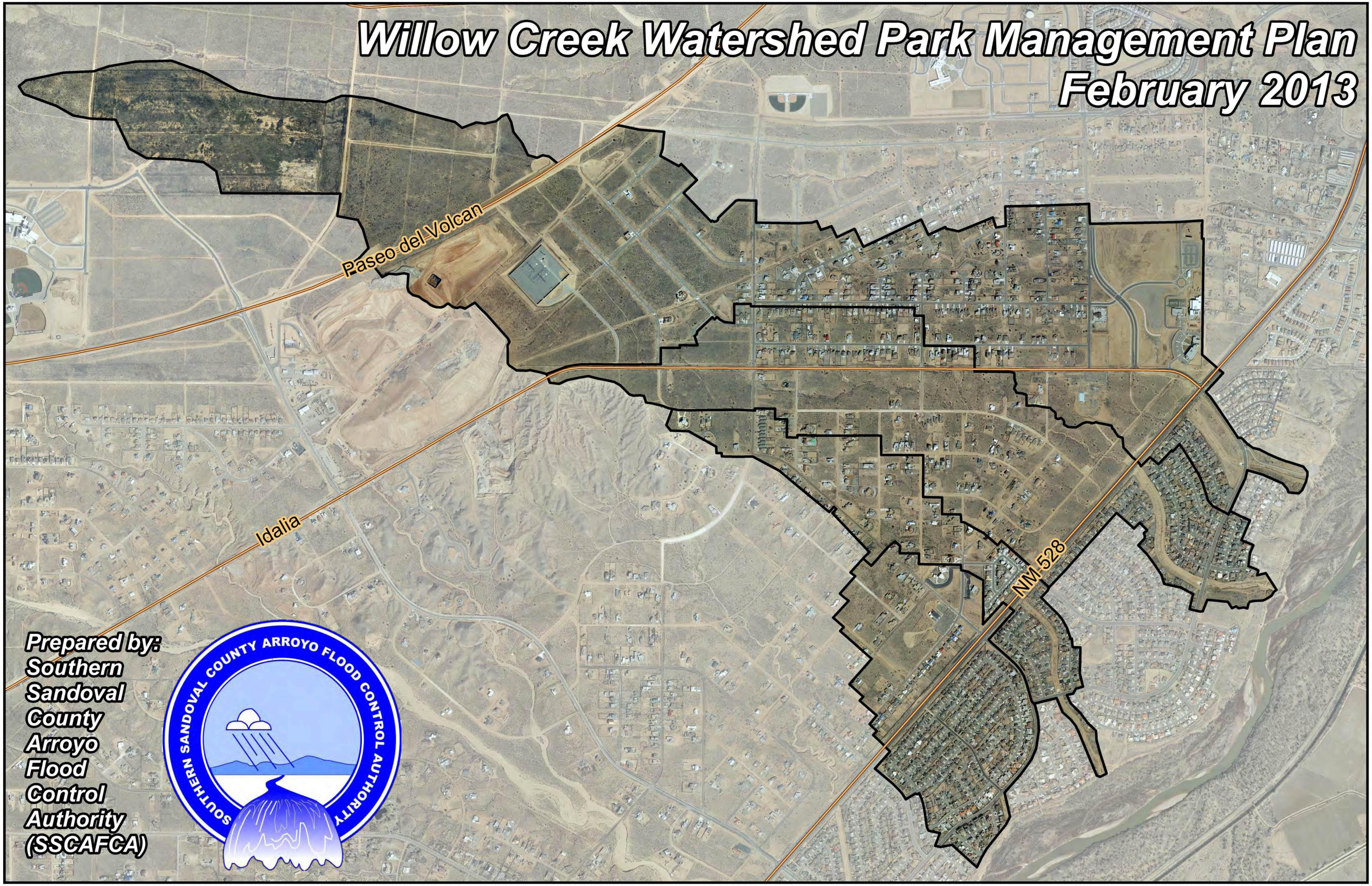
Willow Creek Watershed Park Management Plan
February 2013



Prepared by:
Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA)

WILLOW CREEKWATERSHED PARK MANAGEMENT PLAN

This is a planning document. Nothing herein constitutes any commitment by SSCAFCA to construct any project, study any area, acquire any right of way or enter into any contract. This watershed park management plan does not obligate SSCAFCA in any way.

Drainage facility alignments, conveyance treatments, corridors, locations, rights-of-way and cost estimates are conceptual only, and may be altered or revised based upon future project analysis, changed circumstances or otherwise.

Land uses included in this document were assumed for the basis of hydrologic modeling only. This document does not grant "free discharge" from any proposed development.
Naturalistic channel treatments and piped storm drains are to be used for conveyance stabilization, unless otherwise authorized by SSCAFCA.

Southern Sandoval County Arroyo Flood Control Authority

Southern Sandoval County Arroyo
Flood Control Authority
(SSCAFCA)

DRAFT WILLOW CREEK
WATERSHED PARK MANAGEMENT PLAN
(WCWMP)

The SSCAFCA Willow Creek Watershed Park Management Plan was accepted by the SSCAFCA Board of Directors on 2-15-2013.

By:________________ Date: FEB 15, 2013
Charles Thomas, P.E.
Executive Engineer

By:________________ Date: February 15, 2013
Donald Rudy
Chairman

CONCURRENCE:

________________ Date: 2/21/2013
City of Rio Rancho

A. To ensure public health, safety and welfare, SSCAFCA will develop and maintain the adopted "Master" regional hydrology for all watersheds within its jurisdiction. Updates and revisions will be made and tracked by SSCAFCA or its designee.
B. A copy of the "Master" hydrology model will be available for reference or use by others. Contact SSCAFCA for the process to obtain copies of the model and see the SSCAFCA website for the Watershed Management Plan status. Use of electronic media provided by SSCAFCA is solely at the user's risk.

Southern Sandoval County Arroyo Flood Control Authority
1041 Commercial Drive SE, Rio Rancho, New Mexico 87124
(505) 892-7246   FAX (505) 892-7241

WILLOW CREEK WATERSHED PARK MANAGEMENT PLAN (WCWMP) REVISION HISTORY

CURRENT THROUGH NOVEMBER 2012

Revision	Type	Title	Description of Changes	Prepared by	Effective Date/ Approval Date
v.1 2013	Initial Release	Willow Creek Watershed Park Management Plan	n/a	SSCAFCA	

UNIFORM WATERSHED HYDROLOGY MAINTENANCE

A. To ensure public health, safety and welfare, SSCAFCA will develop and maintain the adopted "Master" regional hydrology for all watersheds within its jurisdiction. Updates and revisions will be made and tracked by SSCAFCA or its designee.

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C. Watershed "Hierarchy." SSCAFCA has established a planning hierarchy for consistency. See SSCAFCA for details.

WILLOW CREEKWATERSHED PARK
MANAGEMENT PLAN

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WILLOW CREEK WATERSHED PARK MANAGEMENT PLAN
ABBREVIATIONS & DEFINITIONS

100-year Storm	-	A storm which has a 1% chance of being equaled or exceeded in any given year
ac	-	Acre
AF	-	Acre-feet of runoff (volume of water that covers one acre one foot deep)
AHYMO	-	**A**rid Lands **HY**drologic **MO**del
AMAFCA	-	Albuquerque Metropolitan Area Flood Control Authority
Arroyo	-	Ephemeral stream in arid or semiarid southwestern U.S. typically with a flat floored channel and vertical or steeply cut banks that is usually dry.
Authority	-	See SSCAFCA
Blvd	-	Boulevard
CBC	-	Concrete Box Culvert
cfs	-	cubic feet per second – flow rate
cfs/ac	-	cubic feet per second per acre
CMP	-	Corrugated Metal Pipe
COA	-	City of Albuquerque
CoRR	-	City of Rio Rancho
USACE	-	United States Army Corps of Engineers
CY	-	Cubic yard
Dam	-	Facility intended for sediment, erosion, and flood control; (see also: "Jurisdictional Dam")
Design Q	-	The flow rate in cfs that the facility was designed for; this assumes that freeboard and other factors were included in the design; this is not the "bank full" capacity
Developed	-	Lot, parcel or area with structures or other man made construction
Detention	-	Collection, temporary storage and controlled release of runoff
DEVEXConditions Hydrology	-	Fully developed watershed, assuming existing platting, and only incorporating currently existing drainage infrastructure
DMP	-	Drainage Master Plan
DPM	-	SSCAFCA 2009 Development Process Manual Chapter 22
Drainage Basin	-	Area of land that drains to a specific location or drainage facility
Drainage Report	-	A document for the purpose of describing the existing drainage conditions, predicting the effects of land use or other changes and proposing solutions to drainage problems
du/ac	-	Dwelling unit per acre
Emergency Spillway	-	A spillway designed to convey excess water through, over or around a dam if the capacity of the dam and principal spillway are exceeded
EPA	-	Environmental Protection Agency
EXISTINGConditions Hydrology	-	Hydrology representing existing development and drainage infrastructure as of the date of the report
Facility	-	Any structure, levee, dike, diversion channel, storm drain, pond, pumping station, detention facility or dam, either natural or manmade, which has the function of conveying, containing, directing or storing stormwater runoff
Facility Name	-	The commonly referenced name for the facility
Facility Plan	-	A drainage study or design analysis of a specific facility, usually limited to a specific drainage basin or sub-basin
Failure	-	An incident resulting in the uncontrolled unintentional release or loss of control of stormwater
FEMA	-	Federal Emergency Management Agency
FIRM	-	Flood Insurance Rate Map
Flood	-	A general and temporary condition of partial or complete inundation of two or more acres of normally dry land or two or more properties from: - Overflow of inland or tidal waters - Unusual and rapid accumulation or runoff of surface waters from any source - Mud flow
Floodplain	-	That area above and alongside a river, an arroyo, floodway or channel, which is subject to inundation by out-of-bank flow
Floodway	-	The central channel or watercourse and the adjacent land area that is administered by FEMA and must be reserved in order to allow discharge of the base flood without increasing the water-surface elevation more than a designated height
fps	-	feet per second
Free Discharge	-	Runoff without peak flow and/or volume attenuation
Fully Developed	-	All areas are assumed to be completely developed (i.e. fully built out) based on existing platting, zoning and/or proposed development
GIS	-	Geographic Information System
Hard Lined Conveyance	-	Constructed channel or other conveyance system with non-pervious lining (concrete, soil cement, etc.)
HEC-HMS	-	Hydrologic Modeling System (HMS) developed and maintained by the US Army Corps of Engineers Hydrologic Engineering Center(HEC); software and manuals can be downloaded for free from the HEC website: http://www.hec.usace.army.mil/software/hec-hms/
Historic Runoff	-	Runoff based on "Pre-Development" conditions. For the purposes of this plan, historic runoff is interpreted as watershed conditions prior to significant human modifications

Jurisdictional Dam	-	Dam under the jurisdiction of the New Mexico Office of the State Engineer; Section 72-5-32 NMSA 19.25.12.7 D. (1) (a) NMAC-N, 3/31/2005, defines a jurisdictional dam as 25 feet or greater in height and storing more than 15 acre-feet or a dam that stores 50 AF or greater and is 6 feet or more in height
Lateral Erosion Envelope (LEE)	-	An identified envelope boundary, inside of which development may be at increased risk from flooding or damage due to lateral migration of the arroyo or channel
MRCOG	-	Mid Region Council of Governments
MRGCD	-	Middle Rio Grande Conservancy District
Natural Arroyo	-	An ephemeral drainage way, typically having a sloping, movable bed with steep or vertical erodible banks, which has not been directly altered by human intervention
Naturalistic Arroyo	-	An ephemeral drainage way, typically having a sloping, movable bed with steep or vertical erodible banks, which has been directly altered by human intervention; and in which non-continuous or limited erosion protection measures have been installed to prevent damage to infrastructure while maintaining the natural bed and bank materials, with the objective of maintaining the natural character of the corridor to the maximum extent practicable such that it can continue to be used by wildlife and recreationist
NM	-	New Mexico
NM528	-	New Mexico Highway 528, also known as Pat D'Arco Highway
NMDOT	-	New Mexico Department of Transportation
NOAA	-	National Oceanic and Atmospheric Administration
NPDES	-	National Pollutant Discharge Elimination System (EPA permit program to reduce pollution in water of the US)
NRCS	-	Natural Resources Conservation Service
O&M	-	Operation and Maintenance
O&M Agency	-	The agency with primary operations and maintenance responsibility for a facility
OSE	-	Office of the State Engineer
PMF	-	Probable Maximum Flood
Pond	-	Facility intended for sediment, erosion, and flood control, which is constructed less than 25 feet in height and can store less than 50 AF of water (see also "Jurisdictional Dam")
Principal spillway	-	The low-flow outlet from a dam, typically a pipe or box culvert
Probable Maximum Precipitation (PMP)	-	Theoretically, the greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographic location

Probable Maximum Flood (PMF)	-	The largest flood that may be expected at a point on a stream or water course resulting from the most severe combination of critical meteorological and hydrologic conditions possible in a particular watershed
Proposed Facility	-	A new recommended drainage facility
Q	-	Flow rate, in cfs
RCP	-	Reinforced Concrete Pipe
Regional Stormwater Detention Facility	-	See Major Facilities
ROW	-	Right-of-way
Retention	-	Collection and storage of runoff without release
SAD	-	Special Assessment District
SCS	-	Soil Conservation Service (previous name for NRCS)
Soft Lined Conveyance	-	Constructed channel, swale or other conveyance system with pervious lining, with or without erosion control measures (i.e. riprap, grass, natural soil, etc.)
SSCAFCA	-	Southern Sandoval County Arroyo Flood Control Authority
Sub-basin	-	Portion of a watershed; see also "drainage basin"
ULTIMATE Conditions Hydrology	-	Fully developed watershed including all existing drainage facilities along with anticipated future drainage infrastructure
USACE	-	United States Army Corps of Engineers
USGS	-	United States Geological Survey
Watershed	-	Drainage area usually incorporating several drainage basins or sub-basins, typically with an outfall directly to the Rio Grande or into an independent system which conveys the watershed runoff to the Rio Grande
Watershed Park Management Plan	-	A comprehensive study of the drainage characteristics of a watershed establishing the plan for managing drainage within the watershed
WC	-	Two letter identifier for the Willow Creek Watershed Park
WCWMP	-	Willow Creek Watershed Park Management Plan
WMP	-	Watershed Management Plan

EXECUTIVE SUMMARY

The Willow Creek Watershed Park, located within Units 20 and 17 of the City of Rio Rancho, is characterized by steep slopes and soils prone to erosion. Development is mainly residential with some planned commercial development along NM 528 and Idalia Road. Portions of the watershed have minimal or no drainage infrastructure and have been impacted by flooding and erosion during large storm events, most recently in the summer of 2006. Due to this history of storm damage, SSCAFCA has prepared the Willow Creek Watershed Park Management Plan (WCWMP). The plan establishes the hydrology of the watershed both for existing and anticipated future conditions, identifies specific drainage deficiencies, and recommends needed drainage improvements.

SSCAFCA currently owns no property within the watershed. All existing drainage right-of-way is owned by the City of Rio Rancho or Sandoval County, and many of the smaller arroyos are on private land. SSCAFCA is responsible for flood control on a regional scale, and many of the proposed improvements fall below that regional threshold. It is therefore important for all affected agencies and stakeholders to work collaboratively towards solving the drainage and water quality issues affecting the Willow Creek Watershed Park.

SUMMARY OF PROPOSED IMPROVEMENTS

Proposed Stormwater Detention Facilities

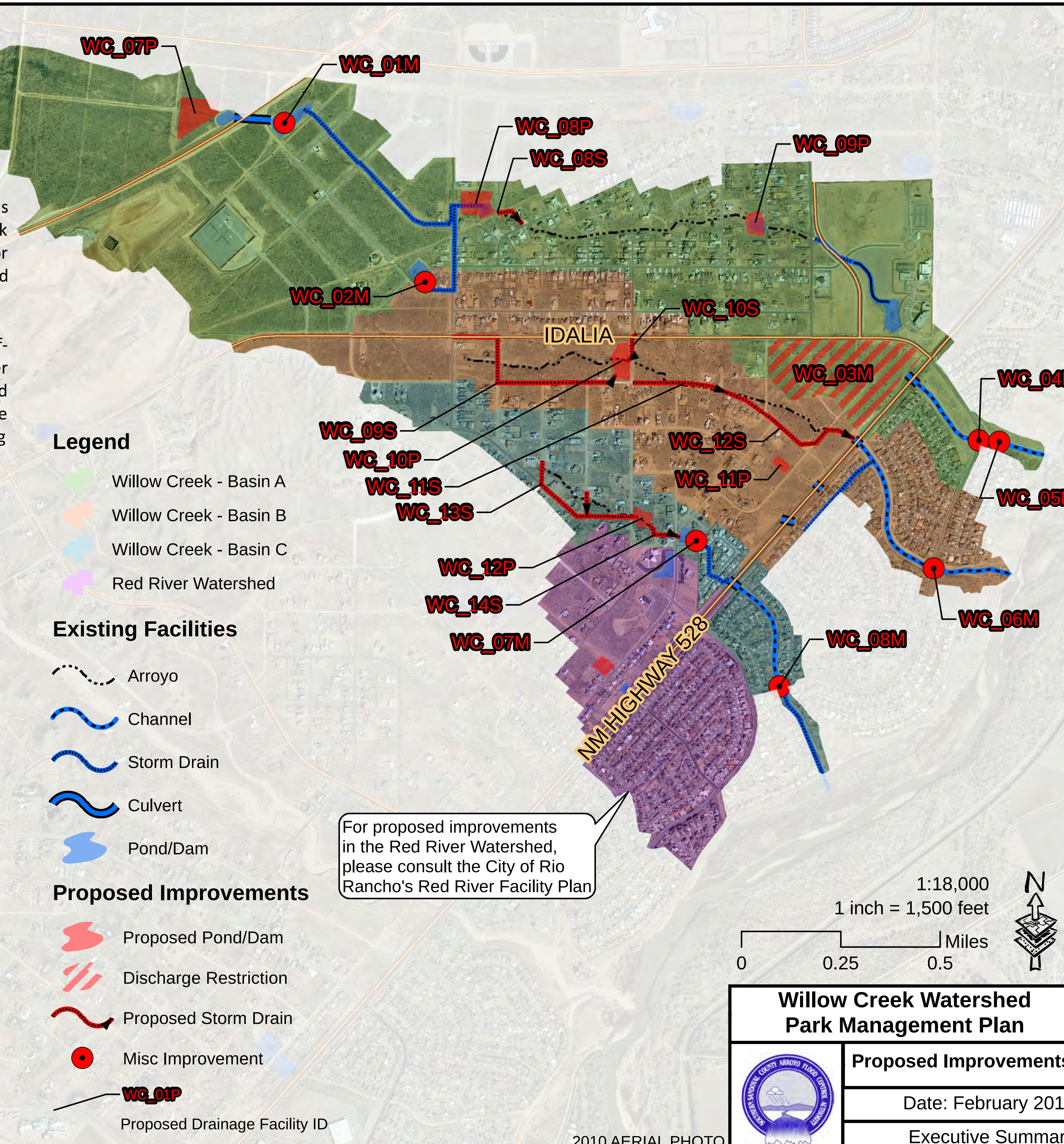
Facility ID	Name	Description/Notes
WC_07P	Pond # 12	15 AF
WC_08P	SAD 6 Pond # 6 upgrade	9 AF
WC_09P	SAD 5 Pond # 10 upgrade	8 AF
WC_10P	Campeche Pond	17 AF (includes WQ feature)
WC_11P	Tampico Pond	3.5 AF
WC_12P	Upper Christopher Pointe Pond	5 AF

Proposed Conveyance Facilities

Facility ID	Name	Description/Notes
WC_08S	Pond # 6 outfall SD	design & build in conjunction with WC_08P
WC_09S	Upper Vatapa Rd SD	coordinate with Vatapa Rd improvements
WC_10S	Idalia SD	coordinate with Idalia Rd improvements
WC_11S	Middle Vatapa Rd SD	coordinate with Vatapa Rd improvements
WC_12S	Lower Vatapa Rd SD	
WC_13S	Pasilla Rd SD	
WC_14S	Upper CP Pond outfall SD	design & build in conjunction with WC_12P

Proposed Misc. Drainage Improvements

Facility ID	Name	Description/Notes
WC_01M		Remove pond
WC_02M		Rehab outlet structure
WC_03M		Restrict developed discharge (< 75 cfs)
WC_04M		Upgrade crossing
WC_05M		Replace failing drop structures
WC_06M		Upgrade crossing
WC_07M		Rehab outlet structure
WC_08M		Upgrade crossing & downstream conveyance



Willow Creek Watershed Park Management Plan

Proposed Improvements

Date: February 2013

Executive Summary

I. INTRODUCTION

A. BACKGROUND

The Willow Creek Watershed Park Management Plan (WCWMP) was prepared by the Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA). The Willow Creek Watershed Park is located in the City of Rio Rancho, between the Venada Watershed Park to the north and the Barranca Watershed Park to the south.

