Salem Area
Drainage Master Plan

Prepared for County of Doña Ana

Grant No. 2798-CIF
June 2016

Prepared by:

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3. Urban Hydrology for Small Watersheds, US Department of Agriculture Soil Conservation Service, Technical Release 55, June 1986.

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4. National Engineering Handbook, Part 630, Chapter 15 – Time of Concentration. Natural Resource Conservation Service. May 2010. (Documentation that Lag Time = 0.6 Time of Concentration).
5. Sediment Bulking Factors were assumed based on select pages – Figure 3.8 within – Sediment and Erosion Design Guide, November 2008. Prepared by Mussetter Engineering Inc. Prepared for the Southern Sandoval County Arroyo Flood Control Authority.
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EXECUTIVE SUMMARY

Description and Purpose of Project

This Drainage Report was prepared by Smith Engineering Company (**Smith**) to develop drainage improvement options, recommendations, and conceptual level engineer's opinions of probable costs (EOPC) for the community of Salem and the adjacent surrounding areas.

Summary of Existing Problem Areas and Proposed Options

A number of problematic areas within Salem were identified through various field observations, meetings with Doña Ana County Flood Commission (DACFC), and discussions with area residents. The majority of issues are a direct result of non-engineered conveyance systems in densely developed areas (on privately owned properties) and a lack of maintenance of said facilities. These areas are identified on **Figures 3, 4 and 5** included in the Map Pocket.

The approximate contributing drainage area for Salem was provided by the DACFC. **Smith** analyzed and delineated a number of sub-basins within the aforementioned area. These basins were lumped into five respective scenarios: sub-basins outfalling into the Velarde Dam, the North Salem Dam, the South Salem Dam, the Reed-Thurmand Dam, and those basins that do not flow to a detention structure (Uncontrolled Basins). Existing condition HEC-HMS hydrologic models were developed for the design storms: 5-year, 10-year, and 100-year return periods of 24-hour duration. The modeling results can be found later within this report.

Smith held meetings with the DACFC and residents of Salem to present a number of possible improvements to lessen the effects of the 5-year and 10-year design storm events. From these meetings, a total of nine (9) different options were developed to help mitigate stormwater runoff within the community of Salem. Options 1 through 7 and 9 directly affect the developed area of Salem; while Option 8 affects the uncontrolled basin just west of Salem. Various Option schematics and resulting hydrologic benefits of each Option can be found within **Section 3** of this report.

Conclusions and Recommendations

Based on input from the DACFC and area residents, the various options were narrowed down to the most efficient, cost effective, and constructible. The selected options are Options 4, 5, 6, and 7. A Composite Option and corresponding HEC-HMS hydrologic model was built to model the affects of the selected improvements. The results and schematic of the Composite Option can be found in **Section 4** of this report.

Smith recommends the Composite Option for consideration of the Doña Ana County Flood Commission based on the existing conditions within the community of Salem; in conjunction with maintenance of existing storm drainage systems.

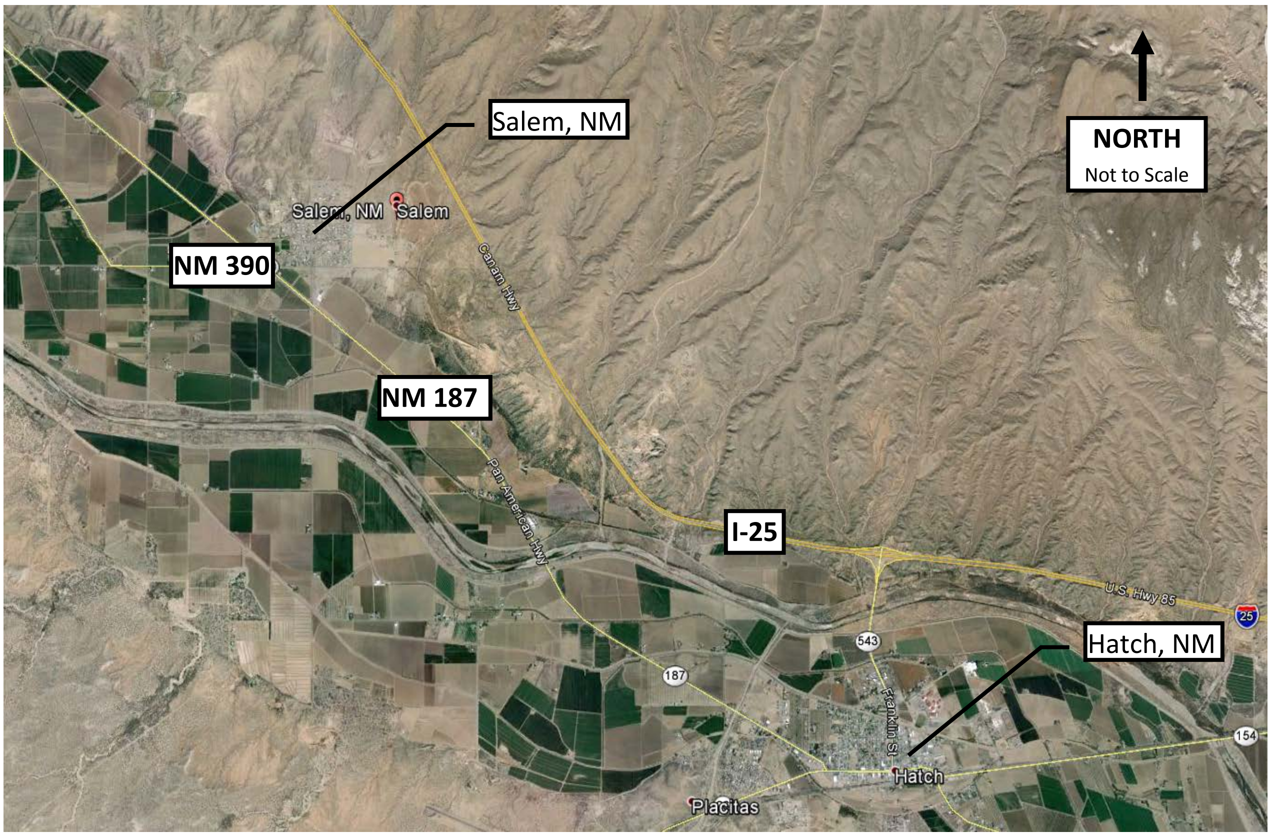
If improvements are not implemented within the next five (5) or so years, or if significant change(s) occur within Salem or adjacent areas, the modeling, subsequent results, and proposed improvements should be re-visited and evaluated in detail.

SECTION 1. GENERAL PROJECT INFORMATION

1.1 Description and Purpose of Project

The Doña Ana County Flood Commission (DACFC) authorized **Smith** to prepare this Drainage Master Plan. The purpose is to develop drainage improvement options, recommendations, and conceptual level engineer's opinions of probable costs (EOPC) for the community of Salem and the adjacent surrounding areas. **Figure 1** presents the Salem Vicinity Map.

Figure 1: Salem Project Vicinity Map



1.2 Field Observation

Smith conducted three field observations in August, September, and November 2015. **Appendix 1** contains annotated photographs of the various locations in the Salem community and some existing drainage infrastructure.

SECTION 2. EXISTING HYDROLOGIC AND HYDRAULIC ANALYSES

2.1 Existing Flood Control Structures

The Salem Basin contains four small dams or "floodwater retarding structures" designed and built by the USDA Soil Conservation Service in cooperation with the Caballo Soil Conservation District. The Construction Plans for each dam are included in **Appendix 2.** The dam names and basic data are presented in the following table.

Name – Year Built	Drainage Area	Pond Depth to Top of Dam (Nov. 2015 *)	Maximum Storage Volume to Top of Dam (Nov. 2015 *)	Principal Spillway Pipe Diameter	Emergency Spillway Length*
	(MI²)	feet	acre-feet	inches	feet
Velarde Arroyo Floodwater Retarding Structure 1957	2.95	30	471	18	200
North Salem Arroyo Floodwater Retarding Structure 1956	3.78	20	280	18	200
South Salem Arroyo Floodwater Retarding Structure 1959	0.91	14	95	18	120
Reed-Thurmand Arroyo Floodwater Retarding Structure 1958	3.69	14	362	24	200

*Computed by **Smith** based on DAC Lidar 2 foot contours

The other significant structure is a reinforced concrete grade control or "drop structure" located immediately east of Grande Avenue and 200 feet south of Salem Street. **Appendix 1** contains annotated photographs of this structure.

2.2 Drainage Basin Description and Basin Delineation

A. Drainage Basin Description

Most of the basin is undeveloped range land with mild to steep topography. The community of Salem is the developed urban area, and the remaining land use is agricultural land in the valley areas below the four dams and below the steep hills as can be seen on **Figures 3, 4 and 5** (map pocket).

Interstate 25 (I-25) passes through the basin and has many culverts that provide stormwater conveyance under I-25. NM 187 is the other main highway that is located at the southern end of the drainage basin, and it has a few culvert locations that convey stormwater south of the highway.

B. FEMA Floodplains

FEMA has developed Flood Insurance Rate Maps (FIRMs) for the Salem area and these are dated September 27, 1991 (a copy of these are included in **Appendix 2)**. Note that only Approximate A Floodzones have been delineated and the maps are at a very small scale.

C. Drainage Basin Delineation

Figures 3, 4 and 5 (map pocket) presents the drainage basin and sub-basin delineations. The orthophotography date is 2010 and date of the Lidar two foot contours development is 2010.

The sub-basin numbering scheme was assigned as listed here:

Sub-basins numbered 1 through 29
These are uncontrolled meaning they do not outfall into any of the four dams.

Sub-basins numbered in the 100 series
Outfall into the Velarde Dam

Sub-basins numbered in the 200 series
Outfall into the North Salem Dam

Sub-basins numbered in the 300 series
Outfall into the South Salem Dam

Sub-basins numbered in the 400 series
Outfall into the Reed-Thurmand Dam

Analysis points were determined based on the following:

1. Outfall locations based on topography
2. Culvert and drainage channel locations
3. Existing features (dams, principal and emergency spillway outfall locations)
4. East side of the most dense Salem development
5. Drainage paths (soil or streets) within Salem
6. Street locations

The total area of all sub-basins is 14.5 square miles.

2.3 Drainage Analysis Criteria and Program

A. Design Storm

The DACFC requested that the design storms shall be the 5-year and 10-year 24-hour storms. The proposed options will not include design for the 100-year 24-hour storm, although the results will be included.

B. Hydrologic Computer Program

The US Army Corps of Engineers "HEC-HMS - Hydrologic Modeling System" program or commonly called "HEC-HMS" (Version 4.0) was selected for simulation of basin storm rainfall – runoff for existing basin and also for the proposed options.

C. Existing Dams

The DACFC stated that none of the four dams were designed as flood control dams with respect to present dam design standards. Therefore, none of these dams will meet criteria and regulations as specified by the NM State Engineers Dam Safety Bureau (NMOSE DSB).

In the existing and proposed options HEC-HMS models, all four dams will be assumed to remain in place the 100-year, 10-year and 5-year, 24-hour durations storms.

2.4 Rainfall Data

A. Rainfall Distribution

The study basin is located within the USDA Natural Resources Conservation Service (NRCS) (previously the Soil Conservation Service (SCS)) Type II rainfall distribution area as defined by the NRCS. Please refer to **Appendix 4** for Figure B-2 that illustrates the Type II boundaries.

However, the DACFC dictated that the 25% Frequency Storm Distribution be adopted. That distribution is available in the HEC-HMS program and it places most of the rainfall in a short period at 25% of the storm duration, or at 6 hours for a 24-hour storm. **Appendix 3** contains **Figures R1**-Cumulative and **Figure R2**-Incremental rainfall distribution.

B. Areal Reduction Factors

Areal reduction factors were considered from Figure 14 – NOAA Atlas 2, Vol. IV, **Appendix 4** contains a copy. NOAA 14 has not yet developed areal reduction factors. The total basin area = 14.5 square miles, however the sub-basin drainage areas to the four dams and outfall locations are small and range from about 1 square mile to about 3.7 square miles. Therefore a rainfall areal reduction factor is not applicable and was not applied.

C. Point Rainfall Data

Point rainfall data for the 5-year, 10-year, and 100-year return period storms for various durations were obtained from NOAA Atlas 14 website for the lower basin (west of I-25) and also for the upper basin (east of I-25).

Appendix 4 contains the printouts from the NOAA Atlas 14 point rainfall data results. The point rainfall depths are basically identical between the lower and upper basins, therefore the upper basin point depths were assumed applicable to the entire basin model. **Table 1** (**Appendix 3**) contains the point rainfall depth data.

2.5 Soils Data and Runoff Curve Numbers (CNs)

Soils data used to determine Runoff Curve Numbers (CNs) were obtained from the Natural Resources Conservation Service (NRCS) internet site Web Soil Surveys as follows:

http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

Appendix 4 contains the Web Soil Survey information. The Figures in **Appendix 4** illustrate the soil map unit locations and tables that summarize the hydrologic soil groups and cover types for the various soil map units.

Table 3 (**Appendix 3**) contains a summary of the CNs for each sub-basin and the areal weighted CN data and results for all sub-basins. The data and assumptions applied to develop **Table 3** are based on the following:

A. Antecedent Runoff Condition II (ARC II) is defined as the soil average runoff condition (moisture condition) by the NRCS. Antecedent Runoff Condition III (ARC III) is defined as the wetter soil condition. For all sub-basins denoted as “Arid and Semiarid Rangelands” with “Desert Shrub Cover Type” a composite (average) CN value between ARC II CN and ARC III CN was adopted.

B. Hydrologic Soil Group (A, B, C, or D) – Determined by the NRCS per soil map unit (**Appendix 4** contains the Web Soil Survey Data).

C. Land Use Type is either – arid rangeland (most sub-basins), urban (within the community of Salem) or cultivated agricultural land. The orthophotography as presented on the Drainage Basin Maps (map pocket) was used to make the land use type determinations. The CN tables are obtained from “Urban Hydrology for Small Watersheds, US Dept of Agricultural Soil Conservation Service, Technical Release 55 (TR-55), June 1986. *

D. The TR-55 CN tables are listed here:

Table 2-2a Runoff Curve Numbers for Urban Areas. *
Table 2-2b Runoff Curve Numbers for Cultivated Agricultural Land. *
Table 2-2c Runoff Curve Numbers for Other Agricultural Lands. *
Table 2-2d Runoff Curve Numbers for Arid and Semiarid Rangelands. *

*Copies included at the end of **Table 3** (**Appendix 3**).

E. Cover Type, Hydrologic Condition and Percent Imperviousness

Arid Rangeland - assumed Cover Type and Hydrologic Condition – Desert Shrub, etc., poor hydrologic condition (Table 2-2d applies)

Urban - assumed Cover Type and Average Impervious Area – 1/8 acre., 65% impervious (Table 2-2a applies)

Cultivated Agricultural Land - assumed Cover Type and Hydrologic Condition – Row Crops – Straight Row. 65%, poor hydrologic condition (Table 2-2b applies)

F. CN selections were based on the previous data, assumptions and NRCS soils data / and Tables.

G. Areal weighted CNs were computed by areal weighting the CN per soil map unit by the acreage of that map unit relative to the total sub-basin acreage.

2.6 Split hydrographs for Sub-basins

A. Purpose

When sub-basins are mostly homogeneous in terms of land use type and runoff curve numbers are similar, an areal weighted CN approach may be acceptable. When non-homogeneous land use types occur and a greater range of CNs occur between those land used types, the sub-basin runoff is more accurately simulated with spilt hydrographs as described in Subsection 2.6.B.

Sub-basins sb.14, sb.19 and sb.20 are located below the North and South Salem Dams and have both undeveloped and developed area (refer to **Figures 5 and 6** – map pocket). For these three sub-basins, the most appropriate way to simulate the runoff is simulate the pervious sub-basin area with one hydrograph and the impervious sub-basin area with another hydrograph. The total basin hydrograph is the combination of both hydrographs (“split hydrographs”).

Hydrograph 1 of 2 hydrographs will simulate the pervious or undeveloped sub-basin area and will have a sub-basin name such as sb.14P ("P" for pervious). Hydrograph 2 of 2 hydrographs will simulate the impervious or developed sub-basin area and will have a sub-basin name such as sb.14I ("I" for impervious). The pervious area CN values are computed in **Table 3 (Appendix 3)**. The impervious area CN values are computed in **Table 3.1 (Appendix 3)** as described here.

B. Impervious Area Assumptions and Computations for Sub-basins sb14, sb.19, & sb.20

1. Measure the developed and graded approximate limits, and compute that total area in square feet, acres and square miles.

2. Measure a typical roof in the developed area, and count the number of roofs in the developed area, multiply number of roofs by typical area, to compute the total impervious roof area in square feet and acres.

3. From TR-55 Table 2-2a (end of Table 3), the CN for a roof for any Hydrologic Soil Group CN = 98.

4. Assume the remainder of the developed area is compacted gravel and dirt roads. The gravel - road area equals the total developed area minus the roof area. From TR-55 Table 2-2a, assume "Gravel (including right-of-way)" and Hydrologic Soil Group B, therefore the CN = 85.

5. Compute an areal weighted CN value for the developed area based on the roof area and CN = 98, and the remaining gravel area CN = 85.

2.7 Travel Time (Tt), Time of Concentration (Tc) and Unit Hydrograph Lag Time (TL) Computations and Unit Hydrograph

A water course may have up to three sub-reaches that comprise the longest flow path. The upper overland flow reach, then a shallow concentrated flow reach followed by a channel reach. The NRCS TR-55 Tt and Tc method was applied to each water course. The time of concentration (Tc) for the watercourse equals the summation of travel times (Tt) from each sub-reach. **Appendix 4** contains the TR-55 description and procedures.

The NRCS Unit Hydrograph Lag Time Method (TL) was applied to the Tc to compute the unit hydrograph Time to Peak (Tp). Note that Lag Time = 0.6 Tc. **Appendix 4** contains the reference pages from Part 630 Hydrology, National Engineering Handbook, May 2015, Chapter 15 that describes the lag time concept and method.

Manning's Roughness Coefficients "n" assumptions were obtained from TR-55, by experience and by review of "n" value tables by Chow, 1959 (copies include in **Appendix 4**).

Channel slopes were computed from elevations and length measurements from the drainage basin maps using the DACFC supplied imagery and LIDAR data (map pocket). Typical channel widths were also measured from the drainage basin maps.

Tables 4.1 through **4.5** (**Appendix 3**) summarizes the travel time, time of concentration and lag time data and results. **Table 2** (**Appendix 3**) also presents the lag time results.

2.8 Channel Routing

The Muskingum-Cunge channel routing method was applied to route hydrographs. **Figures 3, 4, and 5** (map pocket) illustrates the routing reaches. Manning's "n" values were assumed based on experience and the Manning's "n" values from Chow, 1959 and locations of routing reaches as observed on the drainage basin maps. Bottom width assumptions were determined as the typical channel width from the drainage basin maps. **Table 5 (Appendix 3)** presents the Muskingum-Cunge channel routing input data summary.

Note that runoff losses to channel bed infiltration and percolation were assumed to be small and were therefore not simulated.

