**Steady-State Seepage**	Failure of downstream embankment slope
Calculated	FS = 1.81	95% confidence that FS > 1.65
Minimum	FS = 1.50	*Per Table 3-1, USACE EM 1110-2-1902*
Case 3	**Rapid Draw-Down**	Failure of upstream embankment slope
Calculated	FS = 1.76	95% confidence that FS > 1.65
Minimum	FS = 1.30	*Per Table 3-1, USACE EM 1110-2-1902*

4.1.4 Embankment Seepage

The proposed dam is not designed to permanently impound water and seepage will be negligible. However, numerous seepage control features including a toe drain, drainage blanket, and cutoff trench; will be incorporated into the embankment design in order to transmit seepage safely in the un-anticipated circumstance that the dam holds a reservoir for a significant length of time.

The geotechnical seepage analysis examined all loading conditions with the inclusion and exclusion of the interior drainage blanket, toe drain, and coarse and fine grained foundation conditions, in order to determine the necessity of features and the effects of the varying possible foundation conditions.

Permeabilities were estimated based on assumptions about blended fill materials assumed to be used in construction. Permeabilities for the foundation materials were estimated from USCS soil types and SPT blow counts. See *Exhibit C – Hatch Dam Geotechnical Analysis.*

Exit gradients along the downstream slope correspond to a FS of greater than 20 with a toe drain, drainage blanket, and cutoff trench incorporated into the design.

5.0 OUTLET WORKS

A reinforced concrete conduit will pass below the dam embankment and serve as the outlet works. The conduit will be 3 ft x 5 ft in section and will cross the embankment at station 32+32.83A. The conduit will be incised into the existing overburden and the excavation for conduit installation should be wide enough to allow for access of compaction equipment. The conduit will be founded on 3 ft of compacted fill with a 1.5-ft-thick drainage blanket placed around the entire conduit for the downstream one-third of the conduit length (40 ft). This will help to capture and safely discharge any seepage flow near the conduit. The filter material will be designed prior to preparation plans and specifications to ensure filter compatibility. The conduit must have a minimum of 1H:10V battered walls to allow for embankment compaction.

An RCC overflow spillway will extend from station 33+38.40A to 36+88.40A to pass flow from the PMF event. The spillway is 350 ft long with 1V:3H side slopes and provides a maximum discharge capacity of 18,530 cubic feet per second (cfs) at an elevation of 4075.1 ft (NAVD88). The internal drainage blanket of the embankment shall be tied into the filter material under the RCC section of the spillway to provide positive seepage control and safe discharge of any seepage flow.

6.0 ADDITIONAL INVESTIGATION AND ANALYSIS

Additional subsurface investigations will be required during the Detailed Design Phase of the project. Additional work may include Cone Penetrometer Testing (CPT) to measure in-situ permeability and collect a continuous record of soil strata in the dam vicinity. Alternatively, these data may be collected using continuous drilling and sampling, and monitoring well testing. Test pits may be excavated near the proposed diversion ditch and in areas where near surface gravels may be present. Additional lab testing site may be performed on recovered soil samples.

Additional slope stability and seepage analyses for static loading conditions (i.e. end of construction, steady seepage, and rapid drawdown) will be required to support detailed geotechnical design of the dam. Seismic analyses, including evaluation of liquefaction susceptibility, post-earthquake stability analyses, and possible seismic deformation analyses, will be required to evaluate the seismic performance of the dam embankment and foundation during the design earthquake.

Small Flood Risk Management Project Hatch, NM

Exhibit A

2011 Sub-Surface Investigation

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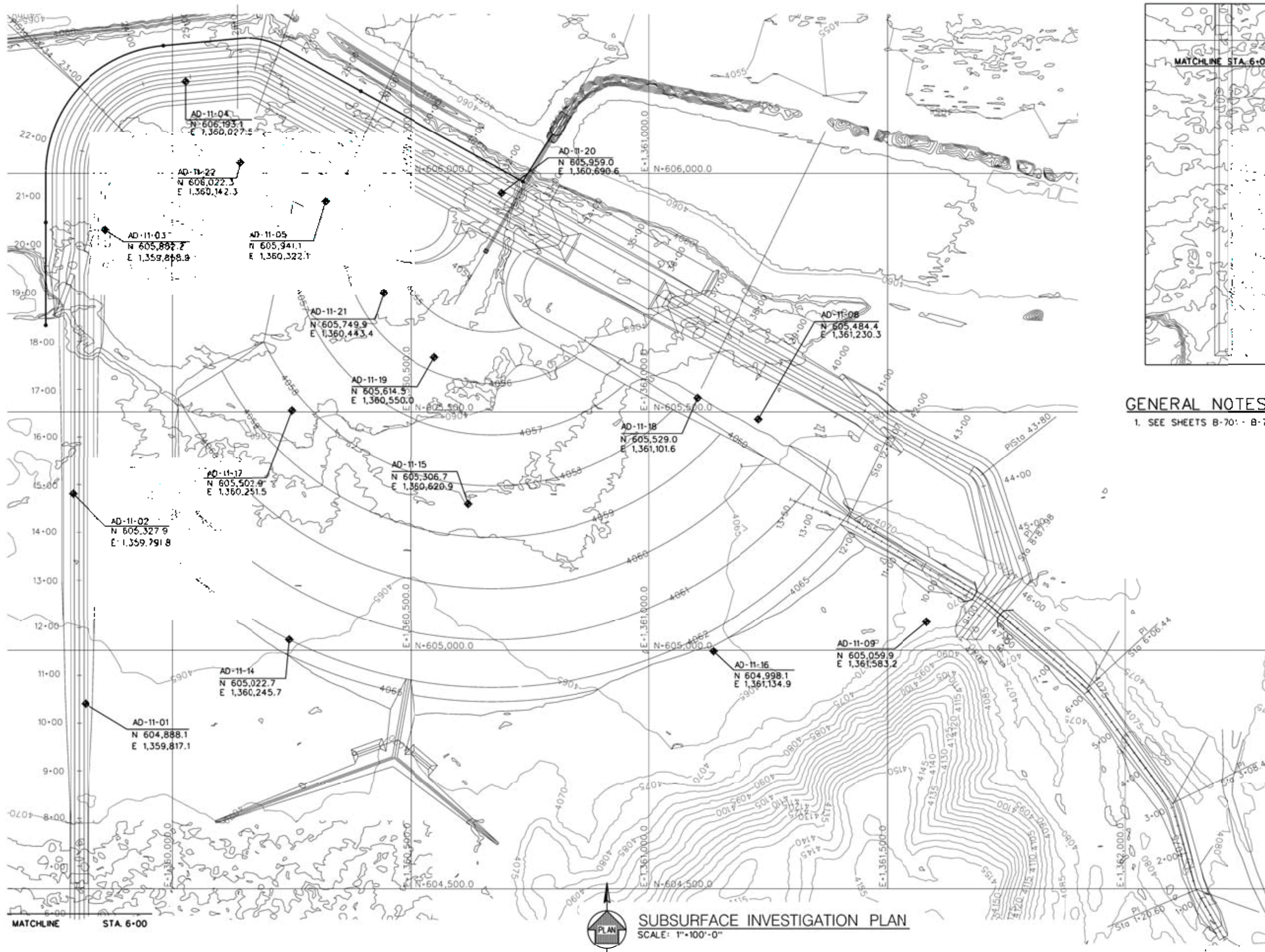
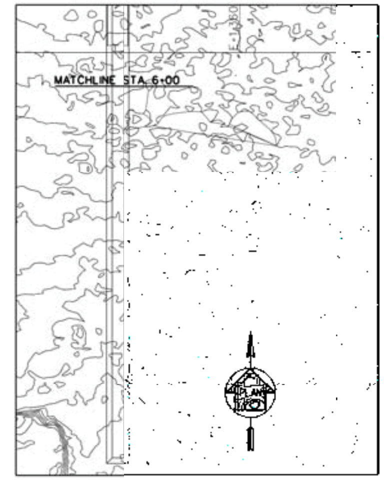


SUBSURFACE INVESTIGATION PLAN
SCALE: 1"=100'-0"



GENERAL NOTES

1. SEE SHEETS B-701 - B-706 FOR DRILLING LOGS.

1" = 100'-0"

US Army Corps of Engineers
Albuquerque District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ALBUQUERQUE, NEW MEXICO

CITY OF HATCH, DONA ANA COUNTY, NM
HATCH DAM AND RESERVOIR
C.W.

SUBSURFACE INVESTIGATION PLAN

SHEET NO
B-101

SEQUENCE NO.
-

PRELIMINARY DRAWINGS

Small Flood Risk Management Project Hatch, NM

Exhibit B

2000 Sub-Surface Investigation

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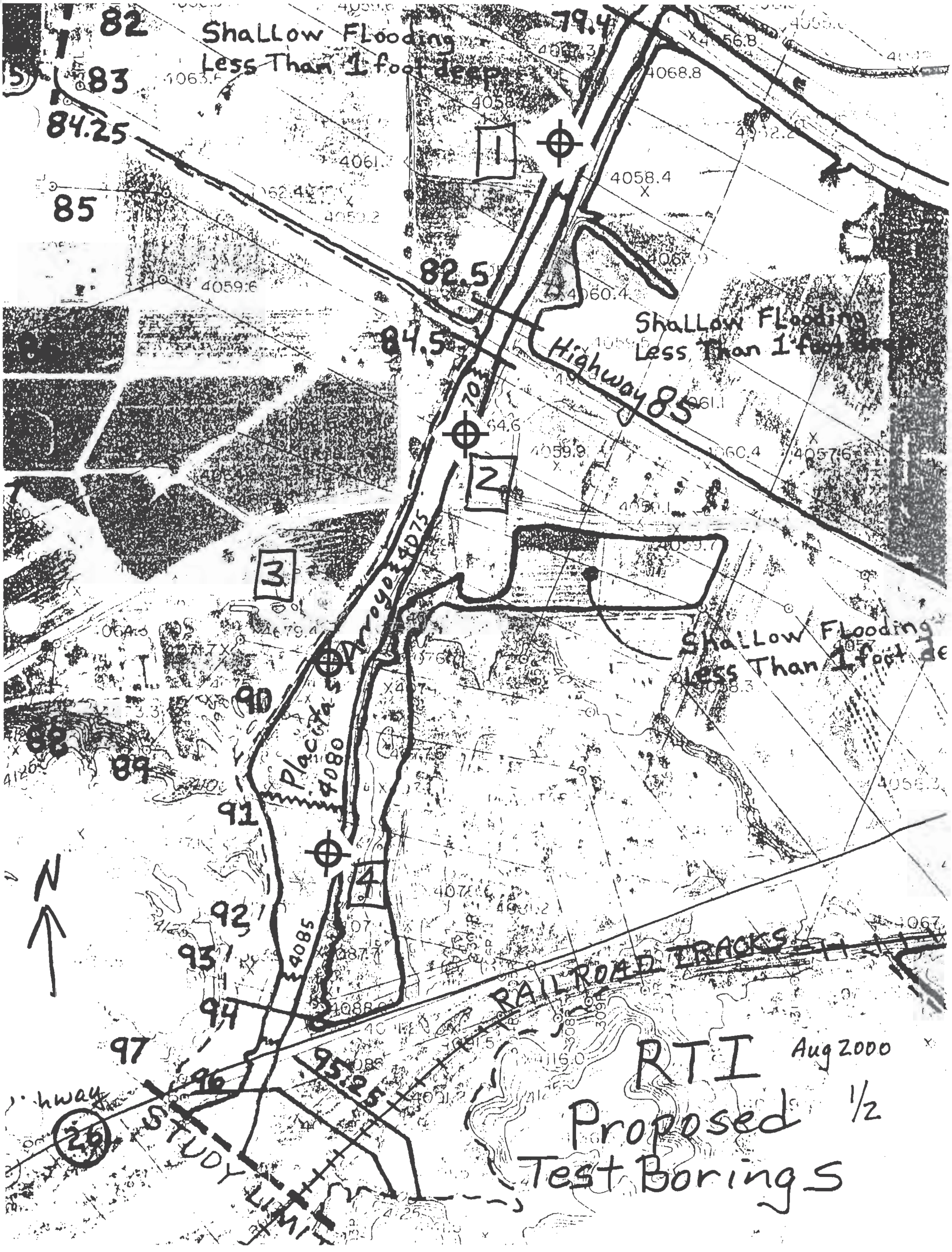
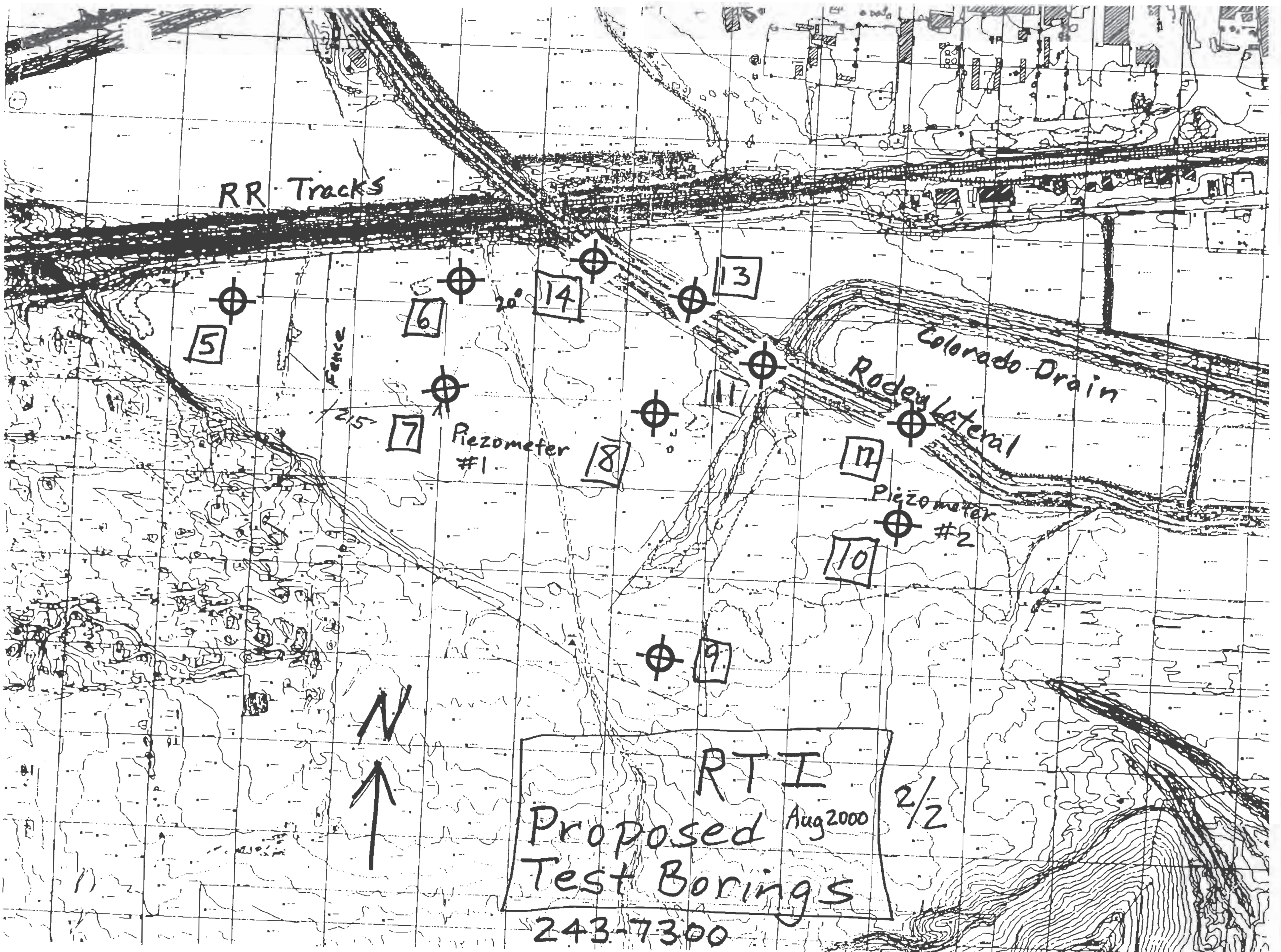

Shallow Flooding Less Than 1 foot deep
Shallow Flooding Less Than 1 foot deep
Shallow Flooding Less Than 1 foot deep
Highway 85
Placitas Arroyo
RAILROAD TRACKS
STUDY LIMIT
N
1
2
3
4
82
83
84.25
85
82.5
84.5
79.4
88
89
90
91
92
93
94
95.25
96
97
4075
4080
4085
RTI
Aug 2000
1/2
Proposed
Test Borings



RR Tracks
Colorado Drain
Rodew Lateral
Fence
5
6
7
8
9
10
11
12
13
14
20°
2/5
Piezometer #1
Piezometer #2
N
RTI
Proposed Test Borings
Aug 2000
2/2
243-7300

PLACITAS ARROYO
PROJECT NO. 00-160

PHYSICAL PROPERTIES CHART

Test Hole	Depth (feet)	Unified Classification	Natural Moisture Content	Natural Dry Density	GRADATION % PASSING BY WEIGHT										ATTERBERG	LIMITS	Description
			%	PCF	200	100	50	30.0	16.0	10.0	4.0	3/4 IN	1.5 IN	3.0 IN	LL	PI	
1	2	SM	3.1	94.5	27.1												Silty Sand with Gravel
	5	SM	3.4	98.8	35.6												Silty Sand with Gravel
	10	CH															Fat Clay with Sand
	12	CH															Fat Clay with Sand
	15	SP	Sat														Poorly Graded Sand
2	2	SM	3.5	103.3	40.3	69	92	98	99	100							Silty Sand
	5	SM	7.0	85.4													Silty Sand
	9.5	ML	8.9		54.5	83	99	99	100								Sandy Silt
	10	SC-SM															Clayey-Silty Sand
	12	CH	22.0		90.1	94	96	98	99	100					72	44	Fat Clay with Sand
	14.5	SC															Clayey Sand
	15	CH															Fat Clay with Sand
3	2	GM	3.6		3.5	15	20	25	30	35	40	75	100	100.0			Poorly Graded Sandy Gravel
	4.5	SP-SM															Poorly Graded Sand With Silt
	5	CH															Fat Clay with Sand
	10	SM	5.2		45.7	82	94	98	100								Silty Sand
	15	SP-SM															Poorly Graded Sand With Silt
4	2	SP	13.0	93.4													Poorly Graded Sand With Gravel
	6	SP-SM															Poorly Graded Sand With Silt and Gravel
	10	SP-SM	2.5		10.7	27	36	43	49	54	64	78	100				Poorly Graded Sand With Silt
	15	SM															Silty Sand
	15.5	CL															Lean Sandy Clay

Spring Canyon Detention Dam
RTI Project No. 00-160

PHYSICAL PROPERTIES CHART

Test Hole	Depth	Unified Classification	Natural Moisture Content	Natural Dry Density	GRADATION % PASSING BY WEIGHT										ATTERBERG	LIMITS	Description
#	FEET		%	PCF	200	100	50	30.0	16.0	10.0	4.0	3/4 IN	1.5 IN	3.0 IN	LL	PI	
5	2	CH	23.4	97.0	93.6	97	99	100	100	100	100	100	100	100.0			Fat Clay with Sand
	5	CH	18.2	84.3													
	10	SP															
	15	SP															
6	2	CH	31.0	87.4													Fat Clay with Sand
	5	SM															
	10	SP															
	15	SP															
7	2	CH															
	5	CH															
	10	SP															
	15	SP															
8	0 - 5	CH			91.8	94	96	98	99	100	100	100	100	100	72	44	Fat Clay with Sand
	5 - 10	SP															Poorly Graded Sand
9	0 - 5	CH			60.7	74	86	94	96	98	99	100	100	100.0	34	14	
	6	SP	15.7														
10	0 - 5	SM			38.6	64	86	93	95	98	99	100	100	100	NV	NP	Silty Sand
	2 - 5	SM															
	5 - 10	SC															
	10 - 12	SP															

Spring Canyon Detention Dam
RTI Project No. 00-160

PHYSICAL PROPERTIES CHART

Test Hole	Depth	Unified Classification	Natural Moisture Content	Natural Dry Density	GRADATION % PASSING BY WEIGHT										ATTERBERG	LIMITS	Description
#	FEET		%	PCF	200	100	50	30.0	16.0	10.0	4.0	3/4 IN	1.5 IN	3.0 IN	LL	PI	
11	2	SM	9.3	104.3	42.8												Silty Sand
	5	SC	21.9	95.2													
	10	CH															
	15	SP															
	20	SP															
	25	SP			3.8	28	49	71	85	95	98	100					Poorly Graded Sand
	30	SP															
	35	SP			2.3	46	79	93	97	99	99	100					Poorly Graded Sand
12	2	SM	16.5	92.8													Silty Sand
	5	CH	20.7	102.4													Fat Clay with Sand
	10	CH															
	15	SP															
13	2	SM	6.3	94.7	37.5	62	82	93	98	100							Silty Sand
	5	SM	22.1	95.1													
	10	CH															
	15	SP			2.8	32	55	76	88	97	99	100					Poorly Graded Sand
14	2	CL	9.8														Lean Clay
	5	SM	16.4	98.6													Silty Sand
	10	CH															
	15	SP															

Small Flood Risk Management Project Hatch, NM

Exhibit C

Hatch Dam Geotechnical Analysis

U. S. Army Corps of Engineers

Albuquerque District

December 2016

US Army Corps of Engineers ®
Albuquerque District

Hatch Dam Geotechnical Analysis

Table of Contents

1.0 Subsurface Investigation Data

Subsurface investigations were performed in 2000 by RTI and in 2011 by the USACE and Licon Engineering. Two datasets are included in this analysis in order to evaluate foundation conditions and determine suitability of borrow materials in the reservoir basin area. *Table FC1* below shows in-situ materials found throughout the reservoir area. Finer grained materials consisting of silty sands (SM), lean clays (CL) and fat clays (CH); consistently make up the upper 10' of the reservoir area and are underlain by poorly graded sands, although some pockets of fine grained materials were encountered at depth. Standard penetration test field N-values can be found in *Table FC2* below; N-values generally indicate loose to medium density where sandy and medium to stiff when clayey.

2.0 Seismic Hazards

Seismic hazards were not analyzed as part of this preliminary geotechnical analysis of the structure. Peak horizontal ground accelerations are on the order of 0.1 g for the maximum design earthquake. This is considered to be a relatively low seismic hazard and is well within the bounds for safe modern dam design and construction. More information regarding the seismic hazards at the site can be found in *Appendix F Geotechnical Engineering.* A detailed seismic hazard analysis will be required during the detailed design phase of the project.

Table FC1: Soil Classification and Bore Hole ID with Depth

SoilClassification																						
Sample #																						
Depth	***AD-11-01***	***AD-11-02***	***AD-11-03***	***AD-11-04***	***AD-11-05***	*AD-11-08*	*AD-11-09*	*AD-11-14*	*AD-11-15*	*AD-11-16*	*AD-11-17*	*AD-11-18*	*AD-11-19*	***AD-11-20***	*AD-11-21*	*AD-11-22*	5	6	11	12	13	14
0	***CL***	***SM***	***CH***	***CH***	***CH***	*SM*	*SM*	*SC-SM*	*CL*	*ML*	*CL*	*ML*	*CH*	***CH***	*CH*	*MH*						
2.5	***CH***	***CL***	***CH***	***CH***	***CH***	*SM*	*SM*	*CL*	*CL*	*CL*	*CL*	*SC-SM*	*CH*	***CH***	*CH*	*CH*						
5	***CH***	***SM***	***CH***	***SC***	***CH***	*SP-SM*	*SM*	*CL*	*CL*	*CH*	*CL*	*SM*	*CH*	***CH***	*CH*	*CL*	CH	CH	CH	SM-CL	SM	SM
7.5	***SM***	***SM***	***SP***	***SP***	***SP***	*SM*	*SM*	*CH*	*CH*	*CL*	*CH*	*ML*	*CL*	***SM***	*SP-SM*	*SP*						
10	***CL***	***CL***	***SP***	***SP***	***SP***	*CH*	*SC*	*SM*	*CL*	*CL*	*ML*	*CH*	*SM*	***SP***	*SP*	*SP*	SP	SP	CH	CL	CH	CH
12.5	***CL***	***CH***	***SP***	***SP***	***SP***	*CL*					*SP*	*ML*	*SP-SM*	***SP***	*SP*	*SP*						
15	***CL***	***CH***	***SM***	***SM***	***SP***	*SC*					*SP*	*CL*	*SP-SM*	***SP***	*SP*	*SP*	SP	SP	SP	SP	SP	SP
17.5	***CL***	***CL***	***SP-SM***	***SP***	***SP***	*CH*								***SP***								
20	***CL***	***ML***	***SP-SM***	***SP***	***SP***	*CH*								***SP***								
25			***SP***	***SP-SM***	***SP***	*SP-SM*								***SP-SM***					SP			
30			***SM***	***SP***	***CL***	*SP*								***SP***								
35			***SP***	***SP***	***SP-SM***	*SW-SM*								***SP***					SP			
40			***SP***	***SM***	***SP-SM***	*SP*								***SP***								

***Bold Italics Boreholes are along the Proposed Dam Centerline, italics boreholes are within the potential borrow area, all other Boreholes are located in the general project vicinity.**

Table FC2: Standard Penetration Test Field N-values

	SPT																					
	Sample #																					
Depth	***AD-11-01***	***AD-11-02***	***AD-11-03***	***AD-11-04***	***AD-11-05***	*AD-11-08*	*AD-11-09*	*AD-11-14*	*AD-11-15*	*AD-11-16*	*AD-11-17*	*AD-11-18*	*AD-11-19*	***AD-11-20***	*AD-11-21*	*AD-11-22*	5	6	11	12	13	14
0	9	10	6	7	9	7	7	6	5	4	8	4	5	11	6	9						
2.5	21	12	9	6	15	7	7	17	9	6	23	6	5	16	8	12						
5	11	10	8	5	11	8	6	9	9	9	15	8	7	18	8	10	11	9	3	9	3	5
7.5	5	4	7	9	7	11	15	9	11	5	7	8	7	8	7	7						
10	7	4	7	5	5	15	15	7	6	9	5	15	6	9	6	5	6	5	5	9	3	3
12.5	4	10	4	15	9	10					7	5	3	4	4	4						
15	9	11	4	14	13	7					2	4	9	5	5	4	6	11	9	5	5	6
17.5	4	10	21	6	8	4								11								
20	6	5	2	6	8	3								6								
25			4	15	4	5								7					11			
30			15	7	7	4								6								
35			9	1	9	16								6					15			
40			9	16	4	4								8								

***Bold Italics Boreholes are along the Proposed Dam Centerline, italics boreholes are within the potential borrow area, all other Boreholes are located in the general project vicinity.**

3.0 Geotechnical Analysis Parameters

Geoslope's GeoStudio Modeling software was used to analyze three basic load cases for the embankment structure. Analysis included and excluded the drainage blanket and toe drain and soil cement cap in order to fully capture the effects these features had on the project. Foundation conditions were varied to provide results for two possible foundation conditions beneath the embankment structure in order to closely correlate to conditions found in the subsurface investigation

The zoned earthen embankment dam consists of random fill shells with a semi-pervious trapezoidal inspection trench and core, 1V:3H side slopes, a 9.5-foot wide soil cement cap on the upstream face, and a 0.5 foot thick gravel slope protection on the downstream face.

The two foundation conditions considered are: a layered foundation system with finer less permeable material overlying a coarser grained lower foundation, and a uniformly coarse grained foundation. These two conditions were formulated based on field explorations shown in *Table FC**1***.

Further refinement of the geometry and materials will be required during the Detailed Design and preparation of final plans and specifications.

3.1 Shear Strengths/Friction Angle

Shear strengths (i.e. angle of internal friction or "friction angles") were developed based on two methodologies. Foundation material friction angles were developed using a composite of seven correlation methods from N60-values obtained from the 2000 and 2011 subsurface investigations. All other materials used typical parameters based on the Unified Soil Classification System (USCS) material classification.

Foundation materials at depths greater than 10' below ground surface averaged a correlated friction angle of 30° with a standard deviation of +/-3.21. Foundation materials found in the upper 10' below ground surface averaged a correlated friction angle of 30° with a standard deviation of +/-2.44. A normal distribution built around these parameters was sampled using a Monte Carlo simulation and constituted the probabilistic analysis to account for foundation variability. The upper 5' of material is expected to be excavated as borrow material for the earthen embankment therefore limiting the upper foundation material layer to 5'.

Random fill and semi-pervious fill materials are assumed to have a constant friction angle of 34° and 33°, respectively, due to the low variability expected from a specified blended and graded material. In-situ materials currently correlate a mean friction angle of 30°; these same materials will be excavated and compacted in the embankment and are therefore anticipated to have a higher friction angle than the insitu materials.

The Gravel downstream slope protection was ignored for this analysis and is expected to provide some slope stability for shallow surface failures which primarily govern the analysis results.