B. VISION AND GOALS

The goals presented in the WCWMP for the Willow Creek Watershed Park represent both the goals of SSCAFCA, which are broad and visionary, and goals specific to the watershed. These goals are:

1. To provide flood protection up to the 100-year storm for the public health, safety and welfare of residents and properties within its boundaries.
2. To recognize the value of the land purchased or controlled for floodways as areas with multi-use potential.
3. To control sediment and erosion within the boundaries of the flood control authority.
4. To assist other entities in the construction of flood control for the good of the public.
5. Control the release of developed flows to meet the capacity of the existing culvert crossings at NM 528 and Willow Creek Road, and provide discharge guidelines for future development.
6. Preserve the natural character of the arroyos where possible and provide improvements to mitigate the effect of developed flows.

II. WATERSHED OVERVIEW

A. JURISDICTION

The watershed lies within Sandoval County, the SSCAFCA jurisdictional boundary, and the City of Rio Rancho, as shown in Figure 1 (Appendix A).

B. STUDY AREA

The study area of the WCWMP encompasses three major drainage basins, all of which cross NM 528 and drain to the Rio Grande in separate locations. From north to south, those basins are called Willow Creek A, B and C; a fourth basin that lies further to the south is called Red River Watershed. In 2006, the City of Rio Rancho compiled a facility plan for the Red River Watershed (WCRD 10), and SSCAFCA defers to the recommendations contained in that plan (see Appendix E). The WCWMP therefore only relates to the Willow Creek basins, although the Red River Watershed is shown on most maps.

C. WATERSHED CHARACTERISTICS

The three major drainage basins in the Willow Creek Watershed Park (see Figure 4, Appendix A) range in size from 140 acres to 380 acres (see Table 1). Existing development as of the date of this report ranges from 25 percent in Basin A to 60 percent in Basin C. Most of the development is residential; two major exceptions are the PNM Electric Substation and the Sandoval County Judicial Complex in Basin A. Residential development west of NM 528 can be categorized as low density (< 4 du/ac); minimal drainage infrastructure exists in Basins B and C, and roads are largely unpaved. West of Paseo del Volcan (PDV), Basin A is undeveloped with the exception of some graded dirt roads. Between PDV and NM 528, Basin A features mostly paved roads and some drainage infrastructure. Located east of NM 528 are River's Edge II & III, high density residential subdivisions with paved roads and established drainage infrastructure. Several portions of River's Edge II and III drain to the Bosque independently and are not part of Basins A, B or C. Those areas were not analyzed as part of this planning document, since they have established drainage infrastructure and do not accept off-site flows.

Table 1: Contributing drainage areas and percent development of the major basins in the Willow Creek Watershed Park

Drainage Basin	*Drainage Area (acres)*	*Percent Developed*
Willow Creek – Basin A	380	25
Willow Creek – Basin B	350	45
Willow Creek – Basin C	140	60

The soils in the Willow Creek Watershed are predominantly loamy fine sands, with some sandy loams in the upper portions of basins A and B. Soil data was obtained from the NRCS (U.S. Department of Agriculture, Natural Resources Conservation Service). Soil types found in the watershed include:

- Grieta fine sandy loam (1-4% slopes)
- Grieta-Sheppard loamy fine sands (2-9% slopes)
- Sheppard loamy fine sand (8-15% slopes)
- Sheppard loamy fine sand (3-8% slopes)

D. REFERENCES

Available reports and plans for existing and proposed developments and drainage facilities within the watershed were assembled and reviewed and have been included in the development of the WCWMP. These reference documents are referred to in the text as Willow Creek Reference Document (WCRD). All reference documents are listed in the table opposite Figure 2 (Appendix A) and are available for review at the SSCAFCA office.

E. EXISTING DRAINAGE FACILITIES

Details of existing drainage facilities are shown on the tiled maps in Appendix B. Each facility is assigned a unique identification number. Technical data pertaining to each existing facility is summarized in the table on the page adjacent to each map. Existing drainage facilities include the following:

- Five stormwater detention ponds currently exist in Basin A and one pond in Basin C:
  - Pond # 13 (WC_01P, Photo 1), Pond # 6 (WC_02P, Photo 2) and Pond # 2 (WC_05P, Photo 3) were constructed in conjunction with the City of Rio Rancho's Special Assessment District (SAD) 6 drainage improvements; contrary to the original plans laid out in the SAD 6 drainage report (WCRD 05), outflow from Pond # 2 (WC_05P) is conveyed north via storm drain in Chayote Road and discharges into Pond # 6 (WC_02P); originally, this runoff would have continued south to Idalia Road and into Basin B.
  - Pond # 10 (WC_03P, Photo 4) is part of the SAD 5 drainage improvements (WCRD 03).
  - The Sandoval County Pond (WC_04P, Photo 5) was constructed in conjunction with development of the Sandoval County Judicial Complex (maintained by the County).
  - The pond in Christopher Pointe Subdivision (WC_06P, Photo 6) is currently the only pond in Basin C.
- Runoff from Basins A, B and C crosses NM 528 and Willow Creek Road through a number of culverts; culvert capacities at NM 528 and Willow Creek Road dictate allowable peak flow rates from the upstream basins (see Table 2 for culvert sizes and estimated capacities).
- Between NM 528 and Willow Creek Road, runoff from Basins A, B and C are conveyed through the River's Edge III subdivision in three engineered earthen channels; the channels are stabilized with concrete grade control structures.

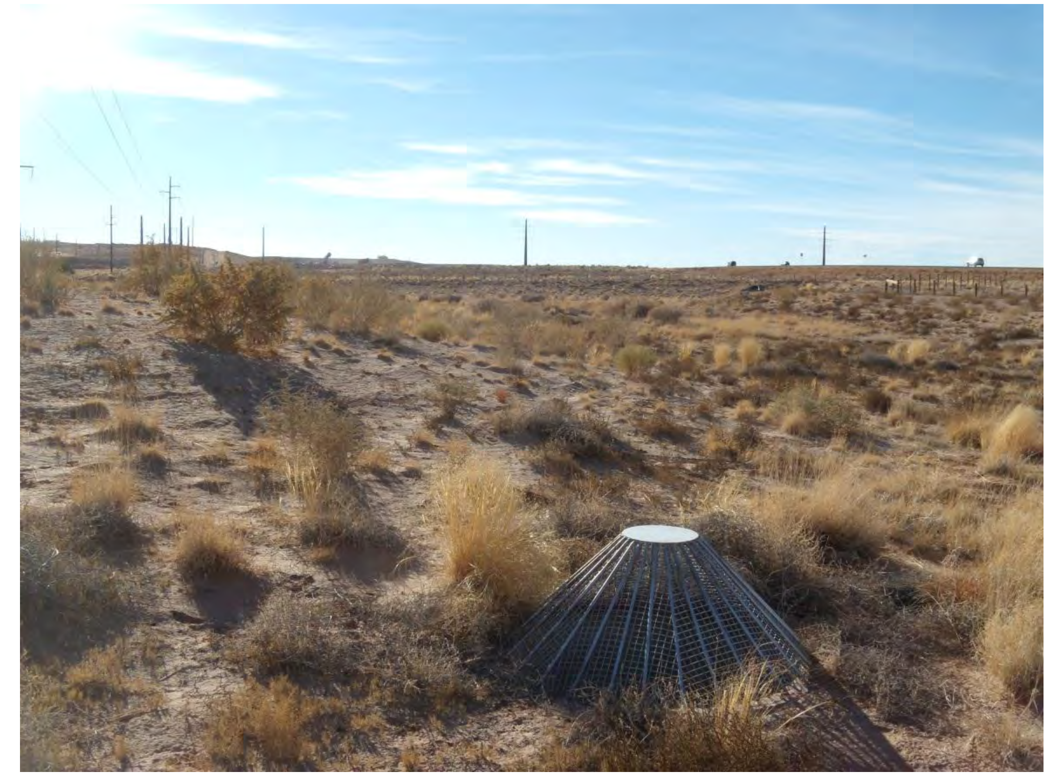


Photo 1: Pond # 13 (WC_01P, capacity ≈ 3 AF), looking west from the outlet.

Photo 2: Pond # 6 (WC_05P, capacity ≈ 3 AF), with the outlet visible in the background.

Photo 3: Pond # 2 (WC_05P, capacity ≈ 9 AF)

Photo 4: Pond # 10 (WC_03P, capacity ≈ 4 AF); culvert crossing serves as outlet structure.

Photo 5: Sandoval County Pond (WC_04P, capacity ≈ 9 AF), with ported riser outlet structure in the background.

Photo 6: Christopher Pointe Pond (WC_06P, capacity ≈ 2 AF), with outlet structure in the foreground.

III. HYDROLOGY

A. CRITERIA AND ASSUMPTIONS

1. Mapping & Topography

Orthophotography used for this project consists of tiled images which depict color digital aerial photographs acquired in the spring of 2010 during leaf-off conditions. LiDAR-derived elevation data (2-foot contour interval) was used to delineate watersheds and sub-basins as well as for calculating hydrologic parameters. Both orthophotogarphy and elevation data are part of the *MRCOG 2010 Digital Orthophotography and Elevation Data Project*.

2. Land Use

Land use data was based on the best available data as of the time of this report. Existing development in the watershed was mapped based on information contained in the City of Rio Rancho parcel geodatabase and verified using 2010 orthophotography. Future development was predominantly based on available platting and zoning information using parameters set forth in the DPM. Exceptions are areas encompassed by the City of Rio Rancho's *La Barranca Specific Area Plan* (WCRD 17) and the *AMREP – Paseo Gateway Drainage Management Plan* (WCRD 18).

3. Hydrology

The methodologies utilized in this study are based on SSCAFCA's Development Process Manual (DPM), Chapter 22, Drainage, Flood Control and Erosion Control (Revised April 2010), and the HEC-HMS 3.5 computer program. All model parameters were computed in accordance with Section 2F of the DPM. The 100-year 24-hour design storm (2.9 inches of precipitation in 24 hours) was used to compute EXISTING and future peak flow rates and runoff volumes.

4. Development Scenarios

Three hydrologic models were developed to identify drainage related problems:

- The *EXISTINGCONDITIONS* model assumes existing development and existing drainage facilities as of the date of this report; it is used to identify current drainage related problems and deficiencies.
- The *DEVELOPED CONDITIONS – EXISTING FACILITIES* (DEVEX) model assumes full development of the watershed based on available platting and zoning information with existing drainage facilities; it is used to identify potential future problems and deficiencies.
- The *ULTIMATECONDITIONS* (ULTIMATE) model assumes full development of the watershed as well as the implementation of all facilities and improvements recommended in the WCWMP.

For hydrologic modeling purposes, each major drainage basin was divided into smaller sub-basins. Peak flow rates and runoff volumes were computed using the computer program HEC-HMS.

B. HYDROLOGY MODEL RESULTS

Table 2 shows the 100-year 24-hour peak flow rates and runoff volumes at selected analysis points for all model scenarios. For a summary of all model results, please consult Appendix C.

In general, both peak flows and runoff volumes are expected to be higher under DEVEX conditions as compared to EXISTING conditions. This is due to the fact that under EXISTING conditions, portions of the watershed are undeveloped. ULTIMATE conditions peak flows may be lower than DEVEX peak flows due to the implementation of proposed drainage infrastructure. Runoff volumes are expected to be similar under Ultimate and DEVEX conditions, since proposed stormwater detention facilities will be designed to drain completely (no significant retention).

Based on the above discussion, there appear to be discrepancies for analysis points one through six.

At analysis point one, peak flows are higher under EXISTING conditions than under DEVEX conditions; this is due to the fact that a portion of basin A_101 has been re-platted as part of the Paseo Gateway Drainage Management Plan (WCRD 18). Under developed conditions, the area west of Iris Road (see map tile 1, Appendix B) will be diverted to the Venada and Barranca watersheds; hence leading to lower peak flows in the DEVEX model

Additionally, Table 2 reports significantly higher runoff volumes for analysis points two through six under ULTIMATE conditions as compared to DEVEX conditions. This discrepancy is caused by two factors:

- Under EXISTING and DEVEX conditions, the culvert at Paseo del Volcan (PDV) limits the amount of flow that can enter subbasin A_102a to approximately 30 cfs; due to this restriction, more than half of the 100-year hydrograph is diverted north to the Venada Arroyo due to overtopping of the existing undersized pond; under ULTIMATE conditions, WC_07P (SAD 6 Pond # 12 proposed in WCRD 05, see map tile 1 in Appendix B) contains and attenuates the 100-year peak flow, and the entire upstream runoff eventually drains through the PDV culvert (no diversion to the Venada).
- Under EXISTING and DEVEX conditions, WC_05P (SAD 6 Pond # 2, see map tile 1 in Appendix B) acts as a retention pond; the proposed improvements to the outlet structure would allow the pond to drain completely under ULTIMATE conditions, thus increasing the runoff volume reaching analysis points downstream of the pond.

The DEVEX and ULTIMATE conditions model scenarios assume a fully developed watershed based on the City of Rio Rancho's specific area plans, or existing platting and zoning information. If actual development in the future deviates from those land use assumptions by increasing densities and impervious area, this will lead not only to increased peak flows, but also to higher runoff volumes than accounted for in this plan. Higher volumes can be detrimental to downstream stormwater detention facilities, even if peak flows from contributing areas upstream are kept at or below rates reported in this plan. Significant deviations from the assumed land uses will therefore require an analysis to ensure that the capacity of downstream stormwater detention facilities is not exceeded. In addition to restricting peak flows, measures to mitigate the effects of increased runoff volumes may be necessary.

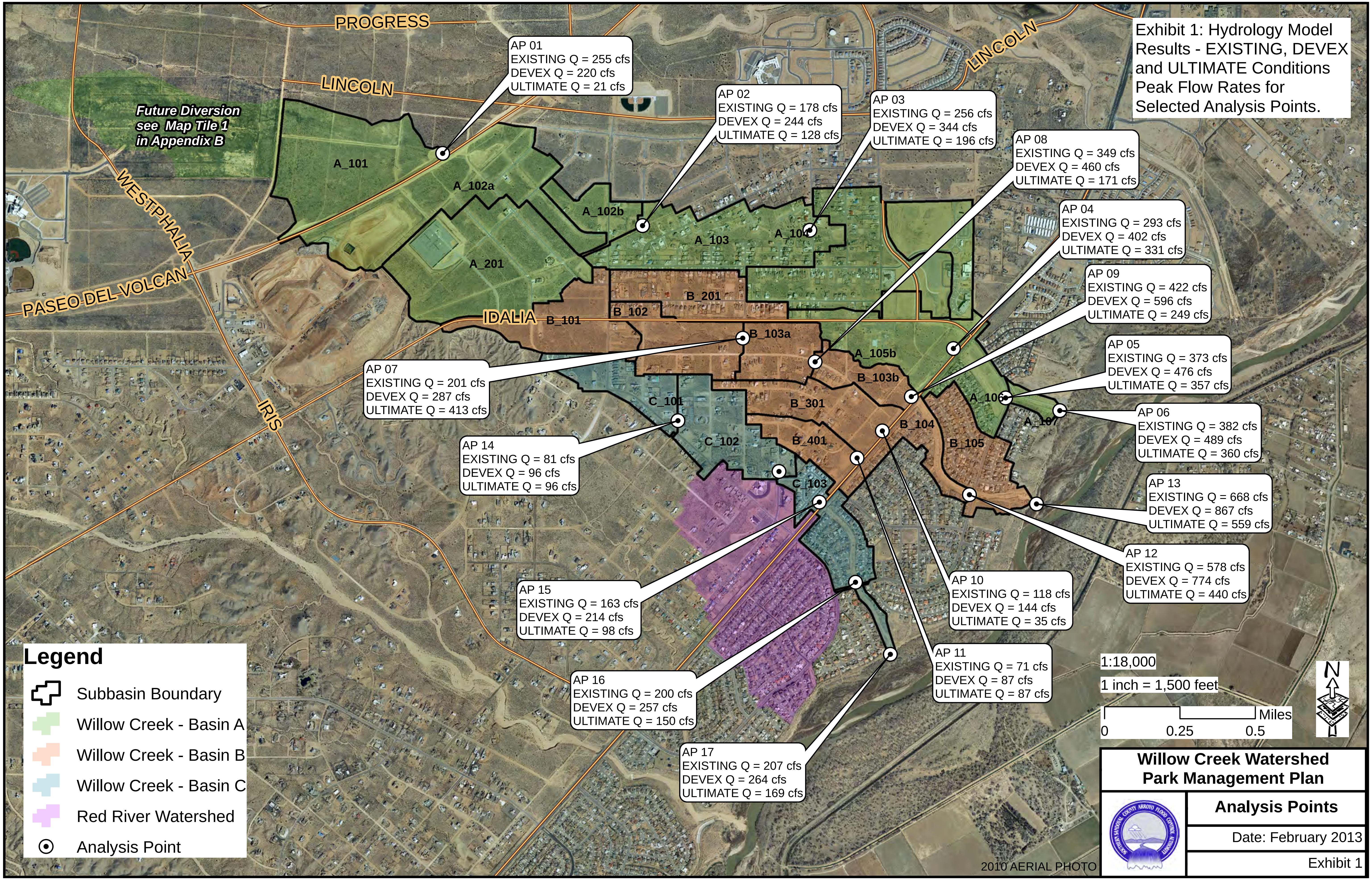


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Table 2: Existing, DEVEX and Ultimate Conditions Flow and Capacity Summary for Selected Analysis Points.