2.9 Sediment Bulking

The HEC-HMS models simulate clear water hydrographs unless a "Flow Ratio" is applied to simulate sediment volume within hydrographs that is also called sediment bulking. Note that a sediment bulking value of about 17% is considered the limit before mud flow would occur.
Due to lack of site specific data, a sediment bulking factor of 10% or a factor of 1.10 was assumed for all sub-basin hydrographs. That assumption is based on review of information presented in Sediment and Erosion Design Guide, Nov. 2008, Mussetter Engineering Inc. **Appendix 4** contains a copy of relevant pages from that document.

2.10 Computation Time Increment for HEC-HMS Models

The computation increment assumed within a HEC-HMS model may make a large difference in model peak discharge results particularly for large drainage basins. Guidance on computation intervals was found in a Digital Engineering Library (McGraw-Hill, a copy included in **Appendix 4**) and summarized here.

Compute / select the computation time increment based on Time of Concentration (Tc) and the following equation:

Tc / 5 ≤ computation time increment ≤ Tc / 3

Table 6 (**Appendix 3**) contains a summary of all sub-basin Tcs and the average Tc. The results of the rule above produce a computation interval of 10 minutes. <u>However, at the direction of Doña Ana County, a 1 minute computation interval was selected for all sub-basins.</u>

2.11 Reservoir Routing Data

Elevation – Area – Storage – Discharge data, assumptions and computations for each dam are summarized in **Tables within Appendix 3** as follows:

Table 7 V Dam:	Velarde Dam Elevation-Storage-Discharge Data
Table 8 NS Dam:	North Salem Dam Elevation- Storage-Discharge Data
Table 9 SS Dam:	South Salem Dam Elevation- Storage-Discharge Data
Table 10 RT Dam:	Reed-Thurmand Dam Elevation- Storage-Discharge Data

Elevation – area data were computed by **Smith** based on the DAC Lidar 2 foot contour data. The principal spillway diameters were obtained from the Construction Plans (**Appendix 2**) and the emergency spillway widths were measured on the drainage basin maps using the DACFC supplied aerial imagery and LIDAR data (map pocket).

2.12 Inflow-Diversion Functions

Inflow-Diversion Functions were applied to each of the dam outflow hydrographs or "reservoir routed hydrographs". The purpose of simulating the routed hydrographs with this method is that this "function" allows separation of the outflow hydrograph into two hydrographs as described here. The first hydrograph or "diversion" hydrograph represents the principal spillway flow and the second hydrograph or "main" hydrograph represents the emergency spillway flow (if any).

The inflow-diversion rating curves that apply to the reservoir outflow hydrograph for each dam are summarized in Tables within **Appendix 3** as follows:

Table 7.1 V Dam:	Velarde Dam Inflow-Diversion Data
Table 8.1 NS Dam:	North Salem Dam Inflow-Diversion Data
Table 9.1 SS Dam:	South Salem Dam Inflow-Diversion Data
Table 10.1 RT Dam:	Reed-Thurmand Dam Inflow Diversion Data

2.13 HEC-HMS Hydrologic Models

Figures EX1 through EX10 (included in **Appendix 5**) presents the HEC-HMS model schematics along with a generic legend.

The following output summary tables are included in **Appendix 5**.

Table 18	5-year 24-hour Storm Existing Conditions Hydrologic Summary
Table 19	10-year 24-hour Storm Existing Conditions Hydrologic Summary
Table 20	100-year 24-hour Storm Existing Conditions Hydrologic Summary
Table 21	Reservoir Routing Summary

Table 21 is also presented on the following page. The table results indicate that the 5-year 24-hour duration storms remain below the emergency spillways for all four dams.

The 10-year 24-hour storms are contained below the emergency spillways in the Velarde, South Salem, and Reed-Thurmand Dams, however, that storm will spill through the emergency spillway in the North Salem Dam.

The 100-year 24-hour storm will spill through the emergency spillways in all four of the dams.

Appendix 5 also contains the HEC-HMS "reservoir routing" output and the "inflow-diversion" function output for each dam.

TABLE 21

Existing Reservoirs - Detention Pond Routing Summary

Salem Area Drainage Master Plan

Reservoir - Detention Pond Name	Principal Spillway Pipe Diameter	**Return Period / year**	Peak Inflow	Peak Outflow	Inflow Runoff Volume	Outflow Runoff Volume	Maximum Design Storage Volume (top of embankment)	Peak Storage Volume	100Yr- 24 Hr Peak Storage Volume	Peak Water Surface Elevation	Emergency Spillway Elevation	Pond Invert Elevation	Max Pond Depth	Peak Water Depth	Top of Pond Embankment Elevation	**Freeboard to Emergency Spillway Elevation**	**Freeboard to top of Pond Embankment**
	inches		cfs	cfs	ac-ft	ac-ft	ac-ft	ac-ft	ac-ft	ft	ft	ft	ft	ft	ft	**ft**	**ft**
a	b		c	c	c	c	c d	c	c	c	b d	d	d		d	**f**	**e**
Velarde Dam	18	**100 / 24**	3,263	268	318.2	318.2	471.0	238.9	238.9	4145.00	4144.50	4122.00	30	23.0	4152.00	**-0.5**	**7.0**
Velarde Dam	18	**10 / 24**	1,587	36	168.3	168.3	471.0	129.8	238.9	4139.80	4144.50	4122.00	30	17.8	4152.00	**4.7**	**12.2**
Velarde Dam	18	**5 / 24**	1,073	32	120.5	120.5	471.0	87.7	238.9	4137.00	4144.50	4122.00	30	15.0	4152.00	**7.5**	**15.0**
North Salem Dam	18	**100 / 24**	4,722	2,038	447.1	447.1	279.8	241.7	241.7	4180.70	4178.50	4162.00	20	18.7	4182.00	**-2.2**	**1.3**
North Salem Dam	18	**10 / 24**	2,422	93	246.2	246.2	279.8	188.1	241.7	4178.70	4178.50	4162.00	20	16.7	4182.00	**-0.2**	**3.3**
North Salem Dam	18	**5 / 24**	1,699	32	180.6	180.6	279.8	141.2	241.7	4176.60	4178.50	4162.00	20	14.6	4182.00	**1.9**	**5.4**
South Salem Dam	18	**100 / 24**	1,239	87	86.4	86.4	94.9	62.5	62.5	4171.30	4171.00	4160.00	14	11.3	4174.00	**-0.3**	**2.7**
South Salem Dam	18	**10 / 24**	557	23	43.0	43.0	94.9	28.4	62.5	4167.50	4171.00	4160.00	14	7.5	4174.00	**3.5**	**6.5**
South Salem Dam	18	**5 / 24**	355	21	29.6	29.6	94.9	17.6	62.5	4165.80	4171.00	4160.00	14	5.8	4174.00	**5.2**	**8.2**
Reed-Thurmand Dam	24	**100 / 24**	4,729	1,196	368.8	368.8	361.8	224.7	224.7	4103.00	4101.50	4092.00	14	11.0	4106.00	**-1.5**	**3.0**
Reed-Thurmand Dam	24	**10 / 24**	2,264	44	191.0	191.0	361.8	145.4	224.7	4100.80	4101.50	4092.00	14	8.8	4106.00	**0.7**	**5.2**
Reed-Thurmand Dam	24	**5 / 24**	1,527	39	135.2	135.2	361.8	97.2	224.7	4099.10	4101.50	4092.00	14	7.1	4106.00	**2.4**	**6.9**

a - Appendix 2 contains the As-built plans see Drainage Basin Maps (located in map pocket) for locations

b - From plans located in Appendix 2

c - From HEC-HMS model output included in Appendix 5

d - See Elevation-Storage-Discharge data tables included in Appendix 3. Elevation - Area data were developed from the DAC Lidar 2-foot contours, storage volume computed from that data.

e- Negative number indicates the flow depth exceeds referenced elevation - no freeboard available therefore cell highlights

f- Negative number indicates the flow depth exceeds referenced elevation - no freeboard available therefore cell highlights (Spills through emergency spillway or top of dam by this depth)

2.14 Existing Drainage Infrastructure Hydraulic Capacities

A. Existing Drainage Infrastructure

The existing drainage infrastructure (excluding the four dams) in the vicinity of Salem are limited. These structures are labeled on **Figures 3, 4 and 5** and include the following facilities:

1. Small soil channel located on the north side of Salem that drains east to west from near the northeast corner of Salem. This soil channel will be called Channel ECH1 and it has several culvert / road crossings. Channel ECH1 then drains south basically through the soil yards of residents and outfalls just south of Salem St. This soil channel will be called Channel ECH2. Channel ECH2 outfalls to a larger soil channel located just east of Grande Avenue that will be called Channel ECH3.

2. Channel ECH3 contains a grade control or “drop structure” located in the soil channel located just east of Grande Avenue and about 200 feet south of Salem Street.

3. Channel ECH3 outfalls to a channel that drains south, parallel to Grande Avenue and that channel will be called Channel ECH4.

4. Channel ECH4 diminishes at the northeast corner of NM 187 and Grande Avenue at the entrance to the Franzoy Produce Warehouse. Beyond this driveway, heading southeast, Channel ECH5 begins and daylights across NM 187 at culvert EC1.

5. Channel ECH6 is located northeast of the intersection of NM 187 and Saratoga Street. It conveys the outflow (both principal and emergency spillways) from the Velarde Dam across the agricultural fields leaving the Salem area through existing culvert EC4.

6. Four drainage culvert crossings are located along NM 187 and these are labeled as culverts EC1, EC2, EC3, and EC4. Please refer to **Figures 4 and 5** (map pocket for their locations).

7. The existing dirt road (ER1-Ford Street) on the east side of the community of Salem acts as a conveyance system. It runs from the start of ECH1 south to its intersection with Salem Street.

B. Open Channel Hydraulic Capacities

Rough hydraulic capacities of Channels ECH1, ECH2, ECH3, ECH4, ECH5, ECH6, and ER1 were computed with the FlowMaster Program (output included in **Appendix 7**).

Smith engineers estimated the typical channel size based on photographs and field observation. The hydraulic summary of those channels as compared to the 5-year, 10-year and 100-year storm peak discharges are presented in **Table 60 in Appendix 7.**

C. Culvert Hydraulic Capacities

Rough culvert capacities were computed with the Bentley CulvertMaster program (output is included in **Appendix 7**). During the basin field observation, **Smith** engineers measured the following culvert related dimensions:

1. number of culverts,
2. material and culvert diameter or dimensions
3. open culvert area to soffit
4. maximum available headwater depth to edge of road

The culvert hydraulic summary as compared to the 5-year, 10-year and 100-year storm peak discharges are presented in **Table 61 in Appendix 7.**

SECTION 3. OPTIONS HYDROLOGIC & HYDRAULIC ANALYSES

3.1 Proposed Options Hydrologic Data

Many of the assumptions (hydrologic) made in the existing model were replicated in the HEC-HMS Proposed Option Models. Brief synopses of the assumptions carried over are presented below:

A. Model computation time increment – 1 minute
B. No additional Sub-Basins were created in the proposed options models
C. Soils data and runoff curve numbers values for each Sub-Basin remain unchanged
D. The storm events models in the existing conditions model are the same events used to create the proposed options models

Additional reservoirs and conveyance channels are proposed in a number of the Options models. The reservoir routing summary results are included in **Table 46 (Appendix 6).** The channel routing summary and capacity results for the proposed improvements are included in **Table 62 (Appendix 7)**.

3.2 Conceptual Design Options

The following design options were considered for conceptual level design:

A. Open Channels
B. Roadway Improvements
C. Detention Ponds: Multiple Use/Storm Water Quality Improvements

Conceptual level Engineer's Opinion of Probable Costs (EOPC) were prepared for each viable option selected by the DACFC. The total cost includes for contingency, engineering, and 2016 New Mexico Gross Receipts Tax (NMGRT). Construction Phase Services have not been included. The conceptual level EOPC estimates are presented later in this plan.

3.3 Most Significant Drainage Problem Areas

The developed areas of Salem are the most adversely affected by storm events. This is due to the lack of engineered facilities within the development to handle stormwater runoff. There are a number of conveyance facilities not designed to handle any certain storm event, but only to help alleviate the affects to adjacent properties. The primary focus of the Proposed Options will be to intercept stormwater runoff upstream of the developed areas and utilize controlled release through Salem without adverse affects to the residents.

3.4 Analyses and Options Summary

Proposed Options 1 through 7 and Option 9 directly affect the community of Salem; while proposed Option 8 affects the uncontrolled basin just west of Salem. Each proposed option was simulated as a standalone hydrologic model; except as denoted later some of the proposed improvements are combined in various options.

A. OPTION 1 (Refer to Figure OPT 1)

1. Option 1 Purpose

   Through examination of existing topography (DACFC LIDAR) and the results of the HEC-HMS hydrologic analysis reveal that substantial stormwater runoff enters the Salem area from Sub-Basin 14 (sb.14) during any rainfall event. The purpose of Option 1 is to detain the runoff generated within sb.14 and utilize controlled release of stormwater into Salem.

2. Option 1 Description

   Simulate a single detention pond complete with both a principal outlet and an emergency spillway. Sub-Basin 14 (sb.14) Pond (on vacant privately owned land at the south end of the basin).

   a. Assume all of sb.14 outfalls into the pond. This is not completely accurate, but for the modeling purposes will provide a slight excess in storage capacity.
   b. The sb.14 pond will be a detention pond sized to detain the 10-year/24-hour storm event (maximum design storage volume is 2.1 ac-ft).
   c. Pond principal outlet (12" CMP) will release a controlled volume of detained water to continue downstream along its natural course.
   d. Pond emergency spillway is sized to allow the 100-year/24-hour stormwater runoff to continue its natural course unimpeded. Should the pond ever become silted in, the spillway would still be capable of passing the 100-year design storm.
   e. Assume the North and Salem Dams are in place.

3. Conceptual Pond Grading Plan(s) are as follows:

   Figure OPT 1 – See following page

4. Option 1 Result:

   sb.14 Detention Pond
   a. will detain all 5-year peak inflow volume of 0.7 ac-ft.
   b. will detain all 10-year peak inflow volume of 1.0 ac-ft.
   c. will detain all 100-year peak inflow volume of 2.1 ac-ft.
   d. See **Figure OPT 1** (next page) for reservoir routing data and freeboard summary.

5. Option 1 Conclusion:
   The pond is very effective for the 5-, 10-, and 100-year storm events.

TABLE 4 - OPTION 1

Proposed Reservoirs - Detention Pond Routing Summary

Salem Area Drainage Master Plan

Reservoir - Detention Pond Name	Principal Spillway Pipe Diameter	**Return Period / year**	Peak Inflow	Peak Outflow	Inflow Runoff Volume	Outflow Runoff Volume	Maximum Design Storage Volume (top of embankment)	Peak Storage Volume	100Yr- 24 Hr Peak Storage Volume	Peak Water Surface Elevation	Emergency Spillway Elevation	Pond Invert Elevation	Max Pond Depth	Peak Water Depth	Top of Pond Embankment Elevation	**Freeboard to Emergency Spillway Elevation**	**Freeboard to top of Pond Embankment**
	inches		cfs	cfs	ac-ft	ac-ft	ac-ft	ac-ft	ac-ft	ft	ft	ft	ft	ft	ft	**ft**	**ft**
a	b		c	c	c	c	c d	c	c	c	b d	d	d		d	**f**	**e**
OPT1.Pond	12	**100 / 24**	36	5	2.1	2.1	2.1	1.2	1.2	4118.80	4119.00	4117.00	3	1.8	4120.00	**0.2**	**1.2**
OPT1.Pond	12	**10 / 24**	17	3	1.0	1.0	2.1	0.5	1.2	4117.70	4119.00	4117.00	3	0.7	4120.00	**1.3**	**2.3**
OPT1.Pond	12	**5 / 24**	11	2	0.7	0.7	2.1	0.3	1.2	4117.50	4119.00	4117.00	3	0.5	4120.00	**1.5**	**2.5**

a - Proposed Option 1 Pond

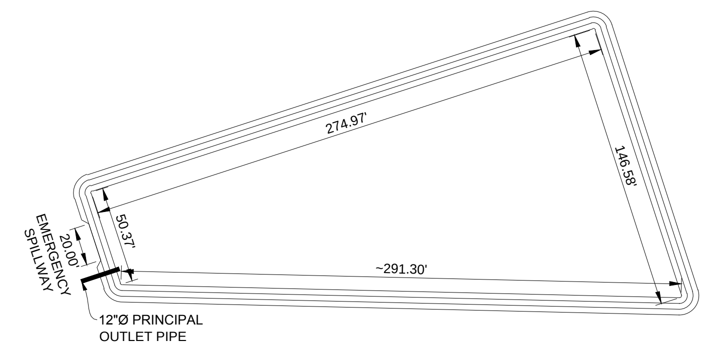
b - Conceptual Design Pipe Outlet

c - From HEC-HMS model output included in Appendix 6

d - See Elevation-Storage-Discharge data tables included in Appendix 3. Elevation - Area data developed from conceptual pond layout, storage volume computed from that data.

e- Negative number indicates the flow depth exceeds referenced elevation - no freeboard available therefore cell highlights

f- Negative number indicates the flow depth exceeds referenced elevation - no freeboard available therefore cell highlights (Spills through emergency spillway or top of dam by this depth)



PROPOSED OPTION 1 POND

0 100' 200'

UNCONTROLLED BASIN (BASINS sb.1 THRU sb.29)
VELARDE DAM BASIN (BASINS sb.100 THRU sb.107)
NORTH SALEM DAM BASIN (BASINS sb.200 THRU sb.205)
SOUTH SALEM DAM BASIN (BASINS sb.300 THRU sb.301)
REED-THURMAND DAM BASIN (BASINS sb.400 THRU sb.409)

LEGEND

- MAJOR BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- sb.## XX AC. XX MI² — SUB-BASIN NUMBER / SUB-BASIN AREA (AC./MI²)
- PRINCIPAL PIPE OUTLET FROM DAM
- EXISTING PROPERTY LINE
- PROPOSED IMPROVEMENTS

NOTE: DIGITAL ORTHOPHOTOGRAPHY AND LIDAR COMPLETED IN 2010 BY DOÑA ANA COUNTY. THE CONTOUR INTERVAL FOR OPT 1 IS 2-FOOT.

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SALEM
DONA ANA COUNTY, NEW MEXICO

DONA ANA COUNTY
SALEM DRAINAGE MASTER PLAN

OPTION 1 - DETENTION POND

SOLUTIONS FOR TODAY... VISION FOR TOMORROW
201 N. Church Street, Suite 310
Las Cruces, NM 88001
Phone: (575) 523-2395
Fax: (575) 523-2396
SMITH ENGINEERING COMPANY
TEXAS NEW MEXICO

JOB NO: 815104
DATE: MARCH 2016
SHEET NO: OPT 1

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B. OPTION 2 (Refer to Figure OPT 2)

1. Option 2 Purpose

   Through examination of existing topography (DACFC LIDAR) and the results of the HEC-HMS hydrologic analysis reveal that substantial stormwater runoff enters the Salem Area from Sub-Basin 19 (sb.19) during any rainfall event. The purpose of Option 2 is to detain the runoff generated within sb.19 as well as the stormwater released from the North Salem Dam, via the principal outlet, prior to its continuing downstream into Salem.

2. Option 2 Description

   Simulate a single detention pond complete with both a principal outlet and an emergency spillway.