Table FC3: Friction Angle and Bore Hole ID with Depth

	Friction Angle																					
	Sample #																					
Depth	***AD-11-01***	***AD-11-02***	***AD-11-03***	***AD-11-04***	***AD-11-05***	*AD-11-08*	*AD-11-09*	*AD-11-14*	*AD-11-15*	*AD-11-16*	*AD-11-17*	*AD-11-18*	*AD-11-19*	***AD-11-20***	*AD-11-21*	*AD-11-22*	5	6	11	12	13	14
0	***31***	***32***	***29***	***30***	***31***	*30*	*30*	*29*	*28*	*27*	*30*	*27*	*28*	***32***	*29*	*31*						
2.5	***38***	***33***	***31***	***29***	***35***	*30*	*30*	*36*	*31*	*29*	*39*	*29*	*28*	***35***	*30*	*33*						
5	***32***	***32***	***30***	***28***	***32***	*30*	*29*	*31*	*31*	*31*	*35*	*30*	*30*	***36***	*30*	*32*	32	31	26	31	26	28
7.5	***28***	***27***	***30***	***31***	***30***	*32*	*35*	*31*	*32*	*28*	*30*	*30*	*30*	***30***	*30*	*30*						
10	***30***	***27***	***30***	***28***	***28***	*35*	*35*	*30*	*29*	*31*	*28*	*35*	*29*	***31***	*29*	*28*	29	28	28	31	26	26
12.5	***27***	***32***	***27***	***35***	***31***	*32*					*30*	*28*	*26*	***27***	*27*	*27*						
15	***31***	***32***	***27***	***34***	***34***	*30*					*24*	*27*	*31*	***28***	*28*	*27*	29	32	31	28	28	29
17.5	***27***	***32***	***38***	***29***	***30***	*27*								***32***								
20	***29***	***28***	***24***	***29***	***30***	*26*								***29***								
25			***27***	***35***	***27***	*28*								***30***					32			
30			***35***	***30***	***30***	*27*								***29***								
35			***31***	***23***	***31***	*35*								***29***					35			
40			***31***	***35***	***27***	*27*								***30***								

Note: Friction Angles are based on the "N60" values for each corresponding depth and are the average friction angles corresponding to the following six methods: Dunham 1954 #2, Dunham 1954 #3, Ohsaki et al. 1974, Japan Road Association 1990, Muromachi et al. 1974. A correction factor of 1.3 was used to convert the SPT Blowcount, "N" to "N60".

***Bold Italics Boreholes are along the Proposed Dam Centerline, italics boreholes are within the potential borrow area, all other Boreholes are located in the general project vicinity.**

3.2 Unit Weights

Unit weights for foundation materials were obtained by correlating blow counts to a relative density scale, other materials in the zoned earthen embankment have unit weights correlated using the USCS classifications of the assumed material type and use common unit weights expected for materials of that type.

Foundation materials consist primarily of poorly graded sands (SP). These materials are of a generally loose to medium density based on the SPT N-value obtained during field exploration; *Table FC2***.** A unit weight of 100 pcf was selected as sufficiently representative of the foundation materials.

Random fill embankment materials will consist of blended over-excavation materials from the reservoir area and will be compacted to at least 95% of the maximum density, as determined by ASTM D698. The unit weight used for these materials is approximately 120 pcf which is higher than the foundation materials due to additional densification required on the random fill materials.

Semi-Impervious core material unit weights are expected to be somewhat less than the random fill shell materials due to the greater amount of fines present in the material. An input unit weight of 110 pcf which corresponds to generally accepted values for silty or clayey sands was used for modeling purposes.

The Gravel downstream slope protection was ignored for this analysis; however unit weights are anticipated to be approximately 130 pcf based on typical values for a well graded gravel material.

Soil cement on the upstream face is expected to have a unit weight of 125 pcf. However, the soil cement was only looked at in order to account for the possibility of acting as a seepage barrier and its effects on increasing slope stability are not accounted for in this model.

3.3 HydraulicConductivity

Hydraulic conductivities for all material types are based on generally accepted values for hydraulic conductivities for a given USCS material classification. Geoslope's Geostudio develops hydraulic conductivity functions for general material types based on the saturated hydraulic conductivities described above and the USCS soil classification. These parameters are reasonable to establish initial requirements for the embankment but will require further refinement from future sub-surface investigations.

Foundation materials primarily consist of poorly graded sands (SP), however, two seepage scenarios were simulated in order to determine the effects of foundation variability:

1) A two layered foundation with a thin layer of clayey silty materials in the upper 5 ft of the foundation should the over excavation not fully penetrate the upper finer grained layer. Poorly graded sands underlie the finer grained blanket.
2) A single layered foundation consisting of poorly graded sands.

Upper and lower foundation material hydraulic conductivities are based on USCS classifications and upper and lower foundation material conductivities are expected to be in the order of $2x10^{-7}\frac{ft}{s}$ and $2x10^{-4}\frac{ft}{s}$ respectively. Future subsurface investigations including in-situ testing will be required to validate these parameters.

Random fill embankment shell materials will consist of blended over excavation materials, consisting of silty sands (SM) and lean clays (CL), from the reservoir. Random fill will be compacted to at least 95% of the maximum density, as determined by ASTM D698. The hydraulic conductivity for these materials was estimated as $2x10^{-7}\frac{ft}{s}$.

Semi-pervious core embankment and cutoff trench materials are expected to be similar to the random fill materials but due to more stringent requirements are expected to have a lower permeabilities. A value of $2x10^{-8}\frac{ft}{s}$ is expected to be in the range of anticipated hydraulic conductivities for this finer grained material.

The downstream gravel materials are considered to have a negligible effect on seepage rates and are not included in the seepage analysis.

The upstream face soil cement was analyzed as both a pervious layer and impervious layer in order to ensure that all possible embankment seepage scenarios were accounted for. It is anticipated that cracking in the soil cement lifts will contribute to some amount of embankment through seepage.

2.1 Parameters Summary

Table FC4: Material Properties

Material Properties				
Property	Material			
	Foundation Upper 10′ Material	Foundation Below 10′ Material	Random Fill	Semi-Impervious Fill
K (ft/sec)	$2.0x10^{-7}$	$2.0x10^{-4}$	$2.0x10^{-7}$	$2.0x10^{-8}$
Phi (degrees)	30,2.44*	30, 3.21*	34	33
Cohesion (psf)	0	0	0	0

* Denotes that a normal probability distribution function was used to represent these parameters the first value represents the mean and the second value listed is the standard deviation used.
500 Monte-Carlo Trials were run during the probabilistic analysis which corresponds to a confidence of just over 95%.

4.0 Geoslope Model & Results

3.1 Load Cases

Figures FC1-FC5 below show the model geometry including material types and locations, slip surface extents, reservoir side, seepage face, and toe drain locations for the three basic load cases for the selected alternative analyzed. *Figure FC1* shows the analyses for the end of construction condition.

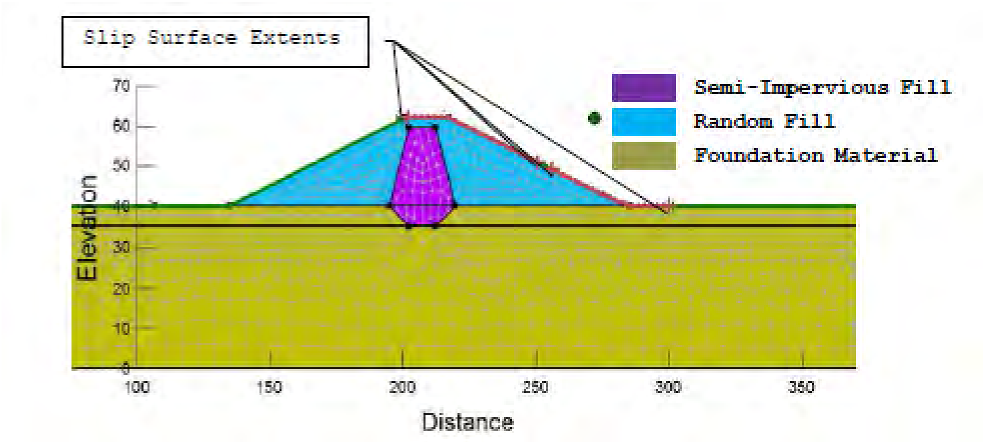


Figure FC1: Hatch Dam Load Case 1 (End of Construction) Model

Figure FC2 and *Figure FC3* show model geometry and inputs for load case 2, steady-state seepage, in which seepage and slope stability on the downstream face are analyzed.

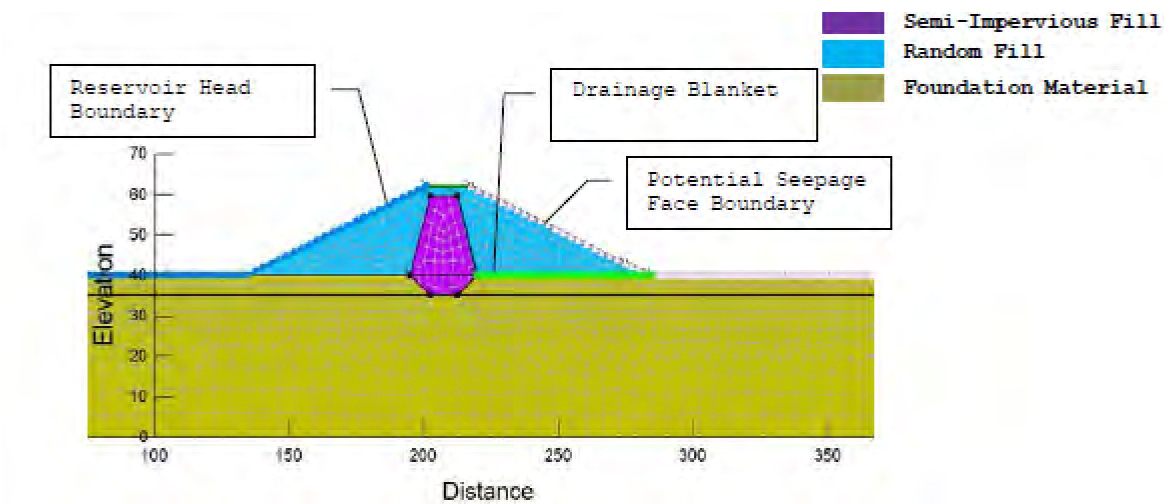


Figure FC2: Hatch Dam Load Case 2 (Steady-State Seepage) Seepage Model

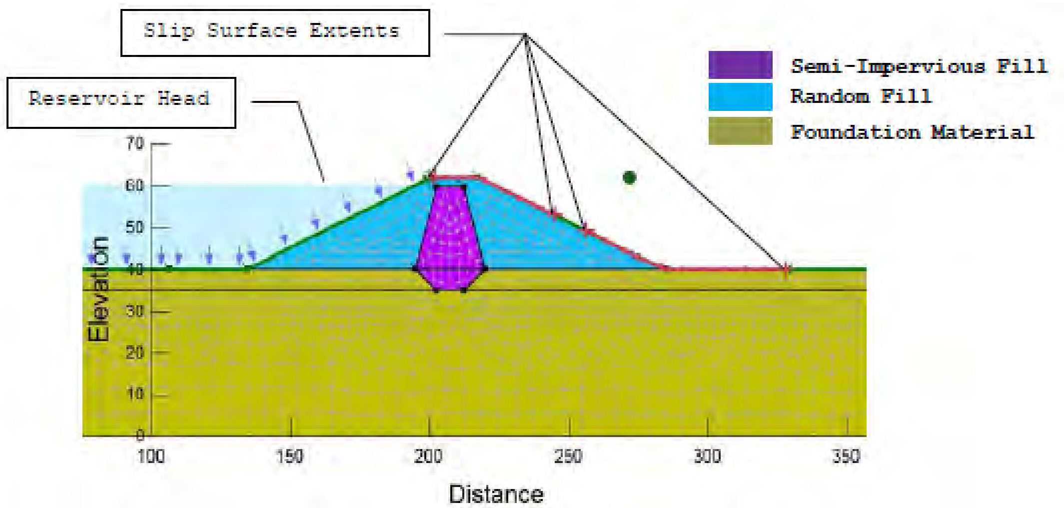


Figure FC3: Hatch Dam Load Case 2 (Steady-State Seepage) Slope Stability Model

Figure FC4 and *Figure FC5* show load case 3, rapid drawdown, which analyzes upstream slope stability during rapid drawdown.

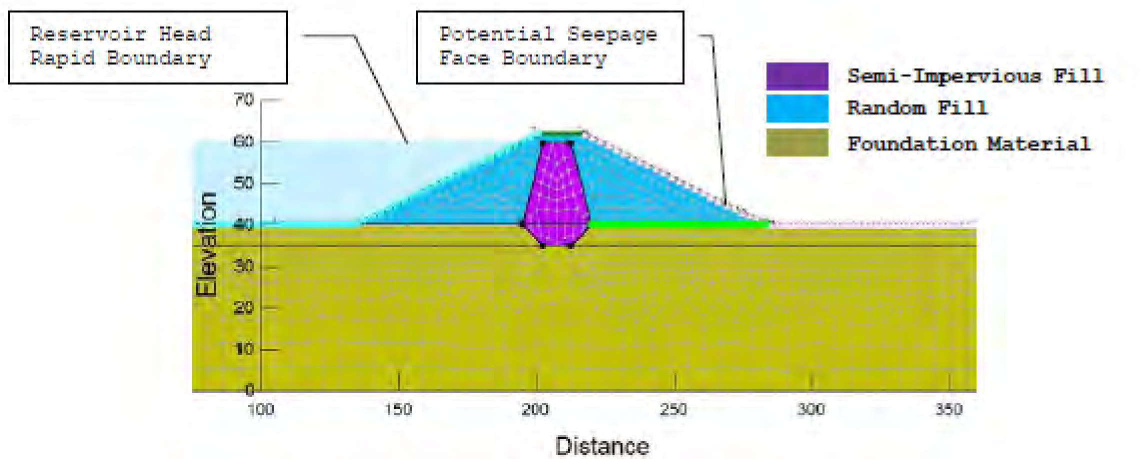


Figure FC4: Hatch Dam Load Case 3 (Rapid Drawdown) Seepage Model

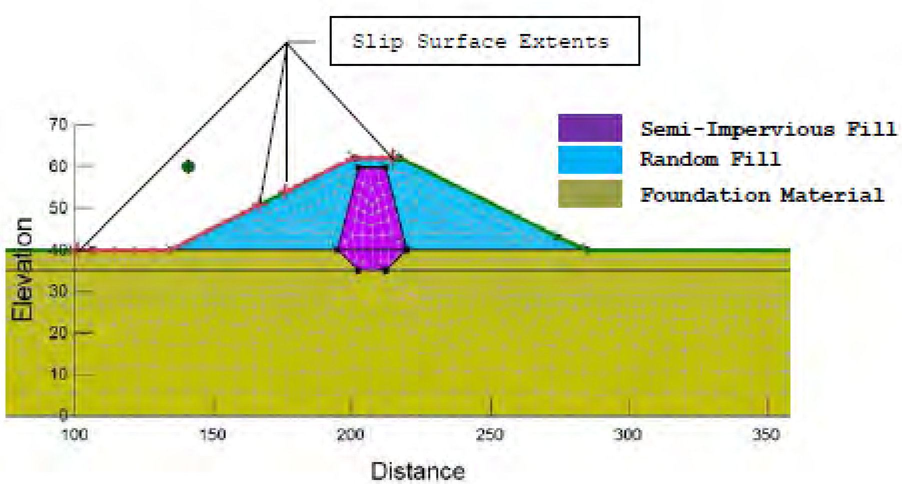


Figure FC5: Hatch Dam Load Case 3 (Rapid Drawdown) Slope Stability Model

3.2 Slope Stability Analysis Results

Results of the three slope stability load cases indicate acceptable factors of safety for all three loading conditions, see *Table FC5*. The mean FS is shown in the table below, however, probability distributions for all applicable load cases indicated with 95% confidence that the factors of safety will remain above the minimum required values per *EM 1110-2-1902.*

Table FC5: Slope Stability FS Summary

Analysis Type	Load Case 1 (Empty Reservoir)	Load Case 2 (Steady State)	Load Case 3 (Rapid Drawdown)
Slope Stability Mean Factor of Safety	2.024	1.810	1.785
Required FS per EM 1110-2-1902	1.30	1.50	1.30

3.2.1 Slope Stability Results Load Case 1 (End of Construction)

Load case 1 analyzed the end of construction slope stability of the earthen embankment structure. The relatively shallow 1V:3H side slopes prevent any significant deep seated slip surfaces from developing and create a high expected factor of safety of 2.024 against the most critical slip surface on the downstream face of the structure.

A probabilistic distribution is not available for load case 1 due to the controlling shallow failure surface that fails to activate the foundation material below, as can be seen in the "green" failure surface in *Figure FC6*.

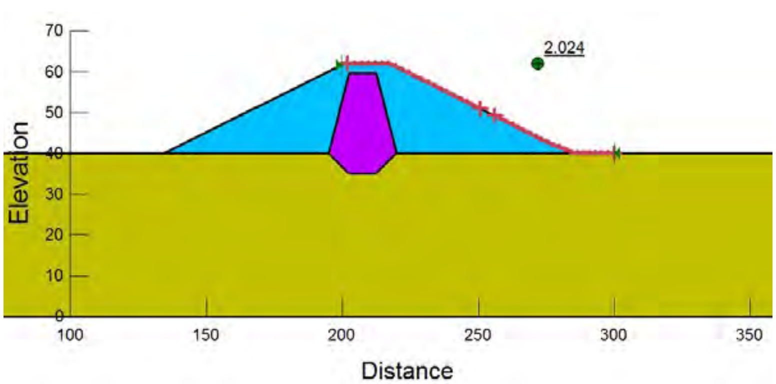


Figure FC6: Load Case 1 (End of Construction) Results (Factor of Safety=2.024)

3.2.2 Slope Stability Results Load Case 2 (Steady State)

Analysis of the slope stability under steady-state seepage conditions resulted in a mean factor of safety of 1.810. A probability distribution function generated using variable foundation conditions, as described in *3.0 Geotechnical Analysis Parameters*, indicates, with 95% confidence that the factor of safety remains above 1.691.

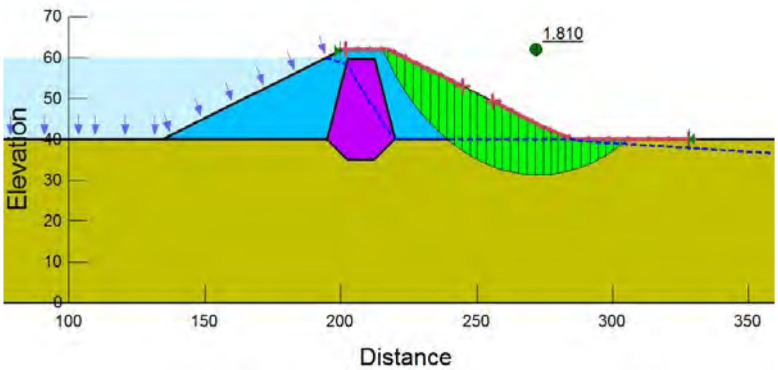


Figure FC7: Load Case 2 (Steady-State Seepage) Slope Stability Results (Controlling Factor of Safety=1.810)

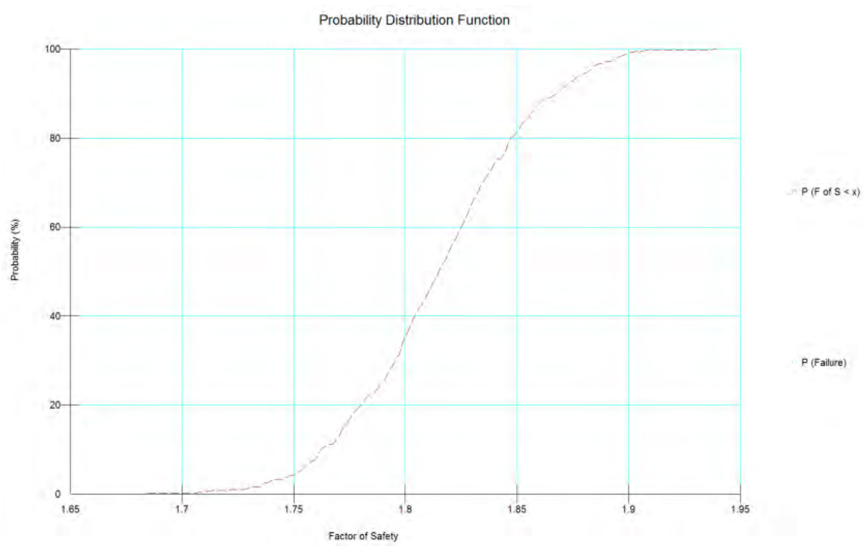


Figure FC8: Load Case 2 (Steady-State Seepage) Slope Stability Factor of Safety Probability Distribution Function

3.2.3 Slope Stability Results Load Case 3 (Rapid Drawdown)

Slope stability results for the rapid drawdown condition indicate a mean factor of safety, at the critical time step, of 1.785 with a 95% confidence that the factor of safety will not be less than 1.695.Similar to load case 2, the foundation material is modeled as a variable material with a probability distribution of friction angles based on mean N-values and standard deviations.

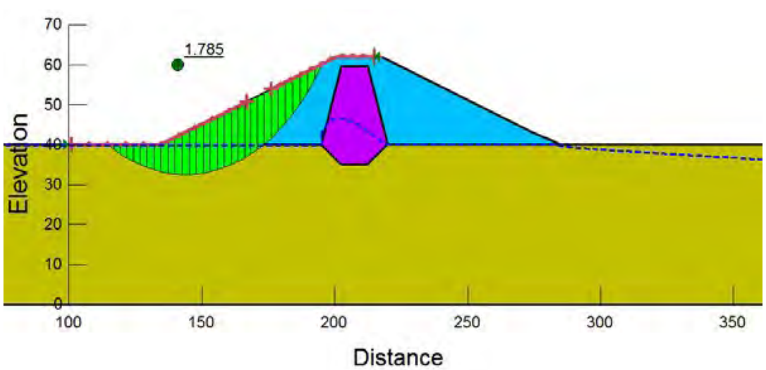


Figure FC9: Load Case 3 (Rapid Drawdown) Slope Stability Results (Mean Controlling Factor of Safety=1.785)

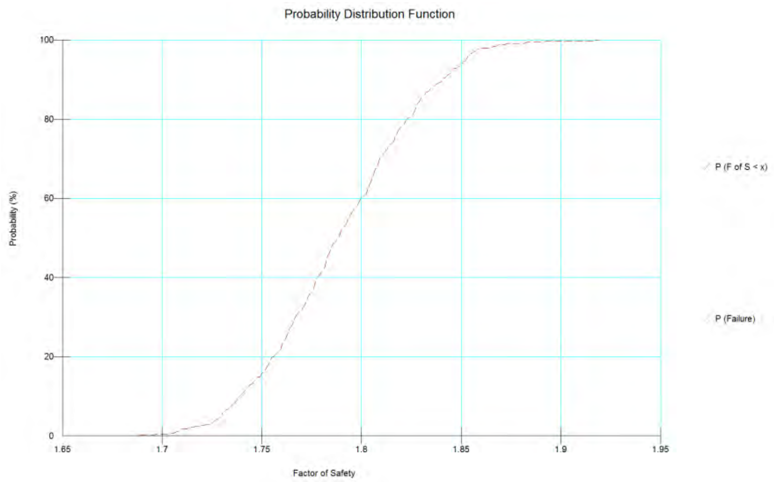


Figure FC10: Load Case 3 (Rapid Drawdown) Slope Stability Factor of Safety Probability Distribution FunctionSeepageResults

Seepage results indicate the need for a downstream drainage blanket and toe drain for the earthen embankment structure. Exit gradients without the toe drain result in factors of safety of less than 2, which is considered unacceptable for a structure of this type. Upon the addition of a drainage blanket and toe drain, the structures performance greatly improved with negligible exit gradients due to seepage interception at the downstream drainage blanket.

Uplift for the soil cement was considered under the rapid drawdown load case and is not expected to be an issue, given the significant size and self- weight of each soil cement lift.

3.2.4 Seepage Results Load Case 2 (Steady-State Seepage)

Seepage flows without a toe drain indicate possible exit gradients of around 0.50 which approaches a factor of safety of 2 per *Figure FC13*. This is well below generally acceptable limits of 4-5, as indicated in EM 1110-2-1901. Results with a drainage blanket and toe drain per *Figure FC14* show exit gradients of approximately 0.1 which provide a factor of safety of 10, thus providing a more than acceptable margin of risk for seepage exit gradients.

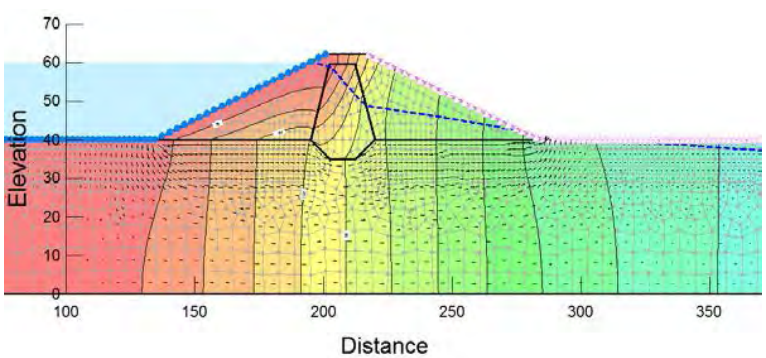


Figure FC11: Load Case 2 (Steady-State Seepage) w/out Drain Flow Vectors

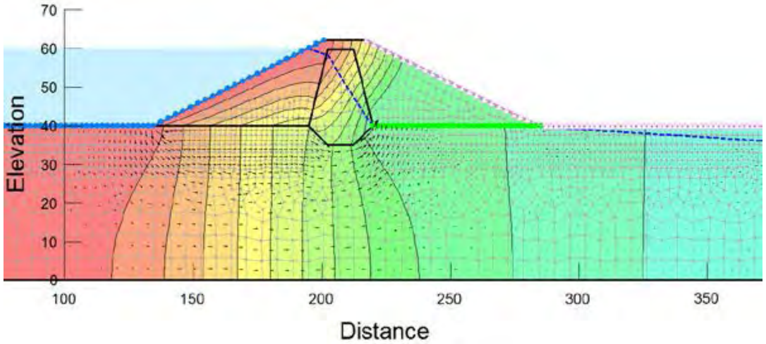


Figure FC12: Load Case 2 (Steady-State Seepage) w/ Drain Flow Vectors

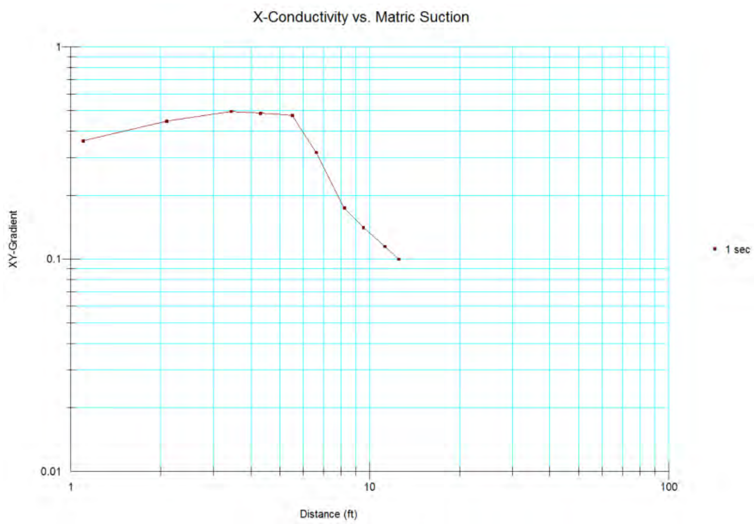


Figure FC13: Load Case 2 (Steady-State Seepage) w/out Drainage Blanket Exit Gradient Graph

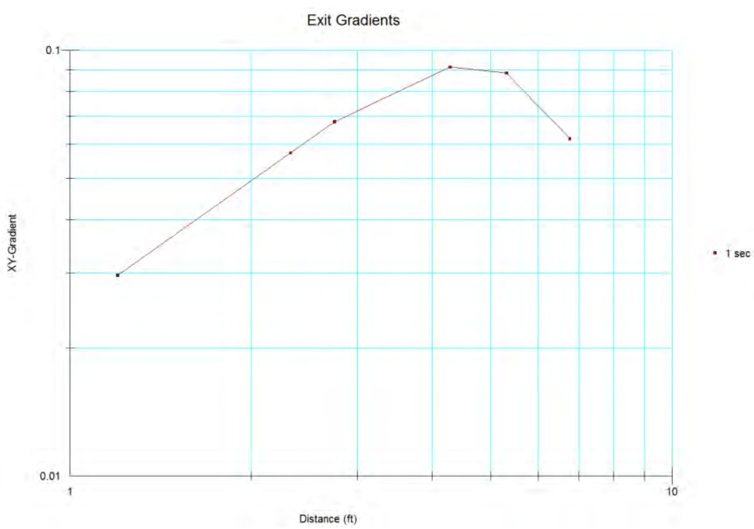


Figure FC14: Load Case 2 (Steady State Seepage) Exit Gradient Graph w/ Drainage Blanket

3.3.2 Seepage Results Load Case 3 (Rapid Drawdown)

The analysis of seepage under rapid drawdown is primarily concerned with determining uplift pressures on the soil cement cap of the upstream face. Pressure of water migrating back into the reservoir area quickly appears on the upstream face upon the quick exodus of the steady state pool. This condition is considered unlikely due to the short duration that the reservoir is allowed to impound water but is nevertheless considered as a worst case scenario. Results indicate that the net uplift per foot of soil cement at the lowest point on the upstream toe reaches approximately -260 psf. This corresponds to a factor of safety of 2.3 at the upstream toe, which quickly increases verticaly along the embankmanet above.This does not include the additional weight of the soil cement lifts above the initial toe lift and only includes the typical 9.5'x0.5' toe lift. The actual factor of safety when including the weight of soil cement above is significantly larger.