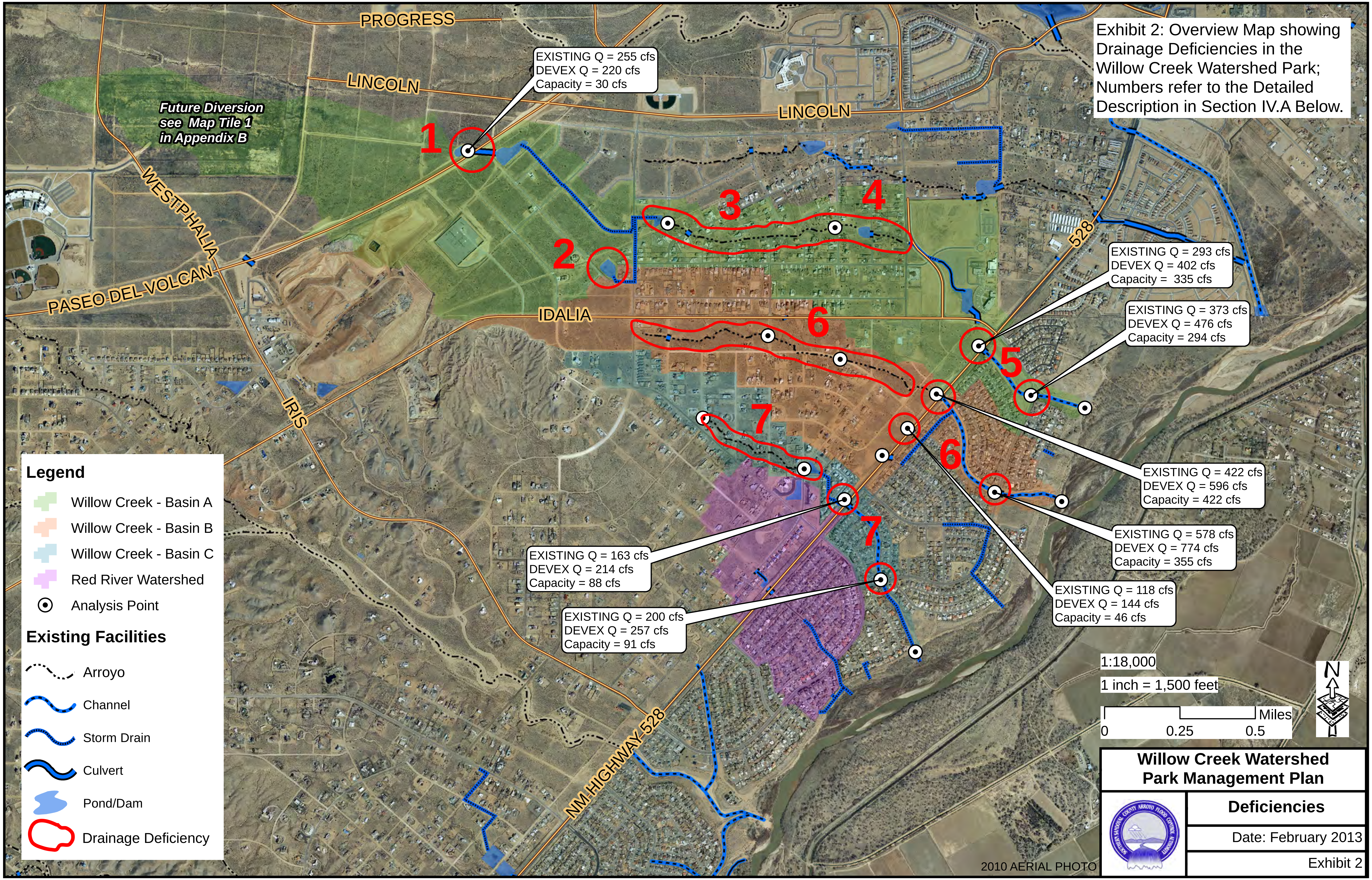
Analysis Point	*Location*	*Existing Structure Description*	*HEC_HMS Element*	*Drainage Area (mi^2)*	*EXISTING 100-year Peak Flow (cfs)*	*EXISTING Runoff Volume (AF)*	*DEVEX 100-year Peak Flow (cfs)*	*DEVEX Runoff Volume (AF)*	*ULTIMATE 100-year Peak Flow (cfs)*	*ULTIMATE Runoff Volume (AF)*	*Estimated Capacity (cfs)*
AP 01	Paseo del Volcan	1 - 30" CMP	A_101/ PDV_Culvert	0.33	255	14.9	220	13.5	21	11.3	30
AP 02	SAD 6 Pond 6 Outlet	Pond Outlet	A_103_R	0.74	178	21.5	244	30.6	128	44.0	
AP 03	Arroyo between Campeche & Oldenburg	Unimproved Arroyo	A_103_J	0.89	256	31.9	344	42.0	196	55.4	
AP 04	NM 528 & Basin A (350' south of Idalia)	2 - 60" CMP	A_105_J	1.20	293	57.0	402	78.7	331	91.3	335
AP 05	Willow Creek Rd & Basin A	1 - 66" CMP	A_106_J1	1.25	373	62.0	476	83.6	357	96.2	294
AP 06	Basin A outfall to Bosque		RG_A	1.26	382	62.4	489	84.1	360	96.7	
AP 07	Campeche Road & Basin B	Unimproved Arroyo	B_102_J	0.16	201	8.4	287	17.8	413	23.7	
AP 08	Vatapa Road	Arroyo in Roadway	B_103a_J	0.28	349	16.5	460	28.9	171	28.0	
AP 09	NM 528 & Basin B (1450' south of Idalia)	3 - 60" CMP	B_103b_J2	0.32	422	19.6	596	35.8	249	32.7	422
AP 10	NM 528 & Basin B (2250' south of Idalia)	1 - 36" CMP	B_301/Tampico_ Pond	0.07	118	4.2	144	6.9	35	6.9	46
AP 11	NM 528 & Basin B (2880' south of Idalia)	1 - 36" CMP	B_401	0.04	71	2.4	87	4.0	87	4.0	71
AP 12	Willow Creek & Basin B	1 - 72" CMP	B_104_J3	0.48	578	30.2	774	49.6	440	48.6	355
AP 13	Basin B outfall to Bosque		RG_B	0.55	668	37.3	867	56.7	559	55.7	
AP 14	Matamoros Road	Beginning of Arroyo in Basin C	C_101	0.06	81	3.3	96	4.8	96	4.8	
AP 15	NM 528 & Christopher Pointe	1 - 36" CMP	C_103_J	0.16	163	10.3	214	13.5	98	13.3	88
AP 16	Willow Creek & Basin C	1 - 36" RCP	C_104_J	0.21	200	15.5	257	18.7	150	18.5	91
AP 17	Basin C outfall to Bosque		RG_C	0.22	207	16.5	264	19.7	169	19.5	

Notes:

(1) All peak flow rates and runoff volumes in this table are for selected locations in the corresponding HEC-HMS models. For complete output files for Existing, DEVEX and ULTIMATE conditions, please refer to Appendix C.

(2) Since peak flow rates occur at different times, the peak flow at a confluence is not necessarily the sum of the peak flows from the corresponding tributaries.

(3) There are apparent discrepancies between DEVEX and ULTIMATE runoff volumes for analysis points 2, 3, 4, 5 and 6, and between EXISTING and DEVEX peak flows for analysis point 1; please see section III.B of the report for discussion.



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IV. DRAINAGE DEFICIENCIES AND RECOMMENDATIONS

Based on the development scenarios described in the previous section, drainage deficiencies were identified and potential solutions evaluated.

A. DEFICIENCIES AND EVALUATION OF ALTERNATIVES

1. Basin A – Culvert at Paseo del Volcan (PDV)

Issues:

The 30” CMP culvert under PDV (Photo 7) has an estimated capacity of 30 cfs. Under EXISTING conditions, the model predicts a peak discharge of 255 cfs from basin A_101 (143 acres).

Under DEVEX conditions, basin A_101 is significantly smaller (95 acres) due to the future diversion in the approved Paseo Gateway Drainage Management Plan (WCRD 18). The 100-year storm would result in a slightly lower peak discharge of 220 cfs.

It is apparent that the existing culvert is insufficient to convey the 100-year flows both under EXISTING and DEVEX conditions. The SAD 6 Drainage Report (WCRD 05) shows a proposed pond just north of Paseo del Volcan (PDV), but that pond has not been constructed. Currently, there is only a small de-silting basin (capacity approximately 1 AF) at the entrance of the culvert.

Under EXISTING conditions, flows exceeding the culvert capacity will overtop the existing basin and continue in north-easterly direction following the embankment of Paseo del Volcan, and will enter the Venada Arroyo between Lincoln and Chayote Roads.

Photo 7: 30” CMP culvert under PDV, partially full of sediment.

Evaluation of Alternatives:

- **Stormwater Detention Pond WC_07P (Option a)**

Purchase necessary right-of-way and construct a stormwater detention pond (WC_07P) with a ported riser outlet structure that connects to the existing 30” culvert and discharges at a peak rate not exceeding 30 cfs;

The storage capacity of the proposed pond is approximately 13 AF, requiring about 4 acres of right-of-way (see Exhibit 3). Due to the planned upstream diversion, the required storage volume is less than the 17.25 AF anticipated in the SAD 6 Drainage Report (WCRD 05).

- **Diversion to Basin B (Option b)**

Construct storm drain to safely convey 100-year runoff north to the Venada Arroyo; this option would require an analysis of existing drainage infrastructure in the Venada watershed between PDV and the Rio Grande Bosque (for EXISTING and DEVEX conditions) to ensure that capacities of crossing structures and conveyances are not exceeded.

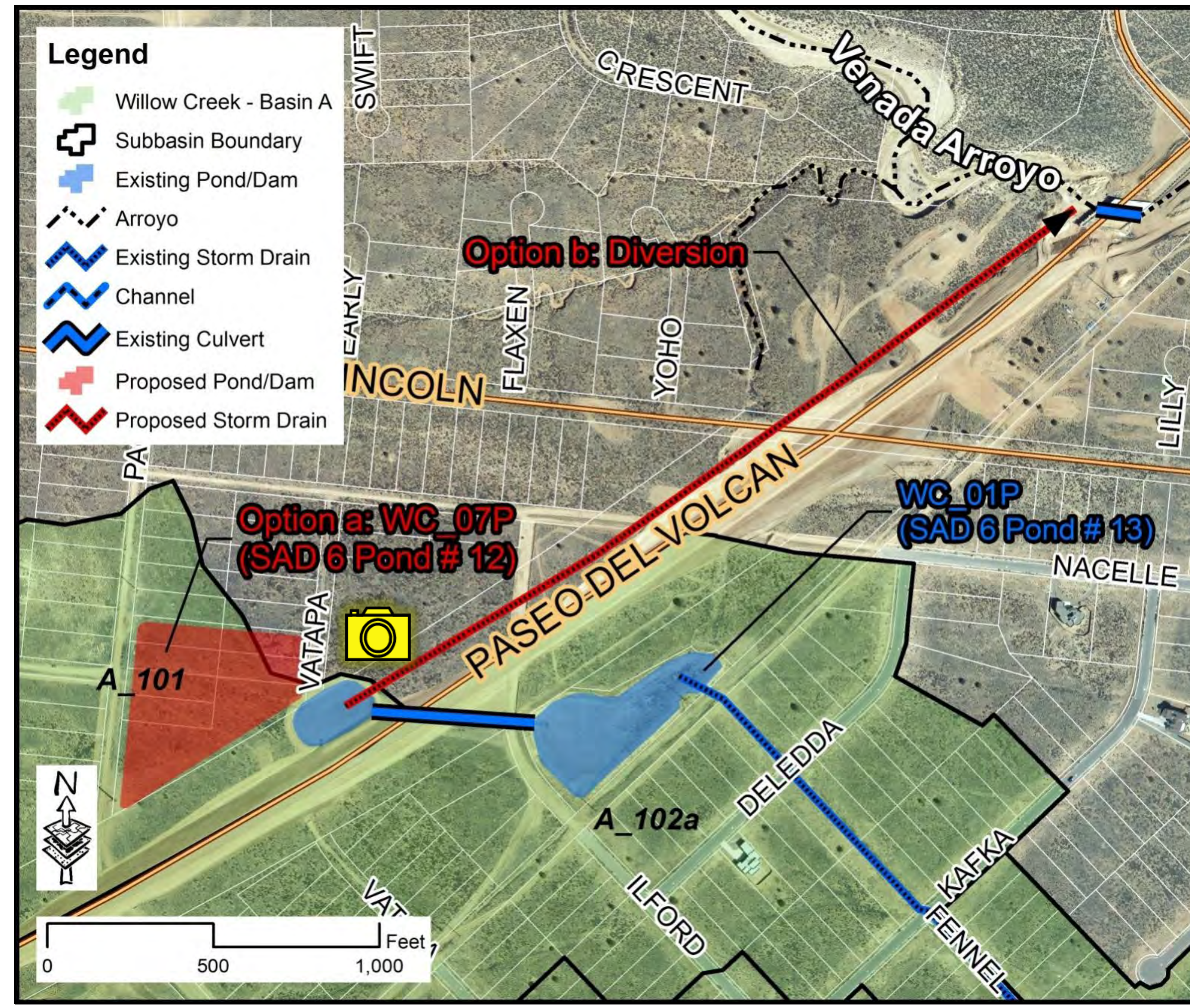


Exhibit 3: Map showing location of proposed pond west of Paseo del Volcan.

2. Basin A – SAD 6 Pond # 2 (WC_05P)

Issues:

Field investigation revealed that SAD6 Pond # 2 (WC_05P) only receives flows through storm drain in Vatapa and Ilford Roads. Evaluation of the pond was therefore based on the assumption that inflow into the pond is limited to the capacity of the storm drain.

According to the SAD 6 drainage report (WCRD 05), the pond was designed for peak storage of 7.7 AF; filled to the top of the embankment, the pond could store approximately 10 AF of water. Under DEVEX conditions, the model indicates that peak storage in the pond would be 10.6 AF and therefore in excess of the pond's capacity (for detailed reservoir routing results, please consult Appendix C).

In addition, the outlet structure of Pond #2 (WC_05P) is a concrete riser pipe without ports (Photo 8). The pond therefore acts as a retention pond until the water surface in the pond reaches the top of the pipe, approximately 7 feet above the pond bottom. According to the SAD 6 report (WCRD 05), the dead storage volume of this pond is estimated at 6.4 AF. This will lead to a stagnant pool of water in the pond after any significant rain event.

Photo 8: Pond # 2 outlet structure is a concrete riser pipe without ports.

Proposed Improvements:

Modify Outlet Structure (WC_05M)

Convert outlet structure to ported riser pipe; during high-frequency rainfall events, ports will act as water quality control by filtering out floatables; in addition, ports allow the pond to drain slowly, thereby allowing a portion of the runoff to infiltrate and evaporate, and allowing for sediment and particulate pollutants to settle out in the pond. During the 100-year storm, the top of the stand pipe will act as the principal spillway.

Re-design of the outlet structure, in particular with respect to size and distribution of ports and top elevation of the stand pipe is necessary to optimize water quality and flood control functions of the pond. Modifications to the outlet structure, particularly lowering the top elevation of the standpipe and allowing the pond to start discharging at a lower water surface elevation will solve the capacity problem of the pond. Re-grading of the pond bottom and introduction of ports in the stand pipe will allow the pond to drain completely.

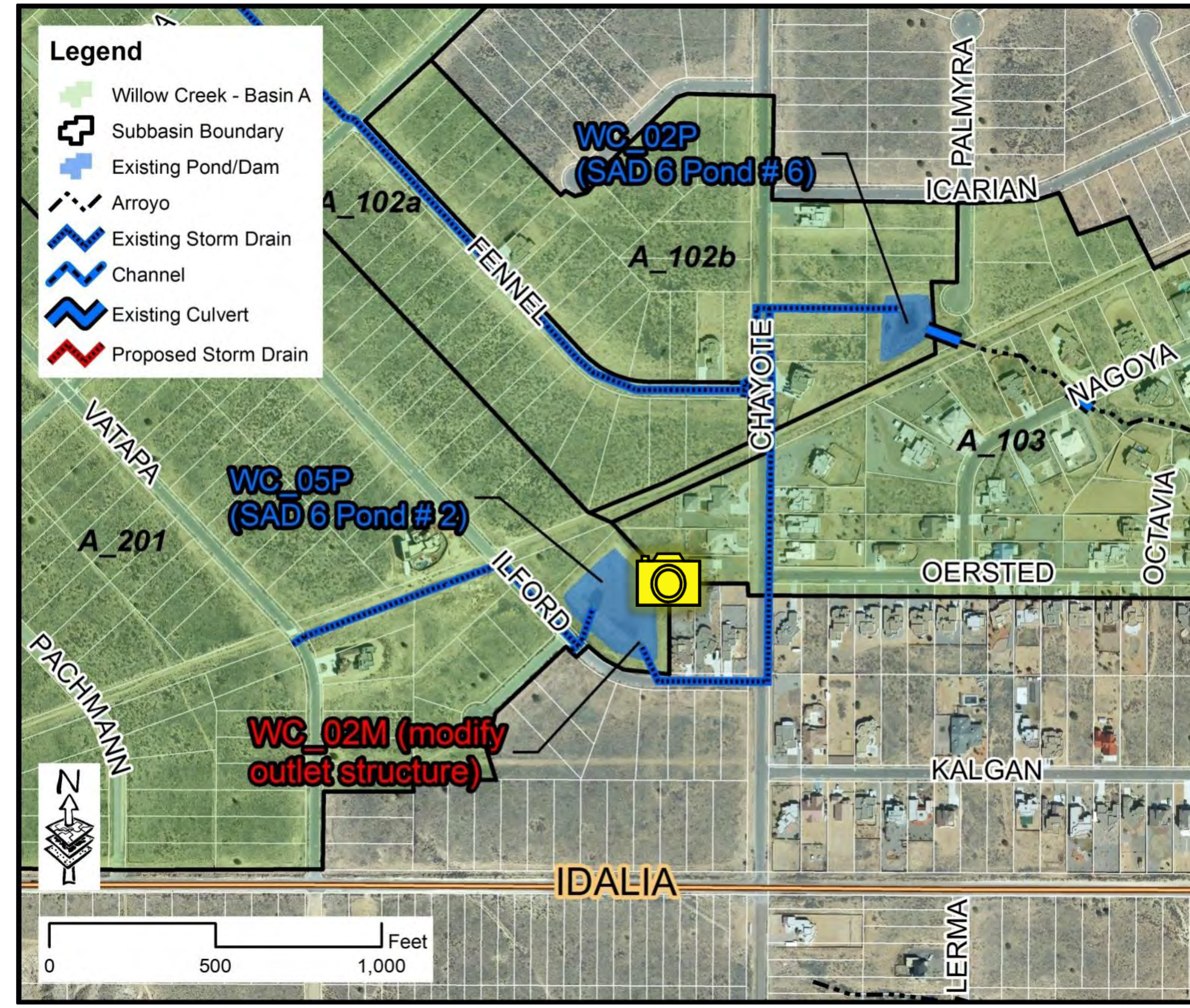


Exhibit 4: Map showing proposed changes to SAD 6 Pond # 2.

3. Basin A – Drainage between SAD 6Pond #6 and Camino Encantadas

Issues:

SAD 6 Pond # 6 (WC_02P) was designed for a peak storage of approximately 3.4 AF. During DEVEX conditions, peak storage in the pond is 3.9 AF, with a peak outflow of 246 cfs. The pond attenuates flows only minimally; sediment-deprived outflow is released back into the historical flow path through two 54 inch RCP culverts. The pond discharges across a gas line easement and onto private property (Photo 9); no public drainage right-of-way exists between the outlet pipes and Nagoya Road. In addition, a home has been constructed in the former flow path, and discharge from the pond will cross the developed lot and cause erosion and flooding.

Further downstream, between Nagoya and Nativitas Road, residential lots are platted to the centerline of the arroyo; in several locations, homes have been built in close proximity to the arroyo (Photo 10) and may be subject to erosion and/or flooding during a large storm event (see Exhibit 6). The original plat for this area shows a generic 20 ft public drainage easement between Nagoya and Nativitas Road; ownership of the easement is unclear.