   Sub-Basin 19 (sb.19) Pond (on vacant privately owned land at the south end of the basin).

   a. Assume all of sb.19 outfalls into the pond. This is not completely accurate, but for the modeling purposes will provide a slight excess in storage capacity.
   b. The sb.19 pond will be a detention pond sized to detain the 10-year/24-hour storm event (maximum design storage volume is 3.5 ac-ft).
   c. Pond principal outlet (12" CMP) will release a controlled volume of detained water to continue downstream along its natural course.
   d. Pond emergency spillway is sized to allow the 100-year/24-hour stormwater runoff to continue its natural course unimpeded.
   e. Assume the North Salem Dam is in place.

3. Conceptual Pond Grading Plan(s) are as follows:

   Figure OPT 2 – See following page

4. Option 2 Result:

   sb.19 Detention Pond

   a. will detain a minimal amount of the 5-year peak inflow volume of 181.5 ac-ft.
   b. will detain a minimal amount of the 10-year peak inflow volume of 229.9 ac-ft.
   c. will detain a minimal amount of the 100-year peak inflow volume of 239.4 ac-ft.
   d. See **Figure OPT 2** (next page) for reservoir routing data and freeboard summary.

5. Option 2 Conclusion:

   The pond is not effective for any of the design storms. The release (through the principal spillway) from the North Salem Dam inundates the proposed detention pond in Option 2.

TABLE 4 - OPTION 2

Proposed Reservoirs - Detention Pond Routing Summary

Salem Area Drainage Master Plan

Reservoir - Detention Pond Name	Principal Spillway Pipe Diameter	**Return Period / year**	Peak Inflow	Peak Outflow	Inflow Runoff Volume	Outflow Runoff Volume	Maximum Design Storage Volume (top of embankment)	Peak Storage Volume	100Yr- 24 Hr Peak Storage Volume	Peak Water Surface Elevation	Emergency Spillway Elevation	Pond Invert Elevation	Max Pond Depth	Peak Water Depth	Top of Pond Embankment Elevation	**Freeboard to Emergency Spillway Elevation**	**Freeboard to top of Pond Embankment**
	inches		cfs	cfs	ac-ft	ac-ft	ac-ft	ac-ft	ac-ft	ft	ft	ft	ft	ft	ft	**ft**	**ft**
a	b		c	c	c	c	c d	c	c	c	b d	d	d		d	**f**	**e**
OPT2.Pond	12	**100 / 24**	50	42	239.4	239.3	3.5	3.2	3.2	4120.70	4120.00	4117.00	4	3.7	4121.00	**-0.7**	**0.3**
OPT2.Pond	12	**10 / 24**	35	35	229.9	229.9	3.5	3.1	3.2	4120.60	4120.00	4117.00	4	3.6	4121.00	**-0.6**	**0.4**
OPT2.Pond	12	**5 / 24**	32	32	181.5	181.5	3.5	3.0	3.2	4120.60	4120.00	4117.00	4	3.6	4121.00	**-0.6**	**0.4**

a - Proposed Option 2 Pond

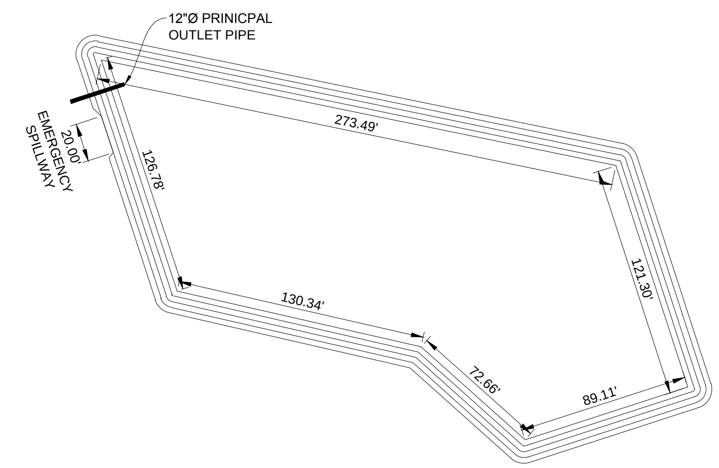
b - Conceptual Design Pipe Outlet

c - From HEC-HMS model output included in Appendix 6

d - See Elevation-Storage-Discharge data tables included in Appendix 3. Elevation - Area data developed from conceptual pond layout, storage volume computed from that data.

e- Negative number indicates the flow depth exceeds referenced elevation - no freeboard available therefore cell highlights

f- Negative number indicates the flow depth exceeds referenced elevation - no freeboard available therefore cell highlights (Spills through emergency spillway or top of dam by this depth)



PROPOSED OPTION 2 POND

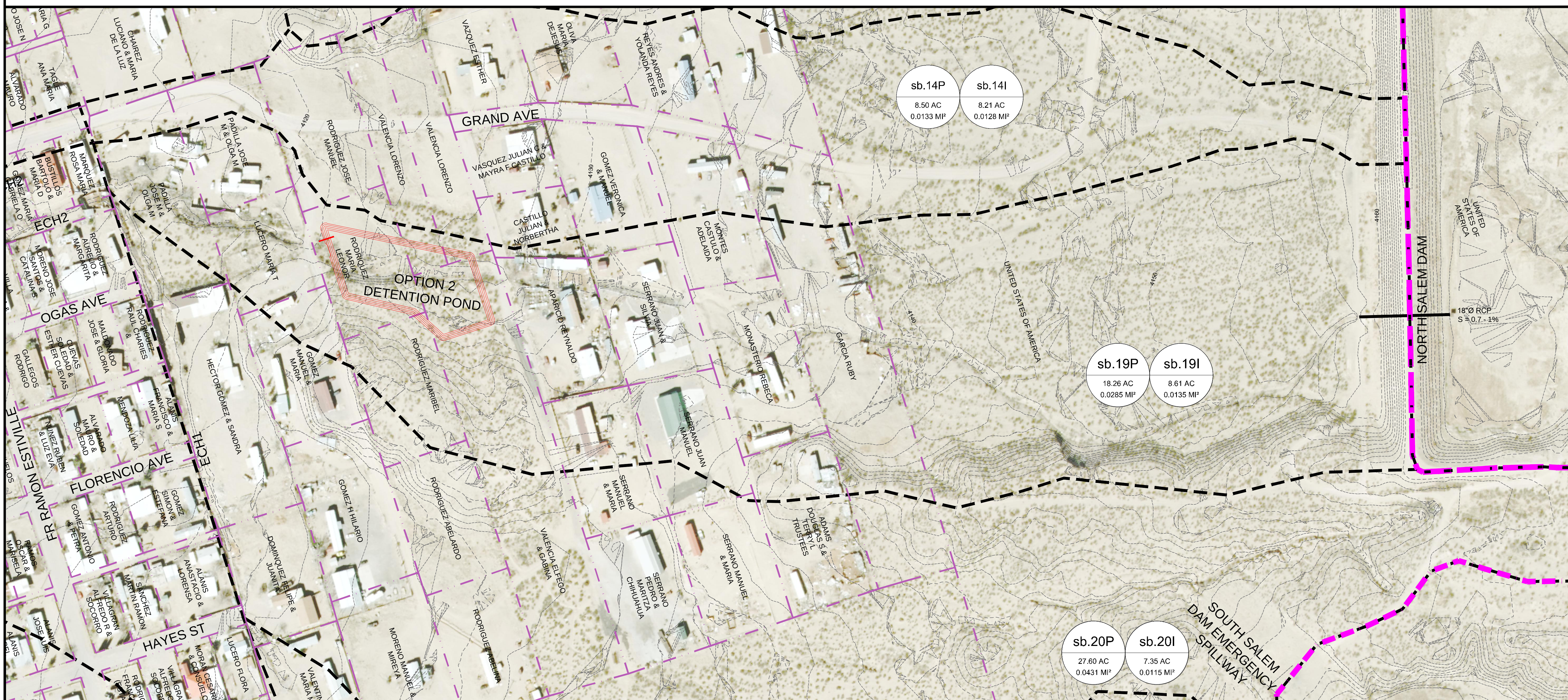
0 100' 200'

UNCONTROLLED BASIN (BASINS sb.1 THRU sb.29)
VELARDE DAM BASIN (BASINS sb.100 THRU sb.107)
NORTH SALEM DAM BASIN (BASINS sb.200 THRU sb.205)
SOUTH SALEM DAM BASIN (BASINS sb.300 THRU sb.301)
REED-THURMAND DAM BASIN (BASINS sb.400 THRU sb.409)

LEGEND

- MAJOR BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- sb.## XX AC. XX MI² — SUB-BASIN NUMBER / SUB-BASIN AREA (AC./MI²)
- PRINCIPAL PIPE OUTLET FROM DAM
- EXISTING PROPERTY LINE
- PROPOSED IMPROVEMENTS

NOTE: DIGITAL ORTHOPHOTOGRAPHY AND LIDAR COMPLETED IN 2010 BY DOÑA ANA COUNTY. THE CONTOUR INTERVAL FOR OPT 2 IS 2-FOOT.



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DONA ANA COUNTY
SALEM DRAINAGE MASTER PLAN

OPTION 2 - DETENTION POND

SMITH ENGINEERING COMPANY
SOLUTIONS FOR TODAY... VISION FOR TOMORROW
201 N. Church Street, Suite 310
Las Cruces, NM 88001
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Fax: (575) 523-2396
TEXAS
NEW MEXICO

JOB NO: 815104
DATE: MARCH 2016
SHEET NO: OPT 2

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C. OPTION 3 (Refer to Figure OPT 3)

1. Option 3 Purpose

   Through examination of existing topography (DACFC LIDAR) and the results of the HEC-HMS hydrologic analysis reveal that substantial stormwater runoff enters the Salem Area from the undeveloped portions of Sub-Basin 20 (sb.20P) during any rainfall event. The purpose of Option 3 is to detain the runoff generated within sb.20P and utilize controlled release of stormwater into Salem.

2. Option 3 Description

   Simulate a single detention pond complete with both a principal outlet and an emergency spillway.

   Sub-Basin 20P (sb.20P) Pond (on vacant land owned and administered by the Bureau of Land Management [BLM]).

   a. Assume all of sb.20P outfalls into the pond. This is not completely accurate, but for the modeling purposes will provide a slight excess in storage capacity.
   b. The sb.20P pond will be a detention pond sized to detain the 10-year/24-hour storm event (maximum design storage volume is 3.8 ac-ft).
   c. Pond principal outlet (12" CMP) will release a controlled volume of detained water to continue downstream along its natural course.
   d. Pond emergency spillway is sized to allow the 100-year/24-hour stormwater runoff to continue its natural course unimpeded. Should the pond ever become silted in, the spillway would still be capable of passing the 100-year design storm.
   e. Assume the North and South Salem Dams are in place.

3. Conceptual Pond Grading Plan(s) are as follows:

   Figure OPT 3 – See following page

4. Option 3 Result:

   sb.20P Detention Pond

   a. will detain all of the 5-year peak inflow volume of 0.5 ac-ft.
   b. will detain all of the 10-year peak inflow volume of 0.9 ac-ft.
   c. will detain approximately half of the 100-year peak inflow volume of 7.7 ac-ft.
   d. See **Figure OPT 3** (next page) for reservoir routing data and freeboard summary.

5. Option 3 Conclusion:

   The pond is very effective for the 5- and 10-year design storms. Approximately half of the 100-year design storm would be detained in this detention pond.

TABLE 4 - OPTION 3

Proposed Reservoirs - Detention Pond Routing Summary

Salem Area Drainage Master Plan

Reservoir - Detention Pond Name	Principal Spillway Pipe Diameter	**Return Period / year**	Peak Inflow	Peak Outflow	Inflow Runoff Volume	Outflow Runoff Volume	Maximum Design Storage Volume (top of embankment)	Peak Storage Volume	100Yr- 24 Hr Peak Storage Volume	Peak Water Surface Elevation	Emergency Spillway Elevation	Pond Invert Elevation	Max Pond Depth	Peak Water Depth	Top of Pond Embankment Elevation	**Freeboard to Emergency Spillway Elevation**	**Freeboard to top of Pond Embankment**
	inches		cfs	cfs	ac-ft	ac-ft	ac-ft	ac-ft	ac-ft	ft	ft	ft	ft	ft	ft	**ft**	**ft**
a	b		c	c	c	c	c d	c	c	c	b d	d	d		d	**f**	**e**
OPT3.Pond	12	**100 / 24**	66	42	7.7	7.7	3.8	3.4	3.4	4135.70	4135.00	4133.00	3	2.7	4136.00	**-0.7**	**0.3**
OPT3.Pond	12	**10 / 24**	6	1	0.9	0.9	3.8	0.4	3.4	4133.30	4135.00	4133.00	3	0.3	4136.00	**1.7**	**2.7**
OPT3.Pond	12	**5 / 24**	3	1	0.5	0.5	3.8	0.2	3.4	4133.20	4135.00	4133.00	3	0.2	4136.00	**1.8**	**2.8**

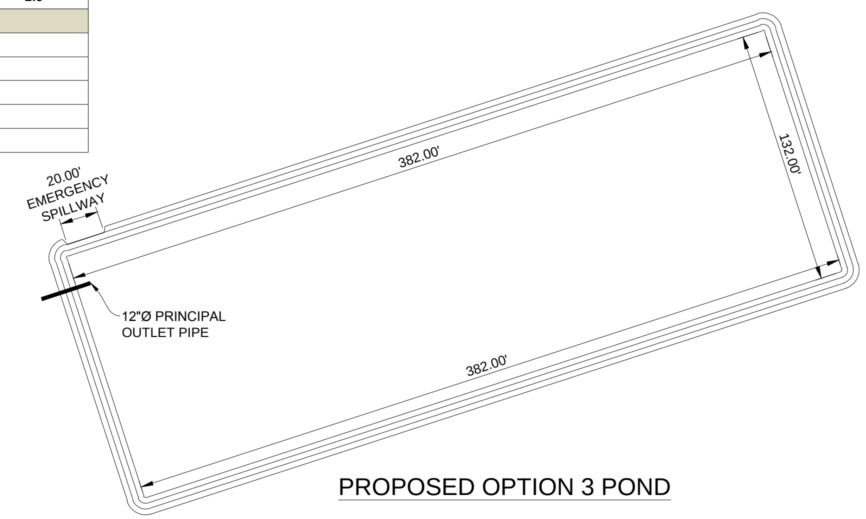
a - Proposed Option 3 Pond

b - Conceptual Design Pipe Outlet

c - From HEC-HMS model output included in Appendix 6

d - See Elevation-Storage-Discharge data tables included in Appendix 3. Elevation - Area data developed from conceptual pond layout, storage volume computed from that data.

e- Negative number indicates the flow depth exceeds referenced elevation - no freeboard available therefore cell highlights



PROPOSED OPTION 3 POND

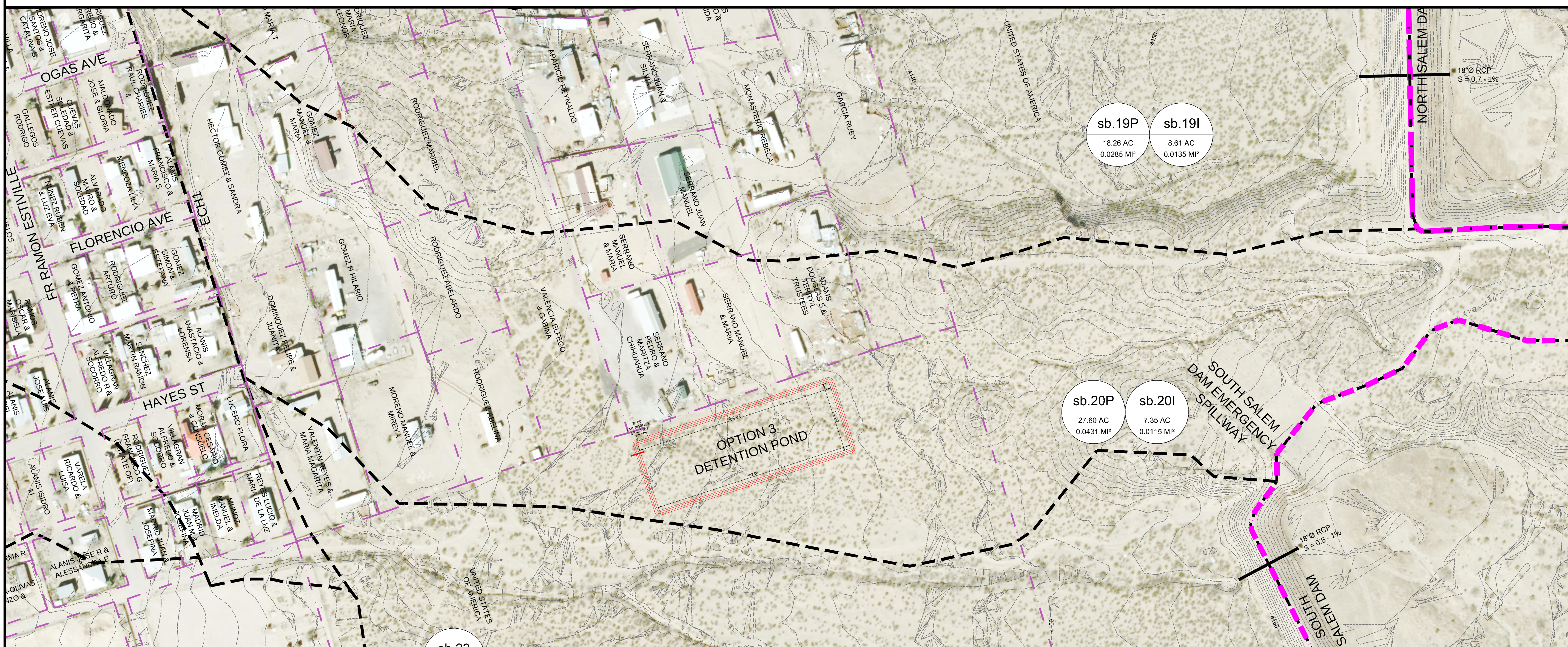
0 100' 200'

UNCONTROLLED BASIN (BASINS sb.1 THRU sb.29)
VELARDE DAM BASIN (BASINS sb.100 THRU sb.107)
NORTH SALEM DAM BASIN (BASINS sb.200 THRU sb.205)
SOUTH SALEM DAM BASIN (BASINS sb.300 THRU sb.301)
REED-THURMAND DAM BASIN (BASINS sb.400 THRU sb.409)

LEGEND

- MAJOR BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- sb.## XX AC. XX MI² — SUB-BASIN NUMBER / SUB-BASIN AREA (AC./MI²)
- PRINCIPAL PIPE OUTLET FROM DAM
- EXISTING PROPERTY LINE
- PROPOSED IMPROVEMENTS

NOTE: DIGITAL ORTHOPHOTOGRAPHY AND LIDAR COMPLETED IN 2010 BY DOÑA ANA COUNTY. THE CONTOUR INTERVAL FOR OPT 3 IS 2-FOOT.



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SALEM DRAINAGE MASTER PLAN

OPTION 3 - DETENTION POND

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Las Cruces, NM 88001
Phone: (575) 523-2395
Fax: (575) 523-2396
TEXAS NEW MEXICO
SMITH ENGINEERING COMPANY

JOB NO: 815104

DATE: MARCH 2016

SHEET NO: OPT 3

D. OPTION 4 (Refer to Figure OPT 4)

1. Option 4 Purpose

   Through examination of existing topography (DACFC LIDAR) and the results of the HEC-HMS hydrologic analysis reveal that substantial stormwater runoff enters the Salem Area from Sub-Basin 23 (sb.23) during any rainfall event. The purpose of Option 4 is to re-route the runoff generated within sb.23 as well as the stormwater released from the South Salem Dam, via the principal outlet, into Sub-Basin 22 (sb.22). The stormwater runoff will continue south along Ford Street bypassing most of the developed areas of Salem under Option 4A. Option 4B presents an alternate alignment to Option 4A; namely an earthen channel adjacent (east side) to Ford Street to convey stormwater runoff south towards Salem Street. At Salem Street the stormwater would be conveyed beneath the roadway in a concrete box culvert (CBC).