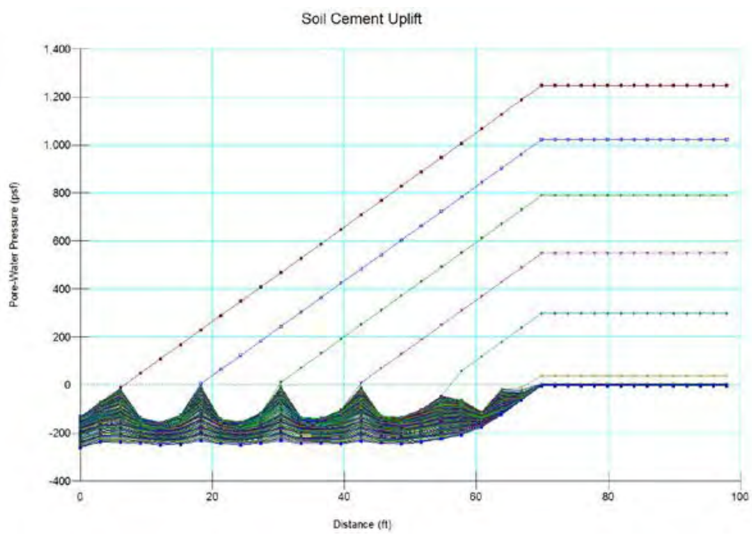


Figure FC15: Load Case 3 (Steady State Seepage) Soil Cement Uplfit for all time steps. (Max Uplift=260 psf)

3.3.3 Seepage Effects for 0.2% (500-year) Event

Seepage results for the 0.2% (500-year) event indicate that seepage will not have any significant effects downstream of the dam. The limited duration of storm water retention will have minimal effects on the seepage appearing in areas downstream of the embankment. Groundwater levels are expected to rise beneath the embankment section but will quickly dissipate into the lower foundation due to the poorly graded sands expected to lie approximately 5 ft below the embankment section.

4.1 Settlement and Horizontal Movement Results

Modeling results for settlement indicate a total vertical settlement of 0.4 ft. Foundation materials primarily consist of poorly graded sands with a the possibility of a thin layer of finer grained materials above, therefore, little consolidation is expected of the embankment beyond that of the elastic settlement.

Horizontal movement of approximately 0.1 ft is estimated to occur under full reservoir, steady-state seepage, conditions. As discussed in earlier sections, this condition is conservative as the reservoir is designed to be evacuated within 48 hours of impoundment and should therefore not reach a steady-state seepage condition.

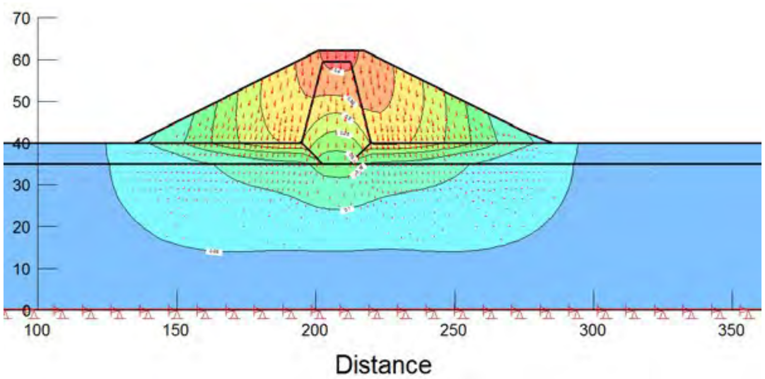


Figure FC16: Vertical Embankment Settlement Contour Plot

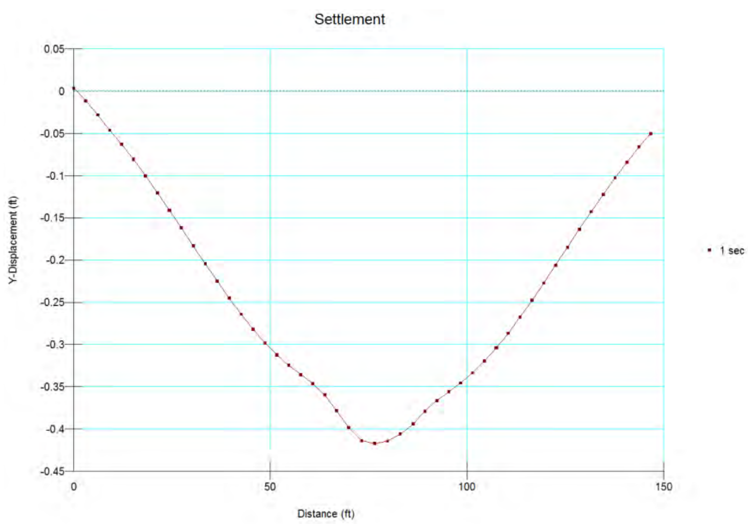


Figure FC17: Vertical Embankment Settlement Along Dam Cross Section

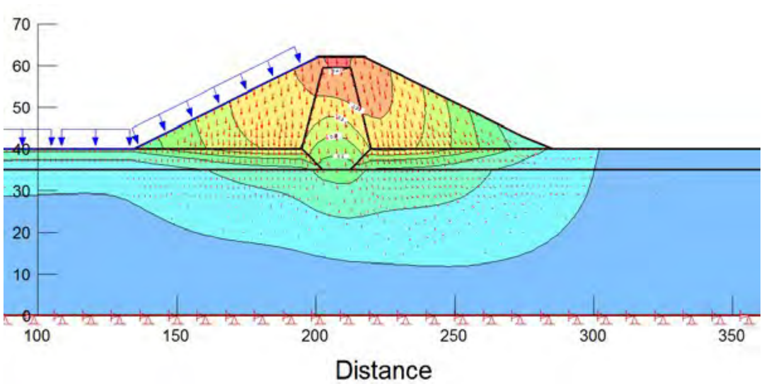


Figure FC18: Horizontal Embankment Movement w/ Pool Contour Plot

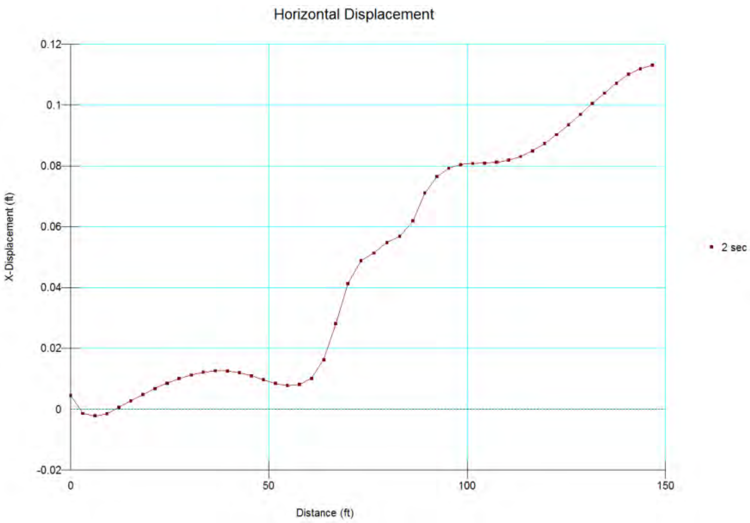


Figure FC19: Horizontal Embankment Movement Along Dam Cross Section w/ Pool

5.0 Summary of Findings

The Hatch Dam earthen embankment section was analyzed, using Geoslope's Geostudio finite element analysis software, for three load cases and various foundation and embankment conditions. Findings indicate that a sufficient factor of safety for slope stability is expected with the presence of a downstream drainage blanket and toe drain. Seepage results indicate low exit gradients with a downstream drainage blanket and toe drain and manageable uplift pressures on the upstream soil cement cap. In conclusion, an earthen embankment dam, as described in paragraph 2.0 above will perform satisfactorily as a flood control structure. *Table 6: Summary of Findings* below summarizes the findings of the analysis described within this document.

Table 6: Summary of Findings

Analysis Type	Load Case 1 (Empty Reservoir)	Load Case 2 (Steady State)	Load Case 3 (Rapid Drawdown)
Slope Stability Mean Factor of Safety	2.024	1.810	1.785
Seepage (With Toe Drain) Max Exit Gradient	N/A	0.1	N/A
Horizontal Movement (ft) Settlement (ft)	X=0.1 Y=-0.4	X=0.1 Y=0.4	N/A

Small Flood Risk Management Project Hatch, NM

Appendix G

Climate and Climate Change

February 2015

DRAFT

US Army Corps of Engineers ®
Albuquerque District

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Table of Contents

1.1 Introduction

This project seeks to provide flood risk reduction to the community of Hatch, located in the northwest corner of Doña Ana County, New Mexico, near the Rio Grande, and approximately 35 miles northwest of Las Cruces, New Mexico. The area is characterized by gently sloping plains separated by rugged mountain ranges. It is located within the Rio Grande floodplain, bounded to the north by the north-south aligned Caballo Mountains and the Sierra de las Uvas. Stream slopes are steep in the watersheds draining the Sierra de las Uvas, but are mild in the Rio Grande Valley. Stream flows are ephemeral, with flash flooding resulting from summer monsoon-season thunderstorms. Development is rural and agriculture in the valley and non-existent elsewhere in the watersheds.

Spring Canyon rises in the Sierra de las Uvas and flows through the Village of Hatch, NM toward the Rio Grande. Recent flooding has repeatedly occurred from tributaries in Spring Canyon, which have experienced overbanking flows at least three times since 1988 that caused more than $1.4 million in damages to the community in each case. Flash flooding along Spring Canyon, particularly during the summer monsoon season, is a major concern for the Village.

The Rio Grande Basin can be divided into two parts: the Upper Rio Grande Basin (above Elephant Butte Dam) and the Lower Rio Grande Basin (Elephant Butte Dam to the Gulf of Mexico). Flows on the Upper Rio Grande are snowmelt dominated, with smaller, flashy late-summer storm flows; the Lower Rio Grande is operated for irrigation with spring runoff held at Elephant Butte Reservoir (and adjoining Caballo Reservoir) in southern New Mexico for irrigation season use by Texas. Flood flows on the mainstem Rio Grande can be held at several points above Hatch, including Cochiti Lake, Elephant Butte Reservoir and Caballo Reservoir, as well as at Abiquiu Lake on the Rio Chama. In addition, a system of levees is in place to protect Hatch from flooding along the Rio Grande. Consequently, mainstem flooding is currently not a major concern at Hatch.

1.2 USACE Climate Change Guidance

Under the *USACE Climate Change Adaptation Policy Statement*, signed by Assistant Secretary of the Army Ms. Jo-Ellen Darcy on 3 June 2011, USACE is required to mainstream climate change adaptation in all activities as a means of enhancing the resilience of USACE's built and natural water-resource infrastructure and reducing its potential vulnerabilities to the effects of climate change and variability. USACE is charged with adaptation planning using the best available and actionable science to consider the impacts of climate change when planning for the future.

USACE Engineering and Construction Bulletin 2016-25, *Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs and Projects* outlines a process for qualitative evaluation of climate change impacts to projects, studies and designs.

1.3 Climate: Existing Conditions

Because climate change is likely to impact the project goals and designs, a qualitative assessment of these impacts was undertaken, supplemented by a quantitative assessment of current trends in precipitation and temperature across the region.

1.3.1 Background

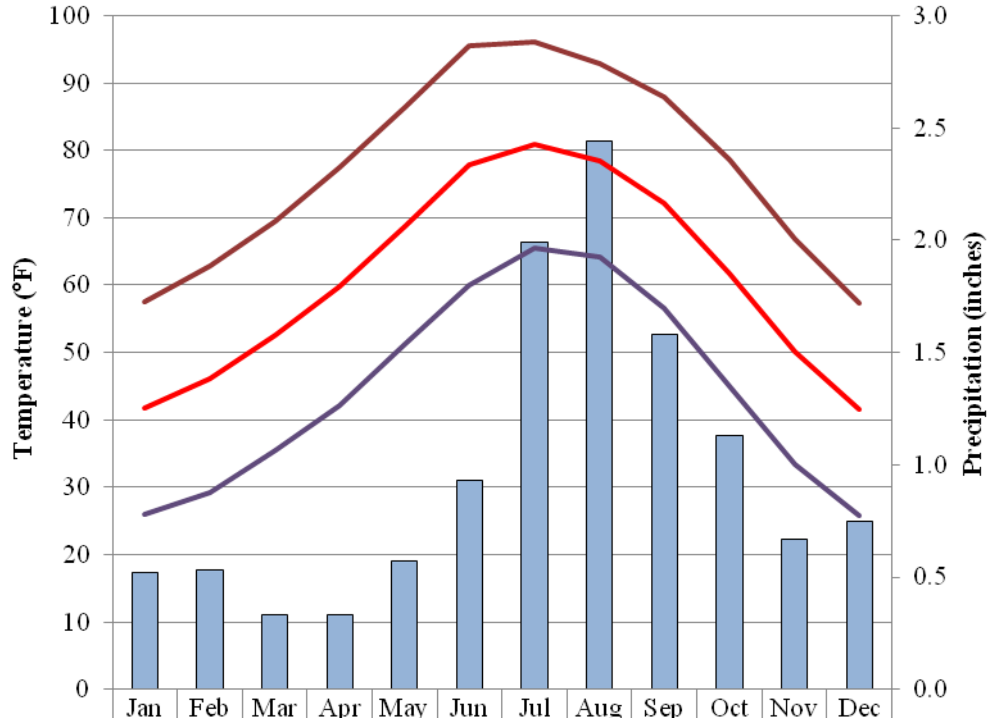
The Village of Hatch is located in the Lower Rio Grande Basin below Elephant Butte Dam, within the floodplain of the Rio Grande at a elevation of approximately 4030 ft asl. Generally, temperatures increase and precipitation decreases with southward movement along the Rio Grande. South of Albuquerque, mountain elevations become considerably lower and do not maintain a significant snowpack. Winter storms infrequently penetrate south of Albuquerque, so winters and springs become increasingly dry downstream of this location. The North American Monsoon becomes an increasing share of annual precipitation moving south from the Colorado border, but typically brings only localized, intense precipitation in contrast to slow, steady wide-area precipitation typical of winter storm systems.

The major controls on inter-annual variation in temperature and precipitation in the Rio Grande basin in New Mexico are imperfectly understood but are heavily influenced by tropical east Pacific and Gulf of Mexico sea surface temperatures. Winter precipitation, in areas receiving any, is affected by sub-decadal scale variations in El Niño-Southern Oscillation (ENSO), which refers to cyclical patterns of sea surface temperature and air pressure in the tropical Pacific that affect temperature and precipitation across North America. In warm (El Niño) years, warm sea temperatures encourage increased winter precipitation and the formation of large snow packs in the southern Rocky Mountains and Southwest (Sheppard et al., 2002). In cool (La Niña) years, cool sea surface temperatures in the tropical eastern Pacific reduce the availability of atmospheric moisture to the Southwest, resulting in low winter precipitation and small snowpacks (Sheppard et al., 2002). Multidecadal changes in Pacific Ocean temperatures known as the Pacific Decadal Oscillation (PDO) can enhance or suppress the effects of El Niño and La Niña, particularly in concert with changes in Atlantic sea surface temperatures (McCabe et al., 2004). Controls on the strength and intensity of North American Monsoon precipitation in the study area are imperfectly understood, but are related to the intensity of surface heating during the summer and summer sea surface temperatures in the Gulf of Mexico and the tropical eastern Pacific.

The number and intensity of hurricanes in any given season, and the likely distribution of their landfall, has proved elusive to predict.

1.3.2 Current Climate of the Study Area

The closest National Weather Service Cooperative Observer (COOP) station with a continuous recent record is the station at Caballo Dam (291286). The average monthly temperature and precipitation values for the most recent 30-year period (1981-2010) are given in Figure 1. Caballo Dam is located on the Rio Grande floodplain approximately 20 miles upriver from Hatch and is 150 feet higher in elevation. Although the NWS operates a COOP station at Hatch, the data collection has been sporadic over the last 15 years.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Precipitation (in.)	0.52	0.53	0.33	0.33	0.57	0.93	1.99	2.44	1.58	1.13	0.67	0.75
Mean Max. Temperature (F)	57.6	62.9	69.5	77.5	86.4	95.6	96.1	92.9	88	78.6	66.9	57.3
Mean Temperature (F)	41.8	46.1	52.5	59.8	68.8	77.8	80.8	78.5	72.2	61.7	50.2	41.5
Mean Min. Temperature (F)	25.9	29.3	35.5	42.1	51.2	60	65.5	64.1	56.5	44.9	33.4	25.8

Figure 1 Climate normal data (1981-2010) for the NWS COOP site at Caballo Dam (291286).

The area in the vicinity of Hatch, NM can be classified as semi-arid, with average annual precipitation totaling 10.48 inches. Daily high temperatures in January average 57.6°F, with minimum overnight temperatures averaging below freezing (25.6°F). Average January precipitation is 0.52 inches. By contrast, daytime highs in July typically average 96.1°F with overnight minimums averaging 65.5°F. Average July precipitation is 1.99 in. Although July is the warmest month, August has the highest average monthly precipitation at 2.44 inches.

Precipitation in the study area is strongly unimodal, peaking in July and August. This pattern reflects the importance of summer and early fall monsoon precipitation and the general paucity of precipitation at other times of the year. Monsoon precipitation comes in the form of convective storms with relatively localized precipitation. The largest one day total on record at Caballo Dam, NM is 3.96 inches on 23 September 1990 (Western Regional Climate Center, 2014a), approximately the 200-year or the 0.005 chance event (NOAA/NWS, 2014). At Hatch, the largest one day total precipitation was 3.46 inches on 23 August 1987, (Western Regional Climate Center, 2014b), approximately the 200-year or the 0.005 chance event (NOAA/NWS, 2014).

At 32.6° N latitude, Hatch lies south of the winter mid-latitude storm track, resulting in little or no snowfall in most years. Average snowfall peaks at approximately 1 inch each for December and January. Occasionally, however, significant snowfall does occur. The record snowfall for Hatch was 10 inches of snow in January 1973 (Western Regional Climate Center, 2014b).

Monthly pan evaporation rates exceed precipitation by an order of magnitude. Annual pan evaporation at Caballo Dam for the period 1938-2005 averaged 107.06 in (Western Regional Climate Center, n.d.). Pan evaporation rates were averaged the least in December at 3.48 inches and the most in June at 14.8 inches, and above 13 inches in both May and July. Annual pan evaporation at Las Cruces for the period 1959-2005 averaged 92.91 in (Western Regional Climate Center, n.d.). Pan evaporation rates were averaged the least in December at 2.79 inches and the most in June at 12.9 inches, and above 12 inches in both May and July.

The observed rates of warming in the period 1981-2010 in the Hatch area are likely comparable to those observed by Nielsen-Gammon (2011) immediately to the south in Far West Texas. Nielson-Gammon observed a 4°F degree rise in winter temperatures since 1960. This is an approximate rate of temperature increase of 0.8°F per decade. Temperatures have gradually risen at a rate of approximately 0.6°F per decade since 1970 for New Mexico as a whole (Tebaldi et al., 2012).

As summarized by Gutzler (2013:4):

> *Temperature across the southwestern U.S. has increased so much and so steadily relative to interannual variability – especially in the warm season – that temperatures from the first half of the 30-year averaging period* [1981-2010] *are considerably colder than temperatures in more recent years, or expected temperatures in future years. Thus the seasonal outlooks almost always indicate enhanced probability of "above normal" temperature ….*

Despite recent drought years, no trends have been observed in annual water year precipitation from 1895/96 through 2010/11 for the six-state Southwest (NOAA, 2013) that includes Colorado and New Mexico. Seasonal time series show no trends for winter, spring and summer; fall shows a slight upward, but not statistically-significant, trend. In a study of climate change along the borderlands, Gutzler (2013) observed no trend in precipitation since 1900 in Texas Climate Division 05.

In addition, there has been no overall trend in the frequency of extreme precipitation events across the Southwest (NOAA, 2011): throughout the 20th century and into the early 21st century, the number of 1-day-duration and 5-year return interval precipitation events fluctuated, but remained within the range of early 20th century values.

The ephemeral arroyo responsible for flooding in the study area is ungauged. Flows at the closest gage on the mainstem Rio Grande are heavily regulated and do not reflect natural flow regimes in the area, reflecting instead water exchange between Elephant Butte and Caballo Reservoirs for irrigation and other purposes. As a result, an analysis of current trends was not conducted using the USACE Nonstationarity Detection Tool or the Climate Hydrology Assessment Tool. (https://maps.crrel.usace.army.mil/projects/rcc/portal.html).

1.4 Projected Changes in Climate

1.4.1 Projected Temperature Change

Model projections indicate that surface temperatures in the Southwest will warm substantially over the 21st Century (highly likely), and warming is likely to be higher in summer and fall than in winter and spring (Cayan et al., 2013). For the Southwest as a whole, compared to the period 1971-2000, models used in the most recent national climate assessment project (Cayan et al., 2013; USGCRP 2014) indicate a potential increase of 2-6°F under low future atmospheric greenhouse gas concentrations, and 5-9°F under higher future atmospheric greenhouse gas concentrations. Warming is likely to be higher inland and to increase from south to north.

Seasonal differences in warming are likely, although the high variation among models reduces confidence in specific results (Cayan et al., 2013). Increases in summer temperatures are likely to be greater than for other seasons, with mean increases across modeled scenarios around 3.5°F in 2021-2050, 5.5°F in 2041-2070, and 9°F 2070-2099. The least amount of warming is anticipated for the winter months, with an average increase of 2.5°F in 2021-2050 increasing to almost 7°F in 2070-2099.

(a) Hatch Area Temperature Projections

There have been no climate change studies specific to Southern New Mexico. However, several studies have focused on Far West Texas (El Paso area) and the Southwest Borderlands. Based on models from the National Center for Atmospheric Research, the average projection for Far West Texas is for a mean annual temperature increase of 6-8°F by 2100 (Norwine et al., 2007). Using a multi-model ensemble running under the A1B (moderate emissions) scenario, an increase of about 1°F is projected for the period 2000-2019 compared to the 1980-1999 baseline period, 2°F for the period 2020-2039, and close to 4°F for the period 2040-2059 (Nielsen-Gammon, 2011). The range of model values for the 2040-2059 is from 2-5.5°F.

Under the A1B (moderate future atmospheric greenhouse gas concentrations) scenario, Texas Climate Division 05 (Far West Texas) is anticipated to warm about 5.5°F in winter and close to 7°F in summer by 2100 (Gutzler et al., 2013). In these models, “even anomalously cold summers late in the 21st Century are warmer than the warmest summer ever observed to date” and “annual average temperature…increases far beyond the historical range of variability before the end of the current century” (Gutzler et al., 2013:7).

1.4.2 Projected Changes in Precipitation

Warming-driven changes to global atmospheric circulation will affect when, where, and by how much precipitation will change. These changes will be superimposed on already highly-variable precipitation patterns resulting from the interplay of long- and short-term climate cycles. Long-term wet and dry cycles in the Southwest are controlled primarily by Pacific sea surface temperatures (SSTs), particularly the multi-decadal Pacific Decadal Oscillation (PDO). Atlantic Ocean SSTs are also important. The driest phases in the Southwest are associated with cool Pacific SSTs (negative PDO) and warm Atlantic SSTs (positive Atlantic Multidecadal Oscillation (AMO)) (Norwine et al., 2007). Interannual (time scales of 1 to less than 10 years) variation in winter precipitation is controlled by the ENSO cycle, with either El Niño or La Niña amplified depending on the state of the PDO. Because of the high variability in precipitation in the Southwest at multiple scales, detecting changes in precipitation has been more challenging than detecting changes in temperature.

Changes in PDO and AMO correspond to the major dry and wet periods (McCabe et al., 2004). From 1944 through 1963, combination of a negative PDO and positive AMO were major contributors to Southwestern drought. From 1964-1976, negative PDO and negative AMO contributed to average precipitation conditions, and from 1977 through 1994, the combination of positive PDO and negative AMO contributed to wetter-than-average precipitation. Since 2000, PDO has been primarily negative (Mantua, 2013) and AMO has been strongly positive (NCAR 2012), contributing to the reemergence of drought across the Southwest. The decade 2001-2010 has had the second-largest area affected by drought (after the period 1951-1960) and the most severe average drought conditions of any decade since 1901 (Hoerling et al., 2013).

In general, warming is anticipated to intensify existing precipitation patterns: wet areas, such as the northeastern U.S., may get wetter and dry areas, such as northern Mexico and southern Arizona, are likely to get drier (USGCRP Melillo et al., 2014; 2009). Most climate models project that the Southwest will become drier. Modelers are highly confident of this result (USGCRP Melillo et al., 2014; 2009). “Highly confident” means that most models agree that drying will occur, even though there is disagreement about the amount of change in precipitation.

Drying will be driven by increased evaporation due to warmer temperatures, and by changes in precipitation due to changes in global scale atmospheric circulation, such as poleward expansion of the subtropical dry zone (Lu et al., 2007). Because the Rio Grande Basin is located at the boundary of the subtropics, and because many of the processes that affect precipitation along this boundary are not well-captured by models, there is greater uncertainty for precipitation change than for temperature change. However, in almost all model scenarios, the rate of evaporation increases faster than any positive change in precipitation, driving the basin to an overall drier state. In addition, water in the basin is fully allocated, so increased aridity will be accompanied by increasing water stress in the region.

Model projections range from essentially no change in precipitation to reductions of about 10% (Barnett and Pierce, 2009). Researchers at the U.S. Global Change Research Program project a 10 to 20% decline in precipitation by 2080-2090 primarily in the winter and spring, resulting from the northward (poleward) shift of midlatitude winter storm tracks bringing the Southwest into the subtropics year-round (Melillo et al., 2014). Land and ocean warming may bring more moisture into the Southwest during the summer months, providing stronger monsoons, but this is only projected by some models. The timing of monsoon precipitation may shift later in the year (Cook and Seager, 2013). Modeling by Dominguez et al. (2010) suggests that the distribution of drying may be uneven across the Southwest: the southern part of the Southwest may become drier, and the northern part slightly wetter, but the modeled trends were not significant. Model projections show that precipitation will continue to be characterized by wet and dry cycles (Cayan et al., 2013). Overall, model simulations used in the most recent National Climate Assessment show changes in precipitation that range from -13% to +10% across all model runs (Cayan et al., 2013). Confidence in model projections is medium-low, reflecting the variation in the magnitude and direction of projected changes.

A key change projected by models is that precipitation may become concentrated in a smaller number of larger-magnitude precipitation events. This would continue the existing trend of increasing frequency and intensity of heavy downpours in the U.S.: in the Southwest from 1958 to 2011, there was a 12% increase in the amount of rainfall falling in very heavy precipitation events (Melillo et al., 2014). Climate models project that the share of precipitation falling in heavy rainfall events will continue to increase. Because precipitation may intensify – more larger storms, fewer small ones – a trend towards drier conditions driven by temperature increases may result in more severe droughts coupled with the potential for more severe floods (Gutzler, 2013).

The Hatch area receives periodic intense precipitation from moist subtropical air masses derived from land falling eastern north Pacific hurricanes. Although it is not clear whether the number of land falling hurricanes will increase, hurricane intensity is projected to increase (fewer category 1 and 2 storms, more category 5 storms) and the amount of precipitation falling from all hurricanes is likely to increase (Gutowski et al., 2008). During late summer, larger, more-persistent hurricanes may provide additional moisture in the monsoon regions. These changes may increase flood risk in the Lower Rio Grande.

Seasonal and annual drought are anticipated to be a persistent feature of future climate across the Rio Grande Basin. Temperature-driven increases in evaporation are projected to lead to sustained dryer climate conditions, particularly in winter such that the average climate of the Southwest by mid-21st Century will resemble that found during a multi-year drought today. The most severe future droughts will still occur during persistent La Niña events, because these events will perturb a base state that is drier than any state experienced recently (Seager et al., 2007). Furthermore, because of the overprinting of a gradual drying in the Southwest, not even the wettest future models predict a return to the two wet decades preceding the 1997-98 El Niño (Seager and Vecchi, 2010).

1.5 Projected Changes in Regional Hydrology

1.5.1 Climate Change Impacts to Flooding in the Hatch Area

In the Hatch area, flooding occurs primarily in response to summer monsoon precipitation (which can be locally very heavy) and monsoon precipitation augmented by moisture from hurricanes originating in the Gulf of Mexico that make landfall in south Texas or northern Mexico. Flood risk may increase in the Hatch area due to increased precipitation intensity, and due to increased hurricane moisture resulting from warmer sea surface temperatures in the Gulf of Mexico.