Evaluation of Alternatives:

- **Stormwater Detention Pond WC_08P (Option a)**

Acquire necessary right-of-way and increase SAD 6 Pond # 6 storage volume from 3.6 to 9 AF (WC_08P); replace pond outlet structure with ported riser pipe; these modifications will decrease the peak outflow from 246 cfs (DEVEX conditions) to approximately 128 cfs during the 100-year design storm. Design of the pond and outfall storm drain will have to take into consideration elevation constraints caused by the high pressure gas line and the existing culvert under Nagoya Road (see Exhibit 6).

- **Diversion to Basin B (Option b)**

Divert upstream flows via new storm drain in Chayote Road to Basin B; replace SAD 6 Pond # 6 outlet with ported riser pipe. This option would reduce the peak discharge from the pond to approximately 30cfs.In addition, the diversion of flows to Basin B would significantly decrease the total runoff volume conveyed by WC_02Aand protect the arroyo reach from erosion.

- **Pond Outfall Storm Drain (All Options)**

Route discharge from SAD 6 Pond # 6 to culvert under Nagoya Road via new storm drain; verify ownership of 20’ drainage easement; depending on implementation of upstream drainage improvements and as necessary in the future, stabilize arroyo between Nagoya Road and Camino Encantadas, taking advantage of existing easement; preserve existing arroyo as open space and linear wildlife corridor.

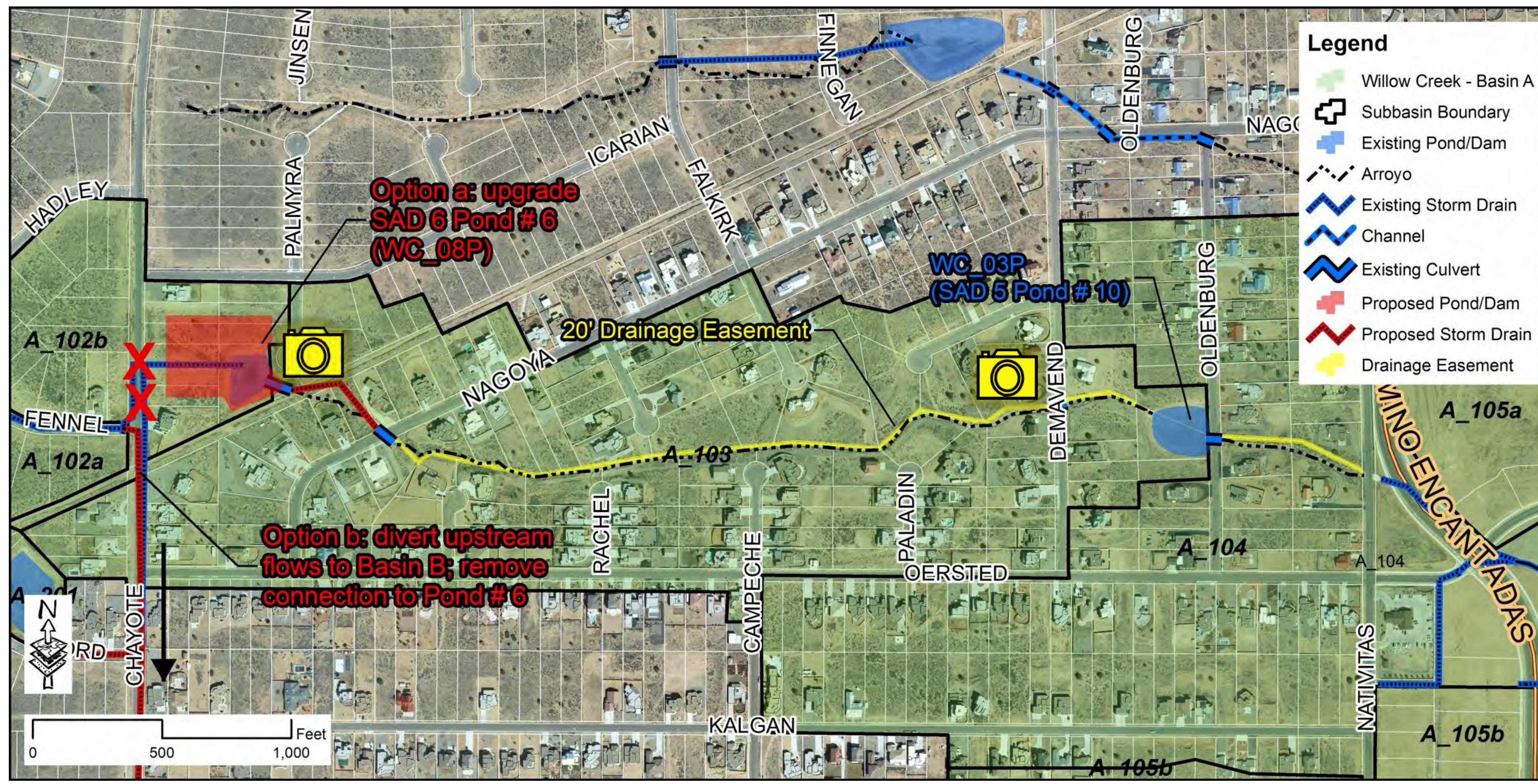
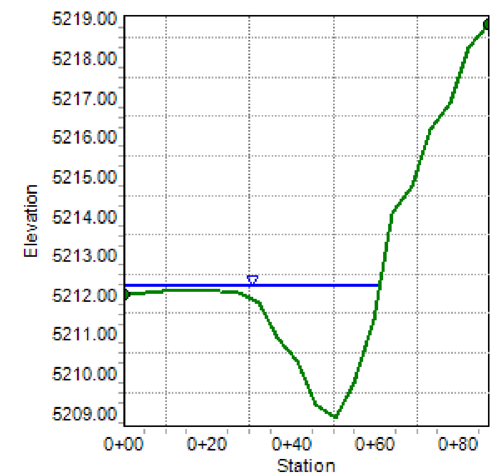


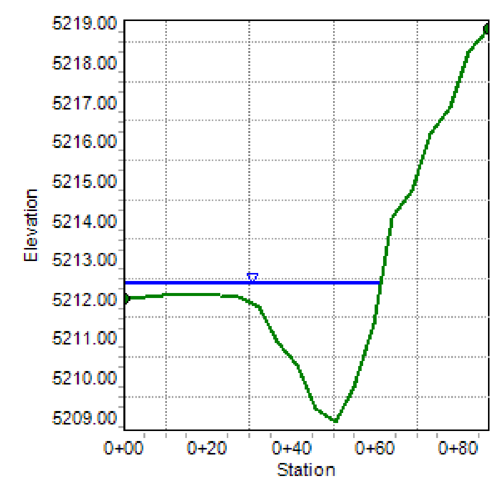
Exhibit 5: Map showing drainage improvement options between Pond # 6 and Camino Encantadas.

Photo 9: Home located in former flow path of Arroyo, looking east from SAD 6 Pond # 6; the outlet structure of the pond (two reinforced concrete pipes) can be seen at the bottom of the photo.

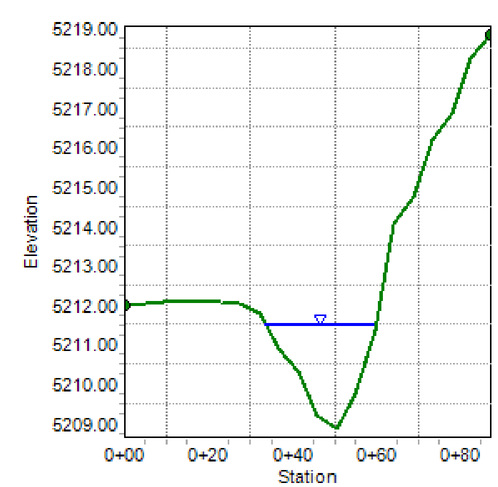
Photo 10: House in close proximity to the Arroyo, looking upstream from Demavend Road.



EXISTING conditions
peak flow (≈ 260 cfs)
exceeds channel capacity



DEVEX conditions
peak flow (≈345 cfs)
exceeds channel capacity



ULTIMATE conditions
peak flow (≈200 cfs)

Exhibit 6: Estimated water surface elevation for EXISTING conditions (top), DEVEX conditions (center), and ULTIMATE conditions (bottom) for the channel shown in Photo 10; the ULTIMATE conditions flow rate of approximately 200 cfs at this location is identical regardless of whether improvement option a or b is implemented; EXISTING and DEVEX flow rates exceed channel capacity.

4. Basin A – SAD 5 Pond # 10 (WC_03P)

Issues:

SAD 5 Pond # 10 (WC_03P, Photo 11) doesn't have a deficiency, but provides an opportunity for drainage improvements that would alleviate problems further downstream in the watershed. Peak storage in the pond is 2.7 AF under EXISTING and 3.7 AF under DEVEX conditions. Both values are below the estimated capacity of 4 AF. Under EXISTING conditions, the pond reduces 100-year peak flows from 256 cfs to 231 cfs. Under DEVEX conditions, flows are reduced from 344 to 290 cfs. Increasing the storage volume in the pond and restricting outflow would help mitigate capacity constraints at NM528 (see Section IV.A.5below)

Proposed Improvements:

Upgrade SAD 5 Pond # 10 (WC_09P)

Increase volume of existing pond to approximately 8 AF; two additional lots (total of 1 acre) will be required for this improvement. Modify outlet structure to decrease peak outflow and optimize attenuating effect of the pond. With improvements in place, ULTIMATE conditions peak flows could be reduced to approximately 136 cfs. This assumes a fully developed watershed with all upstream improvements in place (WC_07P, WC_08P and WC_02M, see above).

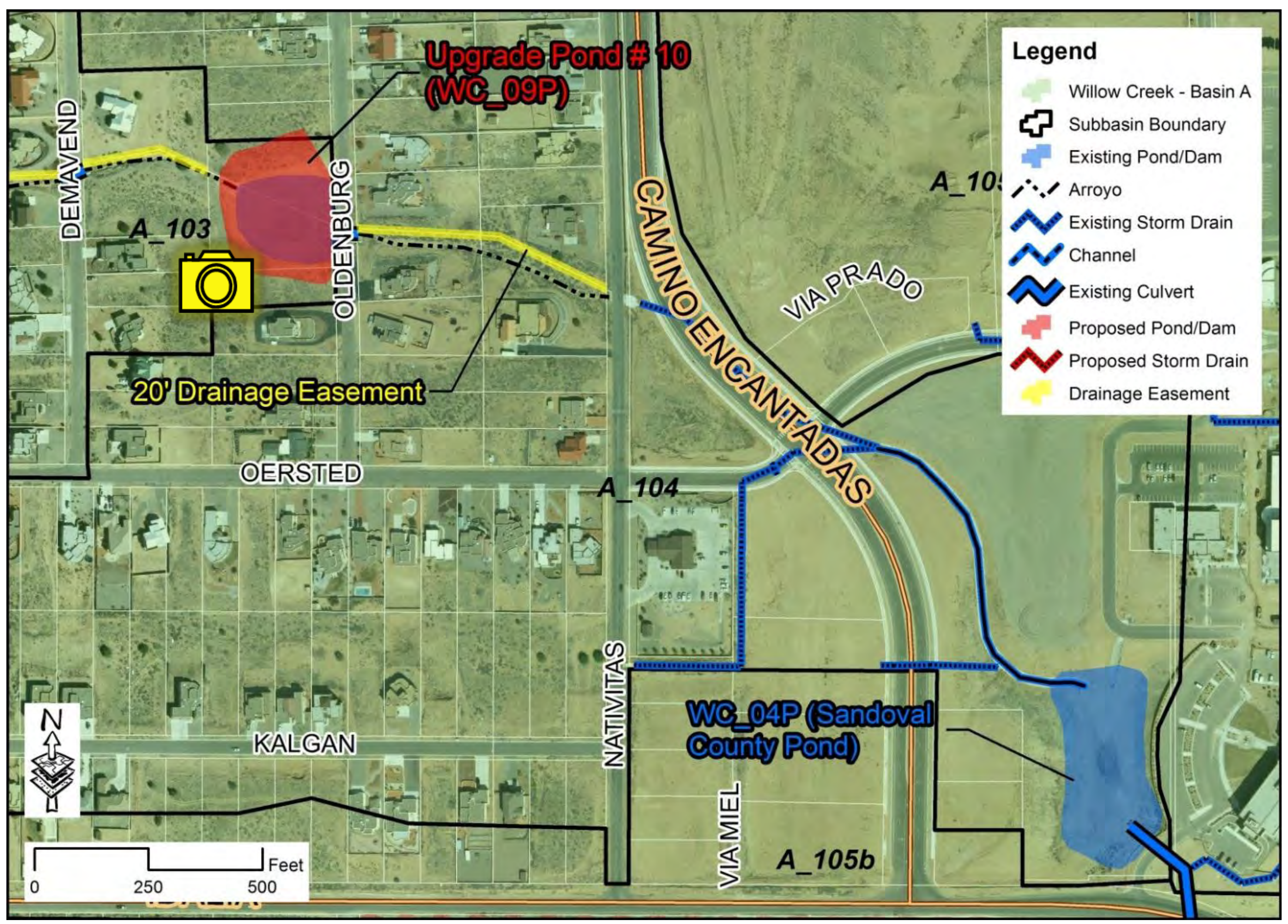


Exhibit 7: Map showing proposed improvements to SAD 5 Pond # 10 (WC_09P)

Photo 11: SAD 5 Pond # 10 (WC_03P)

5. **Basin A – NM 528 to Willow Creek Road**

Issues:

Flows from Basin A cross NM 528 through a set of culverts (estimated capacity: 335 cfs) just south of Idalia Road (Photo 13). Those culverts are undersized for the 100-year storm under DEVEX conditions (peak flow: 402 cfs); further downstream, the Willow Creek crossing structure with a capacity of 290 cfs is undersized both for EXISTING conditions (382 cfs) and DEVEX conditions(489 cfs, see Photo 14). In the earthen channel downstream of Willow Creek Road, several tire bale drop structures are failing (Photo 12).

Photo 12: Failing tire bale drop structure downstream of Willow Creek Road.

Proposed Improvements:

According to stakeholder input, a large stormwater detention pond at the intersection of Idalia Road and NM528 should be avoided if possible due to the high value of commercial real estate in this area; please see the City of Rio Rancho's La Barranca Specific Areas Plan (WCRD 17) for more information. The drainage improvement option presented here is an alternative to a regional pond; it consists of three separate improvements shown below.

In addition to the proposed improvements below, the failing tire bale drop structures in the channel downstream of Willow Creek Road need to be replaced or rehabilitated.

- **Upgrade SAD 5 Pond # 10 (WC_09P)**

See Section IV.A.4above.

- **Discharge Restriction from Basin A_105b**

Restrict discharge from subbasin A_105b to 75 cfs via administrative process so as to not exceed culvert capacity at NM 528; (however, restricting discharge in basin A_105b will not solve the capacity issue further downstream at Willow Creek Road);

- **Resolve Flow Restriction at Willow Creek Road**

Either increase capacity of crossing structure at Willow Creek Road or utilize existing CoRR drainage right-of-way upstream of crossing for a small stormwater detention pond.

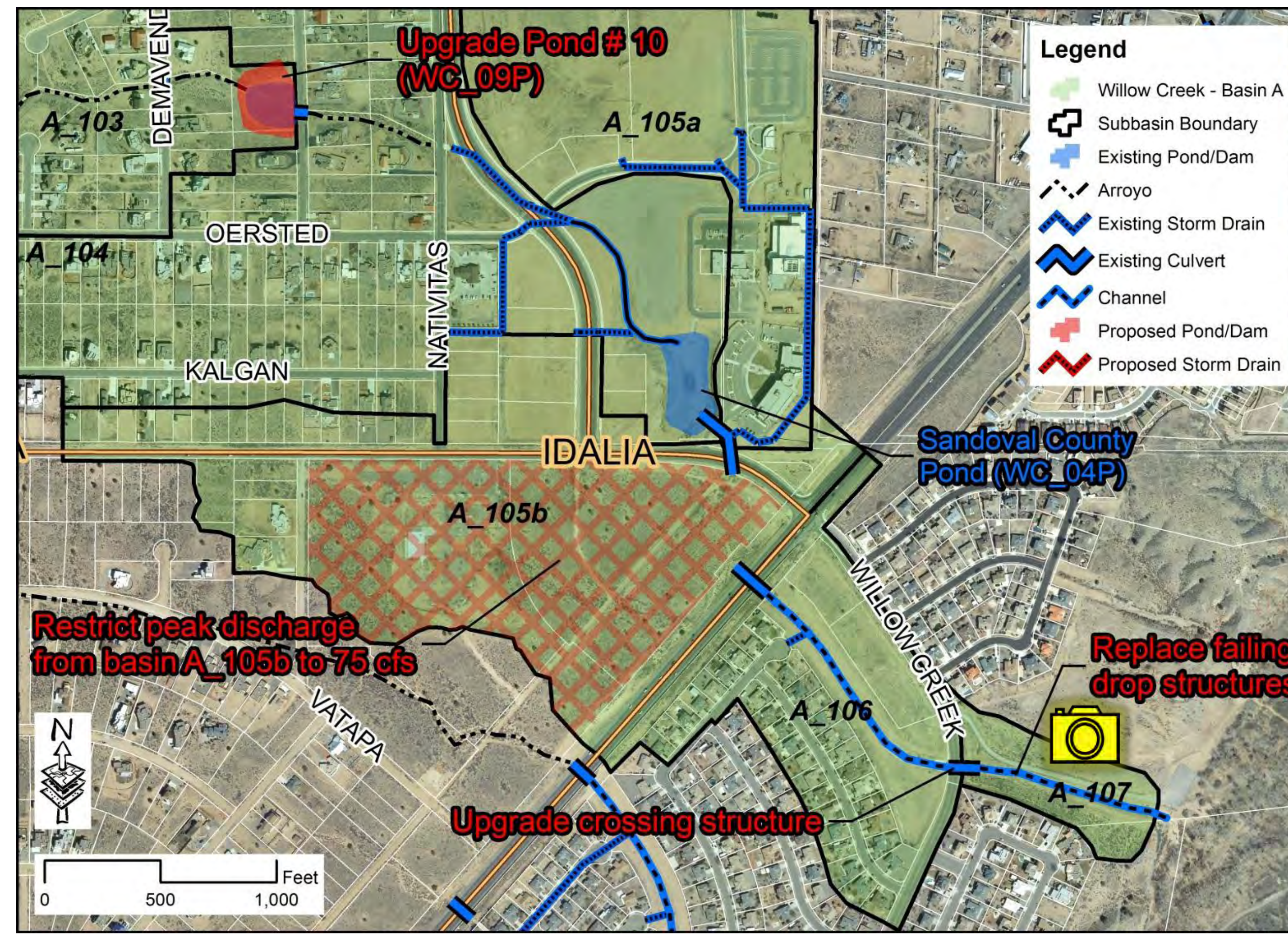


Exhibit 8: Map showing proposed drainage improvements in the lower portion of Basin A

Photo 13: Culverts at NM 528 and Basin A (2 –60” CMP, capacity ≈ 335 cfs)

Photo 14: Culvert at Willow Creek Road and Basin A (1 –66” CMP, capacity ≈ 290 cfs)

6. Basin B – Drainage Deficiencies

Issues:

No drainage improvements currently exist between Chayote Road and NM 528 (south of Idalia). In the upper reach, a small arroyo crosses a number of residential lots with no dedicated drainage right-of-way; runoff from a residential area crosses Idalia through a culvert west of Campeche Road and has led to a deeply incised arroyo between Idalia and Vatapa Roads (Exhibit 9); in the lower reach of Basin B, runoff follows Vapata Road (unpaved) for about 1000 feet and causes erosion damage to the road after any large rain event. Steep slopes in this basin cause stormwater to travel at high velocities, increasing the potential for erosion.