2. Option 4 Description

   Simulate a channel capable of conveying the intercepted stormwater runoff into Ford Street or the earthen channel adjacent to Ford Street.

   a. sb.23 Channel (on vacant land owned and administered by the Bureau of Land Management [BLM])
      i. Assume approximately 97-percent of the stormwater runoff generated in sb.23 and all of the stormwater released from the South Salem Dam principal outlet will be re-routed into sb.22.
      ii. The sb.23 channel is sized to convey the 100-year/24-hour stormwater runoff.

   b. Roadway/Grading Improvement to Ford Street (Option 4A):
      i. Grade improvements will be required along the north end Ford Street; adjacent to the Cemetery and private residences, to create positive slope from sb.23.
      ii. Assume concrete curb and gutter will be placed along Ford Street, as well as a paved inverted crown street for erosion protection and conveyance of stormwater.

   c. Channel (adjacent to Ford Street – Option 4B):
      i. Grade improvements will be required along the northern end east of Ford Street to create positive slope.
      ii. A low flow channel crossing will be installed across the private roadway, along the southern end of the cemetery.
      iii. The channel (PCH 4.B) is sized to convey the 100-year/24-hour stormwater runoff.

   d. Assume that the North and South Salem Dams are in place.

3. Conceptual Grading Plan(s) are as follows:

   Figure OPT 4 – See following page

4. Option 4A Result:

   a. The proposed channel (PCH4) and the proposed improvements to Ford Street (PR4) will convey the 5-year peak discharge of 23 cfs.
   b. The proposed channel (PCH4) and the proposed improvements to Ford Street (PR4) will convey the 10-year peak discharge of 30 cfs.
   c. The proposed channel (PCH4) and the proposed improvements to Ford Street (PR4) will convey the 100-year peak discharge of 57 cfs.
   d. See **Figure OPT 4** for flow depths in the proposed channel and Ford Street.

5. Option 4B Result:

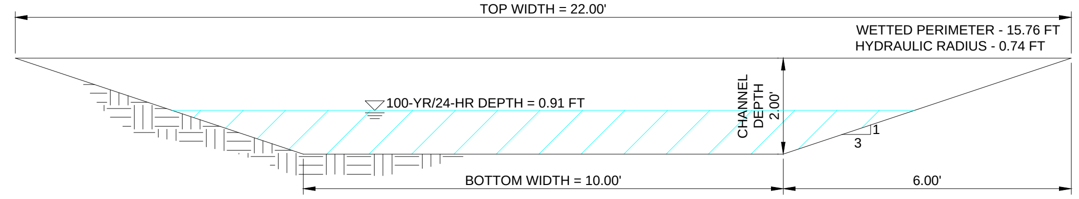
   a. The proposed channels (PCH4 and PCH 4.B) and the proposed CBC will convey the 5-year peak discharge of 23 cfs.
   b. The proposed channels (PCH4 and PCH 4.B) and the proposed CBC will convey the 10-year peak discharge of 30 cfs.
   c. The proposed channels (PCH4 and PCH 4.B) and the proposed CBC will convey the 100-year peak discharge of 57 cfs.
   d. See **Figure OPT 4** for flow depths in the proposed channels.

6. Option 4 A/B Conclusion:

The proposed channel(s) and/or improvements to Ford Street can redirect the intercepted flow from the subject areas for each of the design storm events.

HEC-HMS MODEL RESULTS

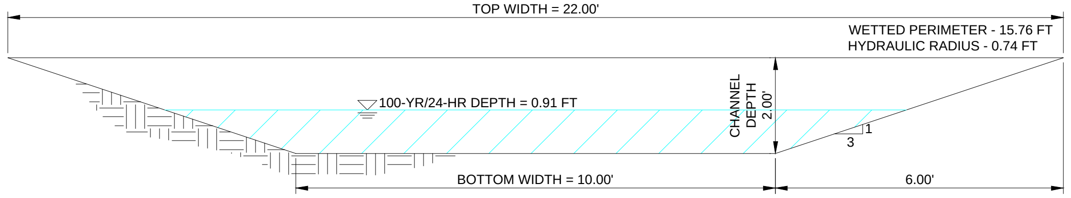
ANALYSIS POINT	AREA	AREA	5-YEAR/24-HOUR STORM EVENT		10-YEAR/24-HOUR STORM EVENT		100-YEAR/24-HOUR STORM EVENT	
			PEAK DISCHARGE	DISCHARGE VOLUME	PEAK DISCHARGE	DISCHARGE VOLUME	PEAK DISCHARGE	DISCHARGE VOLUME
	(AC)	(SQ. MI)	(CFS)	(AC-FT)	(CFS)	(AC-FT)	(CFS)	(AC-FT)
sb.23	38.24	0.0598	5	0.72	10	1.26	32	3.28
rtc.10	-	-	21	29.59	23	43.02	28	81.08
TOTAL TO OPT 4 CHANNEL/STREET			23	30.31	30	44.28	57	84.37



ASSUMPTIONS:
1. CHANNEL SLOPE = 1.50%
2. ROUGHNESS COEFFICIENT - 0.030

RESULTS:
1. CHANNEL Q ~ 244 CFS
2. 100-YR/24-HR Q ~ 57 CFS

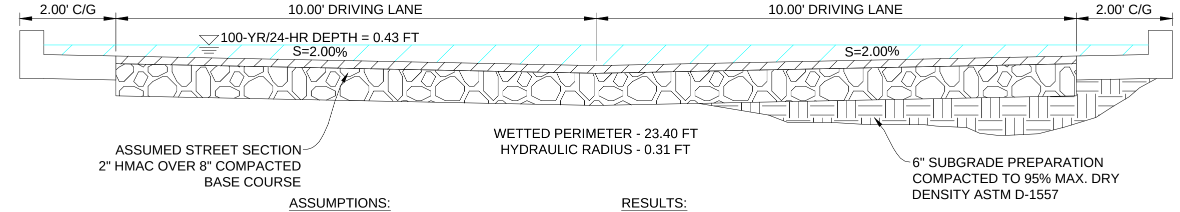
PROPOSED OPTION 4B CHANNEL - ADJACENT TO FORD STREET



ASSUMPTIONS:
1. CHANNEL SLOPE = 1.50%
2. ROUGHNESS COEFFICIENT - 0.030

RESULTS:
1. CHANNEL Q ~ 244 CFS
2. 100-YR/24-HR Q ~ 57 CFS

PROPOSED OPTION 4 CHANNEL



ASSUMPTIONS:
1. STREET SLOPE = 2.50%
2. ROUGHNESS COEFFICIENT - 0.013 (ASPHALT)

RESULTS:
1. CHANNEL Q ~ 180 CFS (TOP OF CURB FLOW)
2. 100-YR/24-HR Q ~ 57 CFS

PROPOSED OPTION 4A-FORD STREET SECTION

0 100' 200'

UNCONTROLLED BASIN (BASINS sb.1 THRU sb.29)
VELARDE DAM BASIN (BASINS sb.100 THRU sb.107)
NORTH SALEM DAM BASIN (BASINS sb.200 THRU sb.205)
SOUTH SALEM DAM BASIN (BASINS sb.300 THRU sb.301)
REED-THURMAND DAM BASIN (BASINS sb.400 THRU sb.409)

LEGEND

- MAJOR BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- sb.## / XX AC. / XX MI² — SUB-BASIN NUMBER / SUB-BASIN AREA (AC./MI²)
- PRINCIPAL PIPE OUTLET FROM DAM
- EXISTING PROPERTY LINE
- PROPOSED IMPROVEMENTS

NOTE: DIGITAL ORTHOPHOTOGRAPHY AND LIDAR COMPLETED IN 2010 BY DOÑA ANA COUNTY. THE CONTOUR INTERVAL FOR OPT 4 IS 2-FOOT.

FOR PLANNING PURPOSES ONLY AND SHALL NOT BE USED FOR CONSTRUCTION, BIDDING, OR PERMITTING PURPOSES

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SALEM
DONA ANA COUNTY, NEW MEXICO

DONA ANA COUNTY
SALEM DRAINAGE MASTER PLAN

OPTION 4 - CHANNEL & ROADWAY IMPROVEMENTS

SOLUTIONS FOR TODAY... VISION FOR TOMORROW
201 N. Church Street, Suite 310
Las Cruces, NM 88001
Phone: (575) 523-2395
Fax: (575) 523-2396
SMITH ENGINEERING COMPANY
TEXAS
NEW MEXICO

JOB NO: 815104
DATE: MARCH 2016
SHEET NO: OPT 4

E. OPTION 5 (Refer to Figure OPT 5)

1. Option 5 Purpose

   This option should be used in conjunction with Option 4. The purpose of Option 5 is to re-route the stormwater runoff from the undeveloped portion of Sub-Basin 20 (sb.20P) and any stormwater runoff leaving the South Salem Dam, via the emergency spillway, into the channel and improvements to Ford Street proposed in Option 4 (PCH4 and PR1). The stormwater runoff will continue south along Ford Street bypassing most of the developed areas of Salem under Option 4A. Option 4B presents an alternate alignment to Option 4A; namely an earthen channel adjacent (east side) to Ford Street to convey stormwater runoff south towards Salem Street. At Salem Street the stormwater would be conveyed beneath the roadway in a concrete box culvert (CBC).

2. Option 5 Description

   Simulate a channel capable of conveying the intercepted stormwater runoff into the channel (PCH4) and the Ford Street Improvements (PR4) proposed in Option 4A or into channel (PCH4) and then south along the channel parallel to Ford Street (Option 4B).

   a. sb.20 Channel (on vacant land owned and administered by the Bureau of Land Management [BLM])

      i. Assume the stormwater runoff generated by the pervious portion of Sub-Basin 20 (sb.20P) will be re-routed into the sb.23 channel (Option 4)
      ii. The sb.20 channel is sized to convey the 100-year/24-hour stormwater runoff.

3. Conceptual Grading Plan(s) are as follows:

   Figure OPT 5 – See following page

4. Option 5 Results with Option 4A:

   a. The proposed channel (PCH5) will convey the 5-year peak discharge of 3 cfs.
   b. The proposed channel (PCH5) will convey the 10-year peak discharge of 6 cfs.
   c. The proposed channel (PCH5) will convey the 100-year peak discharge of 66 cfs.
   d. The proposed channel (PCH4) and the proposed improvements to Ford Street (PR4) will convey the 5-year peak discharge of 26 cfs.
   e. The proposed channel (PCH4) and the proposed improvements to Ford Street (PR4) will convey the 10-year peak discharge of 36 cfs.
   f. The proposed channel (PCH4) and the proposed improvements to Ford Street (PR4) will convey the 100-year peak discharge of 100 cfs.
   g. See **Figure OPT 5** for flow depths in the proposed channel (PCH4) and Ford Street.
   h. See **Figure OPT 5** for flow depths in the proposed channel PCH5.

5. Option 5 Results with Option 4B:

    a. The proposed channel (PCH5) will convey the 5-year peak discharge of 3 cfs.
    b. The proposed channel (PCH5) will convey the 10-year peak discharge of 6 cfs.
    c. The proposed channel (PCH5) will convey the 100-year peak discharge of 66 cfs.
    d. The proposed channels (PCH4 and PCH 4.B) will convey the 5-year peak discharge of 26 cfs.
    e. The proposed channels (PCH4 and PCH 4.B) will convey the 10-year peak discharge of 36 cfs.
    f. The proposed channels (PCH4 and PCH 4.B) will convey the 100-year peak discharge of 100 cfs.
    g. See **Figure OPT 5** for flow depths in the proposed channels (PCH4 and PCH 4.B)
    h. See **Figure OPT 5** for flow depths in the proposed channel PCH5.

6. Option 5 Conclusion:

    The proposed channel(s) and/or improvements to Ford Street can redirect the intercepted flow from the subject areas for each of the design storm events.

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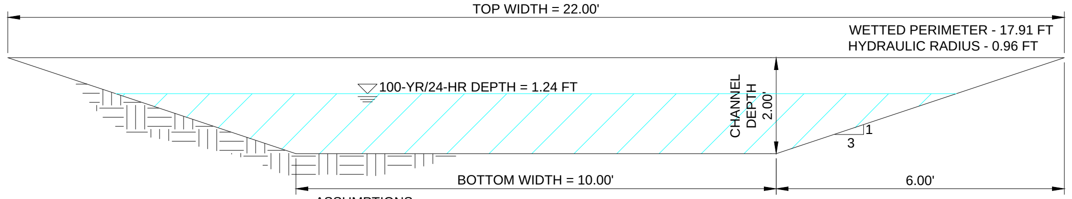
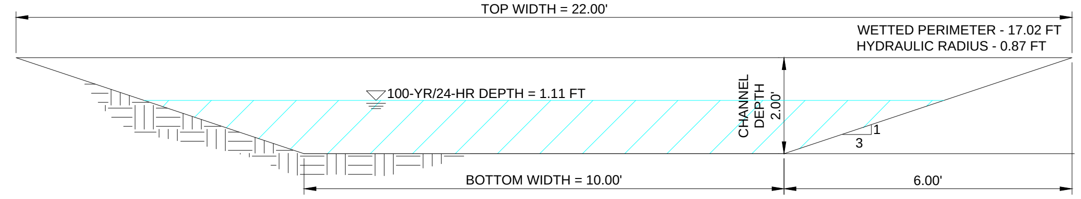


ASSUMPTIONS:
1. CHANNEL SLOPE = 1.50%
2. ROUGHNESS COEFFICIENT - 0.030

RESULTS:
1. CHANNEL Q ~ 244 CFS
2. 100-YR/24-HR Q ~ 100 CFS

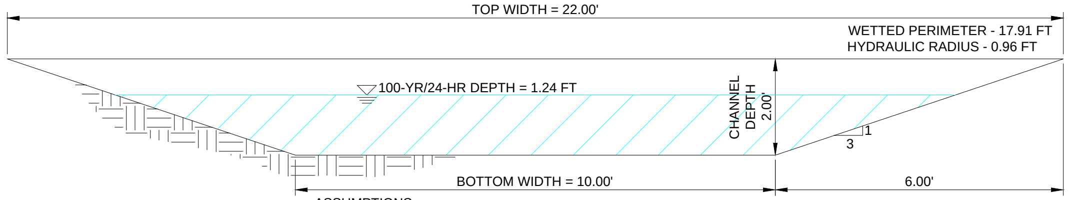
PROPOSED OPTION 4 CHANNEL



ASSUMPTIONS:
1. CHANNEL SLOPE = 1.00%
2. ROUGHNESS COEFFICIENT - 0.030

RESULTS:
1. CHANNEL Q ~ 200 CFS
2. 100-YR/24-HR Q ~ 66 CFS

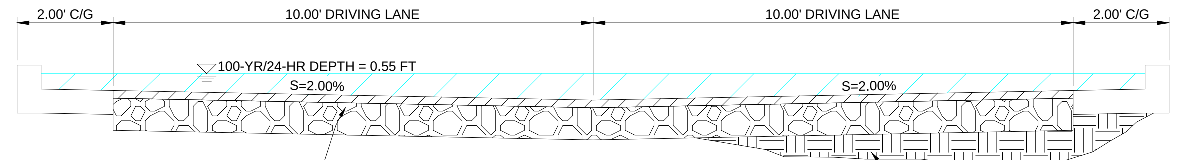
PROPOSED OPTION 5 CHANNEL



ASSUMPTIONS:
1. CHANNEL SLOPE = 1.50%
2. ROUGHNESS COEFFICIENT - 0.030

RESULTS:
1. CHANNEL Q ~ 244 CFS
2. 100-YR/24-HR Q ~ 100 CFS

PROPOSED OPTION 4B CHANNEL - ADJACENT TO FORD STREET



ASSUMED STREET SECTION 2" HMAC OVER 8" COMPACTED BASE COURSE

WETTED PERIMETER - 23.64 FT
HYDRAULIC RADIUS - 0.42 FT

6" SUBGRADE PREPARATION COMPACTED TO 95% MAX. DRY DENSITY ASTM D-1557

ASSUMPTIONS:
1. STREET SLOPE = 2.50%
2. ROUGHNESS COEFFICIENT - 0.013 (ASPHALT)

RESULTS:
1. CHANNEL Q ~ 180 CFS (TOP OF CURB FLOW)
2. 100-YR/24-HR Q ~ 100 CFS

PROPOSED OPTION 4A-FORD STREET SECTION

0 100' 200'

UNCONTROLLED BASIN (BASINS sb.1 THRU sb.29)
VELARDE DAM BASIN (BASINS sb.100 THRU sb.107)
NORTH SALEM DAM BASIN (BASINS sb.200 THRU sb.205)
SOUTH SALEM DAM BASIN (BASINS sb.300 THRU sb.301)
REED-THURMAND DAM BASIN (BASINS sb.400 THRU sb.409)

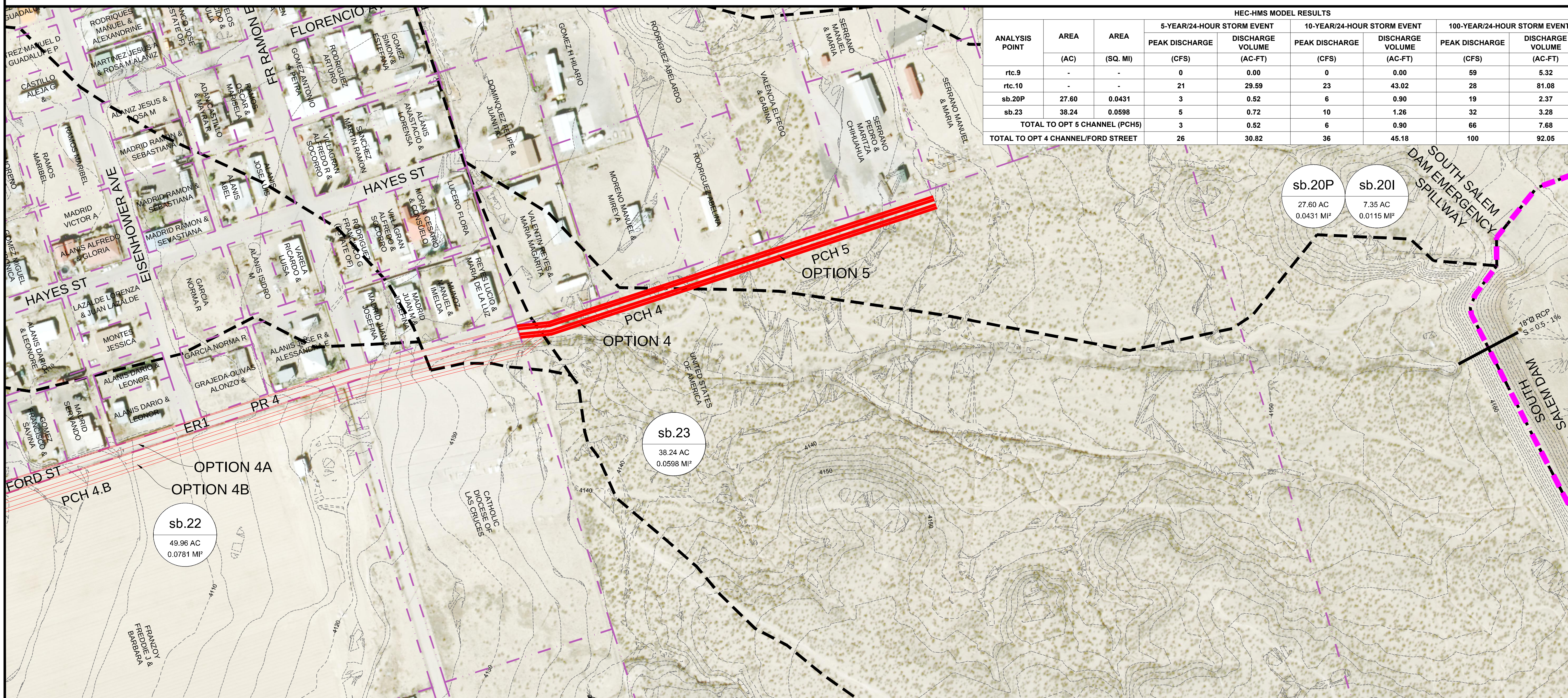
LEGEND

- MAJOR BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- sb.## XX AC. XX MI² — SUB-BASIN NUMBER / SUB-BASIN AREA (AC./MI²)
- PRINCIPAL PIPE OUTLET FROM DAM
- EXISTING PROPERTY LINE
- PROPOSED IMPROVEMENTS

NOTE: DIGITAL ORTHOPHOTOGRAPHY AND LIDAR COMPLETED IN 2010 BY DOÑA ANA COUNTY. THE CONTOUR INTERVAL FOR OPT 5 IS 2-FOOT.