Precipitation extremes are expected to become more frequent and intense even if net precipitation stays the same or decreases (Gershunov et al., 2013). This may occur because the amount of water the atmosphere can hold scales with temperature: a warmer atmosphere is able to hold more water, and, therefore, greater heat and moisture are available to fuel larger storms.

Precipitation under the North American Monsoon is not well modeled by global circulation models (GCMs), and there is little model consensus on its evolution (Gershunov et al., 2013). A recent study by Cavazos and Arriaga-Ramírez (2012) suggests that precipitation in the North American Monsoon region will be reduced by 20% in winter, spring, and summer by the last 20 years of this century under the A2 (high emissions) scenario. Other studies suggest that precipitation during the late summer/early fall monsoon season will remain the same, but much of this rainfall may shift to September and October (Cook and Seager, 2013).

Low confidence also surrounds model projections of extreme precipitation events during the monsoon season (Gershunov et al., 2013). Changes to flood risk during the monsoon cannot be evaluated at this time.

Hurricane intensity and development are driven by sea surface and subsurface temperatures, and are enhanced when wind shear (the difference in wind strength with altitude) is reduced (Emanuel, 2005). A large share of atmospheric warming (past and future) is anticipated to be absorbed by the oceans, leading to increasing ocean temperatures through the depth of mixing. Although it is not clear whether the number of land falling hurricanes will increase, two outcomes are likely: hurricane intensity is projected to increase (fewer category 1 and 2 storms, more category 5 storms) and the amount of precipitation falling from all hurricanes is likely to increase (Gutowski et al., 2008).During late summer, larger, more-persistent hurricanes may provide additional moisture in the monsoon source regions. These changes may increase flood risk in the Lower Rio Grande.

The projected future annual maximum monthly flows for the Rio Grande-Mimbres Basin (HUC 1303) in which Hatch is located were obtained from the USACE Climate Preparedness and Resilience Community of Practice (CPR CoP) Climate Hydrology Assessment Tool (Figure 2) (https://maps.crrel.usace.army.mil/projects/rcc/portal.html). The resulting graph shows a small, gradual but statistically significant increase in future annual maximum monthly flows (blue line), and a continuation of the highly variable flood conditions for the region as a whole (tan shaded area). The increase in variation around the trend likely reflects increasing model uncertainty with time rather than increasing variability.

The CPR CoP Vulnerability Assessment Tool was used to examine sources of vulnerability to future changes in flood risk for the Rio Grande-Mimbres Basin as a whole (Figure 3). While the region is not among the 20% at greatest risk across the conterminous U.S., future sources of flood risk include small potential increases in monthly flood magnitudes (under wetter future climate conditions), concurrent with likely increases in urban populations within the 500-year flood plain.

While the CPR CoP tools provide information on projected future conditions throughout the basin, it is not clear at this time how well they may reflect the conditions within the tiny Hatch project watershed. Furthermore, small increases in the annual maximum monthly flows provide no guidance on how the largest flood flows might change in the future, and should not be used to infer changes in the project design flood.

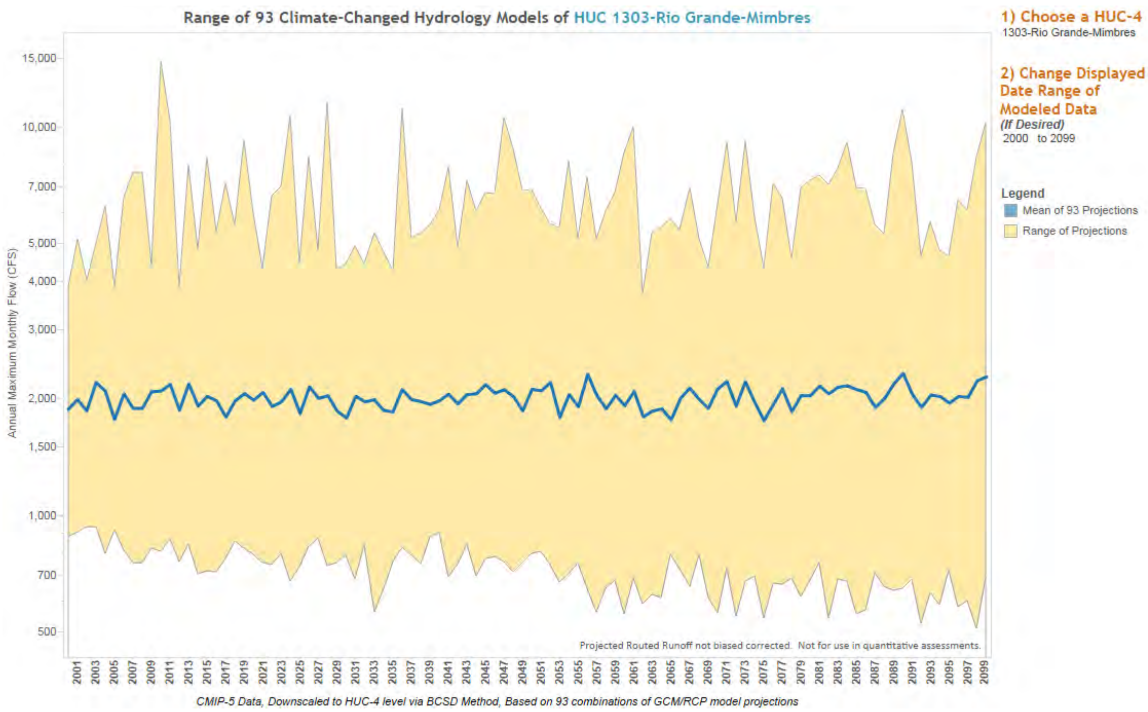


Figure 2 Projected Annual Maximum Monthly Flows, HUC 1303 Rio Grande-Mimbres Basin.

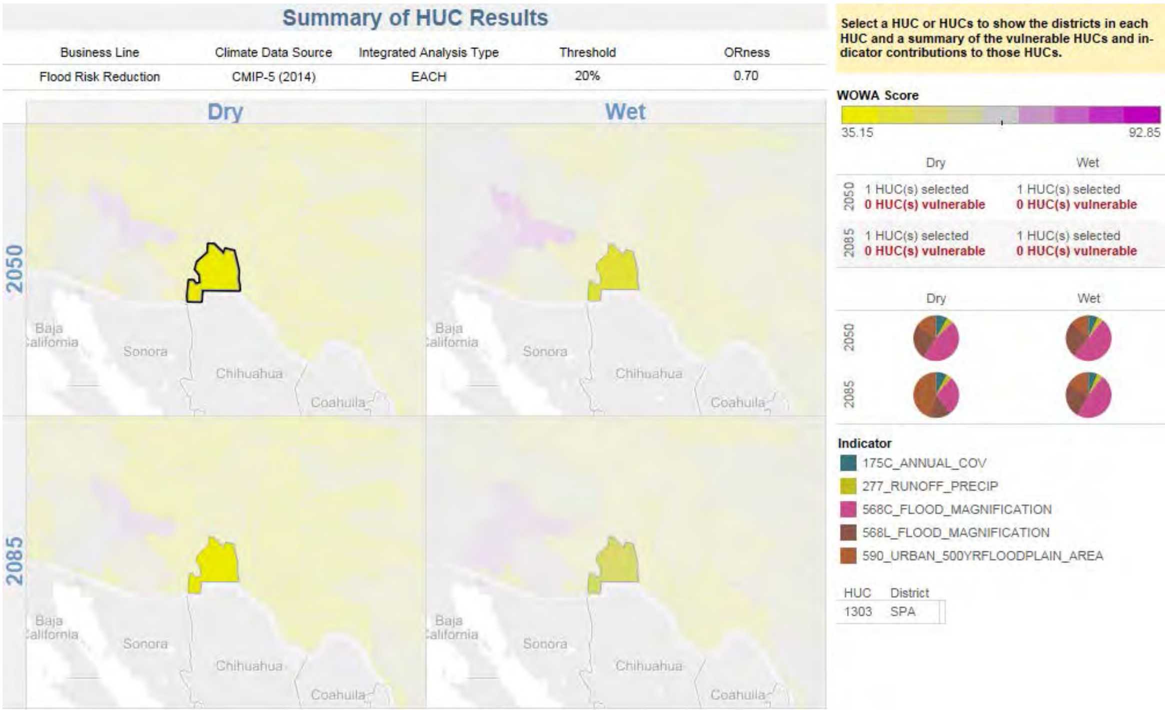


Figure 3 Watershed Vulnerability Assessment with Respect to Flood Risk for HUC 1303 Rio Grande-Mimbres Basin.

1.6 Summary

1.6.1 Existing Conditions

Hatch, NM has a semi-arid to arid climate, with average annual precipitation totaling approximately 10.48 inches. Daily high temperatures in January average 57.6°F, with minimum overnight temperatures averaging below freezing (25.6°F). Average January precipitation is 0.52 inches. By contrast, daytime highs in July typically average 96.1°F with overnight minimums averaging 65.5°F. Average July precipitation is 1.99 in. Although July is the warmest month, August has the highest average monthly precipitation at 2.44 inches. Temperatures have gradually risen at a rate of approximately 0.8°F / decade since 1960 in nearby West Texas (Nielsen-Gammon, 2011) and at about 0.6°F per decade since 1970 for New Mexico as a whole (Tebaldi et al., 2012).

Precipitation in the study area is strongly unimodal, peaking in July and August. This pattern reflects the importance of summer and early fall monsoon precipitation and the general paucity of precipitation at other times of the year. Monsoon precipitation comes in the form of convective storms with relatively localized precipitation. The largest one day total on record at nearby Caballo Dam, NM is 3.96 inches on 23 September 1990 (Western Regional Climate Center, 2014a), approximately the 200-year or the 0.005 chance event (NOAA/NWS, 2014). At Hatch, the largest one day total precipitation was 3.46 inches on 23 August 1987, (Western Regional Climate Center, 2014b), approximately the 200-year or the 0.005 chance event (NOAA/NWS, 2014). At 32.6° N latitude, Hatch lies south of the winter mid-latitude storm track, resulting in little or no snowfall in most years.

Monthly pan evaporation rates exceed precipitation by an order of magnitude. Annual pan evaporation at Caballo Dam for the period 1938-2005 averaged 107.06 in (Western Regional Climate Center, n.d.). Pan evaporation rates were averaged the least in December at 3.48 inches and the most in June at 14.8 inches, and above 13 inches in both May and July. Annual pan evaporation at Las Cruces for the period 1959-2005 averaged 92.91 in (Western Regional Climate Center, n.d.). Pan evaporation rates were averaged the least in December at 2.79 inches and the most in June at 12.9 inches, and above 12 inches in both May and July.

There has been no detectable trend in precipitation for the Southwest as a whole or for the Hatch area over the period of record for precipitation gauges. Analysis of flood trends was not conducted under ECB 2016-25 due to the lack of gauging stations on unregulated streams in the area.

1.6.2 Future Conditions

Climate change is anticipated to impact the study area primarily through temperature increases, which are projected to rise by as much as 3.5°F to as much as 8.5°F by 2100. Temperature increases are likely to drive evaporation increases. There is strong model agreement in the direction and magnitude of projected temperature change.

Changes in precipitation are less certain, although winter precipitation is likely to decrease. Some models predict precipitation decreases of 3-9% in all seasons. Summer precipitation may increase in intensity, result in stronger, wetter storms interspersed with longer dry periods. Hurricanes are likely to increase in strength and moisture content. During late summer, larger, more-persistent hurricanes may provide additional moisture in the monsoon source regions. These changes may increase flood risk in the Lower Rio Grande. Models disagree on future precipitation trends due to:

- High inter-annual precipitation variability.
- Uncertainty over how future precipitation drivers, such as El Niño-Southern Oscillation and hurricanes, might evolve.
- Inability of models to resolve mesocale (local) climate phenomena, such as individual thunderstorms, which makes it difficult to estimate how precipitation variables might change on a scale relative to flooding along Spring Canyon.

The USACE Climate Preparedness and Resilience Community of Practice (CPR CoP) Climate Hydrology Assessment Tool (https://maps.crrel.usace.army.mil/projects/rcc/portal.html) indicates a small but statistically significant increase in annual maximum monthly flows over the 21st Century relative to current conditions in the Rio Grande-Mimbres Basin as a whole. Hatch is located at the northern end of this region. Similarly the CPR CoP Vulnerability Tool suggests a potential increase in monthly flood flow magnitudes for this basin but provides no quantitative increase in that magnitude. How either of these findings might translate into projected changes in instantaneous peak flood flows in the project area is unclear and can not be quantified at this time.

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Small Flood Risk Management Project
Hatch, New Mexico

DRAFT Final Detailed Project Report and Environmental Assessment Section 205

January 2015

Appendix H
Structural Design

US Army Corps
of Engineers
Albuquerque District
South Pacific Division

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1. STRUCTURAL DESIGN

1.1. General. This portion of the write-up describes the design criteria and the loads and allowable stresses used in the structural analysis of the various structures. A brief description of the structure types and the design assumptions peculiar to the individual structures types are discussed in their respective paragraphs. Appendix B contains calculations for the structures on this project.

1.2. Technical Criteria and Standards. The project was designed using the following technical criteria and standards:

a. ETL 1110-2-256, Sliding Stability for Concrete Structures, 24 Jun 81

b. ETL 1110-2-307, Flotation Stability Criteria for Concrete Hydraulic Structures, 20 Aug 87

c. ETL 1110-2-307, Flotation Stability Criteria for Concrete Hydraulic Structures, 20 Aug 87

d. EM 1110-2-2000, Standard Practice for Concrete for Civil Works Structures, 9 Feb 94 (Change 1)

e. EM 1110-2-2102, Waterstops and Other Joint Materials for Civil Works Structures, 9 Sep 95

f. EM 1110-2-2104, Strength Design for Reinforced Concrete Hydraulic Structures, 30 Jun 92

g. EM 1110-2-2400, Structural Design of Spillways and Outlet Works, 2 Nov 64

h. EM 1110-2-2502, Retaining and Flood Walls, 29 Sep 89

i. EM 1110-2-2902, Conduits, Culverts, and Pipes (Ch. 1-3), 31 Mar 98 (Change 1)

j. ER 1110-2-1150, Engineering and Design for Civil Works Projects, 31 Mar 94

k. ACI 318-08, Building Code Requirements for Structural Concrete and Commentary

1.3. Design Loads.

1.3.1 Seismic.

0.2 Sec. Design Spectral Response Acceleration, $S_S = 0.2915$
1.0 Sec. Design Spectral Response Acceleration, $S_1 = 0.0876$

1.3.2 Material Weights.

Water ....62.4 pcf
Reinforced Concrete....................................150.0 pcf

1.3.3 Soil Parameters. The soil parameters will be based on the Foundation Design Analysis (FDA) provided by the Geotechnical Unit. The following values are conservatively assumed for preliminary design. A value listed as "per FDA" will be provided once a geotechnical report is compiled:

1.3.3.1 Material weights.

Backfill moist..............................120.0 pcf
Backfill saturated.........................140.0 pcf
In-situ moist..................................per FDA
In-situ saturated............................per FDA

1.3.3.2 Earth pressures.

a. Backfill materials:

Kr (coefficient at rest).......................0.56
Ka (coefficient active pressure)........0.33
Kp (coefficient passive pressure)......3.00

b. In-situ materials:

Kr (coefficient at rest).......................per FDA
Ka (coefficient active pressure)........per FDA
Kp (coefficient passive pressure)......per FDA
Angle of internal friction backfill.....30 degrees
Angle of internal friction in-situ........per FDA
F, sliding coefficient of concrete on soil….0.45

c. Allowable soil bearing pressure:

In-situ..1.5 ksf
Compacted fill............................3.0 ksf

1.3.4 Design Stresses.

1.3.4.1 Reinforced Concrete.

a. Cast-in-Place. (28 Day Compressive Strengths)
Intake structure, cast-in-place conduit, cast-in-place box culverts, cast-in-place pressure manholes and concrete transition sections… ....4000 psi

All Other Structures..3000 psi

b. Reinforced Concrete Pipe (RCP)..............................ASTM C361 & ASTM C76

1.4.3.2 Precast Reinforced Concrete Manholes...ASTM C478

1.3.4.3 RCP Manhole Connectors...ASTM C923

1.3.4.4 Reinforcing Steel...................................ASTM A615, Grade 60, Fy = 60,000 psi

1.3.4.5 Structural & Misc. Steel...ASTM A36, Fy = 36,000 psi

1.3.4.6 Steel Pipe..............................ASTM A 53, Type E or S, Grade B, Fy = 35,000 psi

1.4. Structural Features.

1.4.1 Description. This project consists of construction of a new flood control dam in the City of Hatch, NM. The design of these structures will rely on previous successful designs of civil works projects completed by the District. The structures involved with this project consist of the following:

a. Reinforced concrete intake structure- this structure will control water outflow from the dam to the gatewell structure.

b. Reinforced concrete box conduit- this will route water flow out and away from the dam.

c. Reinforced concrete manhole – this structure will allow access for inspections of the conduit.

d. Reinforced concrete gatewell structure- this will control the water flow out and away from the dam.

e. One double barrel concrete box conduit- this culvert is located at the south end of the dam and will route incoming flow into the dam.

f. Concrete headwalls/treatments- the treatments will be located at culvert and conduit ends.

g. Concrete trapezoidal channel- this concrete channel shall transition from the box culvert to the main channel.

1.4.2 Assumptions. Preliminary design parameters/assumptions for these concrete structures are contained in Appendix B of this report.

Appendix B
Structural Design Assumptions

1.0 Description. The design of the structures for this project is based on previous, successfully completed, and similar projects within the District. In addition, the structures will be designed according to the applicable codes, manuals and guidance as provided in the Albuquerque District (CESPA) Civil Works Construction A-E Structural Criteria Document (CESPA A-E SCD-CW), dated 25 February 2003 (latest edition).

2.0 Calculations.

a. Reinforced Concrete Intake Structure/Gatewell/Outlet Conduit- this shall be reinforced cast-in-place concrete with reinforcing as shown on plans

1) Intake tower: 8'-6" wide X 8'-6" long X 11'-0" tall tower w/4" wide low flow slots into three sides of the tower and steel trash rack at the top/intake of the tower. Walls shall be a minimum 1"-3" thickness.

2) Tower footing: 19'-3" wide X 16'-6" long X 1'-6" thick shallow footing.

3) Manhole: 4'-7 ½" diameter pressure manhole with frame and bolted lid.

4) Gatewell: 7'-10" x 7'-10" x 20'-0" tall tower with a heavy duty sluice gate. Wall shall be a minimum 10" thickness. Footing shall be 7'-10" x 7'-10" x 1'-6" thick concrete.

3) Transition section: 3'-0" long transition from 6'-0" X 3'-0 rectangular section from the tower to a 5'-0" X 2'-6" rectangular section to connect to outlet conduit.

4) Outlet conduit: 5'-0" X 2"-6" rectangular reinforced conduit approximately 175'-0" long. Walls shall be minimum 8" thick.

b. Double Barrel Concrete Box Conduit- this shall be reinforced cast-in-place concrete with reinforcing as shown on plans.

1) Barrels top and side walls: 9'-0" wide X 5'-0" tall box conduits approximately 66'-0" long which act as an inlet path under the dam embankment at the south east end of the dam. Walls shall be minimum 8" thick.

2) Barrel bottom slab: bottom slab shall match dimensions of box and be a minimum of 12" thick.

c. Concrete headwalls/treatments: this shall be reinforced cast-in-place concrete with reinforcing as shown on plans

1) Walls: walls shall be minimum 8" thick.

d. Concrete trapezoidal channel: this channel shall transition from the box culvert to the soil cement channel. Concrete shall be minimum 8" thick.

Detailed calculations, confirming wall thickness, reinforcing and structural stability, shall be submitted during the Plans & Specifications (P&S) phase of this project.

SMALL FLOOD RISK MANAGEMENT PROJECT
HATCH, NM

Appendix I – Plan Formulation

March 2017

US Army Corps
of Engineers

Albuquerque District
South Pacific Division

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1 - Study Authority

The DPR / EA for the Small Flood Risk Management (FRM) Project, Hatch, NM was prepared as a response to the following authorities provided by Congress:

Flood Control Act 30 June 1948, Section 205 (P.L. 858, 80th Congress, 2nd Session, H.R. 6419), as amended, which reads:

> *"That the Secretary of the Amy is hereby authorized to allot from any appropriations heretofore or hereafter made for flood control, not to exceed $2,000,000 for any one fiscal year, for the construction of small flood-control projects not specifically authorized by Congress, and not within areas intended to be protected by projects so authorized, which come within the provisions of section 1 of the Flood Control Act of June 22, 1936, when in the opinion of the Chief of Engineers such work is advisable: Provided, That not more than $100,000 shall be allotted for this purpose at any single locality from the appropriations for any one fiscal year: Provided further, That the provisions of local cooperation specified in section 3 of the Flood Control Act of June 22, 1936, as amended, shall apply: And Provided further, That the work shall be complete in itself and not commit the United States to any additional improvement to insure its successful operation, except as may result from the normal procedure applying to projects authorized after submission of preliminary examination and survey report."*

2 - Study Information

2.1 *Study Area

The proposed project is located within the Village of Hatch, NM (Hatch). Hatch is located in the northwest corner of Doña Ana County, New Mexico, near the Rio Grande and is approximately 35 miles northwest of Las Cruces, New Mexico (Figure 1 and Figure 2) at the intersection of US Highway 85 and NM Highway 26.

Hatch, NM is situated east of the Continental Divide within the subdivision of the Mexican Highland Section of the Basin and Range Physiological Province. The area is characterized by gently sloping plains separated by rugged mountain ranges. It is located within the Rio Grande floodplain, bounded to the north by the north-south aligned Caballo Mountains and the Sierra de Las Uvas mountains. Spring Canyon rises in the Las Uvas Mountains and flows west through Hatch toward the Rio Grande. An existing upstream detention dam controls 5.4 square miles of the drainage area.

The project area for the proposed earthen dam is located approximately one half mile south of the NM Highway 26 near the head of the Colorado Drain (Figure 2). Elevations range from almost 6,000 feet in the Las Uvas Mountains to 4,030 feet at the confluence with the Rio Grande. Stream slopes are steep throughout most of the watershed, but are mild in the Rio Grande Valley. Development is rural and agriculture in the valley and non-existent elsewhere in the watersheds.

The dam site was selected by the Doña Ana County Flood Commission (the local sponsor) prior to USACE involvement. An A/E firm, RTI, had previously suggested improving the Rodey Lateral embankment for the sponsor to hold back flows of 1% annual chance exceedance (ACE). In April of 2002, the sponsor requested assistance from USACE under Section 205 of the Continuing Authorities Program. The proposed dam site was attractive for three reasons:

1. The Village of Hatch owns the property.

2. The reservoir area is an existing ponding site that collects flows from Spring Canyon Arroyo.

3. The site has an existing outfall (Colorado Drain) for controlled outflows from the dam.

4. The dowstream location captures flows from the majority of the watershed. Figure 3 shows the watersheds relative to the proposed dam location. The site intercepts flows from both the V and the IVA sub-basins. Flows from sub-basin V would not be caught should the dam be located further upstream in Spring Canyon Arroyo.

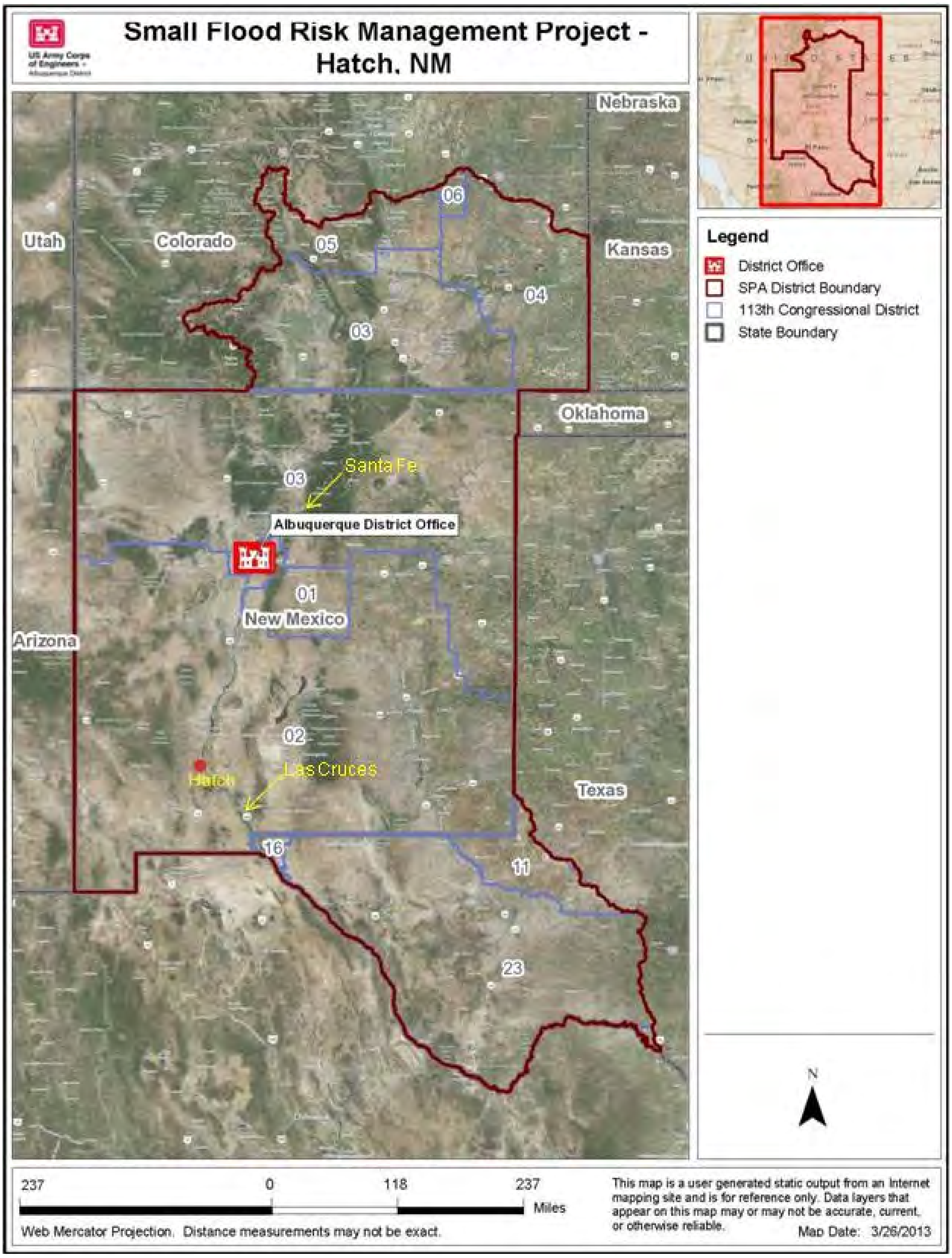

Figure 1 SPA District Boundary and Congressional Map with Hatch, NM indicated.

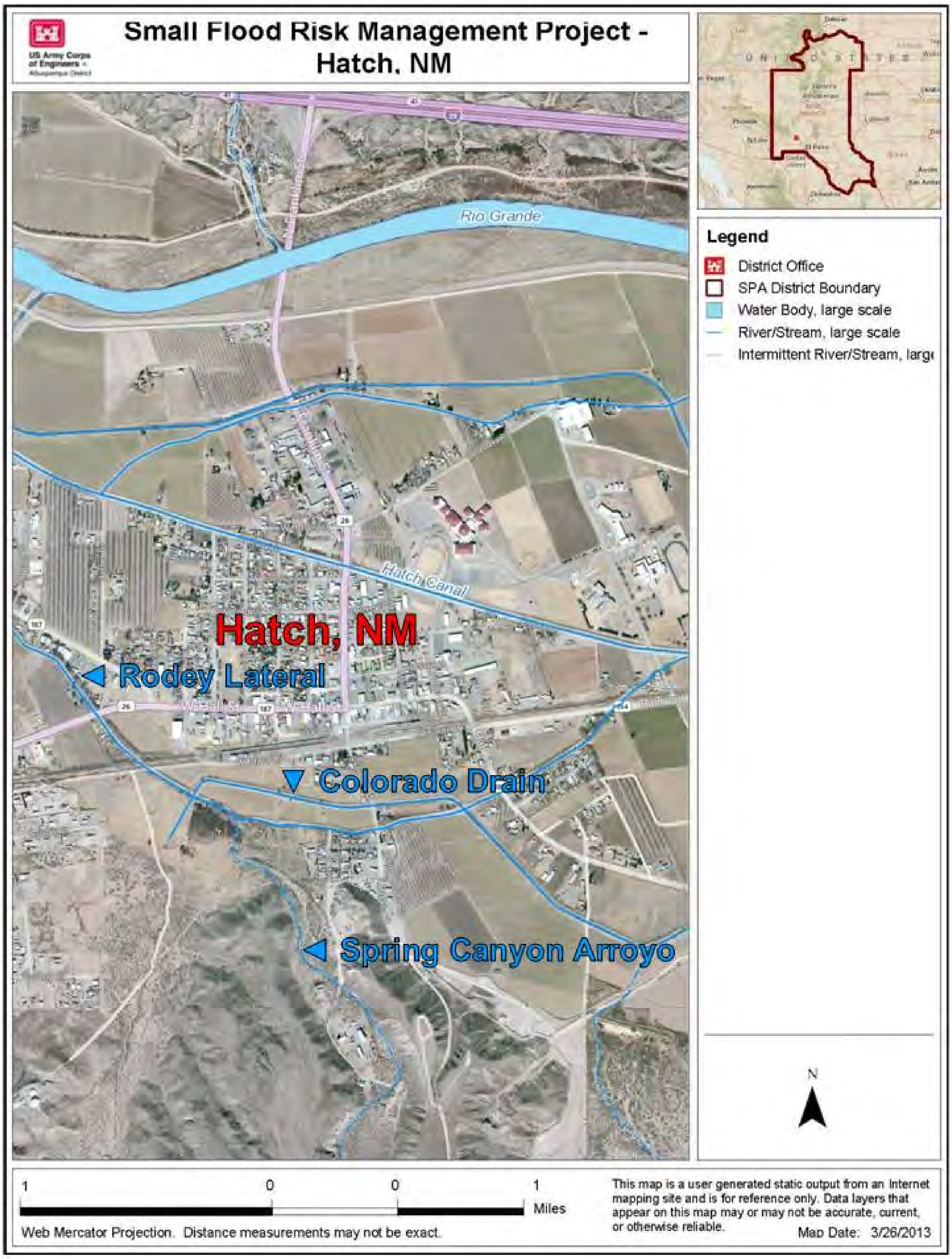

Figure 2 Project Location Map.