Flows from Basin B cross NM 528 through three separate banks of culverts adjacent to River's Edge III (see Photo 15 & Photo 16). Crossing WC_04X (capacity: 422 cfs) is undersized for the 100-year storm under DEVEX conditions (peak flow: 596 cfs). The central culvert (WC_05X, capacity: 46 cfs) is undersized under EXISTING conditions (peak flow: 118 cfs) and DEVEX conditions (peak flow: 144 cfs). Runoff in excess of the culvert capacities flows northward along the west side of NM 528 within DOT right-of-way. Further downstream, the Willow Creek crossing structure (capacity: 355 cfs) is undersized both under EXISTING conditions (peak flow: 578 cfs) and DEVEX conditions (peak flow: 774 cfs, see Photo 17).

Proposed Improvements:

- **Campeche Pond (WC_10P)**

Purchase required right-of-way and construct Campeche Pond, with a storage capacity of about 17 AF; approximately 3.5 acres (6 lots) are required for this regional stormwater detention facility (see Exhibit 10); construct outfall storm drain from pond to NM528 to reduce erosion problems in Vatapa Road. Construct storm drain to convey runoff from Idalia Road and subbasin B_201 into pond to resolve erosion problems between Idalia and Vatapa Road.

- **Tampico Pond (WC_11P)**

Construct Tampico Pond (detention volume: 3.5 AF); approximately 1 acre of right-of-way is required for this stormwater detention facility; construct storm drain improvements associated with this pond (see Exhibit 10).

- **Upgrade crossing structure at Willow Creek Road.**

Increase capacity of crossing structure at Willow Creek Road or allow flows in excess of the culvert capacity to cross roadway (curb cuts) and re-enter the existing channel downstream of Willow Creek Road.

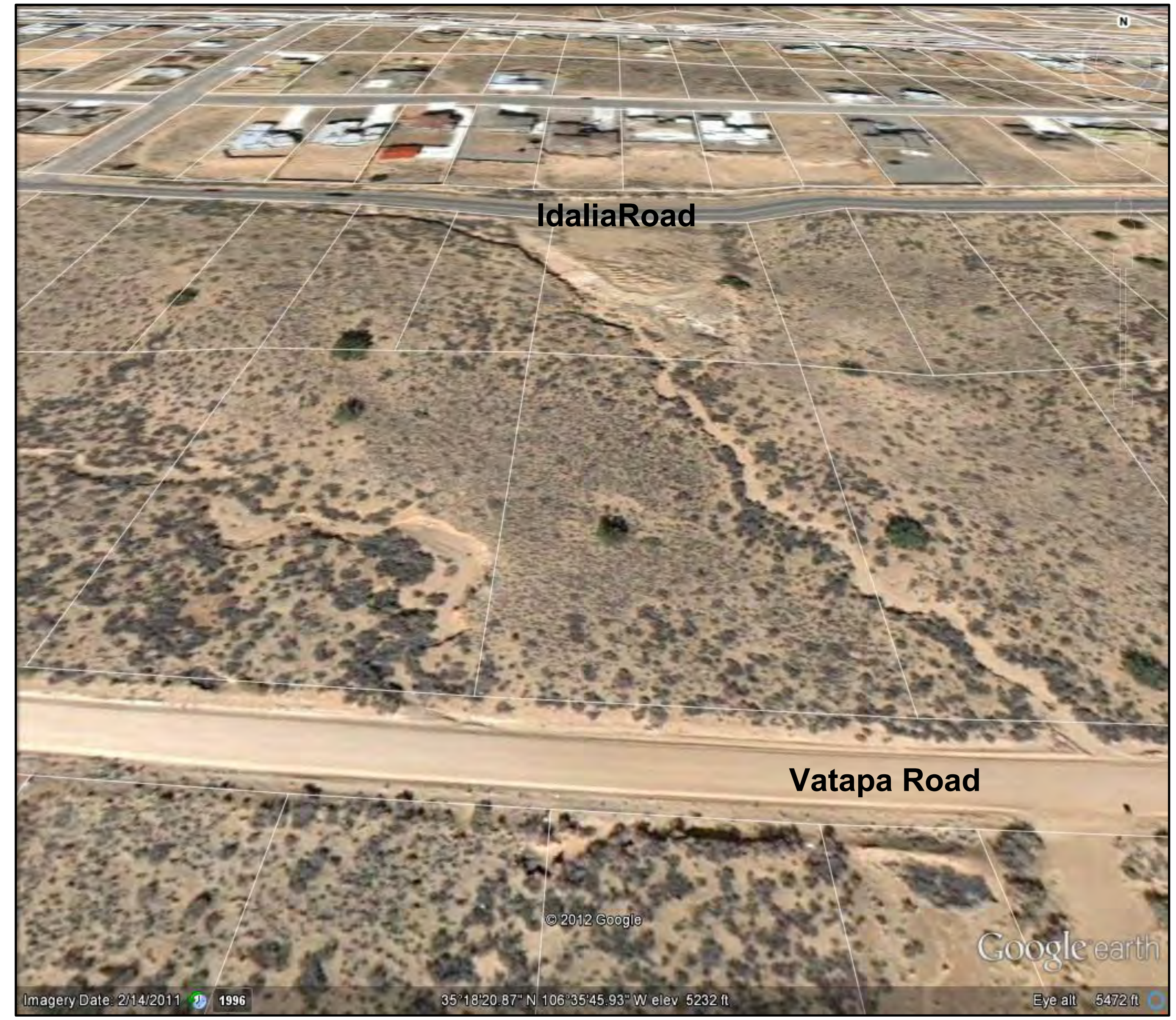


Exhibit 9: Aerial image (Google Earth) of two small arroyos intersecting Vatapa Road.

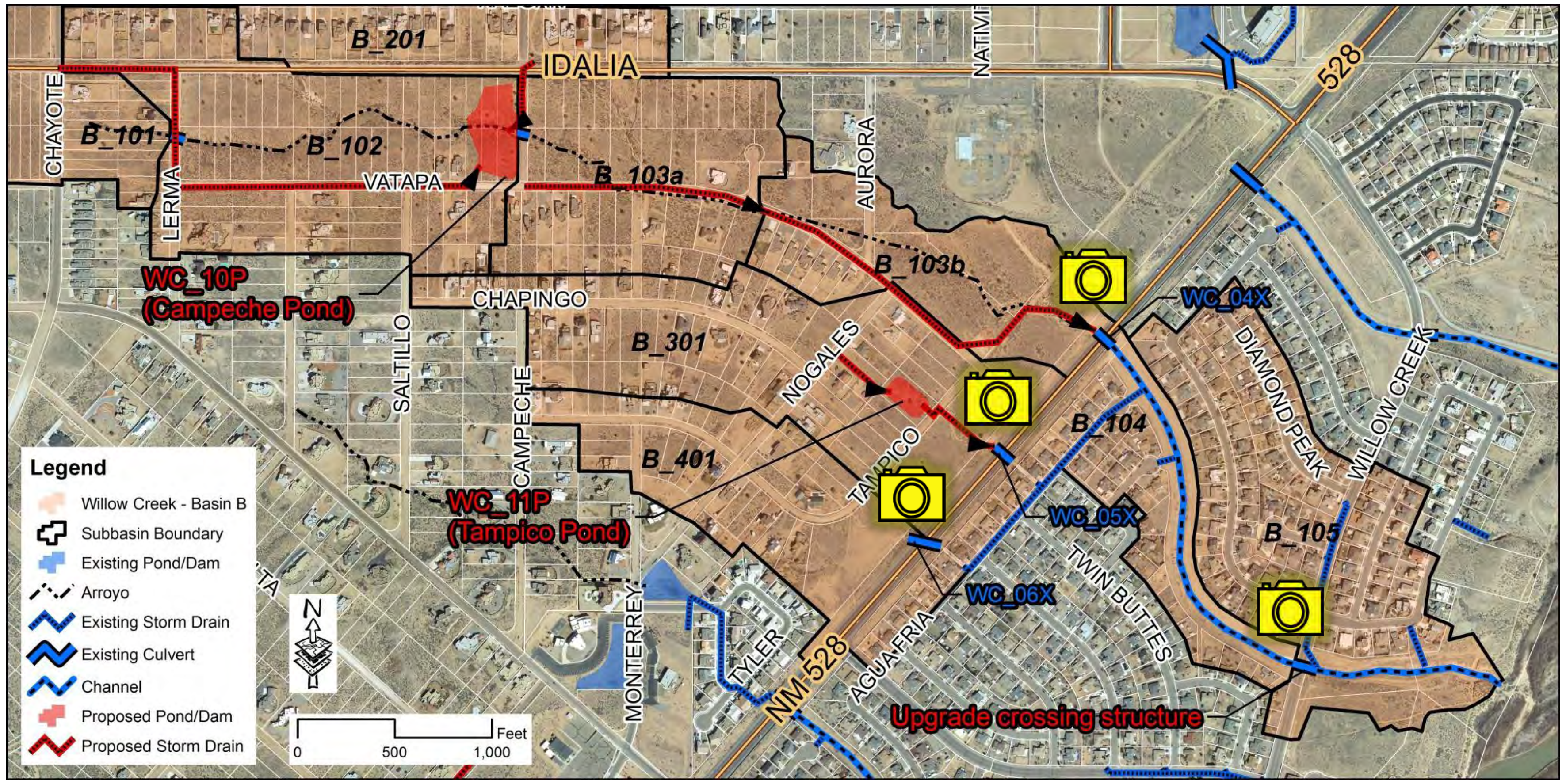


Exhibit 10: Map showing drainage improvement options in Basin B.

Photo 15: Crossing WC_04X (3 – 60" CMP, capacity ≈ 422 cfs)

Photo 16: Crossing WC_05X (left, 1 – 36" CMP, capacity ≈ 46 cfs) and WC_06X (right, 1 – 36" CMP, capacity ≈ 71 cfs)

17: Culvert at Willow Creek Road and Basin B (1 – 72" CMP, capacity ≈ 355 cfs)

7. Basin C – Drainage Deficiencies

Issues:

A small arroyo crosses a number of residential lots between Matamoros Road and Monterrey Road with no designated drainage right-of-way; in several locations, homes have been constructed in close proximity to the arroyo or even within the former flow path, making them susceptible to erosion damage and flooding. Christopher Pointe Pond (Photo 21) does not have sufficient capacity for the 100-year storm, both under EXISTING and DEVEX conditions; the outlet structure (grate) is also prone to clogging. Flows in excess of the pond capacity will travel down Tyler Loop towards NM 528, potentially causing flooding in the Christopher Pointe subdivision.

The culvert at NM 528 just west of the Christopher Point subdivision, as well as the storm drain downstream of Willow Creek Road have insufficient capacity under EXISTING and DEVEX conditions (see Photo 19 and Photo 20).

Proposed Improvements:

- **Upper Christopher Pointe Pond (WC_12P)**

Construct Upper Christopher Pointe Pond with a storage volume of 5 AF; approximately 2 acres (2 lots) are required for this facility (see Exhibit 11); construct associated storm drain.

- **Retrofit Christopher Pointe Pond (WC_07M)**

Replace existing outlet with ported riser pipe to improve efficiency, minimize maintenance and improve water quality.

- **Crossing at Willow Creek Road**

Even with all upstream improvements in place, there is insufficient detention volume to reduce peak flow rates at Willow Creek Road below the capacity of the existing culvert and storm drain. One potential solution would be to allow flows in excess of the culvert capacity to cross the roadway and utilize the public right-of-way downstream to convey the excess runoff the Rio Grande.

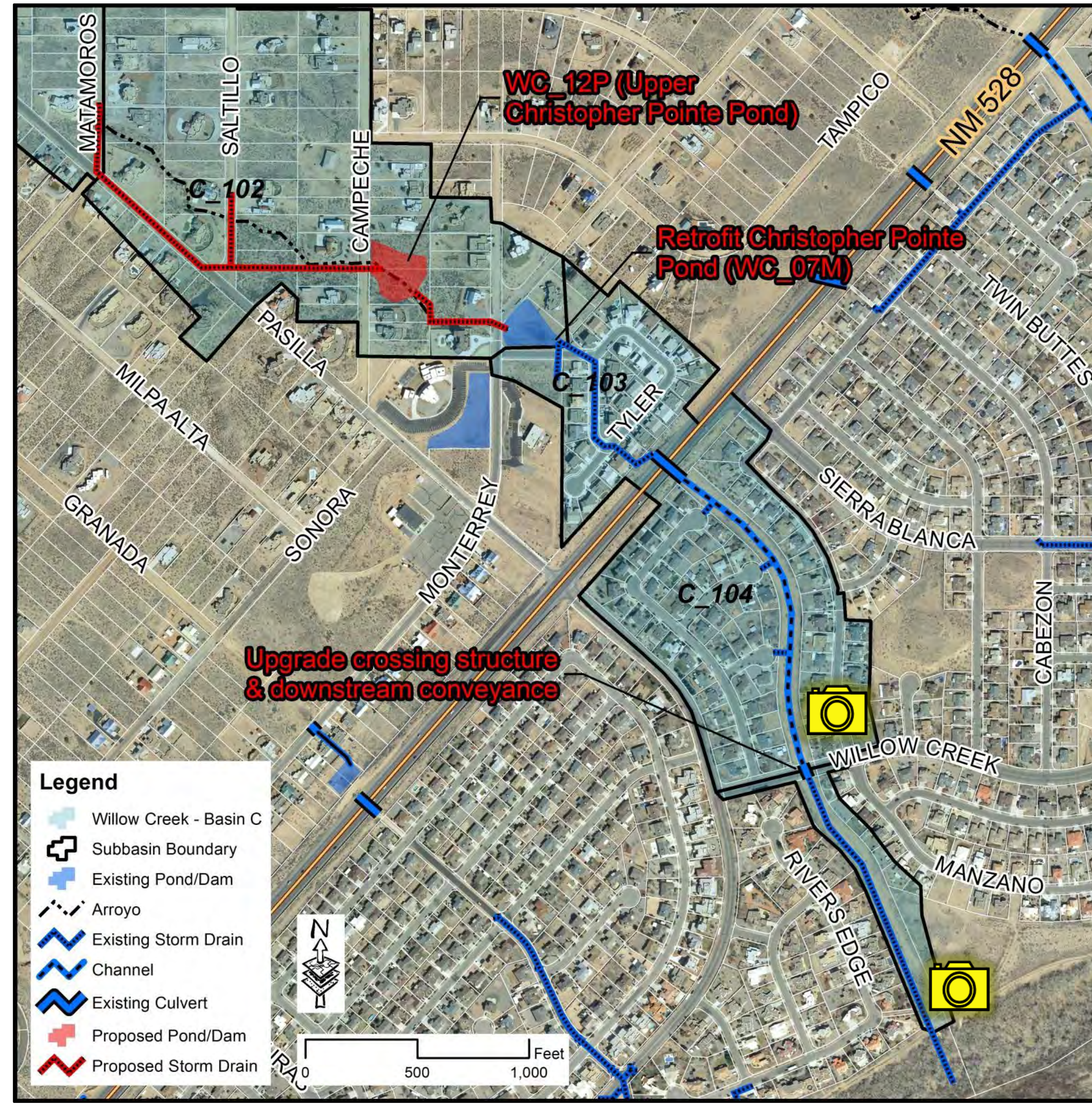


Exhibit 11: Map showing drainage improvement options in Basin C.

Photo 19: Storm drain inlet at Willow Creek Road in Basin C (36” RCP, capacity ≈ 90 cfs).

Photo 20: Outlet of storm drain shown above to the Rio Grande Bosque.

Photo 21: Christopher Pointe Pond (WC_06P), with the outlet structure visible in the foreground.

B. STORMWATER QUALITY

1. Background

It is widely recognized that as land use changes because of urbanization, stormwater runoff quality is adversely impacted. Nearly all of the associated water quality issues result from one underlying cause: loss of the water-retaining and evapotranspiration functions of the soil and vegetation in the urban landscape. Increases in impervious cover result in increased runoff volume and frequency, transporting ever greater quantities of pollutants and sediment to the arroyos and the Rio Grande in short, concentrated bursts of high discharge. When combined with the introduction of pollutant sources from urbanization (such as lawns, motor vehicles, domesticated animals, and industries), these changes in hydrology have led to water quality and habitat degradation in many urban streams.

The Federal Clean Water Act contains provisions to address control of pollution in stormwater through promulgation of the National Pollutant Discharge Elimination System (NPDES). Under this program, entities responsible for the discharge of municipal stormwater runoff to waters of the United States are regulated through an NPDES permit issued by the Environmental Protection Agency. Under the conditions of the NPDES permit, each entity must conduct stormwater quality management activities that seek to reduce pollutant levels in stormwater runoff to the maximum extent practicable. The pollutants of concern are established by the New Mexico Environment Department and are indicated as impairments to the Rio Grande when the state-established water quality standard is exceeded.

Stormwater quality management has not historically been a formal part of the mission of the Authority. The importance of the Authority's facilities in the management and conveyance of water resources in the region and the Authority's dedication to watershed stewardship along with the increasing regulatory attention to water quality management, have expanded the role of the Authority to include water quality. This reinforces elements of the Authority's overall mission to preserve the natural character of the arroyos, provide multi-use and quality-of-life opportunities for lands controlled by the Authority, and to control sediment transport and erosion. The Rio Grande is also viewed as a valuable resource for residents of the jurisdiction including the flora and fauna of these riparian and arroyo corridors.

SSCAFCA, along with the City of Rio Rancho and Sandoval County, were identified as regulated entities under the NPDES in 2006. SSCAFCA submitted a Stormwater Management Plan (SWMP) on May 24, 2007. Under the permit, SSCAFCA is requested to:

- Reduce the discharge of pollutants to the "maximum extent practicable" (MEP);
- Protect water quality; and
- Satisfy the appropriate water quality requirements of the Clean Water Act.

These requirements are accomplished through six minimum control measures:

- Public Education and Outreach
- Public Participation/Involvement
- Illicit Discharge Detection and Elimination
- Construction Site Runoff Control
- Post-Construction Runoff Control
- Pollution Prevention/Good Housekeeping

Details of the requirements and activities completed by SSCAFCA under the permite can be found on our website, www.sscafca.org.

2. Application in the Willow Creek Watershed Park

Many permanent regional best management practices are planned in this watershed park management plan to help reduce potential sediment and pollutants in stormwater runoff (see Exhibit 12), including:

- Water quality treatment mechanisms will be incorporated in the design of all regional stormwater detention facilities.
- Naturalistic channel treatments (earthen channels with drop structures) will be utilized wherever feasible to slow down the velocity of stormwater runoff and promote infiltration into the soil.
- SSCAFCA, in cooperation with the CoRR, has implemented a policy that requires residential, commercial and industrial developments to provide operation and maintenance of on-site stormwater quality facilities to treat the runoff from a 0.6", 6-hour storm event prior to discharge to a public facility. See the SSCAFCA/CoRR Development Process Manual.