HEC-HMS MODEL RESULTS

ANALYSIS POINT	AREA	AREA	5-YEAR/24-HOUR STORM EVENT		10-YEAR/24-HOUR STORM EVENT		100-YEAR/24-HOUR STORM EVENT	
			PEAK DISCHARGE	DISCHARGE VOLUME	PEAK DISCHARGE	DISCHARGE VOLUME	PEAK DISCHARGE	DISCHARGE VOLUME
	(AC)	(SQ. MI)	(CFS)	(AC-FT)	(CFS)	(AC-FT)	(CFS)	(AC-FT)
rtc.9	-	-	0	0.00	0	0.00	59	5.32
rtc.10	-	-	21	29.59	23	43.02	28	81.08
sb.20P	27.60	0.0431	3	0.52	6	0.90	19	2.37
sb.23	38.24	0.0598	5	0.72	10	1.26	32	3.28
TOTAL TO OPT 5 CHANNEL (PCH5)			3	0.52	6	0.90	66	7.68
TOTAL TO OPT 4 CHANNEL/FORD STREET			26	30.82	36	45.18	100	92.05



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DONA ANA COUNTY
SALEM DRAINAGE MASTER PLAN

OPTION 5 - CHANNEL IMPROVEMENTS

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SMITH ENGINEERING COMPANY
TEXAS
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JOB NO: 815104
DATE: MARCH 2016
SHEET NO: OPT 5

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F. OPTION 6 (Refer to Figure OPT 6)

1. Option 6 Purpose

   Through examination of existing topography (DACFC LIDAR) and the results of the HEC-HMS hydrologic analysis reveal that substantial stormwater runoff from upstream Sub-Basins 17 and 22 (sb.17 and sb.22) could be intercepted before inundating downstream agricultural lands.

2. Option 6 Description

   Simulate a single detention pond complete with both a principal outlet and an emergency spillway.

   a. Sub-Basin 16 (sb.16) Pond (on Doña Ana County Owned park at the north end of the basin).

      i. Assume all of Sub-Basins 17 and 22 (sb.17 and sb.22) outfalls into the pond.
      ii. Assume that the proposed improvements in Options 4 and 5 will not be constructed.
      iii. The sb.16 pond will be a detention pond sized to detain the 10-year/24-hour storm event (maximum design storage volume is 5.1 ac-ft).
      iv. Channelization to capture flows from each of the aforementioned sub-basins will be required.
      v. Pond principal outlet (12" CMP) will release a controlled volume of detained water to continue downstream along its natural course.
      vi. Pond emergency spillway is sized to allow the 100-year/24-hour stormwater runoff to continue its natural course unimpeded.
      vii. Assume that both the North and South Salem Dams are in place.

3. Conceptual Pond Grading Plan(s) are as follows:

   Figure OPT 6 – See following page

4. Option 6 Result:

   sb.16 Detention Pond
   a. will detain all 5-year peak inflow volume of 2.1 ac-ft.
   b. will detain all 10-year peak inflow volume of 3.2 ac-ft.
   c. will detain approximately half of the 100-year peak inflow volume of 7.4 ac-ft.
   d. See **Figure OPT 6** (next page) for reservoir routing data and freeboard summary.

5. Option 6 Conclusion:

   The pond is very effective for the 5- and 10-year storm events; and is capable of detaining approximately half of the stormwater runoff during the 100-year storm event.

FOR PLANNING PURPOSES ONLY AND SHALL NOT BE USED FOR CONSTRUCTION, BIDDING, OR PERMITTING PURPOSES

TABLE 4 - OPTION 6																	
Proposed Reservoirs - Detention Pond Routing Summary																	
Salem Area Drainage Master Plan																	
Reservoir - Detention Pond Name	Principal Spillway Pipe Diameter	**Return Period / year**	Peak Inflow	Peak Outflow	Inflow Runoff Volume	Outflow Runoff Volume	Maximum Design Storage Volume (top of embankment)	Peak Storage Volume	100Yr- 24 Hr Peak Storage Volume	Peak Water Surface Elevation	Emergency Spillway Elevation	Pond Invert Elevation	Max Pond Depth	Peak Water Depth	Top of Pond Embankment Elevation	**Freeboard to Emergency Spillway Elevation**	**Freeboard to top of Pond Embankment**
	inches		cfs	cfs	ac-ft	ac-ft	ac-ft	ac-ft	ac-ft	ft	ft	ft	ft	ft	ft	**ft**	**ft**
a	b		c	c	c	c	c d	c	c	c	b d	d	d		d	**f**	**e**
OPT6.Pond	12	**100 / 24**	74	30	7.4	7.4	5.1	3.9	3.9	4086.30	4086.00	4084.00	3	2.3	4087.00	**-0.3**	**0.7**
OPT6.Pond	12	**10 / 24**	28	4	3.2	3.2	5.1	1.8	3.9	4085.10	4086.00	4084.00	3	1.1	4087.00	**0.9**	**1.9**
OPT6.Pond	12	**5 / 24**	16	2	2.1	2.1	5.1	1.1	3.9	4084.60	4086.00	4084.00	3	0.6	4087.00	**1.4**	**2.4**

a - Proposed Option 6 Pond

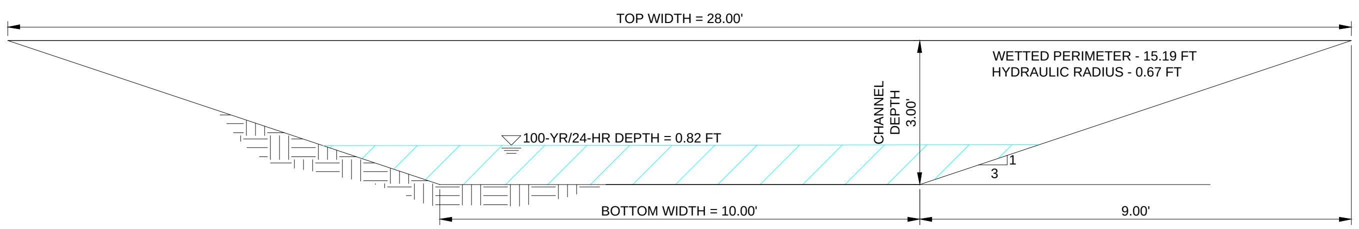
b - Conceptual Design Pipe Outlet

c - From HEC-HMS model output included in Appendix 6

d - See Elevation-Storage-Discharge data tables included in Appendix 3. Elevation - Area data developed from conceptual pond layout, storage volume computed from that data.

e - Negative number indicates the flow depth exceeds referenced elevation - no freeboard available therefore cell highlights

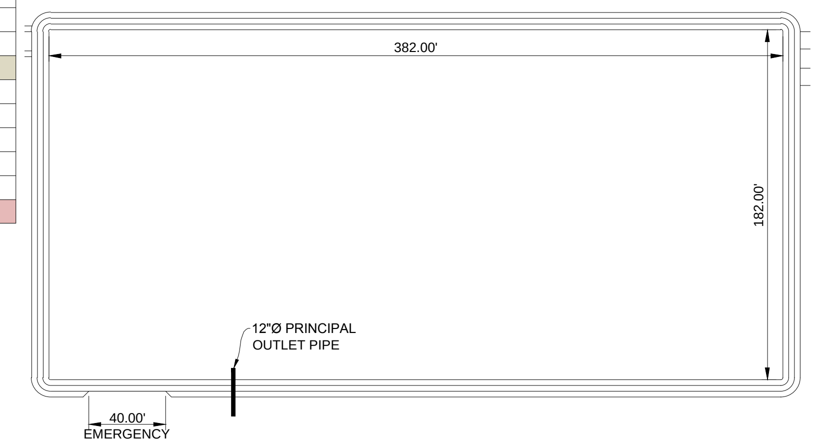
f- Negative number indicates the flow depth exceeds referenced elevation - no freeboard available therefore cell highlights (Spills through emergency spillway or top of dam by this depth)



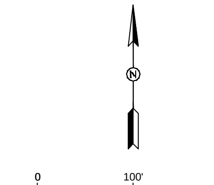
ASSUMPTIONS:
1. CHANNEL SLOPE = 2.50%
2. ROUGHNESS COEFFICIENT - 0.030

RESULTS:
1. CHANNEL Q ~ 701 CFS
2. 100-YR/24-HR Q ~ 61 CFS

PROPOSED OPTION 6 CHANNEL (EAST SIDE OF POND)



PROPOSED OPTION 6 POND

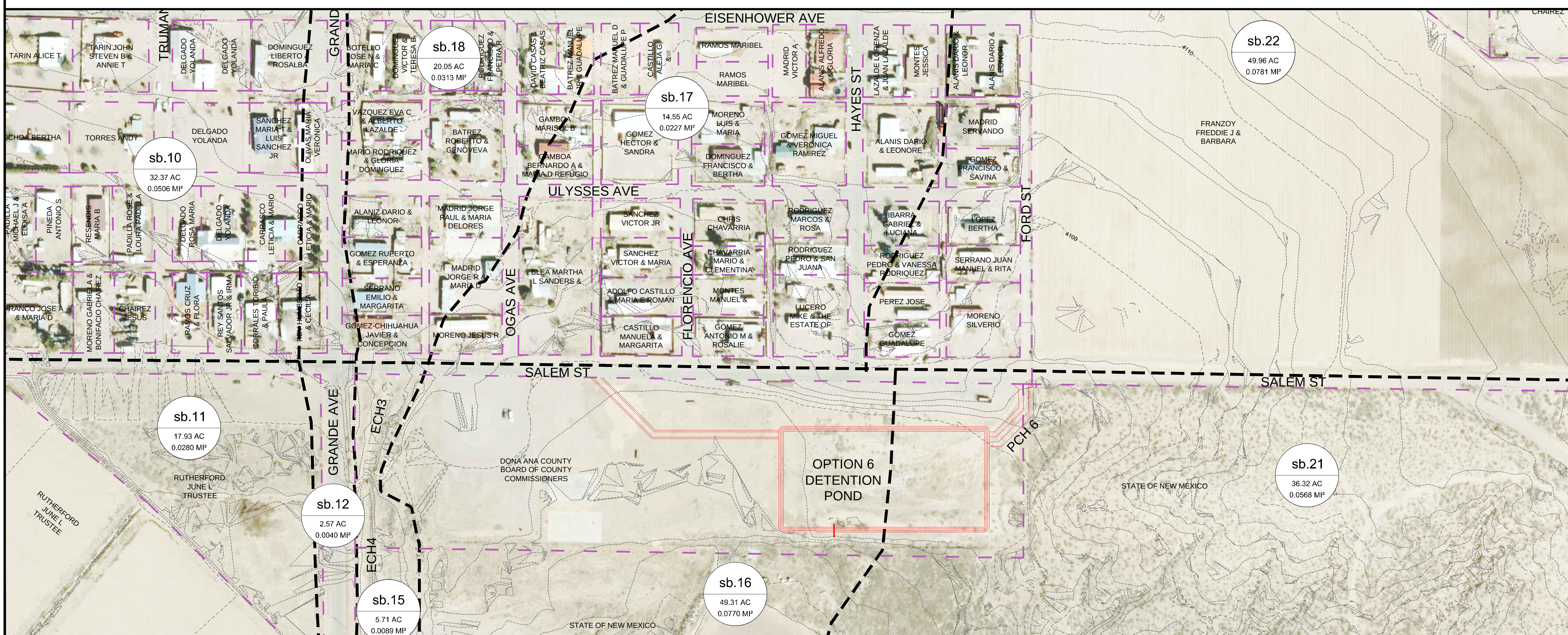


UNCONTROLLED BASIN (BASINS sb.1 THRU sb.29)
VELARDE DAM BASIN (BASINS sb.100 THRU sb.107)
NORTH SALEM DAM BASIN (BASINS sb.200 THRU sb.205)
SOUTH SALEM DAM BASIN (BASINS sb.300 THRU sb.301)
REED-THURMAND DAM BASIN (BASINS sb.400 THRU sb.409)

LEGEND

- MAJOR BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- sb.## XX AC. XX MI² — SUB-BASIN NUMBER / SUB-BASIN AREA (AC./MI²)
- PRINCIPAL PIPE OUTLET FROM DAM
- EXISTING PROPERTY LINE
- PROPOSED IMPROVEMENTS

NOTE: DIGITAL ORTHOPHOTOGRAPHY AND LIDAR COMPLETED IN 2010 BY DOÑA ANA COUNTY. THE CONTOUR INTERVAL FOR OPT 6 IS 2-FOOT.



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SALEM DRAINAGE MASTER PLAN

OPTION 6 - DETENTION POND

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Las Cruces, NM 88001
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SMITH ENGINEERING COMPANY
NEW MEXICO
TEXAS

JOB NO: 815104
DATE: MARCH 2016
SHEET NO: OPT 6

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G. OPTION 7 (Refer to Figure OPT 7)

1. Option 7 Purpose

   This option should be adopted in conjunction with Options 4A or 4B and Option 5. Through examination of existing topography (DACFC LIDAR) and the results of the HEC-HMS hydrologic analysis reveal that substantial stormwater runoff from upstream Sub-Basins 17 and 22 (sb.17 and sb.22) could be intercepted before inundating downstream agricultural lands.

2. Option 7 Description

   Simulate a single detention pond complete with both a principal outlet and an emergency spillway.

   a. Sub-Basin 16 (sb.16) Pond (on Doña Ana County Owned park at the north end of the basin).

      i. Assume Sub-Basins 17, 20P, 22 and 23 (sb.17, sb.20P, sb.22, and sb.23) outfall into the pond.
      ii. Assume that the proposed improvements in Options 4 and 5 will be constructed.
      iii. Channelization to capture flows from each of the aforementioned sub-basins will be required.
      iv. The sb.16 pond will be a detention pond sized to detain the 10-year/24-hour storm event (maximum design storage volume of 16.2 ac-ft).
      v. Pond principal outlet (24" CMP) will release a controlled volume of detained water to continue downstream along its natural course.
      vi. Pond emergency spillway is sized to allow the 100-year/24-hour stormwater runoff to continue its natural course unimpeded.
      vii. Assume that both the North and South Salem Dams are in place.

3. Conceptual Pond Grading Plan(s) are as follows:

   Figure OPT 7 – See following page

4. Option 7 Result:

   sb.16 Detention Pond

   a. will detain approximately half of the 5-year peak inflow volume of 32.9 ac-ft.
   b. will detain about one-third of the 10-year peak inflow volume of 48.4 ac-ft.
   c. will detain about one-tenth of the 100-year peak inflow volume of 99.4 ac-ft.
   d. See **Figure OPT 7** (next page) for reservoir routing data and freeboard summary.

5. Option 7 Conclusion:

   The pond will detain a portion of runoff from the 5- and 10-year design storms, but won't provide much benefit during the 100-year storm event.

TABLE 4 - OPTION 7																	
Proposed Reservoirs - Detention Pond Routing Summary																	
Salem Area Drainage Master Plan																	
Reservoir - Detention Pond Name	Principal Spillway Pipe Diameter	**Return Period / year**	Peak Inflow	Peak Outflow	Inflow Runoff Volume	Outflow Runoff Volume	Maximum Design Storage Volume (top of embankment)	Peak Storage Volume	100Yr- 24 Hr Peak Storage Volume	Peak Water Surface Elevation	Emergency Spillway Elevation	Pond Invert Elevation	Max Pond Depth	Peak Water Depth	Top of Pond Embankment Elevation	**Freeboard to Emergency Spillway Elevation**	**Freeboard to top of Pond Embankment**
	inches		cfs	cfs	ac-ft	ac-ft	ac-ft	ac-ft	ac-ft	ft	ft	ft	ft	ft	ft	**ft**	**ft**
a	b		c	c	c	c	c d	c	c	c	b d	d	d		d	**f**	**e**
OPT7.Pond	24	**100 / 24**	140	60	99.4	99.4	16.2	13.6	13.6	4086.20	4086.00	4082.00	5	4.2	4087.00	**-0.2**	**0.8**
OPT7.Pond	24	**10 / 24**	59	22	48.4	48.4	16.2	6.8	13.6	4084.20	4086.00	4082.00	5	2.2	4087.00	**1.8**	**2.8**
OPT7.Pond	24	**5 / 24**	37	19	32.9	32.9	16.2	5.1	13.6	4083.70	4086.00	4082.00	5	1.7	4087.00	**2.3**	**3.3**

a - Proposed Option 7 Pond

b - Conceptual Design Pipe Outlet

c - From HEC-HMS model output included in Appendix 6

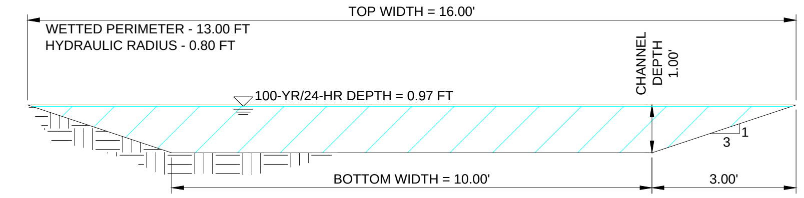
d - See Elevation-Storage-Discharge data tables included in Appendix 3. Elevation - Area data developed from conceptual pond layout, storage volume computed from that data.

e- Negative number indicates the flow depth exceeds referenced elevation - no freeboard available therefore cell highlights

f- Negative number indicates the flow depth exceeds referenced elevation - no freeboard available therefore cell highlights (Spills through emergency spillway or top of dam by this depth)

NOTE:

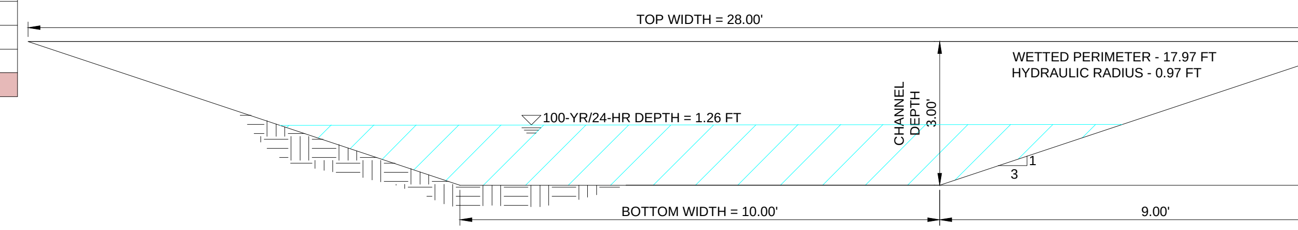
REFER TO OPTION #5 FOR DEPTHS IN PROPOSED CHANNELS (PCH4, PCH 4.B & PCH5) AS WELL AS DEPTH IN THE PROPOSED FORD STREET (PR4).