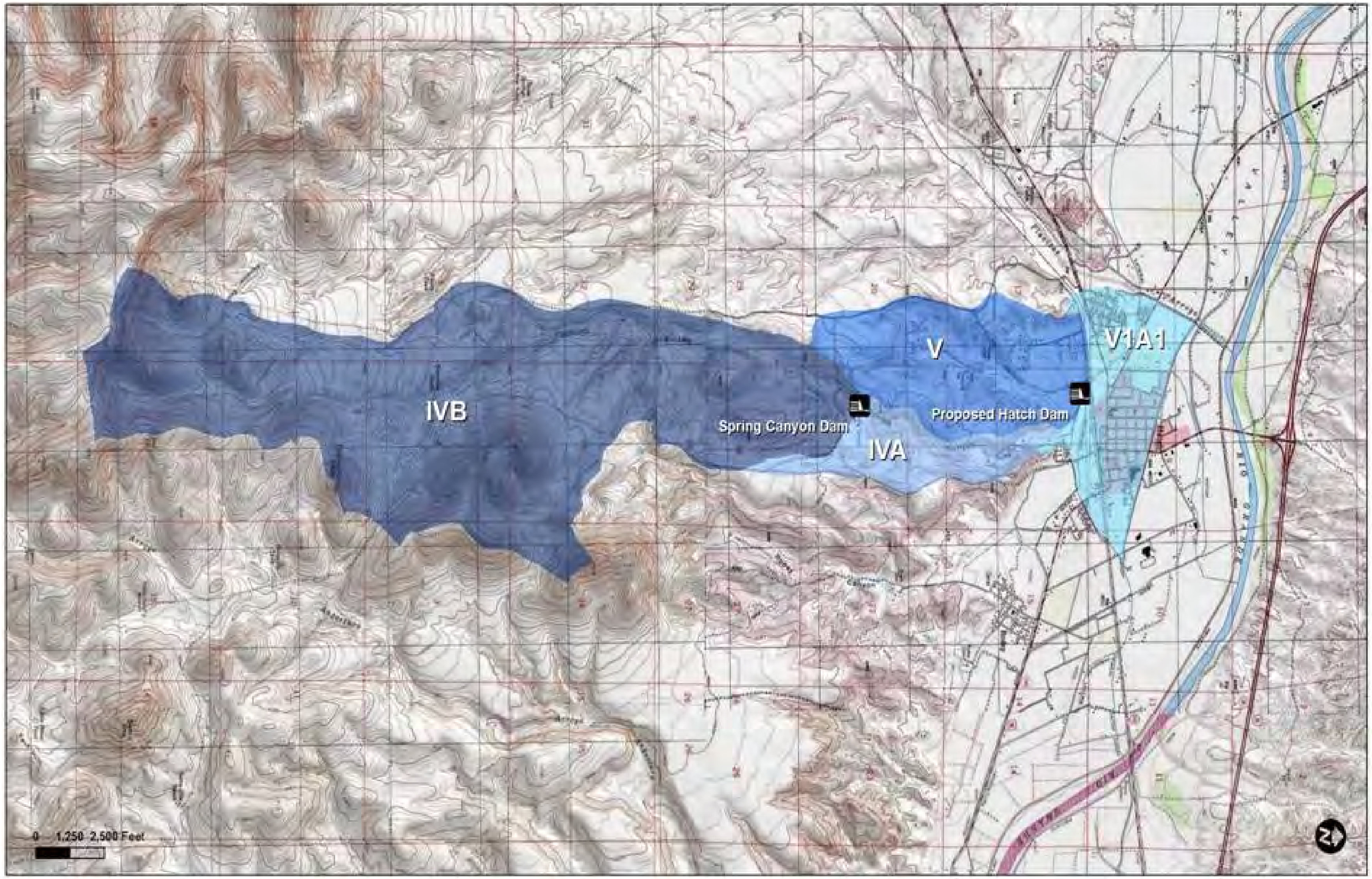

Figure 3 Spring Canyon Watershed – Area V1A1 shows area of inundation.

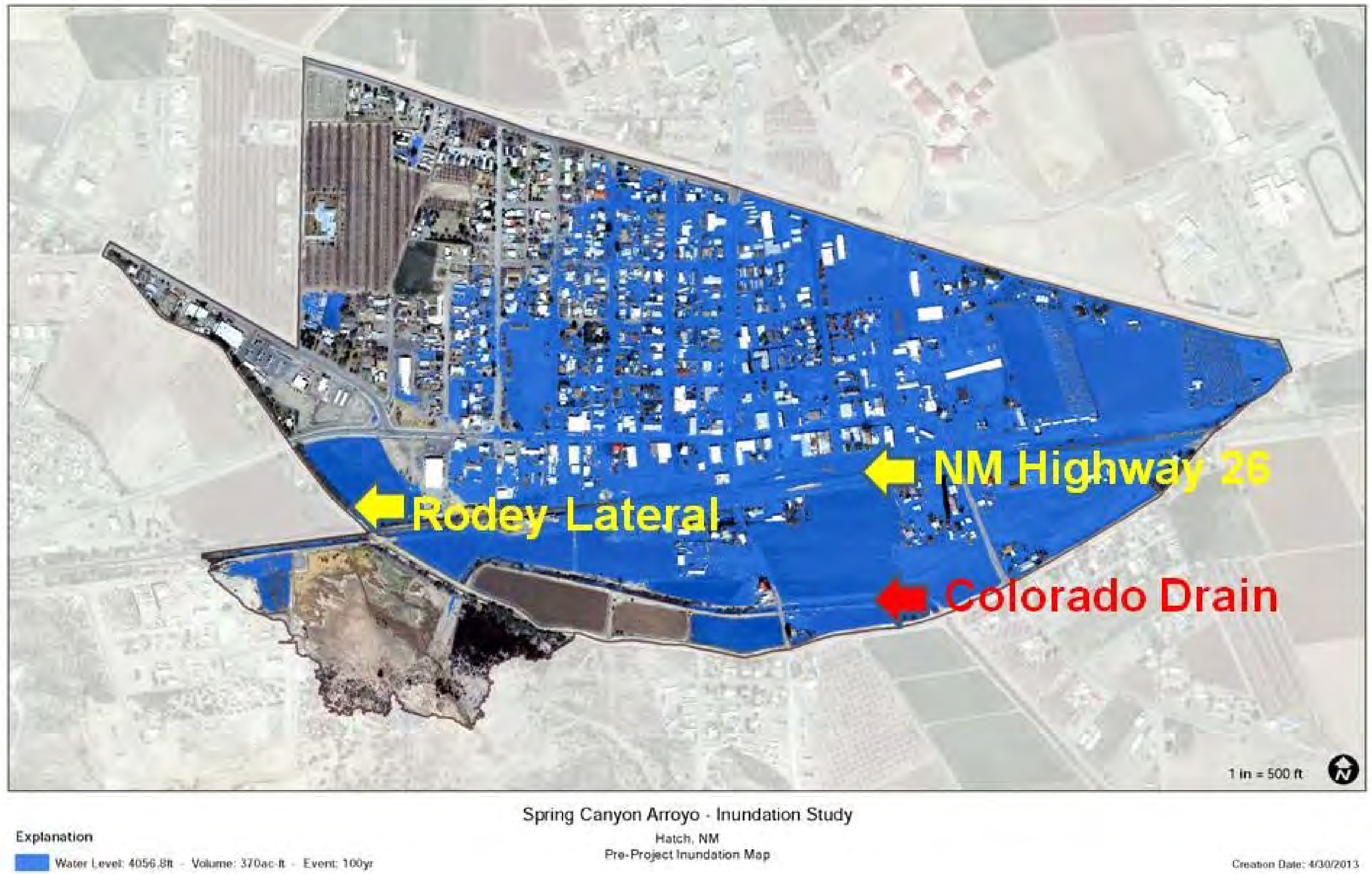

Figure 4 Hatch, NM 1% Annual Chance Exceedance (ACE) floodplain.

2.2 Study Purpose and Scope

The U.S. Army Corps of Engineers (USACE) collaborates with a non-Federal local sponsor (sponsor) to plan and construct small FRM projects that have not previously been specifically authorized by Congress and are not part of a larger project. Projects may be structural (i.e., dams, localized floodwalls, diversion channels, pumping plants and bridge modifications) or non-structural (i.e., floodproofing, relocation of structures and flood warning systems). Projects must be engineeringly sound, economically justified, and environmentally acceptable.

The authority, as amended, is often referred to as Section 205 under the Continuing Authorities Program. There is a limit of $10 million in Federal funds per-project under this authority. The authority included two phases with differing cost share proportion; the Feasibility Phase and the Design-implementation phase. The Federal government provided the first $100,000 of the feasibility phase. Feasibility phase costs that exceed $100,000 were cost-shared 50% Federal and 50% non-Federal. The non-Federal share, of the amount in excess of the initial Federal $100,000, may be provided as 100% work-in-kind.

During the feasibility phase, the PDT conducted the study to determine if there was Federal interest in the FRM project. There is a Federal interest in building a project; there is a plan with greater benefits than there are costs that is also environmentally sound. This study recommends proceeding to the Design and Implementation phase. The PDT determined that there was a Federal interest by evaluating different alternatives – comparing costs and benefits and identifying potential environmental affects.

During the Design and Implementation (DI) phase, the PDT will develop detailed design and descriptions of the project and the project will be constructed. This phase will be cost-shared 65% Federal and 35% non-Federal.

For structural projects, at least 5% of the cost of the DI phase must be contributed in cash by the local sponsor, but the remainder can be credited by work-in-kind and LERRDS (all project lands, easements, rights-of-way, relocations, and disposal sites) as items of local cooperation. Should those costs exceed 35% of the total construction costs, the sponsor must still provide these items in addition to the 5% cash. In addition, the Doña Ana County Flood Commission must agree to operate and maintain the project after completion of construction.

2.3 Need For the Project / Proposed Action

Under the authority of Section 205 of the Flood Control Act of 1948, USACE proposes to implement a small FRM project in Hatch, New Mexico. The flood hazard in the project area is extensive. All of Hatch, NM is in the 1% ACE floodplain from flows coming from the Spring Canyon Arroyo (Figure 3 and Figure 4). Significant flooding occurred in 1935 (Figure 5 – Figure 8), 1964, 1972, 1988, 1992 and 2006 (Figure 9 – Figure 15) with up to three feet of water in the streets. Flood damages exceeded $1,000,000 in 1964 and 1972 and totaled approximately $1,400,000 in 1988, $1,750,000 in 1992, and several million in 2006. In each of these floods, numerous homes and businesses received flood damage and many families lost the majority of their belongings. The flooding displaced many families from their homes for several months.

Figure 5 Hatch, NM flood of 1935.

Figure 6 Hatch, NM flood of 1935.

Figure 7 Hatch, NM flood of 1935.

Figure 8 Hatch, NM flood of 1935.

Figure 9 Hatch, NM flood of 2006.

Figure 10 Hatch, NM flood of 2006.

Figure 11 Hatch, NM flood of 2006.

Figure 12 Hatch, NM flood of 2006.

Figure 13 Hatch, NM flood of 2006.

Figure 14 Hatch, NM flood of 2006.

Figure 15 Hatch, NM flood of 2006.

2.4 History of the Investigation

Initial investigations determined that there is a Federal interest in constructing a small FRM projects at Hatch, NM.

The Doña Ana County Flood Commission and USACE signed a Feasibility Cost Sharing Agreement (FCSA) on 20 May 2004. Significant flows have flooded the community three times over the past 25 years, affecting private and commercial properties, and public infrastructure. The most recent flood occurred in July 2006. This flood was estimated to be approximately a 1% chance event based on high water and debris marks.

This project has experienced delays due to funding issues and changes in USACE policy. In 2007, the business processes for Continuing Authority Program projects changed, requiring the Doña Ana County Flood Commission to provide their cash contribution for cost sharing at the start of implementation phase, rather than at construction phase. However, the sponsor had already signed a FCSA in May 2004, which allowed the sponsor to provide their cost-share funds just prior to the advertisement for the contract to construct the project.

Costs associated with changes and interruptions in the planning process increased the total project cost from approximately $6.9 million to more than $12,368,000. The project's FCSA does not currently reflect these increased costs and delays in schedule.

2.5 Planning Process and Report Organization

ER 1105-2-100, Planning Guidance Notebook dated 22 April 2000, as amended, provides the planning process used by the PDT in this feasibility study. The process identifies and responds to problems and opportunities associated with the study objectives and specific Federal, State, and local concerns. USACE planning involves a systematic approach to making determinations during the feasibility study so that the interested public and decision-makers are fully aware of the basic assumptions employed. The data and information analyzed, the areas of risk and uncertainty, the reasons and rationales used, and the significant implications of each alternative plan are exposed through this process. The planning process culminates in the selection of a recommended plan. These steps are further described in Chapter 6, Plan Formulation and Evaluation.

The final product of this feasibility study is a detail project report and Environmental Assessment (EA) that will serve as the basis for obtaining implementation funding for the recommended plan.

2.6 Environmental Operating Principles

Environmental Operating Principles applicable to all its decision-making and programs. These principles, as presented below, foster unity of purpose on environmental issues, reflect a new tone and direction for dialogue on environmental matters, and ensure that conservation, environmental preservation, and restoration are considered in all Corps activities.

1. Strive to achieve environmental sustainability. An environment maintained in a healthy, diverse and sustainable condition is necessary to support life.

2. Recognize the interdependence of life and the physical environment. Proactively consider environmental consequences of Corps programs and act accordingly in all appropriate circumstances.

3. Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another.

4. Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that impact human health and welfare and the continued viability of natural systems.

5. Seek ways and means to assess and mitigate cumulative impacts to the environment while bringing systems approaches to the full life cycle of our processes and work.

6. Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and of impacts of our work.

7. Respect the views of individuals and groups interested in Corps activities, listen to them actively, and learn from their perspective in the search to find innovative win-win solutions to the Nation's problems that also protect and enhance the environment.

Federal, State, and local environmental quality goals and policies are considered in evaluating the long-term effect that the alternatives may have on significant environmental resources. Significant environmental resources are defined by the Water Resources Council as those components of the ecological, cultural, and aesthetic environments which, if affected by the alternatives, could have a material bearing on the decision-making process. Avoidance of adverse impacts, followed by minimization and then mitigation of unavoidable, significant adverse impacts, is the formulation direction that is called for within NEPA.

For additional information and details on how SPA incorporated the USACE Environmental Operating Principles into the feasibility study process, please see the main report and Appendix C – Environmental Resources.

3 - Prior Studies, Reports, and Existing Water Projects

Prior to the beginning of this feasibility study, many efforts were conducted to identify, quantify, and seek funding to implement solutions to help alleviate flooding and improve environmental quality in the Rio Grande ecosystem. This chapter discusses these studies and reports that have been prepared on issues relating to the Rio Grande Basin and the current study area, and identifies existing projects and structures located within the area.

3.1 Prior Studies and Reports

Various agencies and engineering consulting firms have conducted or published many studies and reports on the Rio Grande since the 1950s. The topics of the reports and studies include water resources, FRM, recreation, urban development, and environmental assessment. A sample of the prior studies and reports related to this study is presented by topic below. The findings in these reports, and the chronology of change within the Rio Grande corridor, are important and essential in describing the changes over time and in outlining the importance of this project.

3.2 Existing and Ongoing Water Projects

4 - *Existing and Future Without Project Conditions

In conducting this feasibility study, a wide range of technical issues were analyzed with the goal of developing an accurate description of historic, existing, and future without-project conditions in the study area.

Existing conditions are defined as those conditions that exist within the study area at the time of the study. The term baseline is sometimes used to refer to the existing conditions at the time of a measurement, observation, or calculation and may be used occasionally throughout the report. Without a good understanding of the existing condition, one cannot understand what constitutes an improvement from a degraded condition.

The future without-project condition is defined as that condition expected to exist in the absence of any action taken (by the Federal government) to solve the stated problems. This condition is vitally important to the evaluation and comparison of alternative plans and the identification of impacts (both beneficial and adverse) attributable to proposed Federal actions. The future without-project condition forecast provides a description of anticipated actions external to the project and the anticipated consequences of these actions.

Available information was initially collected about existing studies and projects that could assist in the preparation of the inventory of historic and existing conditions and the forecasting of future without-project conditions for the study area. The information presented under without-project conditions is considered in order to formulate alternative measures that address the watershed problems and opportunities discussed in Chapter 5 of this appendix, Plan Formulation. Major technical areas of focus for the study include hydrologic and hydraulic studies, environmental studies related to biological resources, cultural resource and recreation studies, and economic analysis. Conclusions of the analysis as they relate to selection of a recommended plan are discussed in the main document. Detailed discussions of these analyses can be found in the respective appendices.

5 - Plan Formulation and Evaluation

Plan formulation is the process of building plans that meet planning objectives and avoid planning constraints (Section ˜) . It requires knowledge, experience, and judgments of many professional disciplines. Planners define the combination of management measures that comprise an alternative plan (plan) in sufficient detail that realistic evaluation and comparison of the alternative's contributions to the planning objectives and other effects can be identified, measured, and considered. Plan formulation requires the views of stakeholders and others in agencies and groups outside USACE to temper the process with different perspectives. Plan formulation capitalizes on imagination and creativity wherever it is found, across technical disciplines and group affiliations.

In most cases, there will be more than one alternative that will meet the planning objectives, although they meet them to varying degrees. Good planning eliminates the least suitable alternatives while refining the remaining alternatives fairly and comprehensively.

Sometimes, the formulation process emphasizes structural details, costs, outputs, safety, reliability, and other technical matters. Nonetheless, plan formulation must be balanced with environmental, social, institutional, and other considerations that are often less quantifiable and less comfortable to consider in plan formulation and evaluation.

5.1 Summary of Historic and Existing Conditions

As can be seen by the existing conditions presented in Chapter 1, Section 1.5 of the main report, and Chapter 2, Section 2.3 of this appendix, the FRM problems associated with Spring Canyon are considerable. Costs to repair flood damages from multiple events have been in the millions of dollars.

5.2 USACE Planning Process

The plan formulation process was used to develop measures and elements used in solving identified problems and ultimately to develop an array of comprehensive alternatives from which a plan is recommended for implementation.

This section presents the rationale used in the development of this plan. The USACE six-step planning process specified in ER 1105-2-100 *Planning Guidance Notebook* is used to develop, evaluate, and compare the array of candidate plans that are considered. The plan formulation process includes the following steps:

1. **Identifying Problems and Opportunities: Th**e specific problems and opportunities to be addressed in the study are identified, and the causes of the problems are discussed and documented. Planning goals are set, objectives are established, and constraints are identified. This has been accomplished for the current study stage.

2. **Inventorying and Forecasting Resources: Identifying Problems and Opportunities:** The specific problems and opportunities to be addressed in the study are identified, and

the causes of the problems are discussed and documented. Planning goals are set, objectives are established, and constraints are identified. This has been accomplished for the current study stage.

3. **Inventorying and Forecasting Resources:** Existing and future without-project conditions are identified, analyzed, and forecast for a 50-year period of analysis. The existing condition resources, problems, and opportunities critical to plan formulation, impact assessment, and evaluation are characterized and documented. This has been accomplished for the current study stage. A forecast of conditions that will exist for a 50-year period of analysis without a Federal project was used as the baseline.

4. **Formulating Alternative Plans:** Alternative plans are formulated that address the planning objectives. An initial set of alternatives are developed and evaluated at a preliminary level of detail, and are subsequently screened into a more final array of alternatives. A public involvement program was used to obtain public input to the alternative identification and evaluation process. Each plan is evaluated for its costs, potential effects, and benefits, and is compared with the No Action alternative for the 50-year period of analysis.

5. **Evaluating Alternative Plans:** Alternative project plans are evaluated for their potential to meet specified objectives and constraints, and evaluated for effectiveness, efficiency, completeness, and acceptability. The impacts of alternative plans are evaluated using the system of accounts framework specified in USACE' *Principles and Guidelines* and ER 1105-2-100. This process is performed for the final array of alternatives and recommended plan.

   a. National Economic Development (NED)

   b. Environmental Quality (EQ)

   c. Regional Economic Development (RED)

   d. Other Social Effects (OSE)

6. **Comparing Alternative Plans:** Alternative plans are compared with one another and with the No Action alternative. Results of analyses are presented (e.g., benefits and costs, potential environmental effects, trade-offs, risks and uncertainties) to prioritize and rank FRM alternatives. For the current study thus far, benefits and costs have been evaluated for the final array of alternatives, and a rationale is provided to justify selection of a recommended plan.

These planning steps are part of an incremental and iterative planning process that is dynamic and involves feedback effects across the various steps that may sharpen the planning focus or change its emphasis as new information is generated.

5.2.1 <u>The four accounts</u>

1. **National Economic Development (NED):** This account displays changes in the economic value of the national output of goods and services

2. **National Ecosystem Restoration (NER) or Environmental Quality (EQ):** This account displays non-monetary effects on ecological, cultural and aesthetic resources including the positive and negative aspects of ecosystem restoration plans. Example: habitat units.

3. **Regional Economic Development (RED):** This account displays changes in the distribution of regional economic activity (e.g. income and employment). Examples of RED effects could be, but are not necessarily limited to: employment, business income and local tax revenues.

4. **Other Social Effects (OSE):** This account displays non-monetary effects on social aspects such as community impacts, health and safety, displacement, energy conservation and others. Example: changes in population at risk.

5.3 Public Concerns

The entire Village of Hatch, NM is in the 1% ACE floodplain. Significant flooding occurred in 1935 (Figure 5 – Figure 8), 1964, 1972, 1988, 1992 and 2006 (Figure 9 – Figure 15) with up to three feet of water in the streets. Flood damages exceeded $1,000,000 in 1964 and 1972 and totaled approximately $1,400,000 in 1988, $1,750,000 in 1992, and several million in 2006. In each of these floods, numerous homes and businesses received flood damage and many families lost the majority of their belongings. The flooding displaced many families from their homes for several months.

Should the project not be constructed, flood flows would continue to adversely impact Hatch threatening Hatch's agricultural industry, structures and human health and safety.

5.4 Problems and Opportunities

Water resources projects are planned and implemented to solve problems, meet challenges, and seize opportunities. In the planning setting, a problem can be thought of as an undesirable condition, while an opportunity offers a chance for progress or improvement. The identification of problems and opportunities gives focus to the planning effort and aids in the development of planning objectives. Although problems and opportunities are considered in plan formulation, they should not be confused with planning objectives for which solutions will be formulated or plans recommended. Problems and opportunities can also be viewed as local and regional resource conditions that could be modified in response to expressed public concerns. This section identifies the problems and opportunities in the study area based on the assessment of existing and expected future without-project conditions.

- Historic flood events and current floodplain mapping demonstrates the potential flood risks to private property, public infrastructure and to human health and safety because of inundation from Spring Canyon flows.
    - *Opportunities exist to reduce flood risk to private property and public infrastructure within the study area.*

- o *Opportunities exist to prevent flood risks to human health and safety within the study area.*
- o *Opportunities exist to increase awareness of flood potential within the study area.*
- o *Opportunities exist to provide a basis for future local planning regarding development within the floodplain within the study area.*

5.5 Planning Objectives and Constraints

Planning objectives are specified in an iterative process. It begins with broad and general objectives and proceeds through a refining process to study specific objectives. Early in the study, they are vague but reasonable statements of what we want our recommended plan to produce. As the study progresses and our understanding of the problems increases, the objectives become more specific. Unless otherwise specified, it should be assumed that the period of analysis is the appropriate time frame for meeting the objectives. Constraints may evolve in a similar fashion.

5.5.1 Federal Planning Objectives

The Federal objective of water and related land resources project planning is to contribute to the NED consistent with protecting the Nation's environment, pursuant to national environmental statutes and applicable executive orders, and following other Federal planning requirements. Water and related land resources project plans shall be formulated to alleviate problems and take advantage of opportunities in ways to contribute to this objective. Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units.

The Federal Objective for the relevant planning setting should be stated in terms of an expressed desire to alleviate problems and realize opportunities related to the output of goods and services or to increased economic efficiency. (P&G, Chapter I, Section II).

5.5.2 Specific Planning Objectives

Clear statements of specific planning objectives and constraints act as basic building blocks for developing alternative management measures and plans to alleviate stated problems and achieve opportunities. Through coordination with local and regional agencies, the public involvement process, site assessments, interpretation of prior studies and reports, and review of existing water projects, specific planning objectives were identified for this feasibility effort. The water and related land resource problems and opportunities identified in this study are stated as specific planning objectives to provide focus for the formulation of alternatives. The planning objectives listed below reflect the problems and opportunities and represent desired positive changes along the Rio Grande and its tributaries within the study area:

- Reduce the risk of flood hazard to health and human safety within the study area.
- Reduce flood damages to existing properties, infrastructure and agricultural lands in the study are from floods originating in Spring Canyon.

- Reduce damages to existing properties, infrastructure in Hatch from sediment deposition.

5.5.3 Planning Constraints

Unlike planning objectives represent desired positive changes, planning constraints represent restrictions that should not be violated. The planning constraints identified in this study include:

- The project is limited to runoff from the Spring Canyon drainage area.
- Any constructed project must comply with the New Mexico State Engineer and Interstate Compact requirements that any stored surface runoff must be released within 96 hours.
- Flood risk management features should not induce or compound negative effects to flooding or environmental resources outside the study area.

Background:

Rio Grande Water Ownership, Allocations and Downstream Deliveries – Water laws in New Mexico and along the Rio Grande and its tributaries are many and complicated. Any FRM measure that included retention were formulated to evacuate all water within 96 hours; measures that would retain flows for longer than 96 hours were not considered.

Under the Rio Grande Compact, New Mexico is required to deliver a certain amount of water to Texas each year, depending on how much water is in the Rio Grande. Failure to meet our delivery requirements could result in severe penalties. Compact delivery requirements are determined yearly, based on flows at designated gaging stations in Colorado and New Mexico.

Another water agreement with particular importance for the study area is the Upper Colorado River Basin Compact. New Mexico was apportioned 11.25% of the flows of the Upper Colorado because two Colorado tributaries—the San Juan and Animas Rivers—drain the northwestern portion of the state. Water is imported annually from the San Juan River into the Rio Grande Basin by the San Juan-Chama Project (Section **Error! Reference source not found.**) as part of New Mexico's entitlement under the Upper Colorado River Compact. This water must be fully consumed within the state, and cannot be used to meet Rio Grande Compact deliveries.

The Office of the State Engineer (OSE) of New Mexico manages the state's surface and ground water rights and has the authority to issue permits recognizing a user's right to water. Water rights can be inherited, and may be transferred (or sold) to another party who intends to put the water to beneficial use. Water rights transfers are subject to certain conditions. A transfer may change the point of diversion or purpose of use of the water, but any change must be "without detriment to existing water rights" (non-impairment), "not contrary to the conservation of water" and "not detrimental to the public welfare of the state".

New Mexico's pueblos have several different types of water rights. However, most have yet to be quantified or adjudicated, their priority dates supersede the priority dates of all other water rights in the state. Tribal water rights may affect other rights and uses once they are quantified and declared by a court of law.

The Treaty of Guadalupe Hidalgo recognizes existing water rights on lands acquired from Mexico. The *Convention between the United States and Mexico, Equitable Distribution of the Waters of the Rio Grande*, dated 1906, requires the United States to deliver 60,000 acre-feet of Rio Grande water to Mexico each year.

5.6 *Development of Alternative Plans

Alternatives were formulated in consideration of current Federal, state, and local planning and environmental guidance, laws, and policy concerning ecosystem restoration, FRM, recreation, water quality, and related purposes.