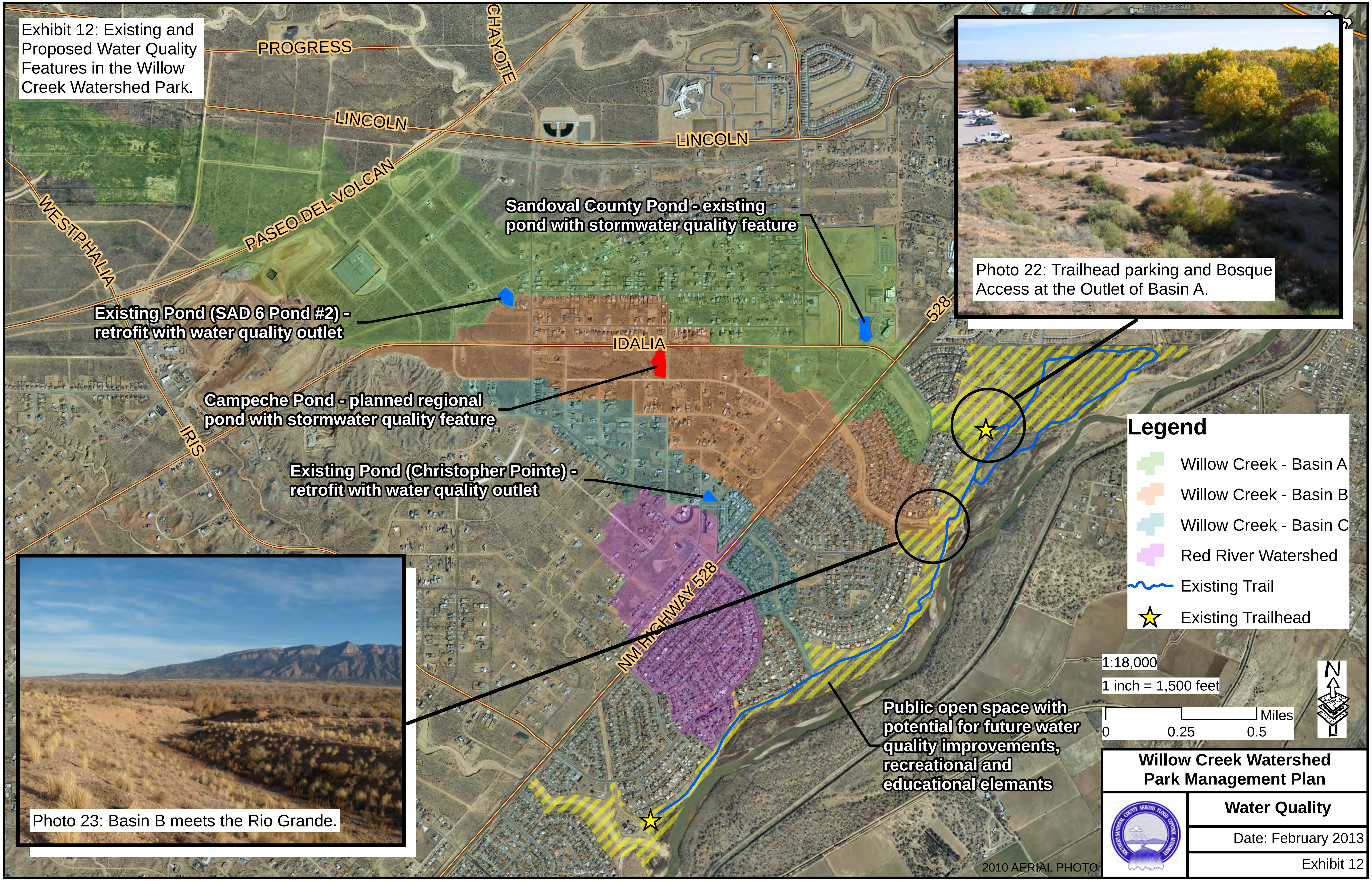
3. Rio Grande Bosque Open Space

A continuous ribbon of public open space stretches along the Rio Grande Bosque from the Venada Arroyo in the north to the Barranca Arroyo in the south (see Exhibit 12). The Interstate Stream Commission (ISC) is currently planning a "Rio Grande Bosque Open Space Habitat Restoration Project "scheduled to begin in February 2013. The project aims to restore river and wildlife habitat, and improve recreational access to the river.

In addition to wildlife habitat and recreational uses, the open space area has the potential for improving stormwater quality from a number of channels and storm drain outfalls before urban runoff enters the Rio Grande. It is therefore recommended for all affected agencies and stakeholders to work collaboratively on a regional multi-use plan that builds on the ISC project and incorporates storm water quality and educational components.

4. Things Individuals can do

There are many relatively simple practices that individual residents can do on a routine basis that will help improve stormwater quality. Many good examples of these practices can be found at the Stormwater Quality Team website: www.keeptheriogrand.org.



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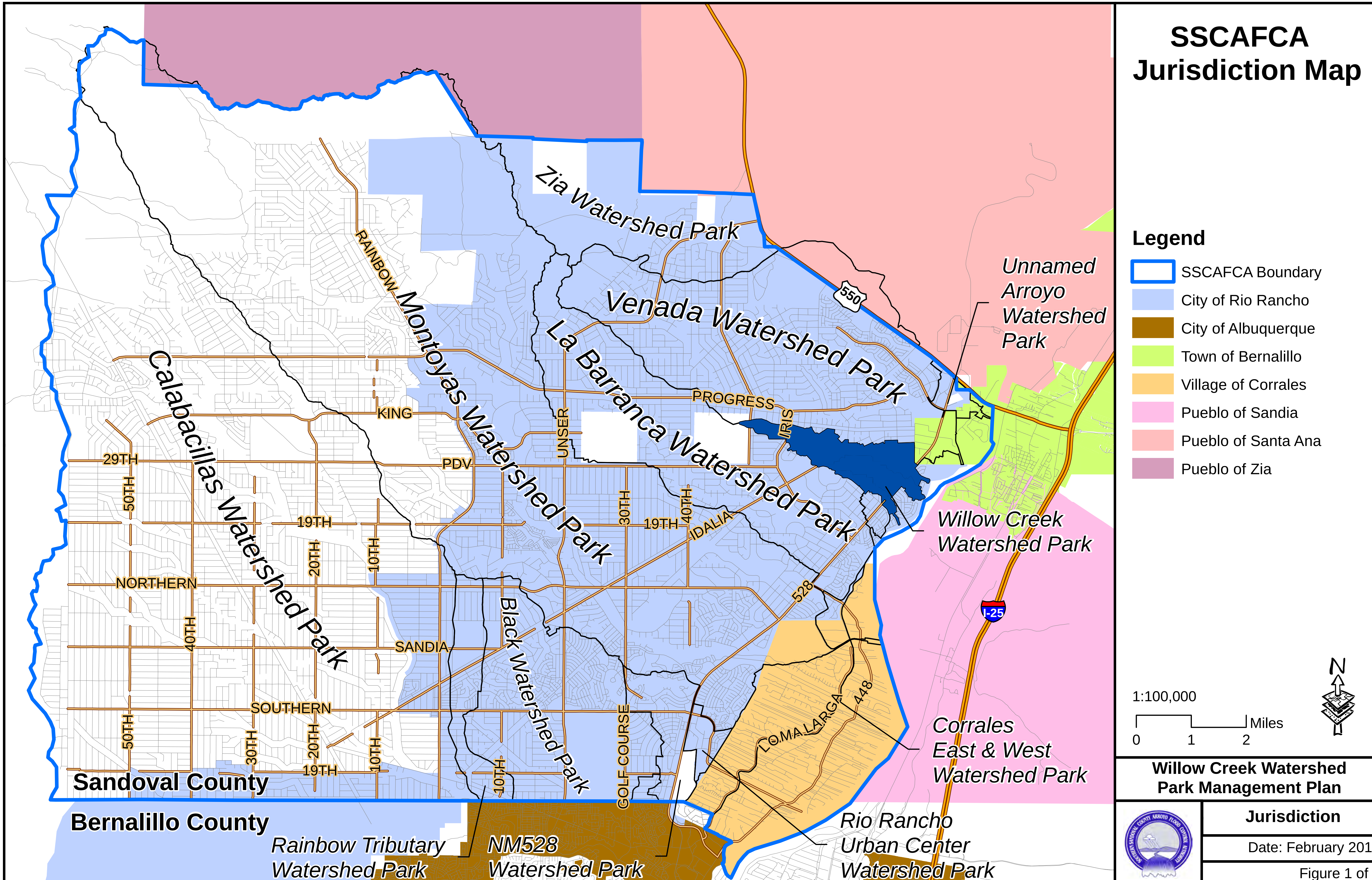
Appendix A – Figures



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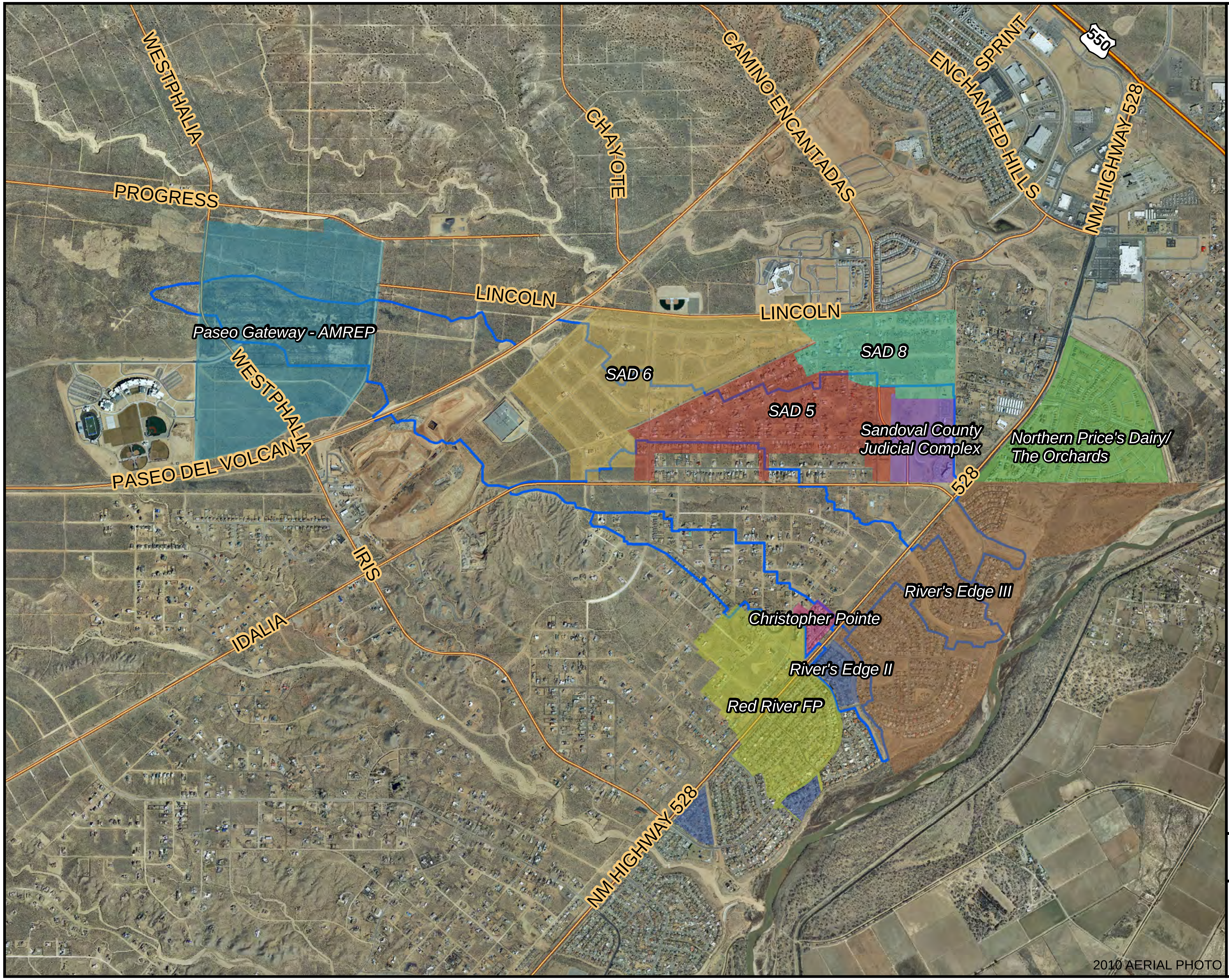
Reference Document	Title	Prepared By	Prepared For	Date
WCRD 01	Drainage Study for Corrales North Unit 2 (River's Edge 2)	Cinfran Engineering, Inc		Oct-88
WCRD 02	Drainage Study for Corrales North Unit 2, REPLAT 2 and Corrales North Unit 2A	Cinfran Engineering, Inc	AMREP Southwest, Inc.	Aug-89
WCRD 03	Rio Rancho SAD 5 Drainage Report	Wilson & Company	City of Rio Rancho	Jul-00
WCRD 04	Drainage Report for Christopher Pointe Subdivision	JC Engineering		Nov-02
WCRD 05	Final Drainage Study for Special Assessment District #6	Huitt-Zollars, Inc.	City of Rio Rancho	Apr-05
WCRD 06	Master Drainage Management Plan for The Orchards	Tierra West, LLC	Intrepid Development LLC	Jul-05
WCRD 07	Mater Drainage Plan for Northern Price's Dairy, Southeast Corner of Montoya and NM 528	Tierra West, LLC	Dudley Price D&G Limited Partnership	Oct-06
WCRD 08	Final Drainage Report, Paseo Del Volcan (Northern Section) Stage II - Iris Road to US 550	HDR	City of Rio Rancho	Feb-09
WCRD 09	SAD 8 City of Rio Rancho Final Drainage Report	Wilson & Company	City of Rio Rancho	Feb-09
WCRD 10	Red River Facility Plan	Huitt-Zollars, Inc.	City of Rio Rancho	Mar-06
WCRD 11	Drainage Study for Corrales North Unit 3 (River's Edge 3)	Cinfran Engineering, Inc		
WCRD 12	SSCAFCA Drainage Policy Amendment 2004-1	SSCAFCA	SSCAFCA	Mar-04
WCRD 13	SSCAFCA Drainage Policy Amendment 2004-2	SSCAFCA	SSCAFCA	Apr-04
WCRD 14	SSCAFCA Quality of Life Master Plan	Community Sciences Corporation	SSCAFCA	Sep-06
WCRD 15	SSCAFCA Drainage Policy	SSCAFCA	SSCAFCA	Jun-08
WCRD 16	SSCAFCA DPM, Chapter 22, Drainage, Flood Control and Erosion Control	SSCAFCA	SSCAFCA	
WCRD 17	La Barranca Specific Area Plan	CoRR	CoRR	Mar-10
WCRD 18	Drainage Management Plan, AMREP - Paseo Gateway	Huitt-Zollars, Inc.	AMREP Southwest, Inc.	Nov-09
WCRD 19	Sandoval County Judicial Complex Facility Drainage Plan	Huitt-Zollars, Inc.	Sandoval County	Jul-06
WCRD 20	Special Assessment District 6 Record Drawings	Huitt-Zollars, Inc.	City of Rio Rancho	Feb-09

Reference Map



1:24,000

1 inch = 2,000 feet

Miles

0 0.25 0.5

N

Willow Creek Watershed Park Management Plan

Reference Map

Date: February 2013

Figure 2 of 5

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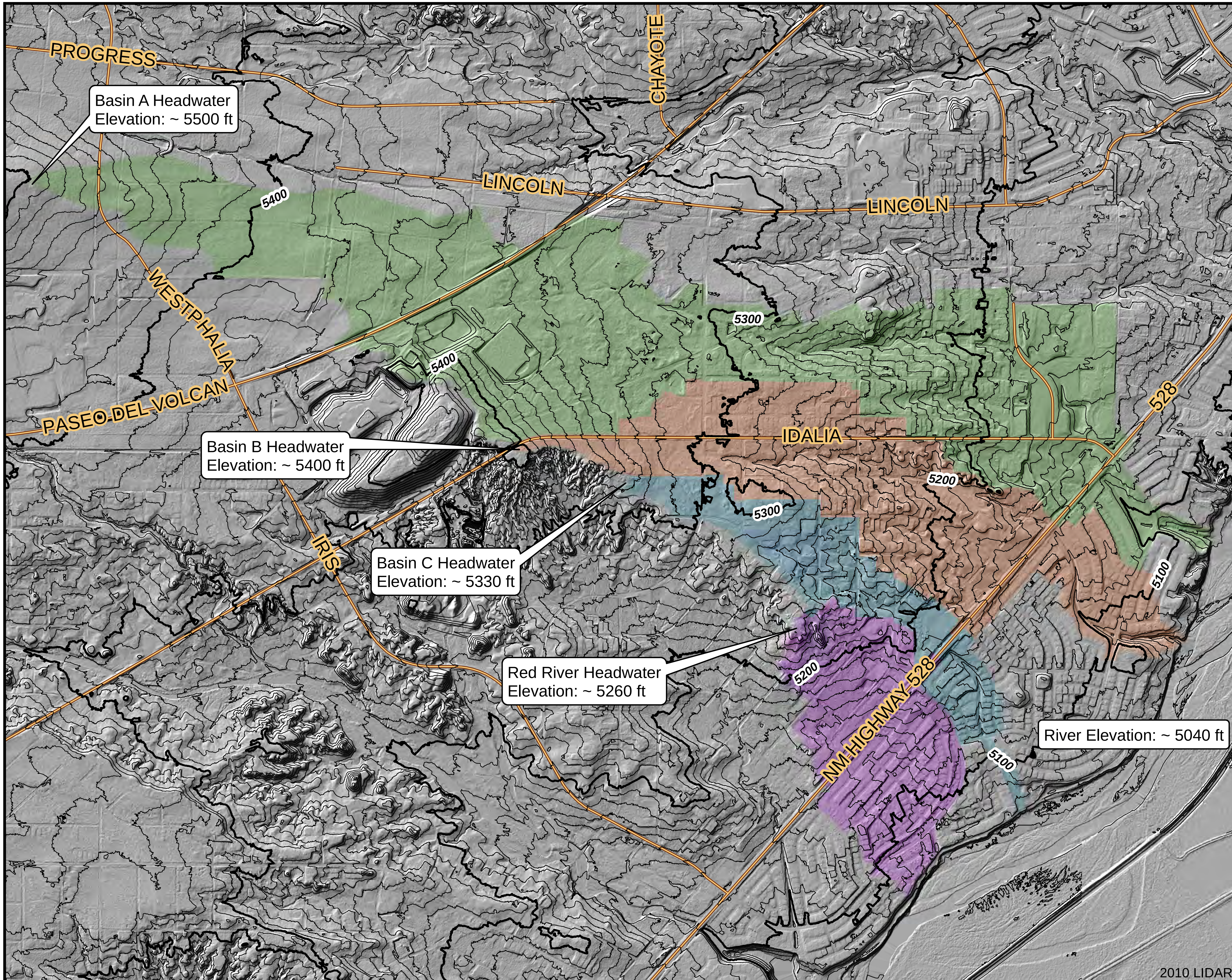

Topography

Legend

- 100ft Contours
- 10ft Contours
- Willow Creek - Basin A
- Willow Creek - Basin B
- Willow Creek - Basin C
- Red River Watershed