ASSUMPTIONS:
1. CHANNEL SLOPE = 0.50%
2. ROUGHNESS COEFFICIENT - 0.030

RESULTS:
1. CHANNEL Q ~ 29 CFS
2. 100-YR/24-HR Q ~ 37 CFS

PROPOSED OPTION 7 CHANNEL-PCH 7.2 (WEST SIDE OF POND)



ASSUMPTIONS:
1. CHANNEL SLOPE = 2.50%
2. ROUGHNESS COEFFICIENT - 0.030

RESULTS:
1. CHANNEL Q ~ 701 CFS
2. 100-YR/24-HR Q ~ 131 CFS

PROPOSED OPTION 7 CHANNEL-PCH7.1 (EAST SIDE OF POND)

UNCONTROLLED BASIN (BASINS sb.1 THRU sb.29)
VELARDE DAM BASIN (BASINS sb.100 THRU sb.107)
NORTH SALEM DAM BASIN (BASINS sb.200 THRU sb.205)
SOUTH SALEM DAM BASIN (BASINS sb.300 THRU sb.301)
REED-THURMAND DAM BASIN (BASINS sb.400 THRU sb.409)

LEGEND

MAJOR BASIN BOUNDARY
SUB-BASIN BOUNDARY
sb.## XX AC. XX MI² — SUB-BASIN NUMBER / SUB-BASIN AREA (AC./MI²)
PRINCIPAL PIPE OUTLET FROM DAM
EXISTING PROPERTY LINE
PROPOSED IMPROVEMENTS

NOTE: DIGITAL ORTHOPHOTOGRAPHY AND LIDAR COMPLETED IN 2010 BY DOÑA ANA COUNTY. THE CONTOUR INTERVAL FOR OPT 7 IS 2-FOOT.

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OPTION 7 - DETENTION POND & CHANNEL IMPROVEMENTS

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SMITH ENGINEERING COMPANY
NEW MEXICO TEXAS

JOB NO: 815104
DATE: MARCH 2016
SHEET NO: OPT 7

H. OPTION 8 (Refer to Figure OPT 8)

1. Option 8 Purpose

   Through examination of existing topography (DACFC LIDAR) and the results of the HEC-HMS hydrologic analysis reveal that substantial stormwater runoff from Sub-Basin 8 (sb.8) could be intercepted before inundating downstream agricultural lands.

2. Option 8 Description

   Simulate a single detention pond complete with both a principal outlet and an emergency spillway.

   a. Sub-Basin 8 (sb.8) Pond (on vacant privately owned land at the south end of the basin).

      i. Assume all of Sub-Basin 8 (sb.8) outfalls into the pond, except for any stormwater runoff that exits the North Salem Dam via the emergency spillway.
      ii. The sb.8 pond will be a detention pond sized to detain the 10-year/24-hour storm event (maximum design storage volume is 25.5 ac-ft).
      iii. Pond principal outlet (24" CMP) will release a controlled volume of detained water to continue downstream along its natural course.
      iv. Pond emergency spillway is sized to allow the 100-year/24-hour stormwater runoff to continue its natural course unimpeded.

3. Conceptual Pond Grading Plan(s) are as follows:

   Figure OPT 8 – See following page

4. Option 8 Result:

   sb.8 Detention Pond

      i. will detain all 5-year peak inflow volume of 13.9 ac-ft.
      ii. will detain all 10-year peak inflow volume of 22.2 ac-ft.
      iii. will detain approximately half of the 100-year peak inflow volume of 51.7 ac-ft.
      iv. See **Figure OPT 8** (next page) for reservoir routing data and freeboard summary.

5. Option 8 Conclusion:

   The pond is very effective for the 5- and 10-year design storms, and will detain approximately half of the 100-year design storm.

TABLE 4 - OPTION 8

Proposed Reservoirs - Detention Pond Routing Summary

Salem Area Drainage Master Plan

Reservoir - Detention Pond Name	Principal Spillway Pipe Diameter	**Return Period / year**	Peak Inflow	Peak Outflow	Inflow Runoff Volume	Outflow Runoff Volume	Maximum Design Storage Volume (top of embankment)	Peak Storage Volume	100Yr- 24 Hr Peak Storage Volume	Peak Water Surface Elevation	Emergency Spillway Elevation	Pond Invert Elevation	Max Pond Depth	Peak Water Depth	Top of Pond Embankment Elevation	**Freeboard to Emergency Spillway Elevation**	**Freeboard to top of Pond Embankment**
	inches		cfs	cfs	ac-ft	ac-ft	ac-ft	ac-ft	ac-ft	ft	ft	ft	ft	ft	ft	**ft**	**ft**
a	b		c	c	c	c	c d	c	c	c	b d	d	d		d	**f**	**e**
OPT8.Pond	24	**100 / 24**	460	216	51.7	51.7	25.5	24.2	24.2	4084.90	4084.00	4082.00	3	2.9	4085.00	**-0.9**	**0.1**
OPT8.Pond	24	**10 / 24**	174	18	22.2	22.2	25.5	12.6	24.2	4083.50	4084.00	4082.00	3	1.5	4085.00	**0.5**	**1.5**
OPT8.Pond	24	**5 / 24**	98	13	13.9	13.9	25.5	7.1	24.2	4082.90	4084.00	4082.00	3	0.9	4085.00	**1.1**	**2.1**

a - Proposed Option 8 Pond

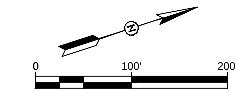
b - Conceptual Design Pipe Outlet

c - From HEC-HMS model output included in Appendix 6

d - See Elevation-Storage-Discharge data tables included in Appendix 3. Elevation - Area data developed from conceptual pond layout, storage volume computed from that data.

e- Negative number indicates the flow depth exceeds referenced elevation - no freeboard available therefore cell highlights

f- Negative number indicates the flow depth exceeds referenced elevation - no freeboard available therefore cell highlights (Spills through emergency spillway or top of dam by this depth)

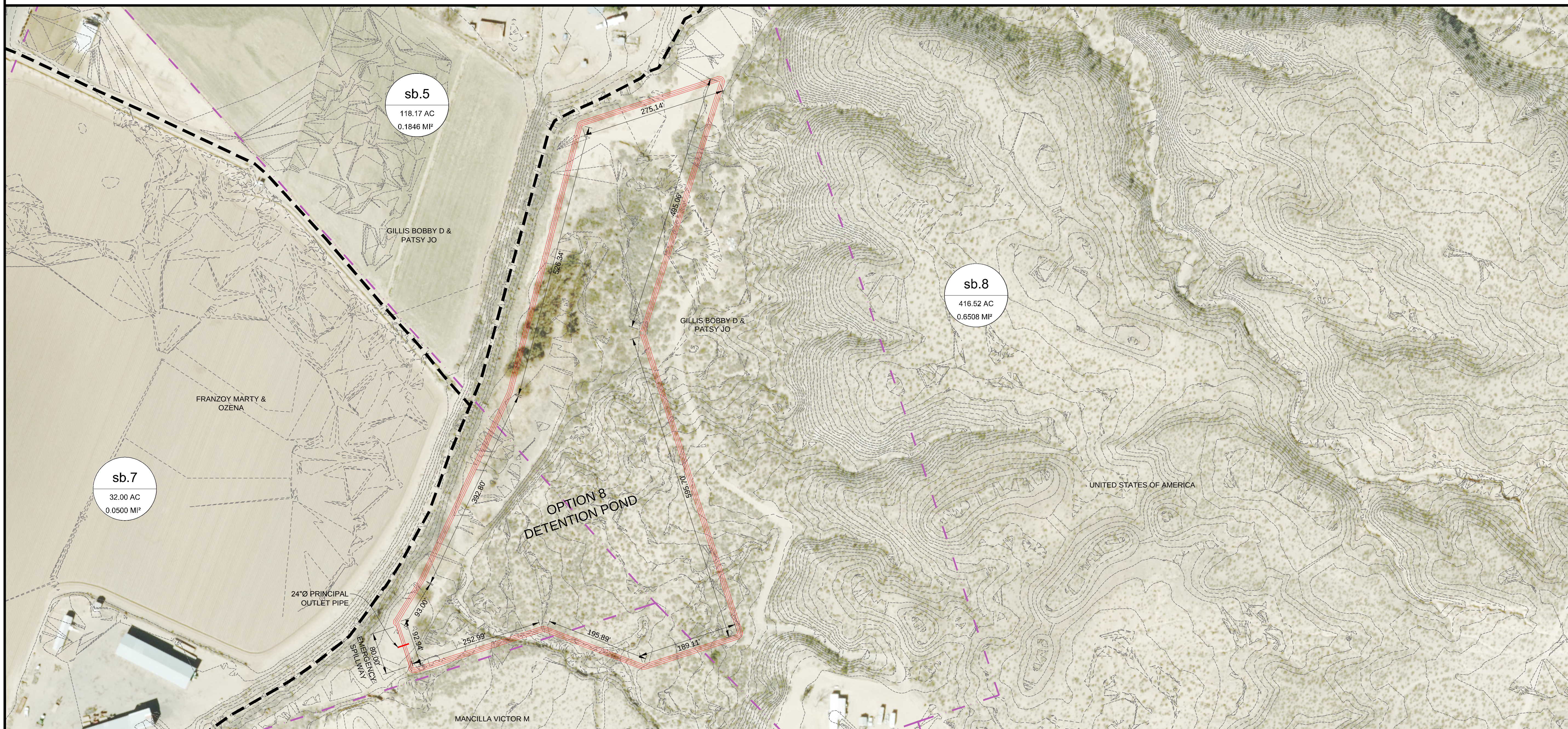


UNCONTROLLED BASIN (BASINS sb.1 THRU sb.29)
VELARDE DAM BASIN (BASINS sb.100 THRU sb.107)
NORTH SALEM DAM BASIN (BASINS sb.200 THRU sb.205)
SOUTH SALEM DAM BASIN (BASINS sb.300 THRU sb.301)
REED-THURMAND DAM BASIN (BASINS sb.400 THRU sb.409)

LEGEND

- MAJOR BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- sb.## XX AC. XX MI² — SUB-BASIN NUMBER / SUB-BASIN AREA (AC./MI²)
- PRINCIPAL PIPE OUTLET FROM DAM
- EXISTING PROPERTY LINE
- PROPOSED IMPROVEMENTS

NOTE: DIGITAL ORTHOPHOTOGRAPHY AND LIDAR COMPLETED IN 2010 BY DOÑA ANA COUNTY. THE CONTOUR INTERVAL FOR OPT 8 IS 2-FOOT.



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SALEM
DONA ANA COUNTY, NEW MEXICO

NO	REVISION DESCRIPTION	DATE	BY
1			
2			
3			
4			
5			

DONA ANA COUNTY
SALEM DRAINAGE MASTER PLAN

OPTION 8 - DETENTION POND

SOLUTIONS FOR TODAY... VISION FOR TOMORROW
201 N. Church Street, Suite 310
Las Cruces, NM 88001
Phone: (575) 523-2395
Fax: (575) 523-2396
TEXAS
SMITH ENGINEERING COMPANY
NEW MEXICO

JOB NO: 815104
DATE: MARCH 2016
SHEET NO: OPT 8

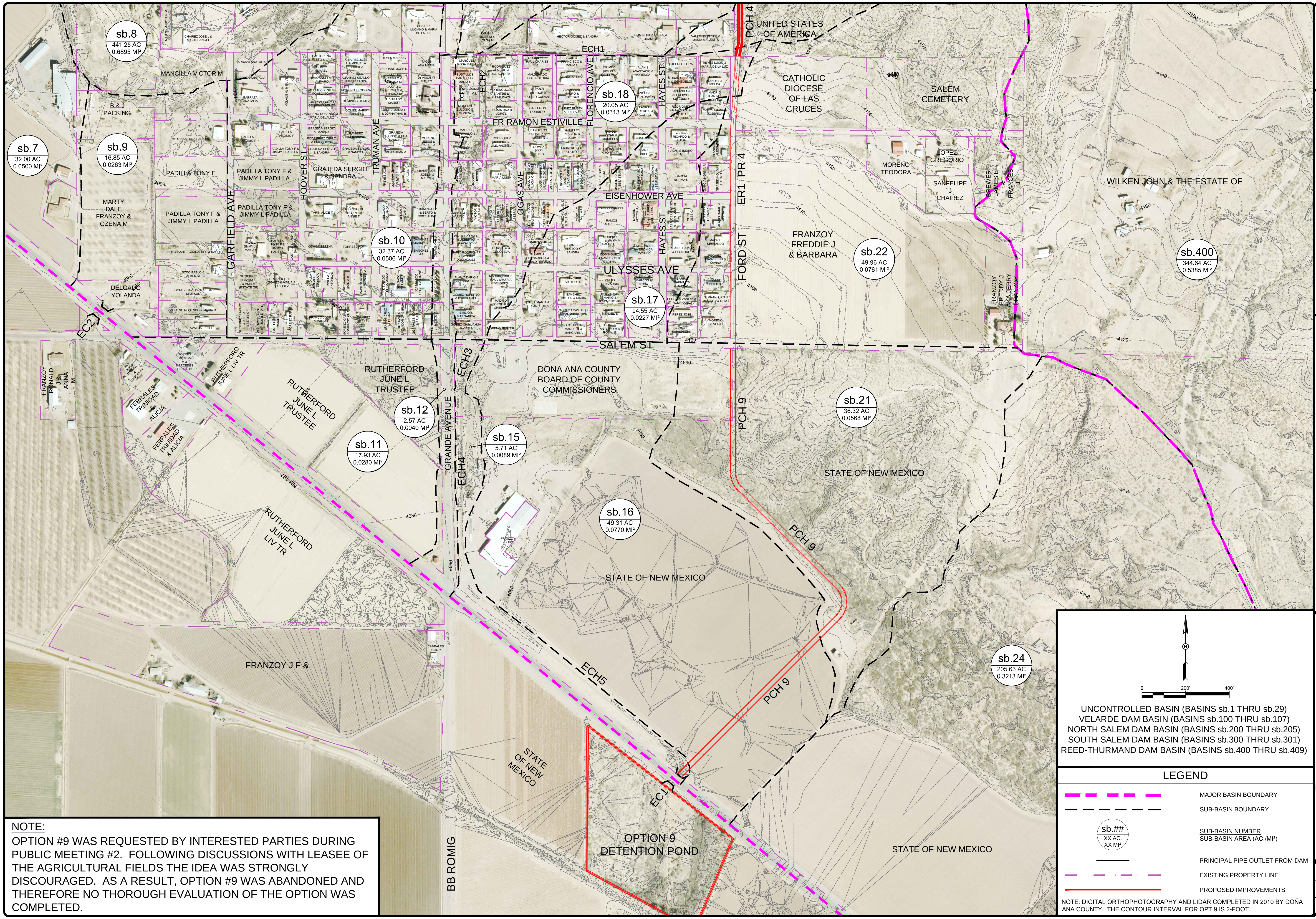
I. OPTION 9 (Refer to Figure OPT 9)

1. Option 9 Purpose and Description

   This option was presented by concerned citizens and interested individuals during the second (2nd) public meeting. It utilizes the same proposed infrastructure in Options 4 and 5, but proposes additional channelization south of the Ford Street and Salem Street intersection. The proposed channel continues south toward the agricultural fields along NM 187. The channel would cut across the existing fields and cross NM 187 at existing culvert EC1. After crossing NM 187, via existing culvert EC1, the flow would be directed into a proposed detention pond (see Figure OPT 9).

2. Option 9 Result and Conclusion:

   This proposed Option 9 was discussed with the lease/landowner of the agricultural fields, to be disrupted by the improvement, and the proposal was determined to be unfeasible and therefore abandoned. Therefore, no thorough evaluation of Option 9 was conducted. See **Figure OPT 9** (next page) for a conceptual layout.



NOTE:
OPTION #9 WAS REQUESTED BY INTERESTED PARTIES DURING PUBLIC MEETING #2. FOLLOWING DISCUSSIONS WITH LEASEE OF THE AGRICULTURAL FIELDS THE IDEA WAS STRONGLY DISCOURAGED. AS A RESULT, OPTION #9 WAS ABANDONED AND THEREFORE NO THOROUGH EVALUATION OF THE OPTION WAS COMPLETED.

0 200' 400'

UNCONTROLLED BASIN (BASINS sb.1 THRU sb.29)
VELARDE DAM BASIN (BASINS sb.100 THRU sb.107)
NORTH SALEM DAM BASIN (BASINS sb.200 THRU sb.205)
SOUTH SALEM DAM BASIN (BASINS sb.300 THRU sb.301)
REED-THURMAND DAM BASIN (BASINS sb.400 THRU sb.409)

LEGEND

(dashed magenta line)	MAJOR BASIN BOUNDARY
(dashed black line)	SUB-BASIN BOUNDARY
sb.## / XX AC. / XX MI²	SUB-BASIN NUMBER / SUB-BASIN AREA (AC./MI²)
(solid black line)	PRINCIPAL PIPE OUTLET FROM DAM
(dash-dot magenta line)	EXISTING PROPERTY LINE
(solid red line)	PROPOSED IMPROVEMENTS

NOTE: DIGITAL ORTHOPHOTOGRAPHY AND LIDAR COMPLETED IN 2010 BY DOÑA ANA COUNTY. THE CONTOUR INTERVAL FOR OPT 9 IS 2-FOOT.