Preliminary alternatives required further analysis to determine whether they addressed the specified problems and opportunities, and planning objectives and constraints. Through modeling, best professional judgment, and calculations alternatives were compared against each other in order to arrive at the Tentatively Selected Plan (TSP). Following the completion of the integrated feasibility report / EA, public feedback, and project authorization by Congress, if such action occurs, additional detailed design analysis and preparation of the TSP's plans and specifications will take place.

5.6.1 Plan Selection

(a) The alternative plan with the greatest net economic benefit consistent with protecting the Nation's environment (the NED plan) is to be selected unless the Secretary of a department or head of an independent agency grants an exception when there is some overriding reasons for selecting another plan, based on other Federal, State, local and international concerns. (P&G,Chapter I, Section X).

Together, the Federal objective and plan selection criterion for civil works projects, including FRM, indicate that, at the individual project level, planners should formulate, evaluate, and select plans to recommend for Federal involvement that provide the greatest net economic benefits to the nation as a whole, subject to an environmental protection constraint. This direction is based on the presumption that Federal civil works investments should be considered only for project plans that maximize net economic benefits—measured in terms of a single index of monetary value—realized by the nation as a whole.

5.6.2 Measures and Alternatives Development and Evaluation Process

The feasibility study process involves developing successive iterations of alternative solutions to the defined problems. These solutions are developed based upon the study objectives, constraints, address problems, and opportunities that have been previously defined. As part of Federal guidelines for water resources projects, there are general feasibility criteria that must be met. According to USACE Engineering Regulation (ER) 1105-2-100 for planning, a project in a feasibility level report must be analyzed with regard to the following four criteria:

- **Completeness –** Does the plan include all necessary parts and actions to produce the desired results?

- **Effectiveness –** Does the alternative substantially meet the objectives? How does it measure up against constraints?

- **Efficiency –** Does the plan maximize net NER and/or NED benefits?

- **Acceptability –** Is the plan acceptable and compatible with laws and policies?

In the initial phase of the study, the team developed measures to satisfy the four feasibility criteria.

5.6.3 Preliminary Management Measures

A measure is defined as a means to an end; an act, step, or proceeding designed for the accomplishment of an objective. The definition of a management measure (or "measure") is a feature (structure) or activity that can be implemented at a specific geographic site to address one or more planning objectives. Measures are the building blocks of which alternative plans are made. Measures become more specific and better defined as planning progresses.

All management measures are evaluated based on their performance over a 50-year period of analysis individually, or in combination with other management measures. FRM measures considered in this study are listed in **Error! Reference source not found.**. Each measure is identified as either meeting a specific study objective or failing to meet a specific planning objective. They are described in the following sections.

The PDT and the Doña Ana County Flood Commission conducted a preliminary screening of management measures to evaluate the applicability of each measure and the potential for each measure to contribute to the planning objectives consistent with planning constraints.

5.6.3.1 Non-structural

Non-structural FRM measures are most often defined by a list of examples. The P&G [1.6.1(f)(1)] described them as "complete or partial alternatives to traditional structural measures. Non-structural measures include modifications in public policy, management practice, regulatory policy and pricing policy."

A. Emergency Preparedness Plans

Having an evacuation plan in place before a flood occurs can help avoid confusion, prevent property damage, and decrease the risks to human health and safety. A thorough evacuation plan should include:

- Conditions that will activate the plan;

- Chain of command;

- Emergency functions and who will perform them;

- Specific evacuation procedures, including routes and exits;
- Procedures for accounting for personnel, customers and visitors;
- Equipment for personnel; and,
- Review of the plan with personnel.

Individuals whose homes or businesses are located in areas that are susceptible to flooding, as well as those planning to visit such areas, should monitor local weather and news sources.

The New Mexico Department of Homeland Security and Emergency Management has a website (http://www.nmdhsem.org/Preparedness.aspx) that contains information about the Emergency Management Accreditation Program (EMAP). "EMAP is a voluntary review process for state and local emergency management programs. Accreditation is a means of demonstration, through self-assessment, documentation and peer review, that a program meets national standards for emergency management programs." The site also contains information by which communities may apply for Federal grants to assist in the preparation of Emergency Preparedness Plans.

The Doña Ana County Flood Commission has been encouraged to prepare flood response plans for the event of flooding, to include government buildings, community centers, education facilities and housing areas. Flood response plans should include identifying critical equipment, records and supplies prior to the onset of a flood in order to aid the recovery of operations. The Doña Ana County Flood Commission should develop specific flood fighting and evacuation plans to enhance the likelihood of success. Implementing these emergency operations is usually the responsibility of management, the homeowner, agency heads, elected officials or other persons with the authority to implement such plans.

B. Flood Forecast And Warning

Important elements in the Nation's program to reduce flood damages include flood warnings and river forecasts. Timely warnings and forecasts save lives and aid disaster preparedness, which decreases property damage by an estimated $1 billion annually. Although the issuance of flood forecasts is now accepted as common and routine, their preparation is no minor feat. This technical achievement is made possible by the joint efforts of several Federal, State, and local agencies and many dedicated people across the Nation.

The two most fundamental items of hydrologic information about a river are stage, which is water depth above some arbitrary datum, commonly measured in feet, and flow or discharge, which is the total volume of water that flows past a point on the river for some period of time, usually measured in cubic feet per second or gallons per minute. These two key factors are measured at a location on the river called a stream-gaging station.

By using automated equipment in the gaging station, river stage can be continuously monitored and reported to an accuracy of 1/8 of an inch. In this way, USGS and NWS hydrologists know the river stage at remote sites and how fast the water is rising or falling. By using an up-to-date stage/discharge rating and a river-stage reading, an accurate estimate of the river discharge can be produced. An important characteristic of a stage/discharge rating is that the process also works in reverse; given a discharge estimate, the corresponding river stage can be determined.

This functionality enables the NWS to transform an obscure river parameter, its discharge, into an easily visualized and well-understood measure of public risk, the flood stage.

The sponsor, as part of their Emergency Preparedness Planning, should institute a process by which a person is appointed to regularly check NWS advisories / warnings, as well a Doppler Radar, for the immediate areas upstream (Spring Canyon and Placitas Arroyos) and warn Hatch, NM of the possibility of flood events.

C. Wet Floodproofing

Per FEMA's *Technical Bulletin 7-93*, wet floodproofing (Figure 17) can be defined as "Permanent or contingent measures applied to a structure and / or its contents that prevent or provide resistance to damage from flooding by allowing flood water to enter the structure." Generally, this includes properly anchoring the structure, using flood resistant materials below the Base Flood Elevation (BFE), protection of mechanical and utility equipment, and use of openings or breakaway walls.

Flooding of a structure's interior is intended to counteract hydrostatic pressure on the walls, surfaces, and supports of the structure by equalizing interior and exterior water levels during a flood. Inundation also reduces the danger of buoyancy from hydrostatic uplift. These measures may require alternation of a structure's design and construction, use of flood-resistant materials, adjustment of building operation and maintenance procedures, and the relocation and treatment of equipment and contents.

An important consideration is that the structure be adequately anchored to its foundation. Uplift forces are often great enough to separate an improperly anchored structure from its foundation. Any existing mechanical and / or electrical systems would need to be relocated to prevent floodwaters and any sediment from entering. Heating and ventilation systems would also need to be relocated if currently placed below the project flood elevation.

Wet floodproofing, in most cases, will require some human intervention when a flood is imminent and so it is extremely important that there be adequate time to execute such actions. This measure also requires some degree of periodic maintenance and inspection to ensure that all components will operate properly under flood conditions. These necessary inspections and maintenance activities must be described in an Inspection and Maintenance plan.

In order for structures to eligible for the application of wet floodproofing measures, the structure must have the following qualities:

- Be of good or excellent construction;
- Be constructed of the appropriate materials (not recommended for frame construction);
- Be located in an area where flow velocities will be less than 3 cfs / second;
- Be located in an area where flood flows contain no significant ice or debris;
- Be located in an area where flood flows rise slowly;
- Be located in an area where the flash flood occurrence is greater than one hour; and,

- The owner must be willing to implement.

NOTE: Application of wet floodproofing as a flood protection technique under the National Flood Insurance Program (NFIP) is limited to enclosures below elevated residential and non-residential structures such as: crawlspaces, basements, and underground garages.

D. Dry Floodproofing

Per FEMA's *Selecting Appropriate Mitigation Measures for Floodprone Structures*, a dry floodproofed structure is made watertight below the level that needs flood protection to prevent floodwaters from entering (**Error! Reference source not found.**). Making the structure watertight requires sealing the walls with waterproof coatings, impermeable membranes, or a supplemental layer of masonry or concrete (Figure 17).

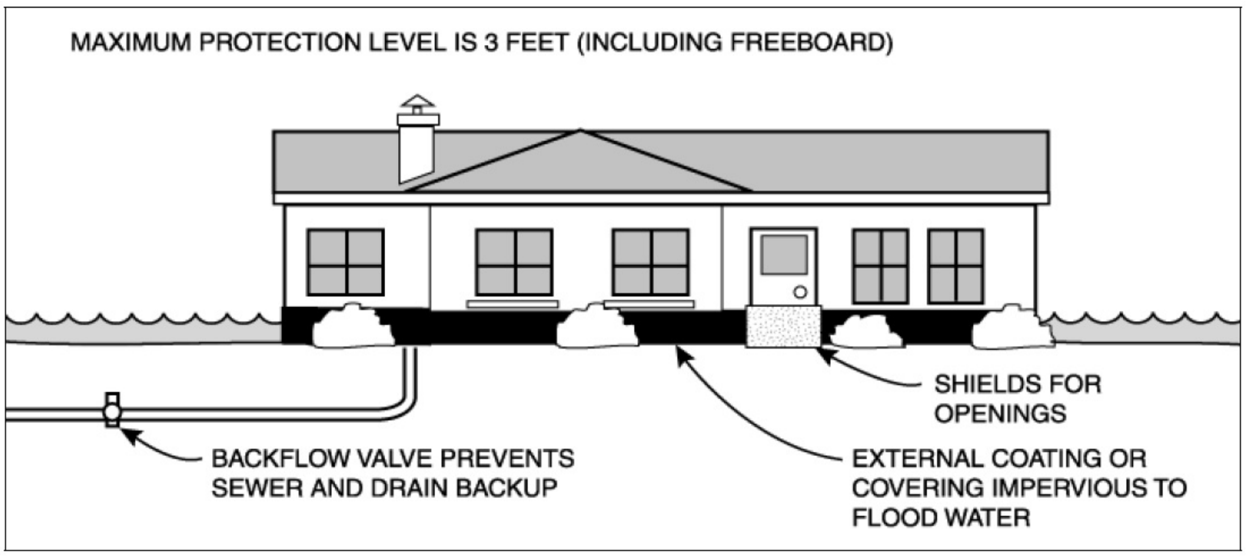

Figure 16 Typical dry floodproofed structure.

This type of floodproofing includes the follow:

- Using waterproof membranes or other sealants to prevent water from entering the structure through the walls;
- Installing watertight shields over windows and doors; and,
- Installing measures to prevent sewer backup.

Waterproof membranes, such as heavy plastic sheeting, can be installed relatively quickly; however, it does require human intervention. The membrane is unsightly and cannot remain in place indefinitely. Further, the plastic will deteriorate with continued exposure to the sun. In addition, openings in the walls need to be closed, either with temporary closures or permanently sealed.

The five main approaches to protect a structure against sewer backup are flood drain plugs, floor drain standpipes, overhead sewers, backup valves, and grinder pumps.

There are technical considerations that must be taken into account in order to accurately determine whether dry floodproofing will be successful. Generally, masonry and masonry veneer walls can usually withstand the water pressures of floods less than 3 feet in depth. Masonry and Masonry veneers are also resistant to moisture damage and can be made watertight with sealants. In flood depths greater than 3 feet, these types of walls require reinforcement.

Dry floodproofing is not recommended when:

- Structure's construction quality is less than good or excellent;
- Structures are located in areas where flood waters may be greater than 3 feet in depth;
- Structures are located in areas where flood waters may stand for days;
- Structure walls are constructed of adobe;
- Structure's foundational soils are very permeable; or,
- The owner is unwilling to implement.

NOTE: Dry floodproofing may not be used to bring a substantially damaged or substantially improved residential structure in compliance with the community's floodplain management ordinance or law.

E. Raising Structures In Place

When a structure is properly elevated, the living or commercial area will be above all but the most severe floods (such as the 500-year flood). Several elevation techniques are available. In general, they involve (1) lifting the structure and building a new, or extending the existing, foundation below it or (2) leaving the structure in place and either building an elevated floor within the house or adding a new upper story.

During the elevation process, most frame, masonry veneer, and masonry structures are separated from their foundations, raised on hydraulic jacks, and held by temporary supports while a new or extended foundation is constructed below. The living area is raised and only the foundation remains exposed to flooding. This technique works well for structures originally built on basement, crawlspace, and open foundations. When structures are lifted with this technique, the new or extended foundation can consist of continuous walls or separate piers, posts, columns, or pilings. Masonry structures are more difficult to lift, primarily because of their design, construction, and weight, but lifting these homes is possible. In fact, numerous contractors throughout the United States regularly perform this work.

A variation of this technique is used for frame, masonry veneer, and masonry structures on slab-on-grade foundations. In these structures, the slab forms both the floor of the structure and either all or a major part of the foundation. Elevating these structures is easier if the structure is left attached to the slab and both are lifted together. After the structure and slab are lifted, a new foundation is constructed below the slab.

For masonry structures on slab-on-grade foundations, some homeowners find it easier to use one of two alternative elevation techniques, in which the structure is left on its original foundation. One technique is to remove the roof, extend the walls of the structure upward, replace the roof, and then build a new elevated living area inside. The second is to abandon the existing lower enclosed area (the level with the slab floor) and move the living space to an existing or newly constructed upper floor. The abandoned lower enclosed area is then used only for parking, storage, and access to the structure.

Raising structures in place is not recommended when:

- Structure's construction quality is less than low cost (i.e. mobile homes and portable buildings), good or excellent;
- Structures are located in areas where flood velocities may be greater than 3 feet /second (foundation walls) or 5 feet / second (posts or fill);
- Structures are located in areas where flood depths may be greater than 6 feet (piers);
- Structure walls are constructed of adobe;
- Structure's foundational soils are very permeable; or,
- The owner is unwilling to implement.

F. Acquisition and / or Relocation of Structures

One method of reducing future damage from floods is for the community to acquire a property and relocate an existing floodprone structure to a new site outside the floodplain. If space and ground elevations allow, a structure may be moved to another location on the same piece of property.

In general, single-story, wood frame structures over a crawlspace or basement foundation are easiest to relocate. Multi-story and solid masonry structures are the most difficult to relocate because their greater size and weight requires additional lifting equipment and makes them more difficult to stabilize during the move. Slab-on-grade foundations complicate the relocation process because they make the installation of lifting equipment more difficult. Due to cracking or peeling, brick and stone veneer may need to be removed prior to moving and replaced after the structure is attached to the new foundation. In some cases, it may be more economical to cut the structure into sections.

Per FEMA's *Scope of Work for Relocation of Floodprone Structures 2005*, the relocation process is complex, expensive, and requires extensive pre-move planning. However, it may be a cheaper alternative than acquiring and demolishing a floodprone structure. The process involves lifting the house off its foundation, placing it on a heavy-duty flatbed trailer, hauling it to the new site, and lowering it onto a new, conventional foundation.

Construction Type	Existing Foundation	Measure	Retrofit	Relative Cost
Frame, Masonry Veneer, or Masonry	Crawlspace or Basement	Wet Floodproofing	Wet floodproof crawlspace to a height of 4 feet above lowest adjacent grade or wet floodproof unfinished basement to a height of 8 feet above basement floor	Lowest
Masonry Veneer or Masonry	Slab-on-Grade or Crawlspace	Dry Floodproofing	Dry floodproof to a maximum height of 3 feet above lowest adjacent grade	
Frame, Masonry Veneer, or Masonry	Basement, Crawlspace, or Open Foundation	Barrier Systems	Levee constructed to 6 feet above grade or floodwall constructed to 4 feet above grade	
Frame, Masonry Veneer, or Masonry	Basement, Crawlspace, or Open Foundation	Elevation	Elevate on continuous foundation walls or open foundation	
Frame, Masonry Veneer, or Masonry	Basement, Crawlspace, or Open Foundation	Relocation	Elevate on continuous foundation walls or open foundation	
Frame, Masonry Veneer, or Masonry	Slab-on-Grade	Elevation	Elevate on continuous foundation walls or open foundation	
Frame, Masonry Veneer, or Masonry	Slab-on-Grade	Relocation	Elevate on continuous foundation walls or open foundation	Highest
Frame, Masonry Veneer, or Masonry	Slab-on-Grade, Crawlspace, Basement, or Open Foundation	Demolition	Demolish existing building and buy or build a home elsewhere	Varies

Figure 17 Relative Costs of Various Retrofit Measures.

5.6.3.2 Structural

In 1993, USACE prepared a report titled *Assessment of Structural Flood-Control Measures on Alluvial Fans*. This document defines structural FRM measures as debris barriers or basins, detention basins, channels, and localized floodwalls. This study looked at localized floodwalls, channels and dams.

NOTE: Late in the feasibility study, the PDT determined that additional structural FRM measures needed evaluation for a more robust study. The PDT determined to look at channels leading from the proposed dam site to the Rio Grande.

A. Floodwalls

Floodwalls are vertical walls, usually made with reinforced concrete, oriented parallel to a waterway to prevent overflows from entering into developed areas. A floodwall is generally used when additional right-of way is not available for a levee, a levee is too expensive or if the foundation conditions will not permit an increase in the levee section. Economic justification of floodwalls cannot usually be attained except in urban areas.

The style of localized floodwall looked at in this study is an inverted T-floodwall (Figure 18). A T-floodwall is a reinforced concrete wall whose members act as wide cantilever beams in resisting hydrostatic pressures acting against the wall. A typical wall of this type is shown in Figure 18. For the inverted T floodwall, the wall should have overall dimensions to satisfy the stability criteria and seepage control as presented in EM 1110-2-2502.

In such a system, where additional right-of-way is not available for earthen levee construction, localized floodwalls are necessary, and a closure structure must be made between sections of floodwalls to allow entrance and egress to and from the protected structure(s). The closures are usually embedded into the floodwall. An example of such a closure is tainter gates. For this reason, human intervention is required for the proper functioning of this measure.

In such a system where only limited right-of-way is available, ramps built between sections of floodwalls to allow entrance and egress to and from the protected structures may be viable. In essence, a road may be built that goes over an earthen section between floodwall sections. This alternative removes the necessity of human intervention in flooding situations.

For this study, the PDT assumed that localized floodwalls would be positioned around individual structures or groups of neighboring structures in close proximity.

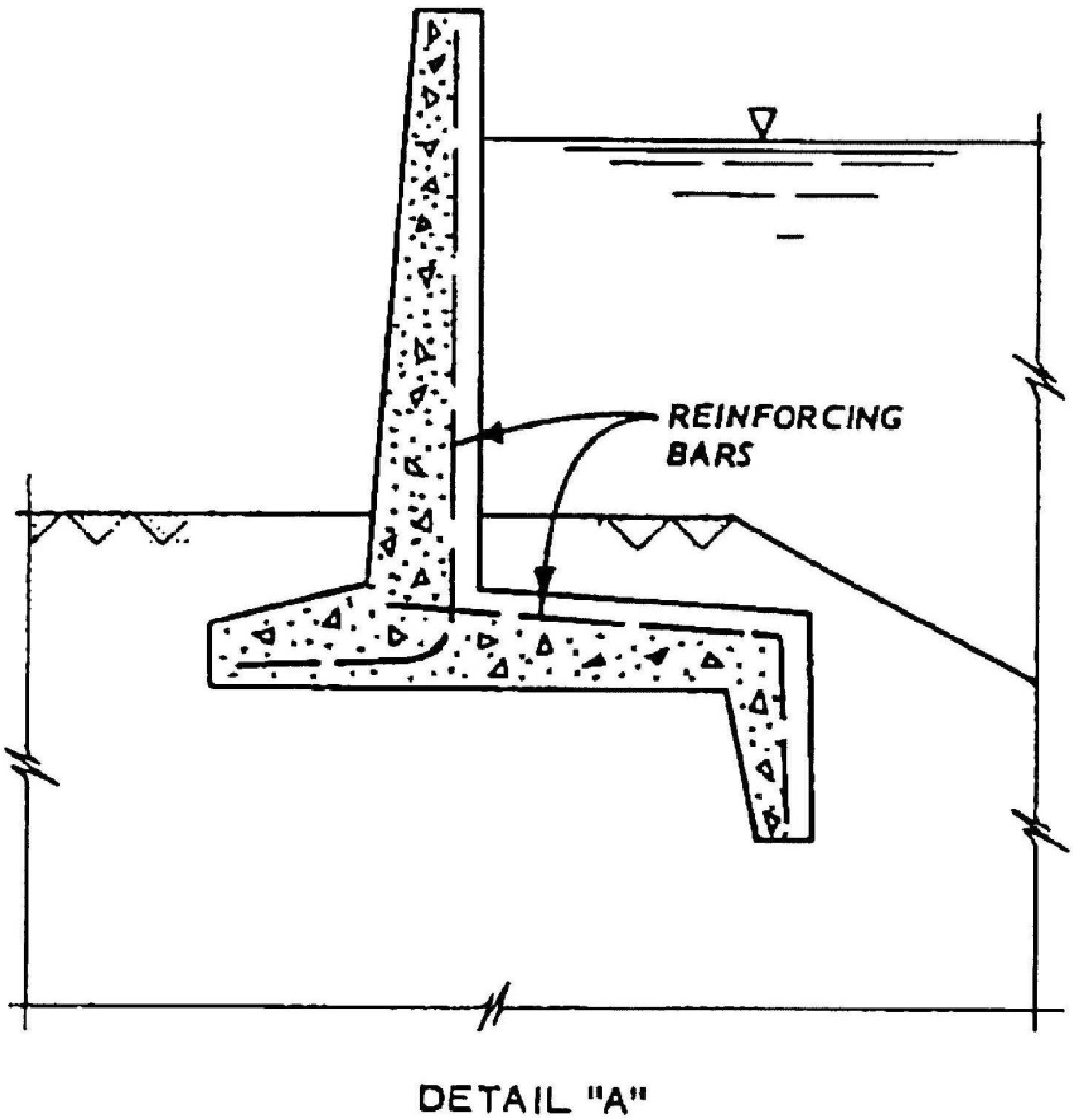

Figure 18 Inverted T-type floodwall

B. Open Concrete Lined Channel

Open channels include drainage ditches, grass channels, dry and wet enhanced swales, riprap channels and concrete-lined channels. This management measure is a concrete-lined channel (Figure 19). Various channel alignments were evaluated to convey flood flows as described in section 6.6.5 Description of Preliminary Alternatives.

In-ground flood control channels are constructed for conveying heavy storm water flows from, and / or through, areas that would otherwise be inundated. Typically, these projects are owned and maintained by the local sponsor. These channels usually: are the primary feature of local flood protection projects, extend for great distances, require significant construction costs due to their extensiveness, and present extreme consequences should failure occur. Therefore, channel design solutions should be developed in a logical and conservative manner, which provides for economical construction and serviceability and ensures functional and structural integrity.

Channel designs should include safety provisions for the needs of the public and operations personnel. Local sponsor is responsible for the safe operation of channels, and designers should coordinate designs with the sponsor so that appropriate provisions are incorporated to ensure safe operation of the project. Railing or fencing should be provided on top of rectangular channel walls and walls of chutes or drop structures for public protection. Ladders should be provided on the sides of rectangular channel walls and steps provided on the sloped paving of trapezoidal channels to provide safe access for operations personnel.

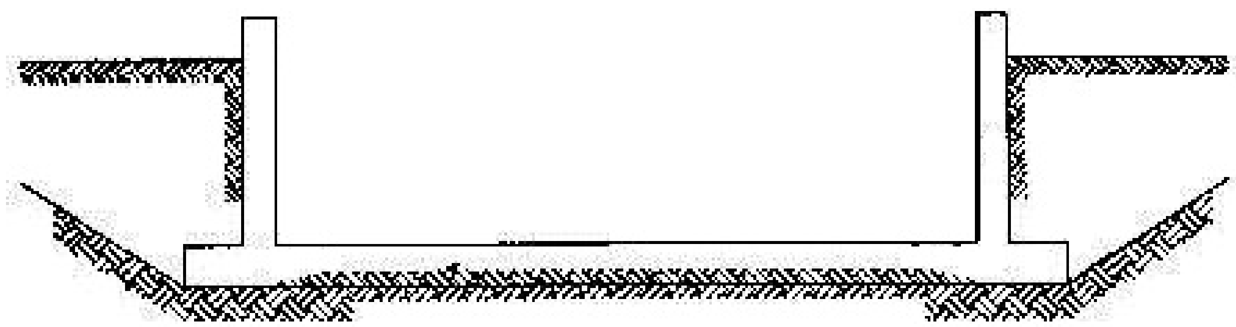

Figure 19 Rectangular channel with U-frame.

A rectangular, concrete channel, as opposed to a trapezoidal concrete channel or open channel, was evaluated in order to fit between the railroad tracks and a utility line located within the easement of NM Highway 26.

C. Open Earthen Channel

This management measure is a trapezoidal, open-channel without lining (Figure 20). Various channel alignments were evaluated to convey flood flows as described in section 6.6.5 Description of Preliminary Alternatives.

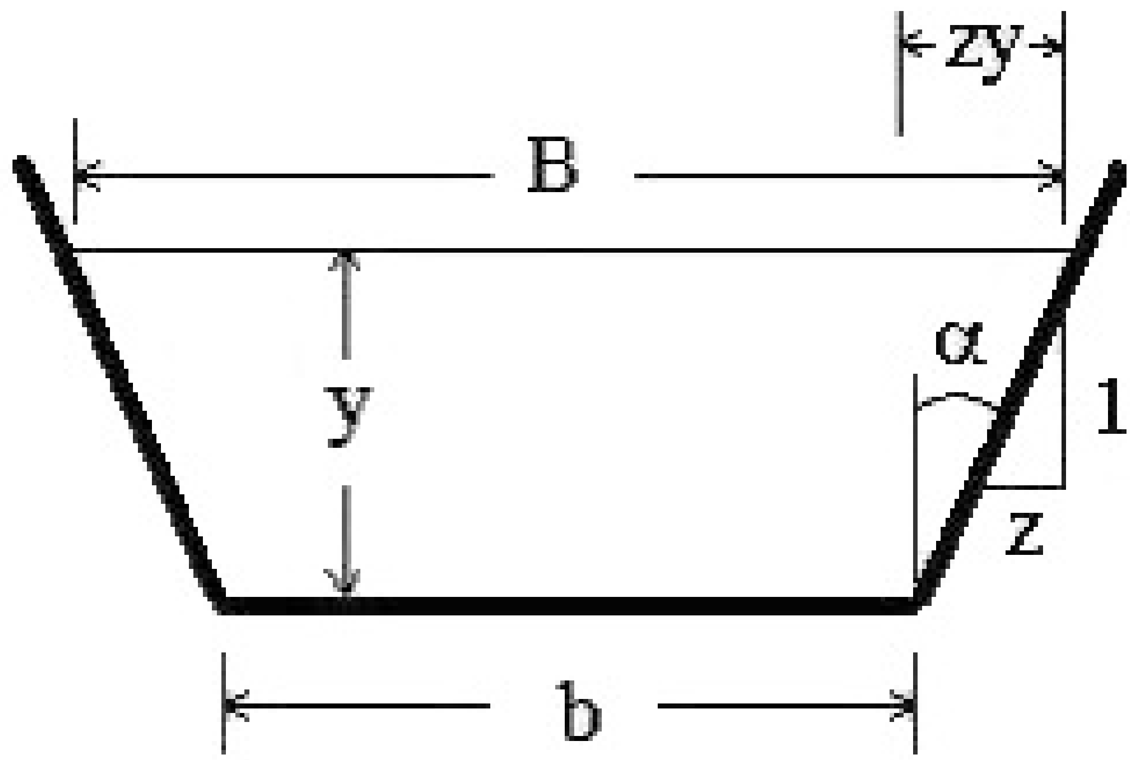

Figure 20 Typical Trapezoidal Channel Cross Section.

D. Earthen Dam

An earthen, dry dam (Figure 21, **Error! Reference source not found.**Figure 22 and Figure 23) is composed of suitable soils obtained from borrow areas or required excavation and compacted in layers by mechanical means. Following preparation of a foundation, earth from borrow areas and from required excavations is transported to the site, dumped, and spread in layers of required depth. The soil layers are then compacted by tamping rollers, sheepsfoot rollers, heavy pneumatic-tired rollers, vibratory rollers, tractors, or earth-hauling equipment. One advantage of an earth dam is that it can be adapted to a weak foundation, provided proper consideration is given to thorough foundation exploration, testing, and design.