1:18,000

1 inch = 1,500 feet

0 0.25 0.5 Miles

N

Willow Creek Watershed Park Management Plan

Topography

Date: February 2013

Figure 3 of 5

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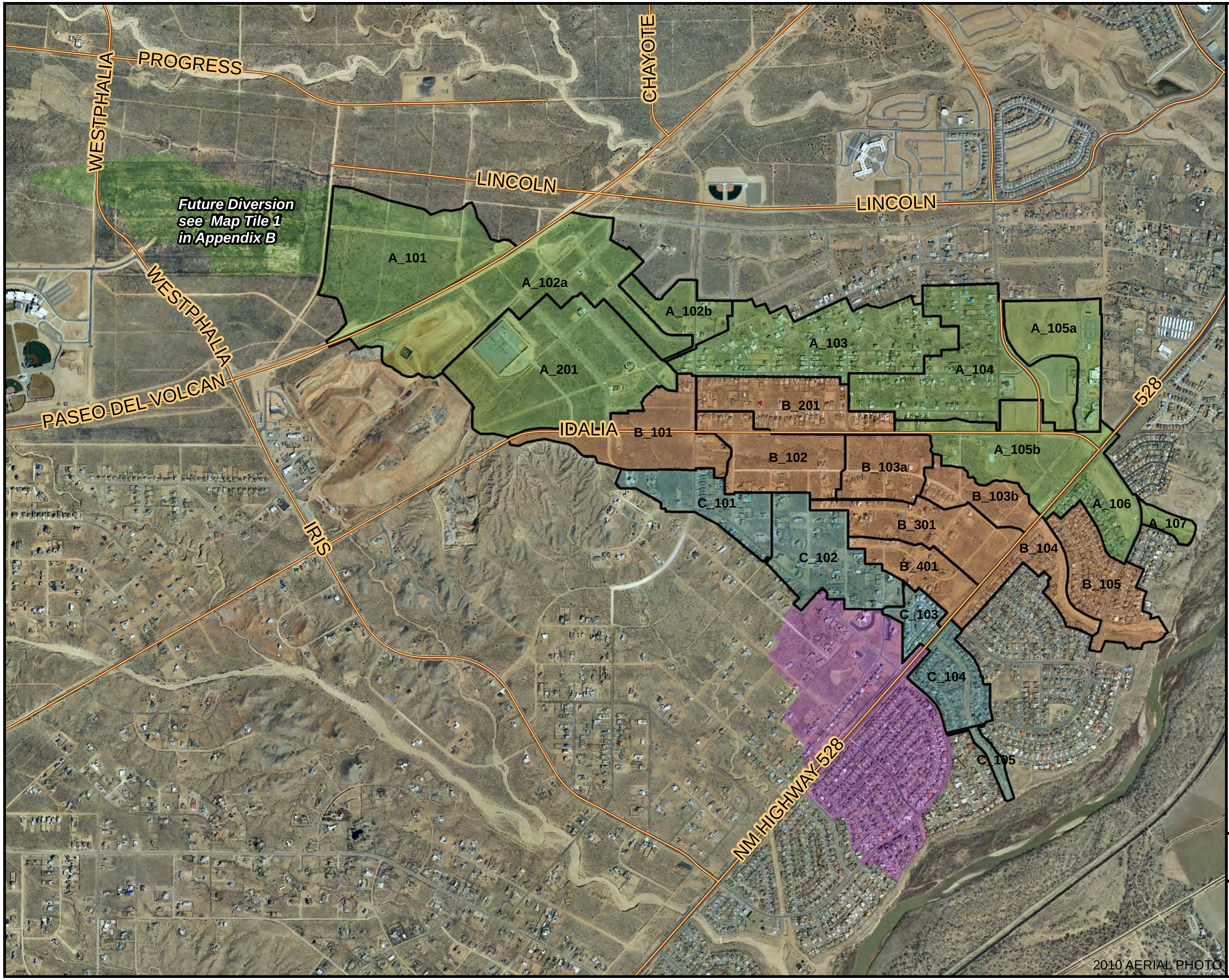


Drainage Basin Map

Legend

- Subbasin Boundary
- Willow Creek - Basin A
- Willow Creek - Basin B
- Willow Creek - Basin C
- Red River Watershed

1:18,000

1 inch = 1,500 feet

0 0.25 0.5 Miles

N

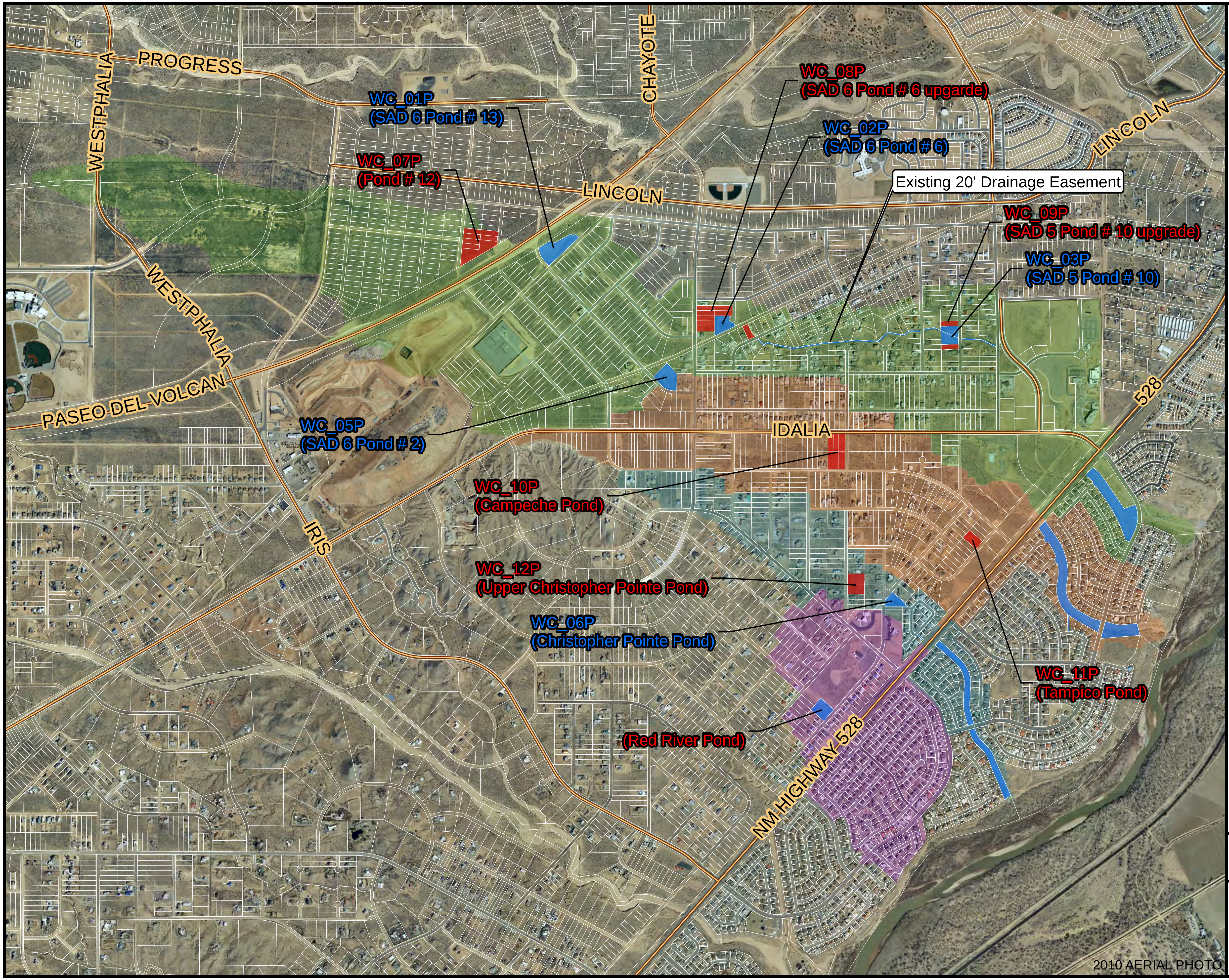
Willow Creek Watershed Park Management Plan

Drainage Basin Map

Date: February 2013

Figure 4 of 5

Path: H:\Watershed_Planning\WillowCreek_WMP\WCWMP_2012\WCWMP_2012_GIS\WCWMP_mxd\4_DrainageBasins.mxd



Right-of-Way

Legend

- Existing Drainage ROW
- Proposed Drainage ROW
- Willow Creek - Basin A
- Willow Creek - Basin B
- Willow Creek - Basin C
- Red River Watershed
- WC_01P — Existing Pond
- WC_01P — Proposed Pond

NOTE:
SSCAFCA currently has no fee simple or easement ownership of any property within the Willow Creek Watershed Park. Lands highlighted in blue on this exhibit are owned by other public agencies.

1:18,000
1 inch = 1,500 feet

0 | 0.25 | 0.5 Miles

N

Willow Creek Watershed Park Management Plan

Right-of-Way

Date: February 2013

Figure 5 of 5

Path: H:\Watershed_Planning\WillowCreek_WMP\WCWMP_2012\WCWMP_2012_GIS\WCWMP_mxd\5_ROW.mxd

Appendix B – Drainage Map Tiles

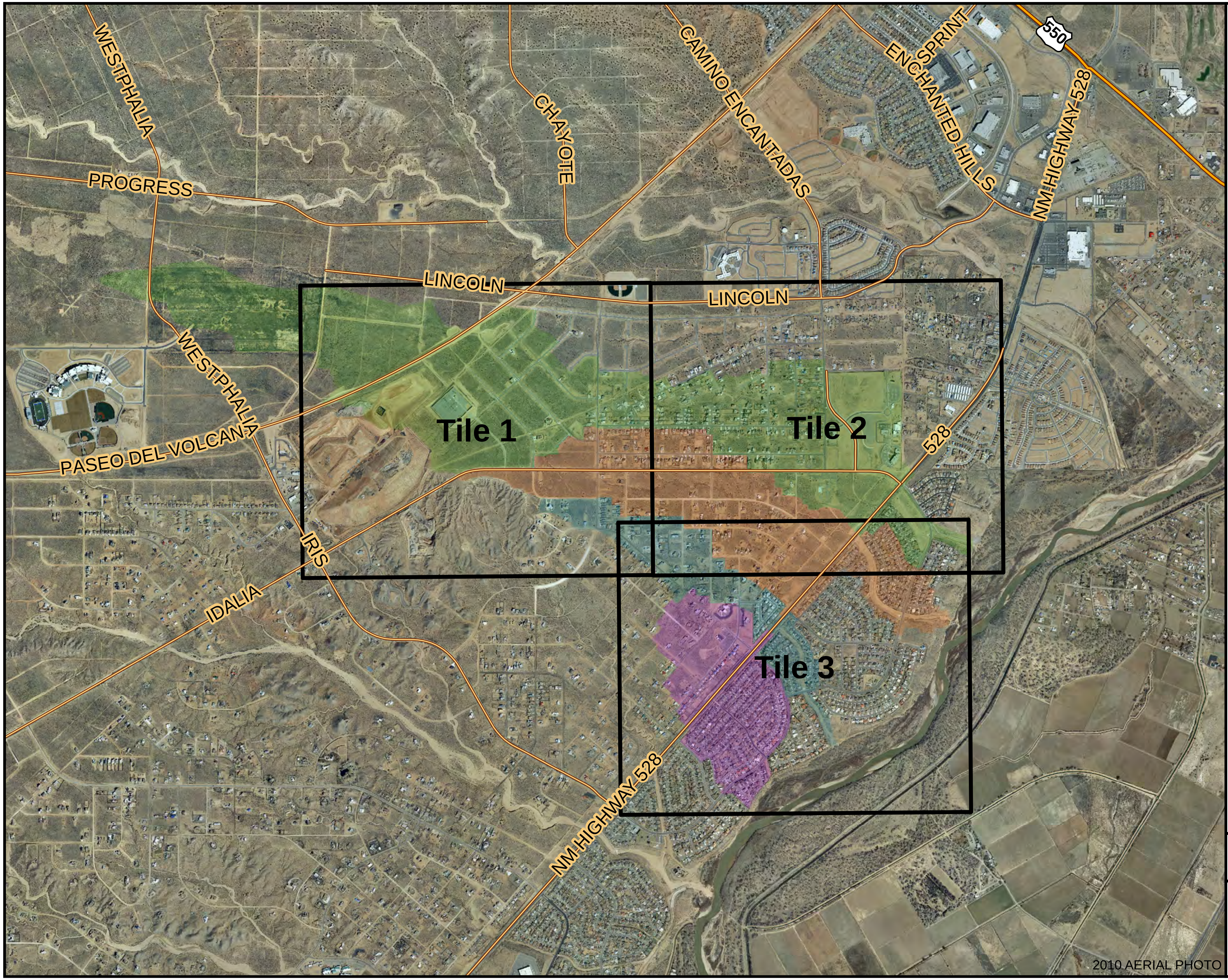
Example Facility Identification Number:

WC_01A

- Facility Type
- Facility Number
- Watershed Designation

Facility Types

A - Natural Arroyo
C - Channel
S - Storm Drain
P - Pond
E - Environmental
X - Crossing Structure
M - Miscellaneous



Drainage Map Tile Index

Legend

- Drainage Map Tile
- Willow Creek - Basin A
- Willow Creek - Basin B
- Willow Creek - Basin C
- Red River Watershed

1:24,000

1 inch = 2,000 feet

0 0.25 0.5 Miles

N

Willow Creek Watershed Park Management Plan

Tile Index

Date: February 2013

Map Tile 0 of 3

Path: H:\Watershed_Planning\WillowCreek_WMP\WCWMP_2012\WCWMP_2012_GIS\WCWMP_mxd\Tile00.mxd

Map Tile 1

Existing Stormwater Detention Facilities										
Facility ID	**Name**	**Description**	**HEC-HMS Element**	**EXISTING Q in (cfs)**	**EXISTING Q out (cfs)**	**EXISTING Peak V (AF)**	**DEVEX Q in (cfs)**	**DEVEX Q out (cfs)**	**DEVEX Peak V (AF)**	**Notes**
WC_01P	SAD 6 Pond # 13		POND_13	30	16	3.1	30	14	3.0	
WC_02P	SAD 6 Pond # 6		POND_6	220	179	3.3	283	246	3.9	
WC_05P	SAD 6 Pond # 2		POND_2	225	22	9.1	225	58	10.6	WQ feature enhancement needed

Existing Conveyance Facilities										
Facility ID	**Name**	**Description**	**HEC-HMS Element**	**Drainage Area (mi^2)**	**EXISTING Q (cfs)**	**EXISTING V (AF)**	**DEVEX Q (cfs)**	**DEVEX V (AF)**		**Notes**
WC_01A		Arroyo, no drainage ROW	POND_6	0.74	179	21.5	246	31		
WC_01S		30" to 60" RCP	A_102a_R	0.33	16	3.8	14	5		
WC_02S		24" RCP	A_201_R	0.19	22	5.2	40	9		
WC_04A		Arroyo, no drainage ROW	B_101	0.08	113	4.4	163	9		

Existing Crossing Structures										
Facility ID	**Name**	**Description**	**HEC-HMS Element**	**Drainage Area (mi^2)**	**EXISTING Q (cfs)**	**EXISTING V (AF)**	**DEVEX Q (cfs)**	**DEVEX V (AF)**	**Est. Capacity (cfs)**	**Notes**
WC_01X		1-30" CMP	PDV_Culvert	0.33	30	5.2	30	6	30	

Proposed Stormwater Detention Facilities										
Facility ID	**Name**	**Description**	**HEC-HMS Element**	**ULTIMATE Q in (cfs)**	**ULTIMATE Q out (cfs)**	**ULTIMATE Peak V (AF)**				**Notes**
WC_07P	Pond # 12	15 AF	POND_12	220	21	9.4				
WC_08P	SAD 6 Pond # 6 upgrade	9 AF	Pond_6_upgrade	321	129	10.7				

Proposed Conveyance Facilities										
Facility ID	**Name**	**Description**	**HEC-HMS Element**	**Drainage Area (mi^2)**	**ULTIMATE Q (cfs)**	**ULTIMATE V (AF)**				**Notes**
WC_08S	Pond # 6 outfall SD		A_103_R	0.56	128	44.0				design & build in conjunction with WC_08P
WC_09S	Upper Vatapa Rd SD		B_101_R2	0.00	68	1.0				coordinate with Vatapa Rd improvements

Proposed Misc. Drainage Improvements										
Facility ID	**Name**	**Description**	**HEC-HMS Element**	**Drainage Area (mi^2)**	**ULTIMATE Q (cfs)**	**ULTIMATE V (AF)**				**Notes**
WC_01M		Remove pond	PDV_connect	0.15	21	11.3				
WC_02M		Rehab outlet structure	POND_2_upgrade	0.19	46	16.0				

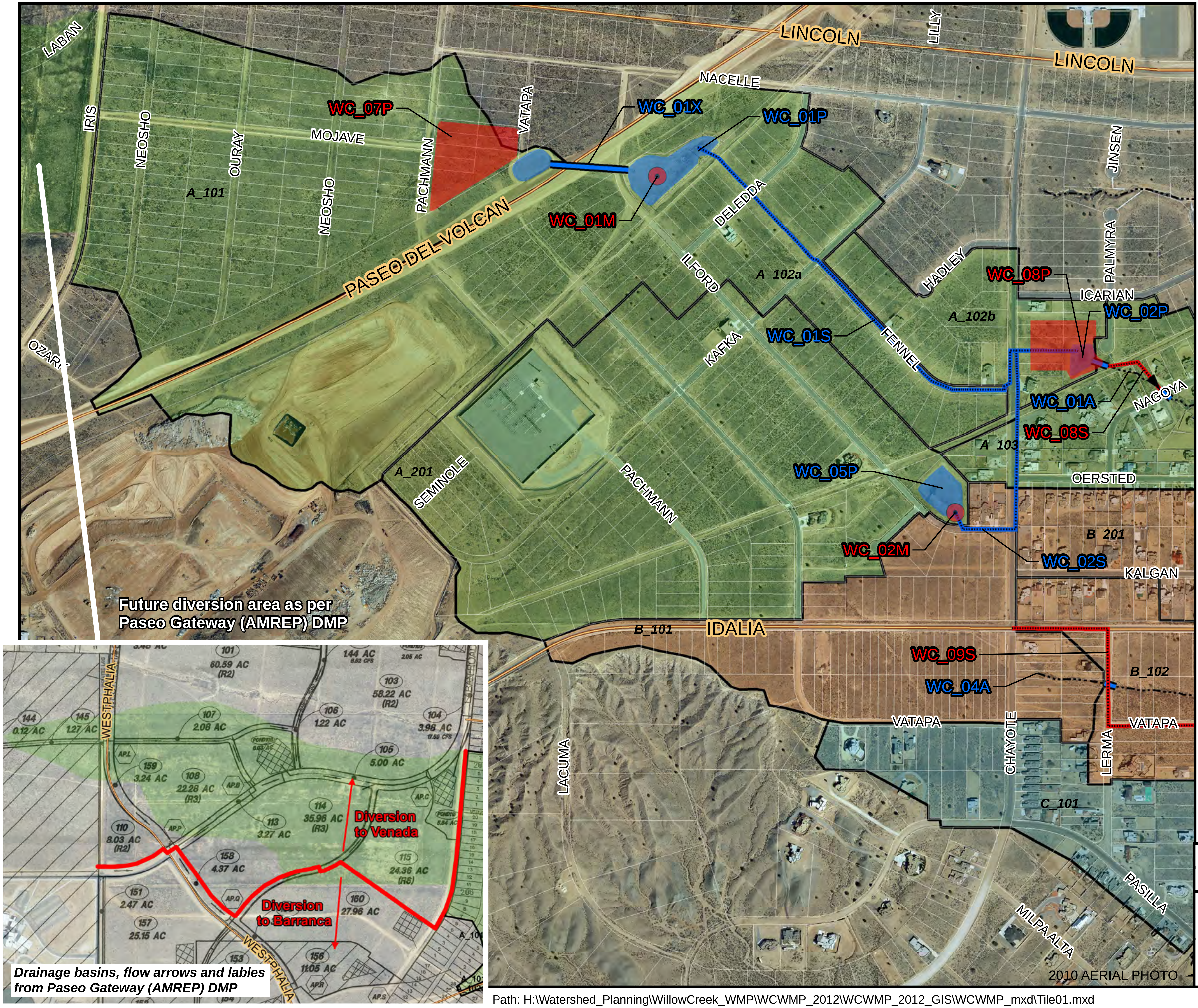
Notes

(1) Drainage areas reported in above tables correspond to the existing conditions model; In Basin A, drainage areas downstream of PDV will be slightly smaller for DEVEX and ULTIMATE conditions due to planned diversions to the Venada and Barranca Arroyos. Please consult detailed HEC-HMS output in Appendix C.