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DONA ANA COUNTY, NEW MEXICO

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DONA ANA COUNTY
SALEM DRAINAGE MASTER PLAN

OPTION 9 - DETENTION POND & CHANNEL IMPROVEMENTS

SOLUTIONS FOR TODAY... VISION FOR TOMORROW
201 N. Church Street, Suite 310
Las Cruces, NM 88001
Phone: (575) 523-2395
Fax: (575) 523-2396
SMITH ENGINEERING COMPANY
NEW MEXICO TEXAS

JOB NO: 815104
DATE: MARCH 2016
SHEET NO: OPT 9

J. MAINTENANCE OF EXISTING FACILITIES

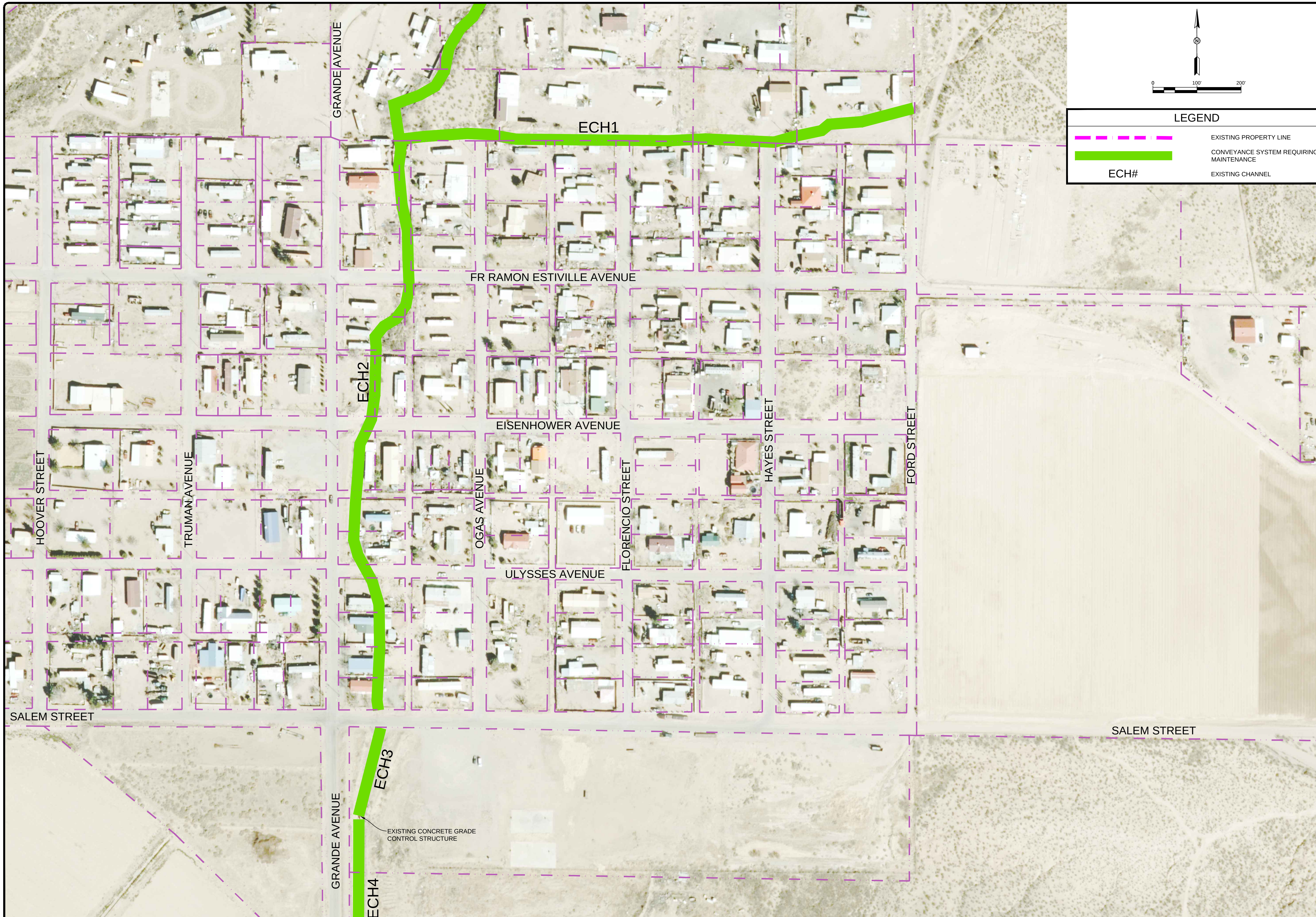
Doña Ana County, in conjunction with the Caballo Soil and Water Conservation District (SCWCD), should evaluate and clean/maintain all facilities on both public (State of New Mexico and Bureau of Land Management Lands) as well as any facilities administered by the County or SCWCD. Many of the conveyance facilities (channel parallel to Grande Avenue from Salem Street north and the channel parallel to Fr Ramon Estiville Avenue) are located within private properties and may not be accessed by County Personnel. In this case private owners should be advised of the possible hazards associated without routine maintenance of their facilities. The Doña Ana County Community and Constituent Services Office have procedures and resources available to assist area residents with maintenance of facilities. See **Figure Maintenance** on the following page for areas requiring maintenance.

3.5 HEC-HMS Hydrologic Models

Figures OP1 through OP8 (included in **Appendix 6**) presents the HEC-HMS model schematics along with a generic legend.

The following output summary tables are included in **Appendix 6**.

Table 22:	5-year 24-hour Storm	Option 1 Proposed Conditions Hydrologic Summary
Table 23:	10-year 24-hour Storm	Option 1 Proposed Conditions Hydrologic Summary
Table 24:	100-year 24-hour Storm	Option 1 Proposed Conditions Hydrologic Summary
Table 25:	5-year 24-hour Storm	Option 2 Proposed Conditions Hydrologic Summary
Table 26:	10-year 24-hour Storm	Option 2 Proposed Conditions Hydrologic Summary
Table 27:	100-year 24-hour Storm	Option 2 Proposed Conditions Hydrologic Summary
Table 28:	5-year 24-hour Storm	Option 3 Proposed Conditions Hydrologic Summary
Table 29:	10-year 24-hour Storm	Option 3 Proposed Conditions Hydrologic Summary
Table 30:	100-year 24-hour Storm	Option 3 Proposed Conditions Hydrologic Summary
Table 31:	5-year 24-hour Storm	Option 4 Proposed Conditions Hydrologic Summary
Table 32:	10-year 24-hour Storm	Option 4 Proposed Conditions Hydrologic Summary
Table 33:	100-year 24-hour Storm	Option 4 Proposed Conditions Hydrologic Summary
Table 34:	5-year 24-hour Storm	Option 5 Proposed Conditions Hydrologic Summary
Table 35:	10-year 24-hour Storm	Option 5 Proposed Conditions Hydrologic Summary
Table 36:	100-year 24-hour Storm	Option 5 Proposed Conditions Hydrologic Summary
Table 37:	5-year 24-hour Storm	Option 6 Proposed Conditions Hydrologic Summary
Table 38:	10-year 24-hour Storm	Option 6 Proposed Conditions Hydrologic Summary
Table 39:	100-year 24-hour Storm	Option 6 Proposed Conditions Hydrologic Summary
Table 40:	5-year 24-hour Storm	Option 7 Proposed Conditions Hydrologic Summary
Table 41:	10-year 24-hour Storm	Option 7 Proposed Conditions Hydrologic Summary
Table 42:	100-year 24-hour Storm	Option 7 Proposed Conditions Hydrologic Summary
Table 43:	5-year 24-hour Storm	Option 8 Proposed Conditions Hydrologic Summary
Table 44:	10-year 24-hour Storm	Option 8 Proposed Conditions Hydrologic Summary
Table 45:	100-year 24-hour Storm	Option 8 Proposed Conditions Hydrologic Summary
Table 46:	Reservoir Routing Summary	



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SALEM
DONA ANA COUNTY, NEW MEXICO

NO	REVISION DESCRIPTION	DATE	BY
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2			
3			
4			
5			

DONA ANA COUNTY
SALEM DRAINAGE MASTER PLAN

AREAS REQUIRING MAINTENANCE

SOLUTIONS FOR TODAY...
VISION FOR TOMORROW

201 N. Church Street,
Suite 310
Las Cruces, NM 88001
Phone: (575) 523-2395
Fax: (575) 523-2396

SMITH ENGINEERING COMPANY
NEW MEXICO
TEXAS

JOB NO:
815104

DATE:
MARCH 2016

SHEET NO:
MAINTENANCE

L:\SEC--PROJECTS\815104 Salem DMP\ENGINEERING\CADD\PLANSET\FIGURE 6 - AREAS REQUIRING MAINTENANCE.dwg Feb 29, 2016 - 2:38pm Saved By: rustyp

3.6 Summary of Options Hydrologic Benefits

Table 46.1 on the following page presents the hydrologic benefits of the proposed options at various key areas within and around the community of Salem. A composite hydrologic model was developed based on the County's selected options; the results of the composite model are presented within Section 4 of this report.

TABLE 46.1

OPTION PEAK DISCHARGE SUMMARY AT CRITICAL ANALYSIS POINTS
(Comparison of Existing Peak Discharges to Option Peak Discharges)
Salem Area Drainage Master Plan

Location Description	Existing or Option No.	HEC-HMS Analysis Point Model Name	5-year 24-hour Peak Discharge	10-year 24-hour Peak Discharge	100-year 24-hour Peak Discharge	Comments
			cfs	cfs	cfs	
a	c	b	d	d	d	
OPTIONS 1 - 7 RELATE TO THE TOWN OF SALEM						
Grande Avenue at Salem Street	Existing	j.sb13&rtc.16	12	19	42	Pond
" "	Option 1	" "	2	3	7	
North End of Ford Street Private Property East Boundary	Existing	j.sb23 & rtc.10	23	30	57	Where existing channel ECH1 enters private property
" "	Option 2	" "	23	30	57	
" "	Option 3	" "	23	30	57	
" "	Option 4	" "	-	-	-	
" "	Option 5	" "	-	-	-	
" "	Option 7	" "	-	-	-	
North End of Channel Parallel to Grande Avenue (East Side)	Existing	j.sb19-sb20&sb.23	56	70	141	Where existing channel ECH1 meets existing channel EHC2
" "	Option 2	" "	54	60	142	
" "	Option 3	" "	54	65	111	
" "	Option 4	" "	33	40	105	
" "	Option 5	" "	32	36	80	
" "	Option 7	" "	32	36	80	
Existing Channel East of Grande Avenue Where it Crosses Salem Street	Existing	j.sb18 & rtc.7	57	73	145	Where existing channel ECH3 starts at Salem Street
" "	Option 2	" "	54	61	143	
" "	Option 3	" "	55	67	144	
" "	Option 4	" "	37	61	140	
" "	Option 5	" "	37	60	139	
" "	Option 7	" "	37	60	139	
Existing Culvert Crossing Under NM 187 that Releases the Stormwater Runoff Above	Existing	out.sb15	58	75	148	Existing Culvert EC1
" "	Option 2	" "	54	61	144	
" "	Option 3	" "	56	69	146	
" "	Option 4	" "	37	61	141	
" "	Option 5	" "	37	61	140	
" "	Option 7	" "	37	61	140	
Proposed Ponding on County Property South of Salem Street	Existing	rtc.11	8	14	36	Proposed detention pond to slow the release of stormwater
" "	Option 6	" "	2	4	29	
" "	Option 7	" "	19	22	60	
OPTIONS 8 RELATES TO UNCONTROLLED BASIN JUST WEST OF TOWN OF SALEM						
Proposed Detention Pond on the South End of Sub-Basin sb.8	Existing	sb.8 + rtc.22	98	174	460	Pond
" "	Option 8	OPT8.Pond	13	18	216	

a - See Drainage Basin Maps in map pocket for location and Report Text for Channel and Culvert Locations
b - See Appendix 5 for Existing and Appendix 6 for Proposed HEC-HMS Modeling Schematics for Analysis Point Locations
c - See Appendix 5 for Existing and Appendix 6 for Proposed HEC-HMS Model Summary Tables
d - See Appendix 6 for Proposed HEC-HMS Hydrologic Summary Results

SECTION 4. PRIORITIZATION OF OPTIONS

The Doña Ana County Flood Commission reviewed each Option Model and their respective results; in conjunction with **Smith,** the following Options were determined to be viable and shall be cost evaluated.

A. Option 4
B. Option 5
C. Option 6
D. Option 7

After comparisons of the selected Option(s) Model output, as well as thorough discussions with the Doña Ana County Flood Commission, the most effective Options were compiled into a Composite Option as explained below.

4.1 Proposed Composite Option Description

The proposed detention ponds (Ponds 1 and 2) are located on the Doña Ana County owned property just south of Salem Street; see **Figure Composite** – Map Pocket. Each of the channel and/or roadway improvements are located along the eastern stretch of the community of Salem.

Composite Option Description

The Composite Options include a Pond 1 (Phase 1) and a Pond 2 (Phase 2). Each of these will also include a conveyance Option A and/or B.

Phase 1 Pond

Phase 1 includes the construction of detention pond, Pond 1, to detain stormwater runoff from sub-basin sb.17; as well as channelization improvements (PCH C.3 and PCH C.4) to route stormwater runoff into the proposed pond.

Phase 2 Pond

Phase 2 includes an expansion of Pond 1 into Pond 2. It enlarges the Pond 2 footprint to include Pond 1 footprint and it deepens the entire pond to increase capacity. Therefore, excavation quantities for the Phase 2-Pond 2 portion of the pond are only those outside or below the Phase 1-Pond 1 area.

Phase 2 also includes the roadway improvements (Ford Street Option A) or channel improvements adjacent to Ford Street (Composite Option B) as well as channelization improvements to intercept upstream stormwater runoff.

Initially Composite Option Pond 1 would be constructed to detain some of the stormwater runoff from the developed portions of Salem. As funding becomes available, the remaining improvements in the Composite Option can be phased into place. The last portion of the Composite Option Pond 2 (detention pond) would increase the storage capacity of the Composite Option Pond 1.

Composite Option Assumptions

Detention Pond 1, as well as detention Pond 2, are located on the Doña Ana County owned park at the north end of the sub-basin sb.16.

a. Assume Sub-Basins 17, 20P, 22 and 23 (sb.17, sb.20P, sb.22, and sb.23) outfall into the Pond 2 once it's completed. Initially, only Sub-Basin sb.17 will outfall into Pond 1.

b. Will require channelization to capture flows from each of the aforementioned sub-basins.

c. The Composite Option Pond 2 will be a detention pond sized to detain approximately one-third of the 10-year/24-hour storm event (maximum design storage volume of 16.2 ac-ft).

d. Pond principal outlet (24" CMP) will release a controlled volume of detained water to continue downstream along its natural course.

e. Pond emergency spillway is sized to allow the 100-year/24-hour stormwater runoff to continue its natural course unimpeded.

e. Assume that both the North and South Salem Dams are in place.

Conveyance Options A or B

The Composite Option also contains channel (PCH C.1, PCH C.2, PCH C.3, PCH C.4, and PCH C.B-Option B) or roadway improvements (Ford Street PR C-Option A) to intercept upstream incoming stormwater runoff and direct it into the Composite Option Pond 2.

The conveyance Options are as follows:

A: Improvements to Ford Street (PR.C) as a conveyance system, or

B: An earthen channel adjacent (east side) to Ford Street (PCH C.B) as the conveyance system.

Refer to **Figure COMPOSITE** – Included in Map Pocket for Pond Option locations and conveyance options.

4.2 HEC-HMS Hydrologic Composite Option Model

The assumptions (hydrologic) made in the Options models were replicated in the HEC-HMS Proposed Composite Option Model. Brief synopses of the assumptions carried over are presented below:

A. Model computation time increment – 1 minute
B. No additional Sub-Basins were created in the Proposed Composite Option Model
C. Soils data and Runoff Curve Numbers values for each Sub-Basin remain unchanged
D. The storm events models in the existing conditions model are the same events used to create the Proposed Composite Option Model
E. Simulate a detention pond complete with both a principal outlet and an emergency spillway.

The Composite Option reservoir routing summary results (Pond 2) are included in **Table 57 (Appendix 6).** The channel routing and capacity summary results for the proposed composite improvements are included in **Table 63 (Appendix 7)**.

Figure Composite Option (included in **Appendix 6**) presents the HEC-HMS model schematic(s) along with a generic legend.

The following output summary tables are included in **Appendix 6**.

Table 54 5-year 24-hour Storm Composite Option Proposed Conditions Hydrologic Summary

Table 55 10-year 24-hour Storm Composite Option Proposed Conditions Hydrologic Summary

Table 56 100-year 24-hour Storm Composite Option Proposed Conditions Hydrologic Summary

Table 57 Composite Option Reservoir Routing Summary

4.3 Composite Option Results

1. Composite Option Detention Pond 2 (including deeper Pond 1)

   a. will detain approximately half of the 5-year peak inflow volume of 32.9 ac-ft.

   b. will detain about one-third of the 10-year peak inflow volume of 48.4 ac-ft.

   c. will detain about one-tenth of the 100-year peak inflow volume of 99.4 ac-ft.

   See **Figure Composite (map pocket)** that also presents the reservoir routing data and freeboard summary.

<u>Composite Option Conclusion:</u>

The Composite Option Pond 2 will detain a fair portion of the 5- and 10-year storm events, but will not provide much benefit against the 100-year storm event. However, each of the Composite Option Channels (PCH C.1, PCH C.2, PCH C.3, PCH C.4, and PCH C.B-Option B) or the roadway improvements to Ford Street (PR C-Option A) can adequately convey the 100-year storm event runoff volumes.

Maintenance, as mentioned previously, is an integral part of the proposed improvements and shall be continued throughout.

4.4 Composite Option – Conceptual EOPC

The conceptual level EOPC for the Composite Option (**Tables 58 and 59-Appendix 6**) are presented on the following pages. As mentioned previously, the EOPC accounts for contingency, engineering services, and 2016 New Mexico Gross Receipts Taxes. Construction phase services (administration and observation) are not included within the EOPC.