The successful design, construction, and operation of a reservoir project over the full range of loading require a comprehensive site characterization, a detailed design of each feature, construction supervision, measurement and monitoring of the performance, and the continuous evaluation of the project features during operation. The design and construction of earth and rock-fill dams are complex because of the nature of the varying foundation conditions and range of properties of the materials available for use in the embankment.

To meet the Federal and state dam safety requirements, the design, construction, operation, and modification of an embankment dam must comply with the following technical requirements:

- The dam, foundation, and abutments must be stable under all static and dynamic loading conditions.

- Seepage through the foundation, abutments, and embankment must be controlled and collected to ensure safe operation. The intent is to prevent excessive uplift pressures, piping of materials, sloughing removal of material by solution, or erosion of this material into cracks, joints, and cavities. In addition, the project purpose may impose a limitation on allowable quantity of seepage. The design should include seepage control measures such as foundation cutoffs, adequate and non-brittle impervious zones, transition zones, drainage material and blankets, upstream impervious blankets, adequate core contact area, and relief wells.

- The dam height must be sufficient to prevent overtopping by waves and include an allowance for settlement of the foundation and embankment.

- The spillway and outlet capacity must be sufficient to safely pass flows that exceed the capacity of the reservoir and prevent over-topping of the embankment and reservoir.

Spillway

A spillway of approximately 350 feet wide would be centered in the dam crest. It will be constructed of roller compacted concrete (RCC).

Dam Outlet Works

The dam outlet works would be constructed of concrete and convey reservoir flows into the Colorado Drain. The outlet works will consist of an intake tower, a gate well structure, a rectangular conduit with manhole access, and a retaining wall with concrete and wire wrapped riprap aprons at the downstream end of the conduit.

The outlet works will be designed such that the dry dam can be evacuated in less than 96 hours for the maximum design capacity.

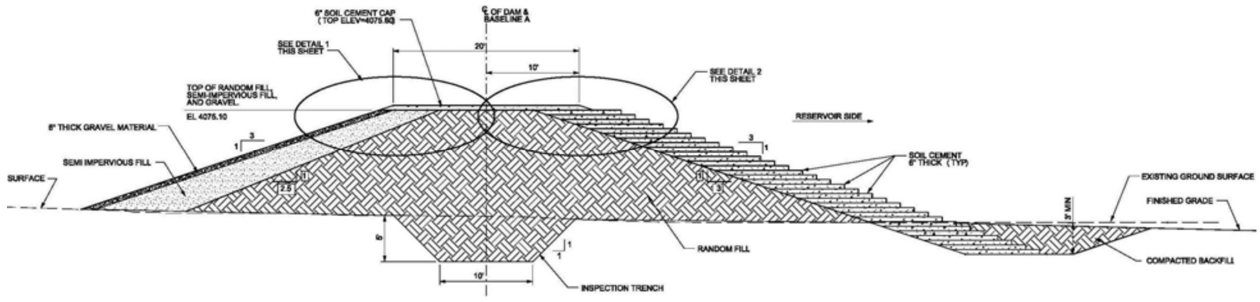

Figure 21 Typical 1 of earthen dam.

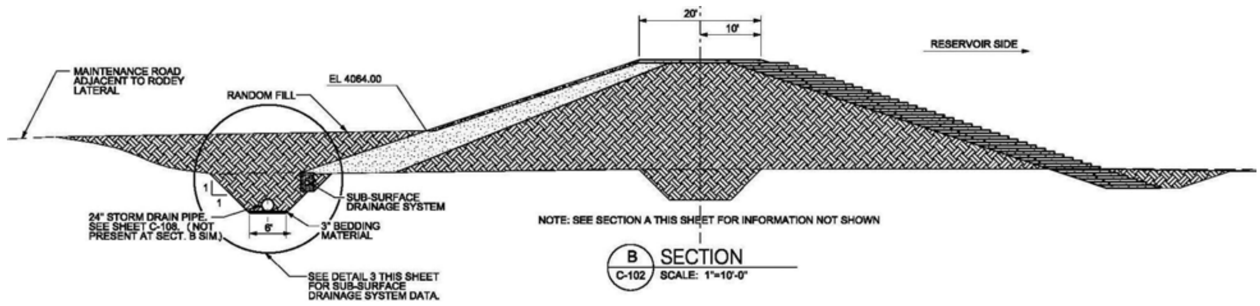

Figure 22 Typical 2 of earthen dam.

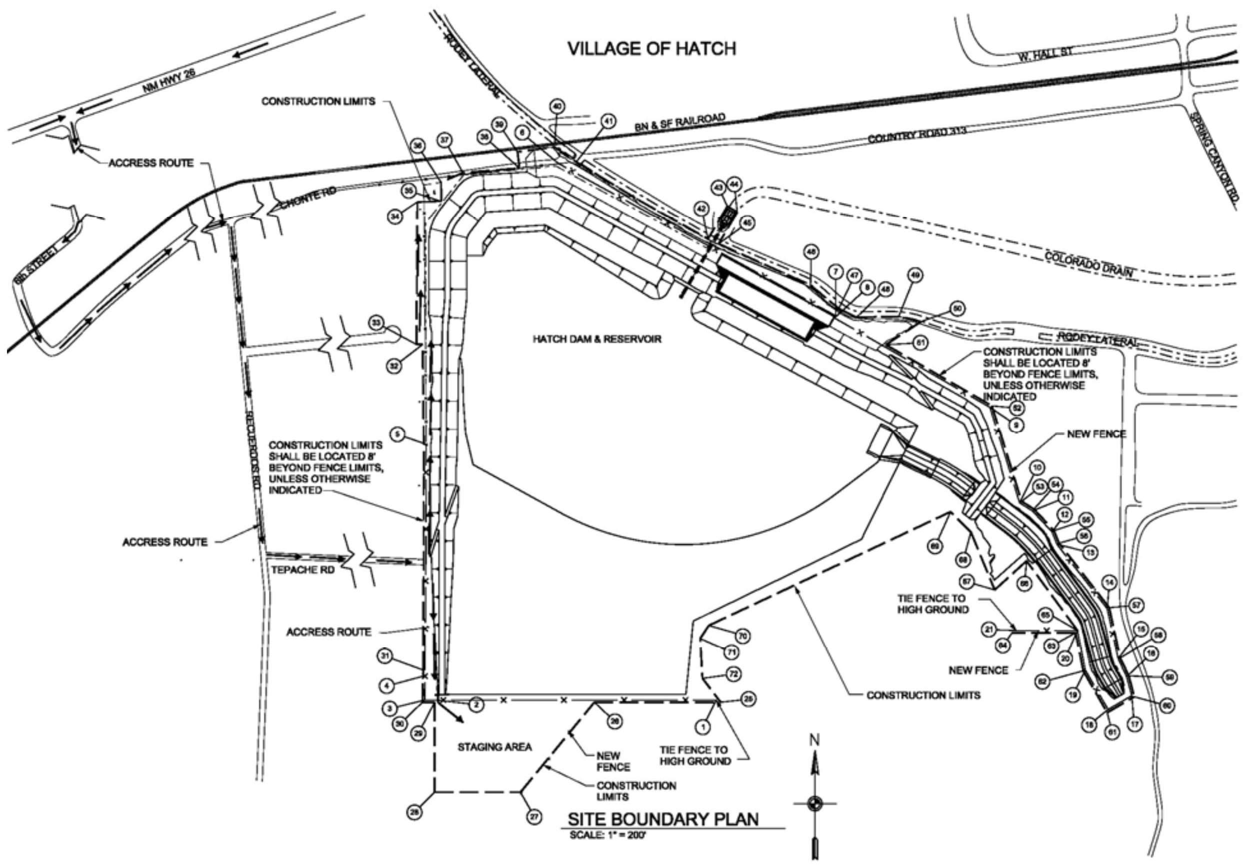

Figure 23 Hatch, NM Proposed Dam Site

Access roads are required on both sides of the dam and ramps will be constructed to access the top of the dam from these roads. Fencing encloses the reservoir and gates are provided as needed for access to the new dam. A new trapezoidal channel transports runoff from nearby Spring Canyon Dam to Dam C's reservoir.

5.6.4 *Evaluation and Screening of Preliminary Alternatives

This section describes the analyses of each preliminary alternative to determine whether they meet the study's specific planning objectives and the Federal goal of contributing to NED.

Initially, the structural FRM management measures, described in this section, were individually evaluated by First Construction Costs vs. Economically Justifiable Construction Costs.

First Construction Costs are not annualized and do not include:

- Mitigation costs
- Real estate costs (LERDDS)
- Pre-Engineering and Design (PED) costs
- Interest during construction costs, or
- Operations, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs

5.6.4.1 Channels

A. Concrete Lined Channel - $27 Million

- This alternative was removed from further consideration as initial project construction costs are greater than Total Project Costs allowable under the Continuing Authorities Program. The initial construction costs for this alternative is more than twice as costly as the most expensive dam alternative and would not reasonably maximize net benefits. This alternative was removed from further consideration.

B. Open Earthen Channel - $18 Million

- This alternative was removed from further consideration as initial project construction costs are greater than Total Project Costs allowable under the Continuing Authorities Program. The initial construction costs for this alternative is more than half again as costly as the most expensive dam alternative and would not reasonably maximize net benefits. This alternative was removed from further consideration.

5.6.4.2 Dams

All dam sizes were carried forward for further economic evaluations, past the initial project construction costs. Each dam size was evaluated for optimization purposes and to determine which provided the highest net benefits (**Error! Reference source not found.**).

5.7 Rationale for the Selection of the Recommended Plan

A. Dam A – 4% ACE

B. Dam B – 1% ACE

C. Dam C – 0.2% ACE

D. Dam D – Greater than the 0.2% ACE

NOTE: Because Dam C was the largest dam analyzed, the PDT analyzed a hypothetical Dam D. It was determined that a larger Dam D would not be economically feasible for the following reasons:

- Costs for Dam C used the existing borrow from its reservoir as borrow for dam construction material. Borrow for a larger dam would require the purchase and transport of additional borrow.
- Costs, such as real estate, and potentially higher mitigation costs increase substantially as the dam footprint increases above that of Dam C..
- Dam C captures over 79% of EAD, and the additional costs for a larger dam are expected to increase substantially faster than the remaining benefits.
- Remaining damages for Dam D would be a result of interior flooding within Hatch and will not decrease with an increase in the dam height.

Construction of Dam C is the Recommended Plan as this dam has the highest net benefits (**Error! Reference source not found.** and Figure 24).

Table 1 Comparison of Costs and Equivalent Annual Benefits for the Proposed Project.

Comparison of Costs and Equivalent Annual Benefits for Alternatives Aug 2014 price levels @ 3.5% interest rate			
(X $1,000)	Dam A	Dam B	Dam C
Construction Cost	$ 8,494	$ 8,344	$ 9,111
Env Mitigation	$ -	$ -	$ -
Real Estate	$ 650	$ 650	$ 650
PED	$ 901	$ 901	$ 901
Total First Cost	$ 10,046	$ 9,895	$ 10,662
IDC, Construction	$ -	$ -	$ -

Total Investment	$ 10,046	$ 9,895	$ 10,662
Avg. Ann. Cost	$ 428	$ 422	$ 455
OMRR&R	$ 23	$ 23	$ 23
Total Avg. Ann. Cost	$ 451	$ 444	$ 477
Equivalent Avg. Ann. Benefits	$ 2,192	$ 2,273	$ 2,432
Benefit/Cost Ratio	$ 4.9	$ 5.1	$ 5.1
Net Benefits	$ 1,741	$ 1,829	$ 1,955

*OMRR&R = operation, maintenance, repair, replacement, and rehabilitation

Error! Reference source not found. displays annualized equivalent annual benefit and cost information, discounting future benefits of flood control (which remains the same due to unchanging H&H and economic growth assumptions) and amortizing those benefits over the project life.

Error! Reference source not found. shows the average annual benefits, average annual costs, the benefit/cost ratio, and net average annual benefits, for dam alternatives considered. The plan that maximizes net benefits is a dam on Spring Canyon (referred to in this appendix as the "Dam C") with a benefit/cost ratio of 5.1 and $1,955,356 in net benefits. At 7% (per EO 12893) the benefit/cost ratio is 2.7 and $1,610,219 in net benefits

Ordinarily, and in this instance, the plan that reasonably maximizes net benefits is known as the NED plan. Dam C is the alternative that reasonably maxims net benefits and is the recommended and NED plan.

5.8 *Description of the Recommended Alternative

The NED and recommended plan is Dam C (Figure 24). Dam C is sized for a 0.2% chance (500-year) event and will detain a storage capacity of 283 acre feet. This storage capacity consists of a 30 AF sediment pool and 253 AF of water. The maximum height of embankment for Dam C is 22.6 ft and the dam includes a roller compacted concrete spillway and concrete outlet works with gate and tower. Dam C is approximately 4,191 feet in length and contains a roller compacted concrete spillway and apron, and concrete outlet works.

NOTE: After the NED analysis was completed, refinement of the preliminary design of the recommended plan was conducted which included several changes resulting in increased cost.

These cost increases are related to real estate acquisition, protecting the facility potential failure of Spring Canyon dam farther upstream, and relocations. All of these features would be apply to all dam alternatives therefore would not result in a recommendation of a different alternative.

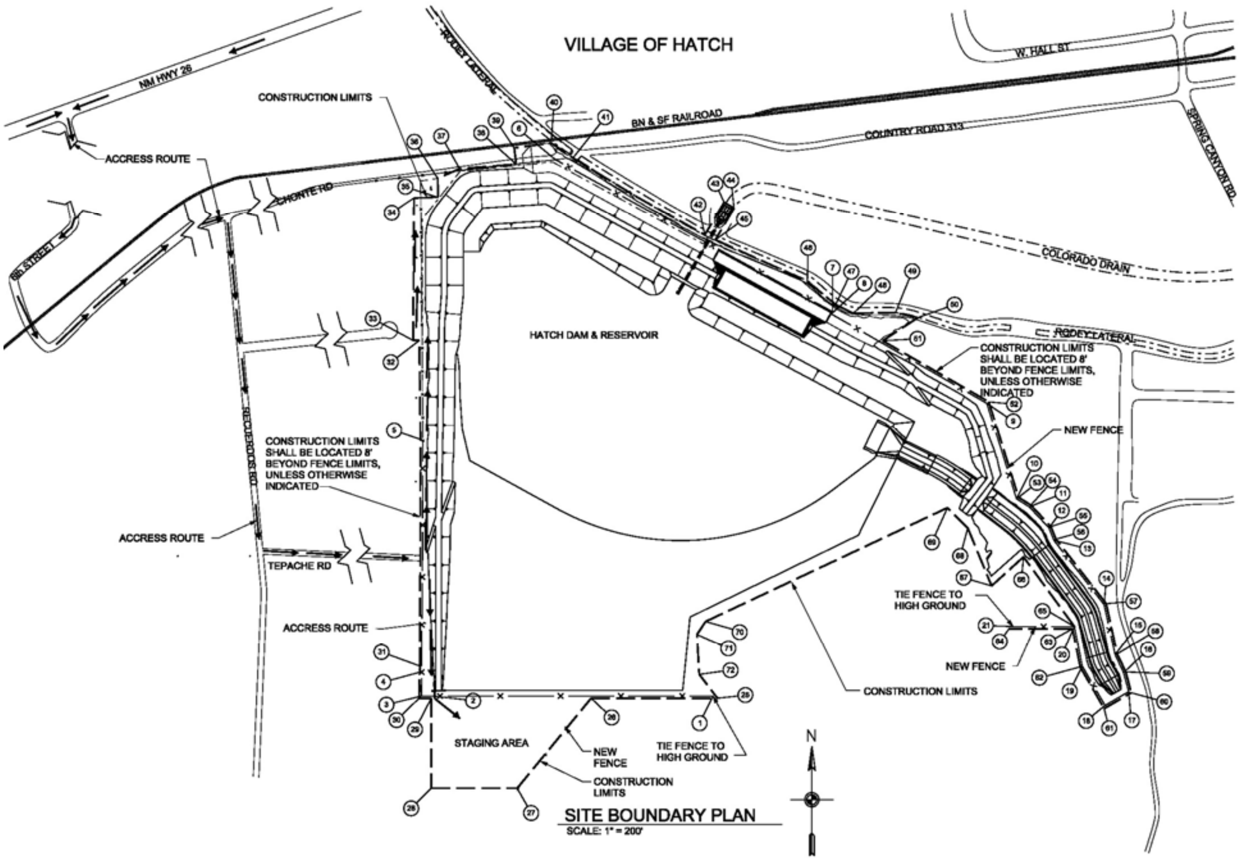

Figure 24 Hatch, NM Recommended D

Small Flood Risk Management Project
Hatch, New Mexico

Final Detailed Project Report and
Environmental Assessment
Section 205

April 2015

Appendix K
Cost Engineering

US Army Corps
of Engineers
Albuquerque District
South Pacific Division

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Under the authority of Section 205 of the Flood Control Act of 1948, the U.S. Army Corps of Engineers (Corps) proposes to implement the Small Flood Risk Management Project (Project) in the Village of Hatch, in Doña Ana County, New Mexico. The Project would include constructing an earthen embankment dam with a roller compacted concrete (RCC) spillway and an inlet channel from Spring Canyon. The proposed project is designed to control the 500- year event from Spring Canyon. The proposed construction period would be approximately ten to fourteen months and would be expected to start in late 2016. The Total Project Cost including contingency and escalation for the Tentatively Selected Plan (TSP) is $12,319,000.00.

Studies for the Project began in 2004, and a scoping letter was sent in March 2006 to all relevant Federal, State and local agencies, as well as a number of non-governmental organizations and miscellaneous other stakeholders.

Specific to the Small Flood Risk Management Project, Hatch, New Mexico, The project area is located in the south-central portion of New Mexico within Doña Ana County, near the west bank of the Rio Grande. The mouth of Spring Canyon is located in the southern municipal limit of the Village of Hatch, NM. Spring Canyon has a total drainage area of 8.1 square miles and has an upstream detention dam controlling 5.4 square miles, or 2/3 of the basin. Spring Canyon flows enter Hatch, NM and leave several ponding areas on Main Street and at the railroad embankments. The entire Village of Hatch, NM is within the 500-year floodplain.
The proposed earth-fill dam will be located just south and west of where the Colorado Drain and the Rodey Lateral meet. Borrow material for the dam would be obtained from the reservoir area directly behind the proposed dam. Riprap will line the inlet channel, which brings water from the Spring Canyon to the dam. The outlet works will drain water from the reservoir into the Colorado Drain. An additional channel is needed on the exterior of the dam to drain water that collects there currently and direct it into the Colorado drain. Two relocations will be performed prior to any borrow excavation. These relocations consist of a large leach field and an existing waterline, both located within the reservoir area.

This project estimate represents the cost to complete a structure that will protect against a 500 year event. The current project base cost estimate, pre-contingency, approximates $8 million. This Abbreviated Risk Analysis study excluded the spent costs of $2.3 million, excludes escalation and is expressed in FY 2015 dollars. Since the Real Estate office provided a separate 20% contingency applied to the Real Estate cost of $385K, it was also excluded from the Abbreviated Risk Analysis study. The Cost Engineering Section (CESPA-EC-TC) performed the Abbreviated Risk Analysis study on the estimated remaining construction costs of $7.63M.

Cost estimates fluctuate over time. During this period of study, minor cost fluctuations can and have occurred. For this reason, contingency reporting is based in cost and percent values. Should cost vary to a slight degree with similar scope and risks, contingency percent values will be reported, cost values rounded.

Table ES-1. Construction Contingency Results

Base Case Construction Cost Estimate	$8,018,000	
Confidence Level	**Construction Value ($$) w/ Contingencies**	**Contingency (%)**
50%	$9,086,000	13%
80%	$9,798,000	22%
90%	N/A	N/A

COST ESTIMATE NARRATIVE

GENERAL

Cost estimates were produced for each of the alternative solutions using current MCACES software. The estimates are detailed as much as possible for the level of design used in alternative formulation. Each estimate is based on current labor, material and equipment databases for the project region and includes costs for project construction, land acquisition, planning, engineering and design and construction management. These costs then have a risk based contingency applied to them and the costs are escalated to an estimated mid-point of construction to arrive at the total project cost. The total project cost is then split with an assumed Federal to Non-Federal sponsor share of 65% to 35% to arrive at each entity's portion of the cost. Table 1 shows a summary of the total project cost for each alternative. Table 2 shows the preferred plan Dam C 500 year (current design).

Table 1 (Original Table Completed in 2011)

Total Project Costs			
Item	**Cost in thousands ($)**		
	25 Year	**100 Year**	**500 Year**
Relocations	192	194	196
Main Dam	4,663	4,951	5,974
Outlet Works	374	377	382
Channels	700	706	715
Land and Damages	653	653	653
Engineering and Design	560	560	560
Construction and Management	568	664	760
Subtotal	**7,713**	**8,105**	**9,240**
Sunk Costs	83	83	83
Contingency & Escalation	1,770	1,866	2,268
Total Project Cost	**9,566**	**10,054**	**11,591**

Table 2 (The Preferred Plan completed in 2015)

Total Project Costs ($K)	
Item	
	Dam C 500 Year
Relocations	215
Main Dam	5,595
Channels	472
Land and Damages	385
Engineering and Design	880
Construction and Management	472
Subtotal	**8,018**
Sunk Costs	2,300
Contingency & Escalation	2,001
Total Project Cost	**12,319**

PROJECT ASSUMPTIONS

Each of the alternatives is essentially the same structure design with changes made to the height of the structure to protect against different flood flows. This means that the alternatives analyzed vary mainly in the amount of excavated and fill material needed to build each of the structures. The spillway size is slightly different between the alternatives and the amount of slope requiring protection also changes with the structure height. Other features of the project such as the rundown structure, channel, utility removals and relocations do not vary between the different alternatives.

Quantities for the main structure, Spring Canyon channel and rundown structure are provided by the General Engineering Section for each of the alternatives. The remaining feature quantities are takeoffs performed by the Cost Engineering Section (CESPA-EC-TC).

The estimate assumes that the contract will be an 8a small business competitive bid acquisition and that there are an adequate number of contractors in the area and an adequate labor force available to construct the project efficiently. The project location is within a reasonable driving distance from Las Cruces, NM, which is a well developed metropolitan area. The successful contractor is assumed to have experience with heavy earthwork projects at a minimum. Most activities outside of earthwork are assumed subcontracted activities for the project cost.

Adequate time for construction is also assumed as there are no known constraints that would require a compressed construction schedule. This being the case, the project labor force is assumed to work normal 40 hour weeks during daylight hours. Overtime is not considered to be necessary for completion. Additionally, no allowances are made for periods during the work year when construction must be halted due to environmental or similar concerns. Year round construction is common in the project region due to the moderate climate and this is reflected in the estimate.

Existing utilities to be removed or relocated are not shown on the current alternative drawings. Information concerning the utilities was obtained from the General Engineering Section, Albuquerque District and is the basis for the costs included in the cost estimate. The utility relocation requirements do not vary between the alternatives; therefore each alternative carries the same direct cost. The piping for the previous drain system will be removed and disposed. It is assumed that the sponsor will be responsible for relocation of the current lift station and costs for this item are not included in the project cost estimate.

Groundwater is assumed to not be encountered while performing any of the required excavation so dewatering cost is not included in the estimate. There is a risk of surface water from a rain event entering the project area and the estimate does include costs for creating temporary berms to protect the work area from smaller rain events. A large weather event would be less frequent, but does pose a risk and is considered in the risk register for contingency calculations.

Earth material used for the retention structure fill is assumed to come from the excavation of the retention basin immediately upstream of the fill area. The material to be excavated is assumed to be suitable material for fill. An allowance for some material to be wasted offsite from the project area is included in the estimate. The intention in the design is to balance the cut and fill for the project so, the estimate assumes there will not be a significant amount of borrow needed or waste to be disposed of offsite. Because the fill material is coming from the retention basin excavation adjacent to the dam the operation is assumed to be predominantly a scraper operation for excavation and transport to the fill area.

Concrete, reinforcement and rock materials are all assumed to be purchased from a supplier in the area (within 40 miles). Concrete is assumed to be placed by pump. Rock is included at estimated delivered prices.

Lands and Damages costs were obtained from the Real Estate report. A contingency of 20% is applied to the acquisition costs. This percentage was derived by the Albuquerque District Real Estate office and is used for the estimate.

Planning, Engineering and Design costs are provided as a detailed breakdown of the estimated effort to produce the final set of construction drawings and specifications for the project. It is estimated that the design effort will not vary significantly between the alternatives because of the similarities; therefore the same cost for design is reflected in each alternative cost.

The Construction Management cost is also arrived at by an estimated detailed breakdown of the personnel and hours required to manage the construction project. These costs do vary between alternatives because the size of the structure varies between alternatives, which effects the schedule duration.

ABBREVIATED RISK ANALYSIS

An Abbreviated Risk Analysis was performed for each of the project alternatives by the Project Delivery Team (PDT) working with the Cost Engineering Section (CESPA-EC-TC). The Abbreviated Risk Analysis methodology is the common standard used to produce a contingency percentage to apply to the fully funded project cost for alternative cost development. The project was analyzed by breaking the costs down by Civil Works Accounts and then assigning a likelihood and impact for each account in each potential risk area.

The general risk areas considered are Project Scope, Acquisition Strategy, Construction Complexity, Volatile Commodities, Quantities, Environmental Risks, Cost Estimating Method and External Project Risks. The potential risks between alternatives do not change, but the impact that each has does change with the alternatives. Risks associated with earthwork have a larger effect on the larger structure as an example.

Analysis determines that the largest risks are assuming excavated material for the most part is suitable as fill for the structure, that fuel costs, concrete costs and steel costs will not increase above normal inflation rates, and that suitable rock is available from a reasonably close supplier. The risk register contains all of the items analyzed and the likelihood and impact each of the potential risk would have.

The final contingency calculations for the alternatives show the lowest construction contingency for the 70 year alternative at 21.24% and the highest construction contingency value for the 500 year alternative at 21.84%. The 100 year alternative has a calculated construction contingency value of 21.41%. Each of the alternatives carries a contingency of 17.84% for the Planning, Engineering and Design, and Construction Management costs respectively. The majority of the contingency in each of the alternatives is carried in the construction of the main earthen dam primarily because of the dependence of the structure on suitable fill materials.

a. Methodology / Process

The Cost Engineering Section (CESPA-EC-TC) performed the Abbreviated Cost Risk Analysis, relying on Albuquerque District staff to provide expertise and information gathering. The PDT conducted initial risk identification in September 2011 on the project alternatives. The initial risk identification meeting also included qualitative analysis to produce a risk register that served as the draft framework for the risk analysis.

As additional information became available throughout the feasibility process the Abbreviated Risk Analysis was updated several times.

Participants in the latest full PDT risk identification meeting held 14 November 2013 included:

Lynette Giesen	USACE - ABQ	Project Management
Kathy Skalbeck	USACE - ABQ	Study Manager
Marvin Urban	USACE - ABQ	Real Estate
Robert Browning	USACE - ABQ	Economics
Ted Solano	USACE - ABQ	Engineering & Design
Bruce Jordan	USACE - ABQ	Engineering Division: Geotech
Steve Boberg	USACE - ABQ	H&H
Pablo Gonzalez	USACE - ABQ	Cost Engineering
Danielle Galloway	USACE - ABQ	Environmental
Steve Brewer	USACE - ABQ	Construction
Jeremy Decker	USACE - ABQ	Cultural Studies

An updated draft Abbreviated Risk analysis was completed on April 19, 2015 for the selected plan District Quality Control (DQC) review. However, subsequent sanity checks and technical review of the base cost estimate required revisions, necessitating additional updates to the Abbreviated Risk Analysis; results were furthered on December 3, 2015, ready for ATR.

b. Identify and Assess Risk Factors

Identifying the risk factors via the PDT is considered a qualitative process that results in establishing a risk register that serves as the document for the quantitative study using the Abbreviated Risk Template. Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences, events, or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

A formal PDT meeting was held with the Albuquerque District office for the purposes of identifying and assessing risk factors. The meeting (conducted November 14, 2013) included capable and qualified representatives from multiple project team disciplines and functions, including project management, cost engineering, design, construction, environmental compliance, and real estate.

The initial formal meeting focused primarily on risk factor identification using brainstorming techniques, but also included some facilitated discussions based on risk factors common to projects of similar scope and geographic location. Additionally, informal meetings were conducted throughout the risk analysis process on an as-needed basis to further facilitate risk factor identification and risk assessment.

c. Quantify Risk Factor Impacts

The quantitative impacts (putting it to numbers of cost) of risk factors on project plans were analyzed using a combination of professional judgment, empirical data and analytical techniques. Risk factor impacts were quantified using the Abbreviated Risk Analysis template.

The resulting product from the PDT discussions is captured within a risk register as presented in Attachment K-B. There was no place to account for schedule impacts separate from cost impacts, any concerns were captured in the same Abbreviated Cost Risk Analysis. Note that the risk register records the PDT's risk concerns, discussions related to those concerns, and potential impacts to the current cost estimate. The concerns and discussions support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

RESULTS

The Abbreviated Risk Analysis results are provided in the following sections.

1. Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The actual risk register is provided in Attachment K-B. The complete risk register includes low level and high level risks, as well as additional information regarding the nature and impacts of each risk.

It is important to note that a risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates, and schedule are further refined, especially on large projects with extended schedules. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context of project controls.
- Communicating risk management issues.
- Providing a mechanism for eliciting feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans

2. Cost Contingency

The result of risk or uncertainty analysis is quantification of the cumulative impact of all analyzed risks or uncertainties. These results, as applied to the analysis herein, depict the overall project cost at intervals of 50% and 80% confidence (probability).

The actual Input/Results and Risk Evaluation Matrix are provided in Attachments K-A and K-C. Cost contingency for the Construction risks was quantified as approximately $1.8M, which is established at a 22% contingency for an 80% confidence level estimate.

ATTACHMENT K-A

RISK ANALYSIS

INPUT AND RESULTS

Abbreviated Risk Analysis

Project Name & Location: **Small Flood Risk Management Project Hatch, New Mexico**
Project Development Stage/Alternative: **Feasibility (Recommended Plan)**
Risk Category: **Moderate Risk: Typical Project Construction Type**

District: SPA
Alternative: Alt C
Meeting Date: 11/14/2013

Total Estimated Construction Contract Cost = **$ 6,281,155**

	CWWBS	Feature of Work	Contract Cost		% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate	$ 385,424		0.00%	$ -	$ 385,424
1	02 03 CEMETERIES, UTILITIES, AND STRUCTURES, Construction Activities	Utilities	$ 214,868		17.79%	$ 38,235	$ 253,103
2	04 01 MAIN DAM	Site Work - Excavation	$ 724,500		34.31%	$ 248,605	$ 973,105
3	04 01 MAIN DAM	Site Work - Embankment Fill (Random)	$ 376,824		37.59%	$ 141,643	$ 518,467
4	04 01 MAIN DAM	Site Work - Soil Cement Armoring (Dam and Channel)	$ 1,667,142		36.44%	$ 607,485	$ 2,274,627
5	04 01 MAIN DAM	Site Work - Gravel Slope Protection	$ 146,273		22.79%	$ 33,335	$ 179,608
6	04 01 MAIN DAM	Site Work - Simi - Impervious Fill (General and Key Trench)	$ 493,144		26.60%	$ 131,183	$ 624,327
7	04 02 SPILLWAY	Roller Compacted Concrete	$ 443,772		24.68%	$ 109,509	$ 553,281.17
8	04 03 OUTLET WORKS	Concrete conduit	$ 358,860		16.96%	$ 60,869	$ 419,729.22
9	04 03 OUTLET WORKS	Gatewell Structure	$ 209,946		16.07%	$ 33,735	$ 243,681.05
10	09 CHANNELS AND CANALS (Except Navigation Ports and Harbors)	Drainage	$ 260,404		19.54%	$ 50,877	$ 311,280.39
11	09 CHANNELS AND CANALS (Except Navigation Ports and Harbors)	Site Work - Wire Wrapped Riprap	$ 211,337		25.16%	$ 53,175	$ 264,511.84
12	All Other (less than 10% of construction costs)	Remaining Construction Items	$ 1,174,087	*23.0%*	8.99%	$ 105,608	$ 1,279,695
13	30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	$ 880,388		12.53%	$ 110,290	$ 990,677
14	31 CONSTRUCTION MANAGEMENT	Construction Management	$ 471,518		11.74%	$ 55,379	$ 526,897
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)					$ -	

Totals

	Contract Cost	% Contingency	$ Contingency	Total
Real Estate	$ 385,424	0.00%	$ -	$ 385,424.00
Total Construction Estimate	$ 6,281,155	25.70%	$ 1,614,260	$ 7,895,414
Total Planning, Engineering & Design	$ 880,388	12.53%	$ 110,290	$ 990,677
Total Construction Management	$ 471,518	11.74%	$ 55,379	$ 526,897
Total	**$ 8,018,484**	**22.2%**	**$ 1,779,928**	**$ 9,798,413**

	Base	50%	80%
Range Estimate ($000's)	$8,018k	$9,086k	$9,798k

* 50% based on base is at 50% CL.

Fixed Dollar Risk Add: (Allows for additional risk to be added to the risk analsyis. Must include justification. Does not allocate to Real Estate.)

ATTACHMENT K-B

RISK ANALYSIS

RISK REGISTER

Small Flood Risk Management Project Hatch, New Mexico

Feasibility (Recommended Plan)

Abbreviated Risk Analysis

Meeting Date: 14-Nov-13

Risk Level

	Negligible	Marginal	Moderate	Significant	Critical
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3

Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Project Scope Growth					Maximum Project Growth	**75%**
PS-1	Utilities	The final location of utilities may change as the design is finalized for a construction contract.	The final cost for utility relocation may increase due to changes in the design.	Marginal	Possible	1
PS-2	Site Work - Excavation	Design could alter the height and width of the Dam as a result of more information/Survey data.	The quantities may increase as the design moves forward, which will increase the cost of the project.	Moderate	Likely	3
PS-3	Site Work - Embankment Fill (Random)	Design could alter the height and width of the Dam as a result of more information/Survey data.	The quantities may increase as the design moves forward, which will increase the cost of the project.	Moderate	Likely	3
PS-4	Site Work - Soil Cement Armoring (Dam and Channel)	Design could alter the height and width of the Dam as a result of more information/Survey data.	The quantities may increase as the design moves forward, which will increase the cost of the project.	Moderate	Possible	2
PS-5	Site Work - Gravel Slope Protection	Design could alter the height and width of the Dam as a result of more information/Survey data.	The quantities may increase as the design moves forward, which will increase the cost of the project.	Marginal	Likely	2
PS-6	Site Work - Simi - Impervious Fill (General and Key Trench)	Design could alter the height and width of the Dam as a result of more information/Survey data.	The quantities may increase as the design moves forward, which will increase the cost of the project.	Marginal	Likely	2
PS-7	Roller Compacted Concrete	Design could alter the height and width of the Dam as a result of more information/Survey data.	The quantities may increase as the design moves forward, which will increase the cost of the project.	Marginal	Possible	1
PS-8	Concrete conduit	Design could alter the height and width of the Dam as a result of more information/Survey data.	The quantities may increase as the design moves forward, which will increase the cost of the project.	Marginal	Unlikely	0
PS-9	Gatewell Structure	Design could alter the height and width of the Dam as a result of more information/Survey data.	The quantities may increase as the design moves forward, which will increase the cost of the project.	Marginal	Unlikely	0
PS-10	Drainage	Design could alter the height and width of the Dam as a result of more information/Survey data.	The quantities may increase as the design moves forward, which will increase the cost of the project.	Marginal	Possible	1
PS-11	Site Work - Wire Wrapped Riprap	Design could alter the height and width of the Dam as a result of more information/Survey data.	The quantities may increase as the design moves forward, which will increase the cost of the project.	Marginal	Possible	1
PS-12	Remaining Construction Items	Design could alter the height and width of the Dam as a result of more information/Survey data.	The majority of the remaining construction items are somewhat incidental to the major changes for earthwork, concrete, drainage, etc. Likely minor changes to the quantities for these items, and minor impacts to the cost.	Marginal	Unlikely	0
PS-13	Planning, Engineering, & Design	Design could alter the height and width of the Dam as a result of more information/Survey data.	Any changes to the design will cause some redesign effort and will impact the Engineering and Design cost.	Moderate	Possible	2

PS-14	Construction Management	Scope growth after construction contract is awarded.	Any changes to the design will cause some redesign effort and will impact the Engineering and Design cost, could extend the project duration and increas the CM cost.	Marginal	Possible	1
Acquisition Strategy					**Maximum Project Growth**	**30%**
AS-1	Utilities	No Concerns	nothing significant to report.	Negligible	Unlikely	0
AS-2	Site Work - Excavation	Acquisition Strategy Meeting has not been conducted yet.	The estimate assumption is that this will be a design/bid/build small buiseness competitive award due to the dollar amount of the construction cost. Unlikely for this project to be bid under any other acquisition strategy, thus unlikely for the cost to change.	Marginal	Unlikely	0
AS-3	Site Work - Embankment Fill (Random)	Acquisition Strategy Meeting has not been conducted yet.	The estimate assumption is that this will be a design/bid/build small buiseness competitive award due to the dollar amount of the construction cost. Unlikely for this project to be bid under any other acquisition strategy, thus unlikely for the cost to change.	Marginal	Unlikely	0
AS-4	Site Work - Soil Cement Armoring (Dam and Channel)	Acquisition Strategy Meeting has not been conducted yet.	The estimate assumption is that this will be a design/bid/build small buiseness competitive award due to the dollar amount of the construction cost. Unlikely for this project to be bid under any other acquisition strategy, thus unlikely for the cost to change.	Marginal	Unlikely	0
AS-5	Site Work - Gravel Slope Protection	Acquisition Strategy Meeting has not been conducted yet.	The estimate assumption is that this will be a design/bid/build small buiseness competitive award due to the dollar amount of the construction cost. Unlikely for this project to be bid under any other acquisition strategy, thus unlikely for the cost to change.	Marginal	Unlikely	0
AS-6	Site Work - Simi - Impervious Fill (General and Key Trench)	Acquisition Strategy Meeting has not been conducted yet.	The estimate assumption is that this will be a design/bid/build small buiseness competitive award due to the dollar amount of the construction cost. Unlikely for this project to be bid under any other acquisition strategy, thus unlikely for the cost to change.	Marginal	Unlikely	0
AS-7	Roller Compacted Concrete	Acquisition Strategy Meeting has not been conducted yet.	The estimate assumption is that this will be a design/bid/build small buiseness competitive award due to the dollar amount of the construction cost. Unlikely for this project to be bid under any other acquisition strategy, thus unlikely for the cost to change.	Marginal	Unlikely	0
AS-8	Concrete conduit	Acquisition Strategy Meeting has not been conducted yet.	The estimate assumption is that this will be a design/bid/build small buiseness competitive award due to the dollar amount of the construction cost. Unlikely for this project to be bid under any other acquisition strategy, thus unlikely for the cost to change.	Marginal	Unlikely	0

AS-9	Gatewell Structure	Acquisition Strategy Meeting has not been conducted yet.	The estimate assumption is that this will be a design/bid/build small buiseness competitive award due to the dollar amount of the construction cost. Unlikely for this project to be bid under any other acquisition strategy, thus unlikely for the cost to change.	Marginal	Unlikely	0
AS-10	Drainage	Acquisition Strategy Meeting has not been conducted yet.	The estimate assumption is that this will be a design/bid/build small buiseness competitive award due to the dollar amount of the construction cost. Unlikely for this project to be bid under any other acquisition strategy, thus unlikely for the cost to change.	Marginal	Unlikely	0
AS-11	Site Work - Wire Wrapped Riprap	Acquisition Strategy Meeting has not been conducted yet.	The estimate assumption is that this will be a design/bid/build small buiseness competitive award due to the dollar amount of the construction cost. Unlikely for this project to be bid under any other acquisition strategy, thus unlikely for the cost to change.	Marginal	Unlikely	0
AS-12	Remaining Construction Items	Acquisition Strategy Meeting has not been conducted yet.	The estimate assumption is that this will be a design/bid/build small buiseness competitive award due to the dollar amount of the construction cost. Unlikely for this project to be bid under any other acquisition strategy, thus unlikely for the cost to change.	Marginal	Unlikely	0
AS-13	Planning, Engineering, & Design	Acquisition Strategy Meeting has not been conducted yet.	The estimate assumption is that this will be a design/bid/build small buiseness competitive award due to the dollar amount of the construction cost. Unlikely for this project to be bid under any other acquisition strategy, thus unlikely for the cost to change.	Marginal	Unlikely	0
AS-14	Construction Management	Acquisition Strategy Meeting has not been conducted yet.	The estimate assumption is that this will be a design/bid/build small buiseness competitive award due to the dollar amount of the construction cost. Unlikely for this project to be bid under any other acquisition strategy, thus unlikely for the cost to change.	Marginal	Unlikely	0
Construction Elements					**Maximum Project Growth**	**25%**
CE-1	Utilities	That there is unknown utilities that may have to be relocated.	The CWE accounts for only the utilities that are defined in the current design. It is possible that with further investigations more utility lines will be identified.	Marginal	Possible	1
CE-2	Site Work - Excavation	can the staging area for excavated material handle that much material.	The assumption is that after they excavate and prep the primary dam location, the excavated material will be brought back and put in place for the Dam. No cost has been included for hauling the material off site to stockpile. If the site does not contain room for a temporary stock pile, then the cost will increase for double handling this material.	Moderate	Possible	2
CE-3	Site Work - Embankment Fill (Random)	The excavation can not support all of the fill required and the contractor will need to purchase and haul in more fill.	Per the civil engineer the excavation quantities should provide all of the fill required to construct the Dam. If this assumption is incorrect there would be a large impact to the cost for imported fill.	Significant	Possible	3

CE-4	Site Work - Soil Cement Armoring (Dam and Channel)	The distance that the material will be purchased from.	The assumption is that the material can be provided in Las Cruces approx. 40 miles away. If they can't supply all of it then the rest would come from El Paso, Tx approx. 60 miles away from the project site.	Moderate	Possible	2
CE-5	Site Work - Gravel Slope Protection	The excavation can not support all of the gravel material required and the contractor will need to purchase and haul in more fill.	Per the civil engineer the excavation quantities should provide all of the gravel material required to construct the Dam. If this assumption is incorrect there would be an impact to the cost for imported material.	Marginal	Possible	1
CE-6	Site Work - Simi - Impervious Fill (General and Key Trench)	The excavation can not support all of the semi-impervious fill required and the contractor will need to purchase and haul in more fill.	Per the civil engineer the excavation quantities should provide all of the semi-impervious material required to construct the Dam. If this assumption is incorrect there would be an impact to the cost for imported material.	Moderate	Possible	2
CE-7	Roller Compacted Concrete	The distance that the material will be purchased from.	The assumption is that the material can be provided in Las Cruces approx. 40 miles away. If they can't supply all of it then the rest would come from El Paso, Tx approx. 60 miles away from the project site.	Moderate	Possible	2
CE-8	Concrete conduit	The distance that the material will be purchased from.	The assumption is that the material can be provided in Las Cruces approx. 40 miles away. If they can't supply all of it then the rest would come from El Paso, Tx approx. 60 miles away from the project site.	Moderate	Possible	2
CE-9	Gatewell Structure	Gate does not function as designed.	could impact project completion and turnover dates. Could incur extended field office overhead costs.	Moderate	Possible	2
CE-10	Drainage	The distance that the material will be purchased from.	The assumption is that the material can be provided in Las Cruces approx. 40 miles away. If they can't supply all of it then the rest would come from El Paso, Tx approx. 60 miles away from the project site.	Marginal	Possible	1
CE-11	Site Work - Wire Wrapped Riprap	The distance that the material will be purchased from.	The assumption is that the material can be provided in Las Cruces approx. 40 miles away. If they can't supply all of it then the rest would come from El Paso, Tx approx. 60 miles away from the project site.	Marginal	Possible	1
CE-12	Remaining Construction Items	Unknown changes to remaining construction changes.	The PDT had no comments.	Marginal	Possible	1
CE-13	Planning, Engineering, & Design	Design criteria that can be ambiguos and lead to multiple interpretations.	contractor's methodology is not approved as they bid the project. Contract cost could increase if the contractor has to change their means and methods to achieve work.	Moderate	Unlikely	1

CE-14	Construction Management	Delayed approval of construction submittals	ontractor's schedule may be impacted and cause extended project duration. Could increase the cost if project is delayed.	Marginal	Unlikely	0
Quantities for Current Scope				**Maximum Project Growth**		**0%**
Q-1	Utilities	The final location of utilities may change as the design is finalized for a construction contract.	The final cost for utility relocation may increase due to changes in the design.	Marginal	Unlikely	0
Q-2	Site Work - Excavation	shrink and swell factors used by the cost estimator may not be consistent with material properties at the site.	shrink and swell factors used to create the estimate seem reasonable. Actual site conditions unlikely to very much from estimated assumptions, marginal impact to cost.l	Moderate	Unlikely	1
Q-3	Site Work - Embankment Fill (Random)	shrink and swell factors used by the cost estimator may not be consistent with material properties at the site.	shrink and swell factors used to create the estimate seem reasonable. Actual site conditions unlikely to very much from estimated assumptions, marginal impact to cost.l	Moderate	Unlikely	1
Q-4	Site Work - Soil Cement Armoring (Dam and Channel)	The soil cement design criteria may change in the final design, and require additional cementitious material.	The quantities may increase as the design moves forward, which will increase the cost of the project.	Significant	Possible	3
Q-5	Site Work - Gravel Slope Protection	Final For Construction Drawings could alter the height and width of the Dam as stated in the feasibility report as a result of more information/Survey data.	The quantities may increase as the design moves forward, which will increase the cost of the project.	Marginal	Possible	1
Q-6	Site Work - Simi - Impervious Fill (General and Key Trench)	shrink and swell factors used by the cost estimator may not be consistent with material properties at the site.	shrink and swell factors used to create the estimate seem reasonable. Actual site conditions unlikely to very much from estimated assumptions, marginal impact to cost.	Moderate	Unlikely	1
Q-7	Roller Compacted Concrete	Final For Construction Drawings could alter the height and width of the Dam as stated in the feasibility report as a result of more information/Survey data.	The quantities may increase as the design moves forward, which will increase the cost of the project.	Marginal	Possible	1
Q-8	Concrete conduit	Final For Construction Drawings could alter the height and width of the Dam as stated in the feasibility report as a result of more information/Survey data.	The quantities may increase as the design moves forward, which will increase the cost of the project.	Marginal	Possible	1
Q-9	Gatewell Structure	Final For Construction Drawings could alter the height and width of the Dam as stated in the feasibility report as a result of more information/Survey data.	The quantities may increase as the design moves forward, which will increase the cost of the project.	Marginal	Possible	1
Q-10	Drainage	Final For Construction Drawings could alter the height and width of the Dam as stated in the feasibility report as a result of more information/Survey data.	The quantities may increase as the design moves forward, which will increase the cost of the project.	Marginal	Possible	1
Q-11	Site Work - Wire Wrapped Riprap	Final For Construction Drawings could alter the height and width of the Dam as stated in the feasibility report as a result of more information/Survey data.	The quantities may increase as the design moves forward, which will increase the cost of the project.	Marginal	Possible	1

Q-12	Remaining Construction Items	The quantities increase or decrease as the design moves forward.	The majority of the remaining construction items are somewhat incidental to the major changes for earthwork, concrete, drainage, etc. Likely minor changes to the quantities for these items, and minor impacts to the cost.	Marginal	Unlikely	0
Q-13	Planning, Engineering, & Design	nothing significant to report.	nothing significant to report.	Negligible	Unlikely	0
Q-14	Construction Management	nothing significant to report.	nothing significant to report.	Negligible	Unlikely	0
Specialty Fabrication or Equipment					**Maximum Project Growth**	**75%**
FE-1	Utilities	No Concerns	N/A	Negligible	Unlikely	0
FE-2	Site Work - Excavation	No Concerns	N/A	Negligible	Unlikely	0
FE-3	Site Work - Embankment Fill (Random)	No Concerns	N/A	Negligible	Unlikely	0
FE-4	Site Work - Soil Cement Armoring (Dam and Channel)	availability of local concrete contractors that can perform this work.	Obtaining a subcontractor to perform this work in Hatch, could be an issue if concrete contractors are very busy with other work closer to home. The price for this work will increase if local sub-contractors are not available.	Moderate	Possible	2
FE-5	Site Work - Gravel Slope Protection	No Concerns	N/A	Negligible	Unlikely	0
FE-6	Site Work - Simi - Impervious Fill (General and Key Trench)	No Concerns	N/A	Negligible	Unlikely	0
FE-7	Roller Compacted Concrete	availability of local concrete contractors that can perform this work.	Obtaining a subcontractor to perform this work in Hatch, could be an issue if concrete contractors are very busy with other work closer to home. The price for this work will increase if local sub-contractors are not available.	Moderate	Possible	2
FE-8	Concrete conduit	availability of local concrete contractors that can perform this work.	Obtaining a subcontractor to perform this work in Hatch, could be an issue if concrete contractors are very busy with other work closer to home. The price for this work will increase if local sub-contractors are not available.	Marginal	Possible	1
FE-9	Gatewell Structure	possible lead time delay in gate manufacturing.	could impact project completion and turnover dates. Could incur extended field office overhead costs.	Moderate	Possible	2
FE-10	Drainage	No Concerns	N/A	Negligible	Unlikely	0
FE-11	Site Work - Wire Wrapped Riprap	Rock size not available in the local area.	longer distance to travel to obtain correct size rock. Could increase the cost for rip rap material	Marginal	Likely	2
FE-12	Remaining Construction Items	No Concerns	N/A	Negligible	Unlikely	0

FE-13	Planning, Engineering, & Design	No Concerns	N/A	Negligible	Unlikely	0
FE-14	Construction Management	No Concerns	N/A	Negligible	Unlikely	0
Cost Estimate Assumptions				**Maximum Project Growth**		**0%**
CT-1	Utilities	used RS Means pricing data.	Material cost at time of contract award may be higher than what was used in the estimate.	Marginal	Likely	2
CT-2	Site Work - Excavation	2014 Equipment and Ownership Manual Cost was used.	If the contractor uses all rented equipment, the cost could increase. Roughly 30% of the construction direct cost is attributable to equipment cost.	Moderate	Likely	3
CT-3	Site Work - Embankment Fill (Random)	2014 Equipment and Ownership Manual Cost was used.	If the contractor uses all rented equipment, the cost could increase. Roughly 30% of the construction direct cost is attributable to equipment cost.	Moderate	Likely	3
CT-4	Site Work - Soil Cement Armoring (Dam and Channel)	2014 Equipment and Ownership Manual Cost was used.	If the contractor uses all rented equipment, the cost could increase. Roughly 30% of the construction direct cost is attributable to equipment cost.	Moderate	Likely	3
CT-5	Site Work - Gravel Slope Protection	2014 Equipment and Ownership Manual Cost was used.	If the contractor uses all rented equipment, the cost could increase. Roughly 30% of the construction direct cost is attributable to equipment cost.	Moderate	Likely	3
CT-6	Site Work - Simi - Impervious Fill (General and Key Trench)	2014 Equipment and Ownership Manual Cost was used.	If the contractor uses all rented equipment, the cost could increase. Roughly 30% of the construction direct cost is attributable to equipment cost.	Moderate	Likely	3
CT-7	Roller Compacted Concrete	2014 Equipment and Ownership Manual Cost was used.	If the contractor uses all rented equipment, the cost could increase. Roughly 30% of the construction direct cost is attributable to equipment cost.	Moderate	Possible	2
CT-8	Concrete conduit	2014 Equipment and Ownership Manual Cost was used.	If the contractor uses all rented equipment, the cost could increase. Roughly 30% of the construction direct cost is attributable to equipment cost.	Moderate	Possible	2
CT-9	Gatewell Structure	Nothing of major concern, price quote for the gate was obtained.	nothing significant to report.	Negligible	Unlikely	0
CT-10	Drainage	2014 Equipment and Ownership Manual Cost was used.	If the contractor uses all rented equipment, the cost could increase. Roughly 30% of the construction direct cost is attributable to equipment cost.	Moderate	Likely	3
CT-11	Site Work - Wire Wrapped Riprap	2014 Equipment and Ownership Manual Cost was used.	If the contractor uses all rented equipment, the cost could increase. Roughly 30% of the construction direct cost is attributable to equipment cost.	Moderate	Likely	3
CT-12	Remaining Construction Items	The quantities increase or decrease as the design moves forward.	The majority of the remaining construction items are somewhat incidental to the major changes for earthwork, concrete, drainage, etc. Likely minor changes to the quantities for these items, and minor impacts to the cost.	Negligible	Unlikely	0
CT-13	Planning, Engineering, & Design	Detailed estimate was completed for this portion of the cost, nothing noted of significant concern.	nothing significant to report.	Negligible	Unlikely	0

CT-14	Construction Management	Detailed estimate was completed for this portion of the cost, nothing noted of significant concern.	nothing significant to report.	Negligible	Unlikely	0
External Project Risks					Maximum Project Growth	0%
EX-1	Utilities	Utility owner demands they complete this work.	This could cause the cost for the utility relocation to increase.	Moderate	Possible	2
EX-2	Site Work - Excavation	Unknown weather delays.	This could cause the contractor to encounter additional cost for clean up from extreme weather run off, mob and demob and the delay of the project.	Moderate	Unlikely	1
EX-3	Site Work - Embankment Fill (Random)	Unknown weather delays.	This could cause the contractor to encounter additional cost for clean up from extreme weather run off, mob and demob and the delay of the project.	Moderate	Unlikely	1
EX-4	Site Work - Soil Cement Armoring (Dam and Channel)	Unknown weather delays.	This could cause the contractor to encounter additional cost for clean up from extreme weather run off, mob and demob and the delay of the project.	Moderate	Unlikely	1
EX-5	Site Work - Gravel Slope Protection	Unknown weather delays.	This could cause the contractor to encounter additional cost for clean up from extreme weather run off, mob and demob and the delay of the project.	Marginal	Unlikely	0
EX-6	Site Work - Simi - Impervious Fill (General and Key Trench)	Unknown weather delays.	This could cause the contractor to encounter additional cost for clean up from extreme weather run off, mob and demob and the delay of the project.	Moderate	Unlikely	1
EX-7	Roller Compacted Concrete	Unknown weather delays. Lack of material supply from supplier.	This could cause the contractor to encounter additional cost for clean up from extreme weather run off, mob and demob and the delay of the project.	Moderate	Unlikely	1
EX-8	Concrete conduit	Unknown weather delays.	This could cause the contractor to encounter additional cost for clean up from extreme weather run off, mob and demob and the delay of the project.	Marginal	Unlikely	0
EX-9	Gatewell Structure	Unknown weather delays.	This could cause the contractor to encounter additional cost for clean up from extreme weather run off, mob and demob and the delay of the project.	Marginal	Unlikely	0
EX-10	Drainage	Unknown weather delays.	This could cause the contractor to encounter additional cost for clean up from extreme weather run off, mob and demob and the delay of the project.	Marginal	Unlikely	0
EX-11	Site Work - Wire Wrapped Riprap	Unknown weather delays.	This could cause the contractor to encounter additional cost for clean up from extreme weather run off, mob and demob and the delay of the project.	Marginal	Unlikely	0
EX-12	Remaining Construction Items	Unknown weather delays.	This could cause the contractor to encounter additional cost for clean up from extreme weather run off, mob and demob and the delay of the project.	Moderate	Unlikely	1
EX-13	Planning, Engineering, & Design	nothing significant to report.	nothing significant to report.	Negligible	Unlikely	0
EX-14	Construction Management	Unknown weather delays.	could impact project completion and turnover dates. Could incur extended field office overhead costs.	Moderate	Possible	2

ATTACHMENT K-A

RISK ANALYSIS

RISK MATRIX EVALUATION

Small Flood Risk Management Project Hatch, New Mexico Alt C

Feasibility (Recommended Plan)

Abbreviated Risk Analysis

Risk Evaluation

WBS	Potential Risk Areas	Project Scope Growth	Acquisition Strategy	Construction Elements	Quantities for Current Scope	Specialty Fabrication or Equipment	Cost Estimate Assumptions	External Project Risks	Cost in Thousands
01 LANDS AND DAMAGES	**Real Estate**								$385
02 03 CEMETERIES, UTILITIES, AND STRUCTURES,	**Utilities**	1	0	1	0	0	2	2	$215
04 01 MAIN DAM	Site Work - Excavation	3	0	2	1	0	3	1	$724
04 01 MAIN DAM	Site Work - Embankment Fill (Random)	3	0	3	1	0	3	1	$377
04 01 MAIN DAM	Site Work - Soil Cement Armoring (Dam and Channel)	2	0	2	3	2	3	1	$1,667
04 01 MAIN DAM	Site Work - Gravel Slope Protection	2	0	1	1	0	3	0	$146
04 01 MAIN DAM	Site Work - Simi - Impervious Fill (General and Key Trench)	2	0	2	1	0	3	1	$493
04 02 SPILLWAY	**Roller Compacted Concrete**	1	0	2	1	2	2	1	$444
04 03 OUTLET WORKS	**Concrete conduit**	0	0	2	1	1	2	0	$359
04 03 OUTLET WORKS	**Gatewell Structure**	0	0	2	1	2	0	0	$210
09 CHANNELS AND CANALS (Except Navigation Ports and	**Drainage**	1	0	1	1	0	3	0	$260
09 CHANNELS AND CANALS (Except Navigation Ports and	**Site Work - Wire Wrapped Riprap**	1	0	1	1	2	3	0	$211
All Other (less than 10% of construction costs)	Remaining Construction Items	0	0	1	0	0	0	1	$1,174
30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	2	0	1	0	0	0	0	$880
31 CONSTRUCTION MANAGEMENT	Construction Management	1	0	0	0	0	0	2	$472
									$7,633
Risk		$ 364	$ -	$ 604	$ 159	$ 151	$ 370	$ 132	**$1,780**
Fixed Dollar Risk Allocation		$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$0**
	Risk	$ 364	$ -	$ 604	$ 159	$ 151	$ 370	$ 132	**$1,780**
								Total	**$9,798**