TABLE 58 - COMPOSITE OPTION A

Includes - detention pond, channel improvements, and roadway improvement to Ford Street

ENGINEER'S OPINION OF PROBABLE COST (EOPC) FOR CONCEPTUAL DESIGN

PHASE 1 - COMPOSITE OPTION A

ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST
1	CLEARING AND GRUBBING, COMPLETE IN PLACE	LUMP SUM	1	$2,500.00	$2,500.00
2	SOIL BULK EXCAVATION FOR PONDS (incl. EXCAVATION AND DISPOSAL), COMPLETE IN PLACE	CY	8,300	$15.00	$124,500.00
3	RELOCATION OF EXISTING PARK AMENITIES	LUMP SUM	1	$1,500.00	$1,500.00
4	UNCLASSIFIED EXCAVATION	CY	560	$10.00	$5,600.00
5	LINEAR GRADING	LIN. FEET	580	$15.00	$8,700.00
6	12" SUBGRADE PREPARATION, COMPLETE IN PLACE	SY	10,100	$5.00	$50,500.00
7	FINAL GRADING, COMPLETE IN PLACE	SY	8,900	$5.00	$44,500.00
8	24" DIAMETER OUTLET PIPE	LIN. FEET	40	$50.00	$2,000.00
9	RIP-RAP CLASS A, COMPLETE IN PLACE	CY	435	$25.00	$10,875.00
10	CHAIN LINK FENCE (6' HIGH), COMPLETE IN PLACE	LIN. FEET	1,264	$25.00	$31,600.00
11	16' DOUBLE CHAIN LINK GATE w/ LOCKING MECHANISM, COMPLETE IN PLACE	EA	1	$4,000.00	$4,000.00
12	SECURITY SIGNING (ATTACHED TO FENCING & GATE)	LUMP SUM	1	$500.00	$500.00
13	CONSTRUCTION TRAFFIC CONTROL	LUMP SUM	1	$2,500.00	$2,500.00
14	MOBILIZATION/DEMOBILIZATION	LUMP SUM	1	8.00%	$28,000.00
15	CONSTRUCTION STAKING (incl. LAYOUT, QUANTITY VERIFICATION, AS-BUILT INFORMATION, COMPLETE)	LUMP SUM	1	2.00%	$7,000.00
16	MATERIALS TESTING	ALLOW	1	2.00%	$7,000.00
17	NPDES PERMITTING AND SWPPP PREPARATION AND IMPLEMENTATION	LUMP SUM	1	$15,000.00	$15,000.00

A)	**SUBTOTAL OF COMPOSITE OPTION A PHASE 1 EOPC:**	$347,000.00
B)	**CONTINGENCY @ 25%:**	$86,750.00
C)	**SUBTOTAL COMPOSITE OPTION A PHASE 1 EOPC AND CONTINGENCY:**	$433,750.00
D)	**PRE-CONSTRUCTION COSTS: (DESIGN, SURVEY, GEOTECHNICAL, & SUE = 20% of C)**	$86,750.00
E)	**SUBTOTAL COMPOSITE OPTION A EOPC, CONTINGENCY, AND PRE-CONSTRUCTION COSTS: (C + D)**	$520,500.00
F)	**ALLOWANCES**	
	UTILITY RELOCATION (IF APPLICABLE)	$5,000.00
	LAND ACQUISITION (ASSUMED VALUE OF $2,000/AC)	*$0.00*
G)	**SUBTOTAL COMPOSITE OPTION A PHASE 1 EOPC: (E + F)**	$525,500.00
H)	**NEW MEXICO GROSS RECEIPTS TAX (NMGRT - JANUARY 2016) - 6.7500%**	$35,471.25
I)	**TOTAL COMPOSITE OPTION A PHASE 1 EOPC w/ TAX (NMGRT 2016): (G + H)**	**$560,971.25**

PHASE 2 - COMPOSITE OPTION A

ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST
1	CLEARING AND GRUBBING, COMPLETE IN PLACE	LUMP SUM	1	$2,500.00	$2,500.00
2	SOIL BULK EXCAVATION FOR PONDS (incl. EXCAVATION AND DISPOSAL), COMPLETE IN PLACE	CY	17,900	$15.00	$268,500.00
3	RELOCATION OF EXISTING PARK AMENITIES	LUMP SUM	1	$1,500.00	$1,500.00
4	UNCLASSIFIED EXCAVATION	CY	1,080	$10.00	$10,800.00
5	LINEAR GRADING	LIN. FEET	2,210	$15.00	$33,150.00
6	12" SUBGRADE PREPARATION, COMPLETE IN PLACE	SY	13,600	$5.00	$68,000.00
7	FINAL GRADING, COMPLETE IN PLACE	SY	8,350	$5.00	$41,750.00
8	2" HMA SP III COMPLETE	SY	3,050	$15.00	$45,750.00

9	BASE COURSE 8"	SY	3,050	$8.00	$24,400.00
10	CHAIN LINK FENCE (6' HIGH), COMPLETE IN PLACE	LIN. FEET	700	$25.00	$17,500.00
11	24" STANDARD CURB & GUTTER	LIN. FEET	2,500	$20.00	$50,000.00
12	SECURITY SIGNING (ATTACHED TO FENCING & GATE)	LUMP SUM	1	$500.00	$500.00
13	CONSTRUCTION TRAFFIC CONTROL	LUMP SUM	1	$2,500.00	$2,500.00
14	MOBILIZATION/DEMOBILIZATION	LUMP SUM	1	8.00%	$54,000.00
15	CONSTRUCTION STAKING (incl. LAYOUT, QUANTITY VERIFICATION, AS-BUILT INFORMATION, COMPLETE)	LUMP SUM	1	2.00%	$14,000.00
16	MATERIALS TESTING	ALLOW	1	2.00%	$14,000.00
17	NPDES PERMITTING AND SWPPP PREPARATION AND IMPLEMENTATION	LUMP SUM	1	$15,000.00	$15,000.00

J)	**SUBTOTAL OF COMPOSITE OPTION A EOPC:**	$664,000.00
K)	**CONTINGENCY @ 25%:**	$166,000.00
L)	**SUBTOTAL COMPOSITE OPTION A EOPC AND CONTINGENCY:**	$830,000.00
M)	**PRE-CONSTRUCTION COSTS: (DESIGN, SURVEY, GEOTECHNICAL, & SUE = 20% of L)**	$166,000.00
N)	**SUBTOTAL COMPOSITE OPTION A EOPC, CONTINGENCY, AND PRE-CONSTRUCTION COSTS: (L + M)**	$996,000.00
O)	**ALLOWANCES**	
	UTILITY RELOCATION (IF APPLICABLE)	$5,000.00
	LAND ACQUISITION (ASSUMED VALUE OF $2,000/AC)	*$4,000.00*
P)	**SUBTOTAL COMPOSITE OPTION A EOPC: (N + O)**	$1,005,000.00
Q)	**NEW MEXICO GROSS RECEIPTS TAX (NMGRT - JANUARY 2016) - 6.7500%**	$67,837.50
R)	**TOTAL COMPOSITE OPTION A PHASE 2 EOPC w/ TAX (NMGRT 2016): (P + Q)**	**$1,072,837.50**
S)	**TOTAL COMPOSITE OPTION A EOPC w/ TAX (NMGRT 2016): (I + R)**	**$1,633,808.75**

ASSUMPTIONS FOR COMPOSITE A OPTION EOPC

1. PHASE 1 OF THE COMPOSITE OPTION WILL CONSTRUCT THE INITIAL POND TO DETAIN THE RUNOFF GENERATED IN SUB-BASIN sb.17 AS WELL AS THE CHANNEL IMPROVEMENTS TO ROUTE STORMWATER RUNOFF INTO THE POND.
2. PHASE 2 OF THE COMPOSITE OPTION WILL INCREASE THE CAPACITY OF THE DETENTION POND TO DETAIN RUNOFF FROM THE INTERCEPTED UPSTREAM SUB-BASINS (sb.17, sb.20P, sb.22, & sb.23). ADDITIONAL ROADWAY (FORD STREET) AND CHANNEL IMPROVEMENTS WILL ALSO BE CONSTRUCTED.
3. ASSUME THAT THE DONA ANA COUNTY OWNED PARK IN sb.16 CAN BE UTILIZED FOR CONSTRUCTION OF THE PROPOSED DETENTION POND.
4. ASSUME THE UTILITY RELOCATION REQUIRED FOR THESE IMPROVEMENTS IS MINIMUM (ASSUMED $5,000).
5. RETENTION POND IS SIZED TO DETAIN APPROXIMATELY ONE-THIRD (1/3) OF THE STORMWATER RUNOFF GENERATED BY THE 10-YEAR/24-HOUR STORM w/ A MINIMUM OF ONE-FOOT (1') FREEBOARD. PHASE 2
6. CONCEPTUAL POND VOLUME TAKES INTO ACCOUNT THE RUNOFF GENERATED BY SUB-BASINS: sb.17, sb.20P, sb.22, AND sb.23. PHASE 2
7. ASSUME PROPOSED CHANNEL (PCH C.4) WILL BE RIP-RAP LINED; AS WELL AS A 40' WIDE BY 20' LONG BY 2' DEEP PAD AT THE EMERGENCY SPILLWAY AND A 10' WIDE BY 10' LONG BY 2' DEEP PAD AT THE PRINCIPAL OUTLET PIPE.
8. UNCLASSIFIED EXCAVATION IS ASSUMED TO BE THE TOTAL VOLUME OF THE PROPOSED CHANNEL IMPROVEMENTS.
9. SOIL BULK EXCAVATION FOR PONDS IS ASSUME TO BE THE TOTAL VOLUME OF THE PROPOSED DETENTION POND.

TABLE 59 - COMPOSITE OPTION B

Includes - detention pond and channel improvements

ENGINEER'S OPINION OF PROBABLE COST (EOPC) FOR CONCEPTUAL DESIGN

PHASE 1 - COMPOSITE OPTION B

ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST
1	CLEARING AND GRUBBING, COMPLETE IN PLACE	LUMP SUM	1	$2,500.00	$2,500.00
2	SOIL BULK EXCAVATION FOR PONDS (incl. EXCAVATION AND DISPOSAL), COMPLETE IN PLACE	CY	8,300	$15.00	$124,500.00
3	RELOCATION OF EXISTING PARK AMENITIES	LUMP SUM	1	$1,500.00	$1,500.00
4	UNCLASSIFIED EXCAVATION	CY	560	$10.00	$5,600.00
5	LINEAR GRADING	LIN. FEET	580	$15.00	$8,700.00
6	12" SUBGRADE PREPARATION, COMPLETE IN PLACE	SY	10,100	$5.00	$50,500.00
7	FINAL GRADING, COMPLETE IN PLACE	SY	8,900	$5.00	$44,500.00
8	24" DIAMETER OUTLET PIPE	LIN. FEET	40	$50.00	$2,000.00
9	RIP-RAP CLASS A, COMPLETE IN PLACE	CY	435	$25.00	$10,875.00
10	CHAIN LINK FENCE (6' HIGH), COMPLETE IN PLACE	LIN. FEET	1,264	$25.00	$31,600.00
11	16' DOUBLE CHAIN LINK GATE w/ LOCKING MECHANISM, COMPLETE IN PLACE	EA	1	$4,000.00	$4,000.00
12	SECURITY SIGNING (ATTACHED TO FENCING & GATE)	LUMP SUM	1	$500.00	$500.00
13	CONSTRUCTION TRAFFIC CONTROL	LUMP SUM	1	$2,500.00	$2,500.00
14	MOBILIZATION/DEMOBILIZATION	LUMP SUM	1	8.00%	$28,000.00
15	CONSTRUCTION STAKING (incl. LAYOUT, QUANTITY VERIFICATION, AS-BUILT INFORMATION, COMPLETE)	LUMP SUM	1	2.00%	$7,000.00
16	MATERIALS TESTING	ALLOW	1	2.00%	$7,000.00
17	NPDES PERMITTING AND SWPPP PREPARATION AND IMPLEMENTATION	LUMP SUM	1	$15,000.00	$15,000.00

A)	**SUBTOTAL OF COMPOSITE OPTION B PHASE 1 EOPC:**	$347,000.00
B)	**CONTINGENCY @ 25%:**	$86,750.00
C)	**SUBTOTAL COMPOSITE OPTION B PHASE 1 EOPC AND CONTINGENCY:**	$433,750.00
D)	**PRE-CONSTRUCTION COSTS: (DESIGN, SURVEY, GEOTECHNICAL, & SUE = 20% of C)**	$86,750.00
E)	**SUBTOTAL COMPOSITE OPTION B EOPC, CONTINGENCY, AND PRE-CONSTRUCTION COSTS: (C + D)**	$520,500.00
F)	**ALLOWANCES**	
	UTILITY RELOCATION (IF APPLICABLE)	$5,000.00
	LAND ACQUISITION (ASSUMED VALUE OF $2,000/AC)	*$0.00*
G)	**SUBTOTAL COMPOSITE OPTION B PHASE 1 EOPC: (E + F)**	$525,500.00
H)	**NEW MEXICO GROSS RECEIPTS TAX (NMGRT - JANUARY 2016) - 6.7500%**	$35,471.25
I)	**TOTAL COMPOSITE OPTION B PHASE 1 EOPC w/ TAX (NMGRT 2016): (G + H)**	**$560,971.25**

PHASE 2 - COMPOSITE OPTION B

ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST
1	CLEARING AND GRUBBING, COMPLETE IN PLACE	LUMP SUM	1	$2,500.00	$2,500.00
2	SOIL BULK EXCAVATION FOR PONDS (incl. EXCAVATION AND DISPOSAL), COMPLETE IN PLACE	CY	17,900	$15.00	$268,500.00
3	RELOCATION OF EXISTING PARK AMENITIES	LUMP SUM	1	$1,500.00	$1,500.00
4	UNCLASSIFIED EXCAVATION	CY	2,700	$10.00	$27,000.00
5	LINEAR GRADING	LIN. FEET	2,260	$15.00	$33,900.00
6	12" SUBGRADE PREPARATION, COMPLETE IN PLACE	SY	13,150	$5.00	$65,750.00
7	FINAL GRADING, COMPLETE IN PLACE	SY	8,350	$5.00	$41,750.00
8	CHAIN LINK FENCE (6' HIGH), COMPLETE IN PLACE	LIN. FEET	700	$25.00	$17,500.00

9	5' SPAN BY 3' RISE CONCRETE BOX CULVERT w/ HEADWALLS AND CONCRETE APRON	LIN. FEET	50	$500.00	$25,000.00
10	SECURITY SIGNING (ATTACHED TO FENCING & GATE)	LUMP SUM	1	$500.00	$500.00
11	CONSTRUCTION TRAFFIC CONTROL	LUMP SUM	1	$2,500.00	$2,500.00
12	MOBILIZATION/DEMOBILIZATION	LUMP SUM	1	8.00%	$46,000.00
13	CONSTRUCTION STAKING (incl. LAYOUT, QUANTITY VERIFICATION, AS-BUILT INFORMATION, COMPLETE)	LUMP SUM	1	2.00%	$12,000.00
14	MATERIALS TESTING	ALLOW	1	2.00%	$12,000.00
15	NPDES PERMITTING AND SWPPP PREPARATION AND IMPLEMENTATION	LUMP SUM	1	$15,000.00	$15,000.00

J)	**SUBTOTAL OF COMPOSITE OPTION B EOPC:**	$572,000.00
K)	**CONTINGENCY @ 25%:**	$143,000.00
L)	**SUBTOTAL COMPOSITE OPTION B EOPC AND CONTINGENCY:**	$715,000.00
M)	**PRE-CONSTRUCTION COSTS: (DESIGN, SURVEY, GEOTECHNICAL, & SUE = 20% of L)**	$143,000.00
N)	**SUBTOTAL COMPOSITE OPTION B EOPC, CONTINGENCY, AND PRE-CONSTRUCTION COSTS: (L + M)**	$858,000.00
O)	**ALLOWANCES**	
	UTILITY RELOCATION (IF APPLICABLE)	$5,000.00
	LAND ACQUISITION (ASSUMED VALUE OF $2,000/AC)	*$4,000.00*
P)	**SUBTOTAL COMPOSITE OPTION B EOPC: (N + O)**	$867,000.00
Q)	**NEW MEXICO GROSS RECEIPTS TAX (NMGRT - JANUARY 2016) - 6.7500%**	$58,522.50
R)	**TOTAL COMPOSITE OPTION B PHASE 2 EOPC w/ TAX (NMGRT 2016): (P + Q)**	**$925,522.50**
S)	**TOTAL COMPOSITE OPTION B EOPC w/ TAX (NMGRT 2016): (I + R)**	**$1,486,493.75**

ASSUMPTIONS FOR COMPOSITE B OPTION EOPC

1 PHASE 1 OF THE COMPOSITE OPTION WILL CONSTRUCT THE INITIAL POND TO DETAIN THE RUNOFF GENERATED IN SUB-BASIN sb.17 AS WELL AS THE CHANNEL IMPROVEMENTS TO ROUTE STORMWATER RUNOFF INTO THE POND.

2 PHASE 2 OF THE COMPOSITE OPTION WILL INCREASE THE CAPACITY OF THE DETENTION POND TO DETAIN RUNOFF FROM THE INTERCEPTED UPSTREAM SUB-BASINS (sb.17, sb.20P, sb.22, & sb.23). ADDITIONAL CHANNEL IMPROVEMENTS WILL ALSO BE CONSTRUCTED.

3 ASSUME THAT THE DONA ANA COUNTY OWNED PARK IN sb.16 CAN BE UTILIZED FOR CONSTRUCTION OF THE PROPOSED DETENTION POND.

4 ASSUME THE UTILITY RELOCATION REQUIRED FOR THESE IMPROVEMENTS IS MINIMUM (ASSUMED $5,000).

5 RETENTION POND IS SIZED TO DETAIN APPROXIMATELY ONE-THIRD (1/3) OF THE STORMWATER RUNOFF GENERATED BY THE 10-YEAR/24-HOUR STORM w/ A MINIMUM OF ONE-FOOT (1') FREEBOARD. PHASE 2

6 CONCEPTUAL POND VOLUME TAKES INTO ACCOUNT THE RUNOFF GENERATED BY SUB-BASINS: sb.17, sb.20P, sb.22, AND sb.23. PHASE 2

7 ASSUME PROPOSED CHANNEL (PCH C.4) WILL BE RIP-RAP LINED; AS WELL AS A 40' WIDE BY 20' LONG BY 2' DEEP PAD AT THE EMERGENCY SPILLWAY AND A 10' WIDE BY 10' LONG BY 2' DEEP PAD AT THE PRINCIPAL OUTLET PIPE.

8 UNCLASSIFIED EXCAVATION IS ASSUMED TO BE THE TOTAL VOLUME OF THE PROPOSED CHANNEL IMPROVEMENTS.

9 SOIL BULK EXCAVATION FOR PONDS IS ASSUME TO BE THE TOTAL VOLUME OF THE PROPOSED DETENTION POND.

4.5 Conclusions and Recommendations

Smith, in conjunction with the Doña Ana County Flood Commission and the residents of Salem, has determined that the Composite Option is the most practical, efficient, and cost effective approach to managing stormwater runoff within the community of Salem. This option is capable of intercepting and detaining a large portion of stormwater runoff; thereby minimizing the localized flooding issues with the developed areas of Salem.

The results and recommendations within this Drainage Master Plan should be reviewed at least every five years or as existing or developed conditions change. The presence of the four SCS Dams upstream of Salem benefit the area greatly, but they're subject to erosion, lost capacity due to sedimentation, and possible failure due to storm events beyond their engineered capacities. Should any of these events occur, or if new development within the community occurs, the findings and recommendations within this Plan should be revisited.

In addition to the recommendation of the Composite Option, the County and residents of Salem should take a proactive approach to maintaining the existing drainage conveyances and systems within the area.

SECTION 5. REFERENCES

Figure 14, Depth-Area Curves (Source: NOAA Atlas 2 Vol. IV, 1973).

NOAA Atlas 2 Precipitation – Frequency Atlas of the Western United States. Vol. IV New Mexico, 1973.

NOAA Atlas 14 Point Precipitation Frequency Estimates (printed from NOAA Atlas 14 internet site)

Soils Data obtained from the Internet – US Dept. of Agriculture - Natural Resource Conservation Service – Web Soil Survey as follows:

http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

Urban Hydrology for Small Watersheds, US Dept of Agricultural Soil Conservation Service, Technical Release 55, June 1986.

A. Figure B-2, Approximate Geographic Boundaries for SCS Rainfall Distributions
B. Table 2-2a. Runoff Curve Numbers for Urban Areas.
C. Table 2-2b. Runoff Curve Numbers for Cultivated Agricultural Lands.
D. Table 2-2c. Runoff Curve Numbers for Other Agricultural Lands.
E. Table 2-2d. Runoff Curve Numbers for Arid and Semiarid Rangelands.
F. Chapter 3 – Time of Concentration and Travel Time Procedure
G. Appendix F – Equations for Figures and Exhibits

National Engineering Handbook, Part 630, Chapter 15 – Time of Concentration. Natural Resources Conservation Service. May 2010.

Manning's "n" Values from – Open Channel Hydraulics, Ven T. Chow, 1959.

Sediment Bulking Factors were assumed based on select pages – Figure 3.8 within – Sediment and Erosion Design Guide, November 2008. Prepared by Mussetter Engineering Inc. Prepared for the Southern Sandoval County Flood Control Authority.

Time Increment Computation based on select pages from Chapter 4 – Hydrology for Drain System Design and Analysis, Digital Engineering Library @ McGraw Hill.