(2) Peak flows (EXISTING Q, etc.) correspond to the 100-year 24-hour design storm

(3) Volumes for conveyances (EXISTING V, etc.) are total runoff volumes resulting from the 100-year 24-hour design storm

(4) Peak volumes for ponds (EXISTING Peak V, etc.) corresponds to the highest volume of runoff stored in the pond at any time during the simulation



Path: H:\Watershed_Planning\WillowCreek_WMP\WCWMP_2012\WCWMP_2012_GIS\WCWMP_mxd\Tile01.mxd

Legend

- Willow Creek - Basin A
- Willow Creek - Basin B
- Willow Creek - Basin C
- Red River Watershed
- Subbasin
- 100yr FEMA floodplain

L2.100 Drainage Basin Number

- Arroyo
- Existing Hardened Channel
- Existing Soft Channel
- Existing Storm Drain
- Existing Culvert
- Existing Pond/Dam
- Proposed Storm Drain
- Proposed Pond/Dam

WC_01P Existing Drainage Facility ID

WC_01P Proposed Drainage Facility ID

1:7,200

1 inch = 600 feet

0 500 1,000 Feet

N

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Willow Creek Watershed Park Management Plan

Drainage Map Tile

Date: February 2013

Map Tile 1 of 3

Map Tile 2

Existing Stormwater Detention Facilities										
Facility ID	Name	Description	HEC-HMS Element	EXISTING Q in (cfs)	EXISTING Q out (cfs)	EXISTING Peak V (AF)	DEVEX Q in (cfs)	DEVEX Q out (cfs)	DEVEX Peak V (AF)	Notes
WC_03P	SAD 5 Pond # 10		POND_10	256	231	2.7	344	291	3.7	
WC_04P	Sandoval County Pond		County_Pond	334	246	8.6	369	315	9.7	

Existing Conveyance Facilities										
Facility ID	Name	Description	HEC-HMS Element	Drainage Area (mi^2)	EXISTING Q (cfs)	EXISTING V (AF)	DEVEX Q (cfs)	DEVEX V (AF)		Notes
WC_01C		Earthen channel, concrete low flow channel	A_104_R3	1.04	334	44.3	369	57		
WC_02A		Arroyo, no drainage ROW	A_103_J	0.89	256	31.9	344	42		
WC_02C		Earthen channel with drop structures	A_106_J1	1.25	373	62.0	476	84		
WC_03A		Arroyo, no drainage ROW	POND_10	0.89	231	31.8	291	42		
WC_03C		Earthen channel with drop structures	A_107_J	1.26	382	62.4	489	84		
WC_03S		54" to 60" RCP	A_104_R2	0.89	230	31.8	290	42		
WC_05A		Arroyo, no drainage ROW	B_102_J	0.16	201	8.4	287	18		
WC_05S		48" RCP	B_104_R2	0.11	114	5.4	115	9		
WC_06A		Arroyo, no drainage ROW	B_103a_J	0.28	349	16.5	460	29		Arroyo is partially within roadway
WC_07A		Arroyo, no drainage ROW	B_103b_J1	0.32	374	18.3	510	34		

Existing Crossing Structures										
Facility ID	Name	Description	HEC-HMS Element	Drainage Area (mi^2)	EXISTING Q (cfs)	EXISTING V (AF)	DEVEX Q (cfs)	DEVEX V (AF)	Est. Capacity (cfs)	Notes
WC_02X		2-60" CMP	A_105_J	1.20	293	57.0	402	79	336	
WC_03X		1-66" CMP	A_106_J1	1.25	373	62.0	476	84	294	
WC_04X		3-60" CMP	B_103b_J2	0.32	422	19.6	596	36	422	
WC_05X		1-36" CMP	B_301_Div	0.07	45	3.0	45	5	46	

Proposed Stormwater Detention Facilities										
Facility ID	Name	Description	HEC-HMS Element	ULTIMATE Q in (cfs)	ULTIMATE Q out (cfs)	ULTIMATE Peak V (AF)				Notes
WC_09P	SAD 5 Pond # 10 upgrade	8 AF	POND_10_upgrade	196	136	6.4				
WC_10P	Campeche Pond	17 AF	Campeche_Pond	413	116	11.5				WQ feature needed
WC_11P	Tampico Pond	3.5 AF	Tampico_Pond	144	35	3.4				

Proposed Conveyance Facilities										
Facility ID	Name	Description	HEC-HMS Element	Drainage Area (mi^2)	ULTIMATE Q (cfs)	ULTIMATE V (AF)				Notes
WC_10S	Idalia SD		B_102_R2	0.08	109	6.4				coordinate with Idalia Rd improvements
WC_11S	Middle Vatapa Rd SD		B_103a_R	0.23	116	23.4				coordinate with Vatapa Rd improvements
WC_12S	Lower Vatapa Rd SD		B_103b_R1	0.28	169	28.0				coordinate with Vatapa Rd improvements
WC_13S	Pasilla Rd SD		C_102_R1	0.06	94	4.8				

Proposed Misc. Drainage Improvements										
Facility ID	Name	Description	HEC-HMS Element	Drainage Area (mi^2)	ULTIMATE Q (cfs)	ULTIMATE V (AF)				Notes
WC_03M		Restrict developed discharge (< 75 cfs)								
WC_04M		Upgrade crossing	A_106_J2	1.06	357	96.2				
WC_05M		Replace failing drop structures	A_107_J	1.07	360	96.7				

Notes

(1) Drainage areas reported in above tables correspond to the existing conditions model; In Basin A, drainage areas downstream of PDV will be slightly smaller for DEVEX and ULTIMATE conditions due to planned diversions to the Venada and Barranca Arroyos.
Please consult detailed HEC-HMS output in Appendix C.

(2) Peak flows (EXISTING Q, etc.) correspond to the 100-year 24-hour design storm

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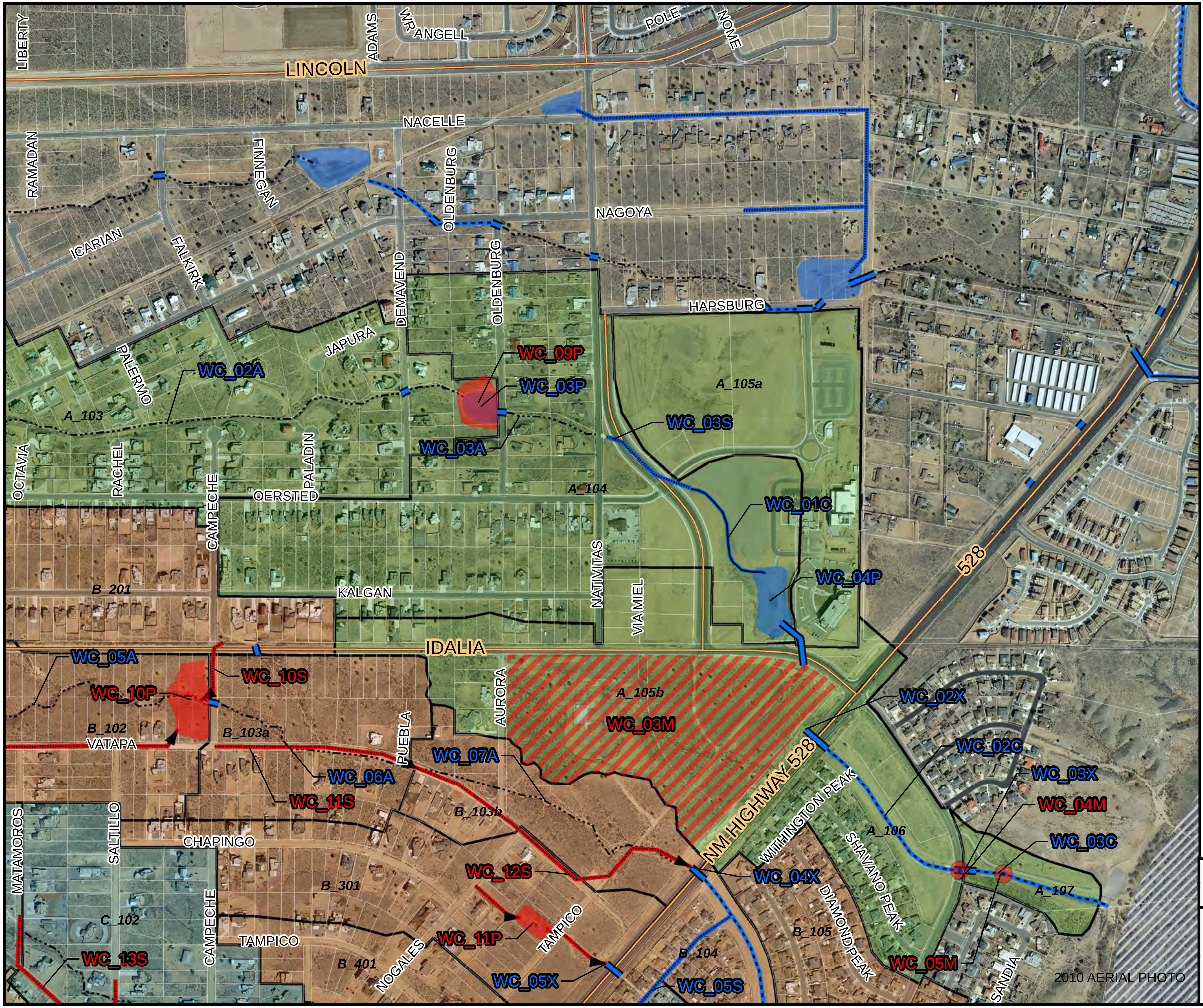

Legend

- Willow Creek - Basin A
- Willow Creek - Basin B
- Willow Creek - Basin C
- Red River Watershed
- Subbasin
- 100yr FEMA floodplain
- *L2.100* Drainage Basin Number
- Arroyo
- Existing Hardened Channel
- Existing Soft Channel
- Existing Storm Drain
- Existing Culvert
- Existing Pond/Dam
- Proposed Storm Drain
- Proposed Pond/Dam
- Discharge Restriction
- WC_01P Existing Drainage Facility ID
- WC_01P Proposed Drainage Facility ID

1:7,200

1 inch = 600 feet

0 500 1,000 Feet

N

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Willow Creek Watershed Park Management Plan

Drainage Map Tile

Date: February 2013

Map Tile 2 of 3

Path: H:\Watershed_Planning\WillowCreek_WMP\WCWMP_2012\WCWMP_2012_GIS\WCWMP_mxd\Tile02.mxd

Map Tile 3

Existing Stormwater Detention Facilities

Facility ID	Name	Description	HEC-HMS Element	EXISTING Q in (cfs)	EXISTING Q out (cfs)	EXISTING Peak V (AF)	DEVEX Q in (cfs)	DEVEX Q out (cfs)	DEVEX Peak V (AF)	Notes
WC_06P	Christopher Pointe Pond		CP_lower	187	144	3.0	219	194	3.2	WQ enhancement needed

Existing Conveyance Facilities

Facility ID	Name	Description	HEC-HMS Element	Drainage Area (mi^2)	EXISTING Q (cfs)	EXISTING V (AF)	DEVEX Q (cfs)	DEVEX V (AF)		Notes
WC_03C		Earthen channel with drop structures	A_107_J	1.26	382	62.4	489	84		
WC_04C		Earthen channel with drop structures	B_104_J3	0.48	578	30.2	774	50		
WC_04S		36" RCP	B_104_R1	0.04	70	2.4	70	4		
WC_05C		Earthen channel with drop structures	B_105_J	0.55	668	37.3	867	57		
WC_05S		48" RCP	B_104_R2	0.11	114	5.4	115	9		
WC_06C		Earthen channel with drop structures	C_104_J	0.21	200	15.5	257	19		
WC_06S		30" RCP	C_103_R	0.14	142	8.0	189	11		
WC_07S		36" to 48" RCP	C_105_R	0.21	199	15.5	254	19		
WC_08A		Arroyo, no drainage ROW	C_102_J	0.14	187	8.0	219	11		

Existing Crossing Structures

Facility ID	Name	Description	HEC-HMS Element	Drainage Area (mi^2)	EXISTING Q (cfs)	EXISTING V (AF)	DEVEX Q (cfs)	DEVEX V (AF)	Est. Capacity (cfs)	Notes
WC_03X		1-66" CMP	A_106_J1	1.25	373	62.0	476	84	294	
WC_04X		3-60" CMP	B_103b_J2	0.32	422	19.6	596	36	422	
WC_05X		1-36" CMP	B_301_Div	0.07	45	3.0	45	5	46	
WC_06X		1-36" CMP	B_401_Div	0.04	70	2.4	70	4	71	
WC_07X		1-72" CMP	B_104_J3	0.48	578	30.2	774	50	355	
WC_08X		1-36" CMP	C_103_J	0.16	163	10.3	214	14	88	

Proposed Stormwater Detention Facilities

Facility ID	Name	Description	HEC-HMS Element	ULTIMATE Q in (cfs)	ULTIMATE Q out (cfs)	ULTIMATE Peak V (AF)				Notes
WC_11P	Tampico Pond	3.5 AF	Tampico_Pond	144	35	3.4				
WC_12P	Upper Christopher Pointe Pond	5 AF	CP_upper	237	101	4.6				

Proposed Conveyance Facilities

Facility ID	Name	Description	HEC-HMS Element	Drainage Area (mi^2)	ULTIMATE Q (cfs)	ULTIMATE V (AF)				Notes
WC_12S	Lower Vatapa Rd SD		B_103b_R1	0.28	169	28.0				coordinate with Vatapa Rd improvements
WC_13S	Pasilla Rd SD		C_102_R1	0.06	94	4.8				
WC_14S	Upper CP Pond outfall SD		C_102_R2	0.14	101	11.1				design & build in conjunction with WC_12P

Proposed Misc. Drainage Improvements

Facility ID	Name	Description	HEC-HMS Element	Drainage Area (mi^2)	ULTIMATE Q (cfs)	ULTIMATE V (AF)				Notes
WC_04M		Upgrade crossing	A_106_J2	1.06	357	96.2				
WC_05M		Replace failing drop structures	A_107_J	1.07	360	96.7				
WC_06M		Upgrade crossing	B_104_J3	0.48	440	48.6				
WC_07M		Rehab outlet structure	CP_lower	0.14	91	11.0				
WC_08M		Upgrade crossing & downstream conveyance	C_104_J	0.21	150	18.5				

Notes

(1) Drainage areas reported in above tables correspond to the existing conditions model; In Basin A, drainage areas downstream of PDV will be slightly smaller for DEVEX and ULTIMATE conditions due to planned diversions to the Venada and Barranca Arroyos. Please consult detailed HEC-HMS output in Appendix C.

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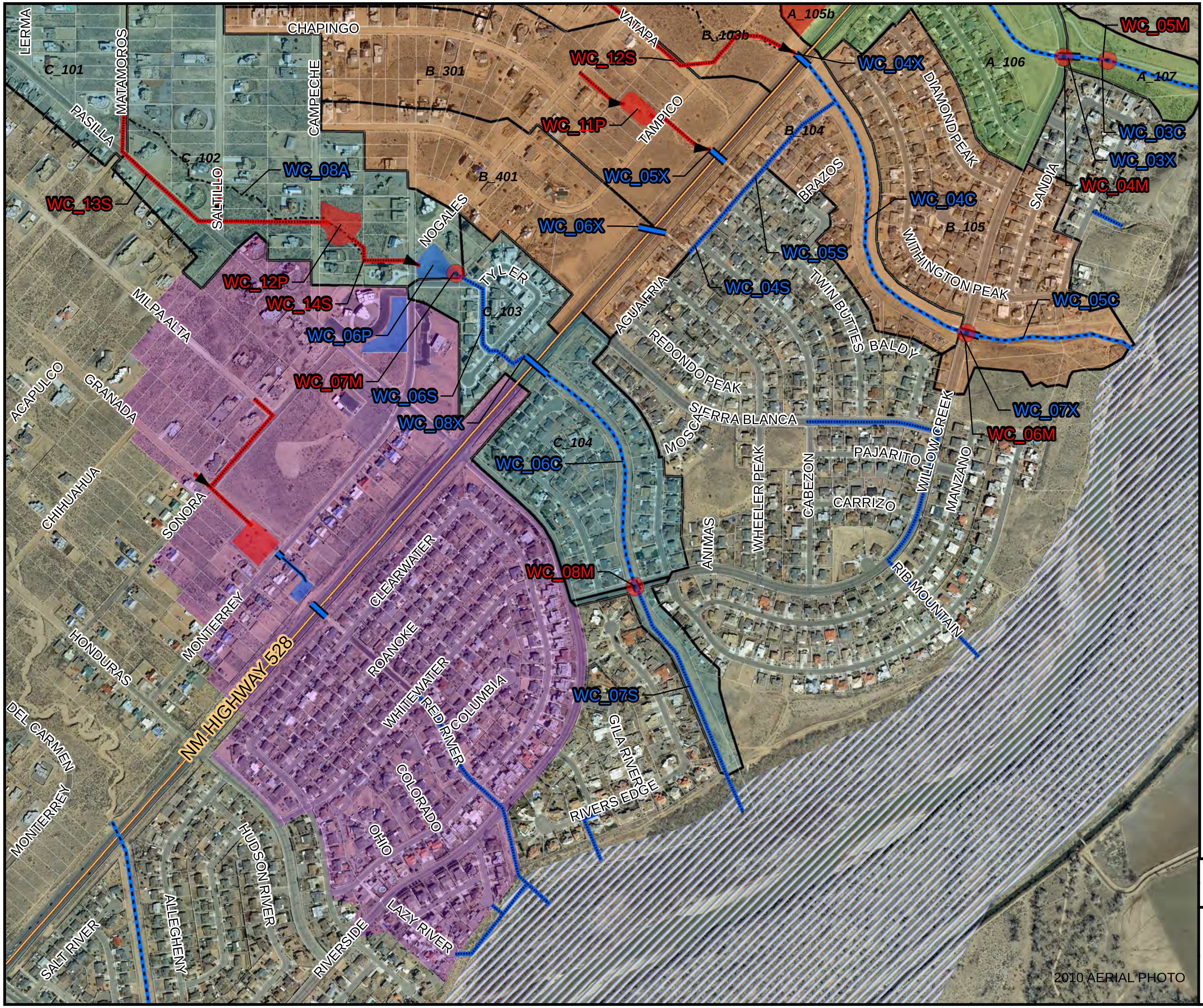

Legend

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- Willow Creek - Basin B
- Willow Creek - Basin C
- Red River Watershed
- Subbasin
- 100yr FEMA floodplain

L2.100 Drainage Basin Number

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- Existing Soft Channel
- Existing Storm Drain
- Existing Culvert
- Existing Pond/Dam
- Proposed Storm Drain
- Proposed Pond/Dam
- Discharge Restriction

WC_01P Existing Drainage Facility ID

WC_01P Proposed Drainage Facility ID

1:7,200

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0 500 1,000 Feet

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Willow Creek Watershed Park Management Plan

Drainage Map Tile

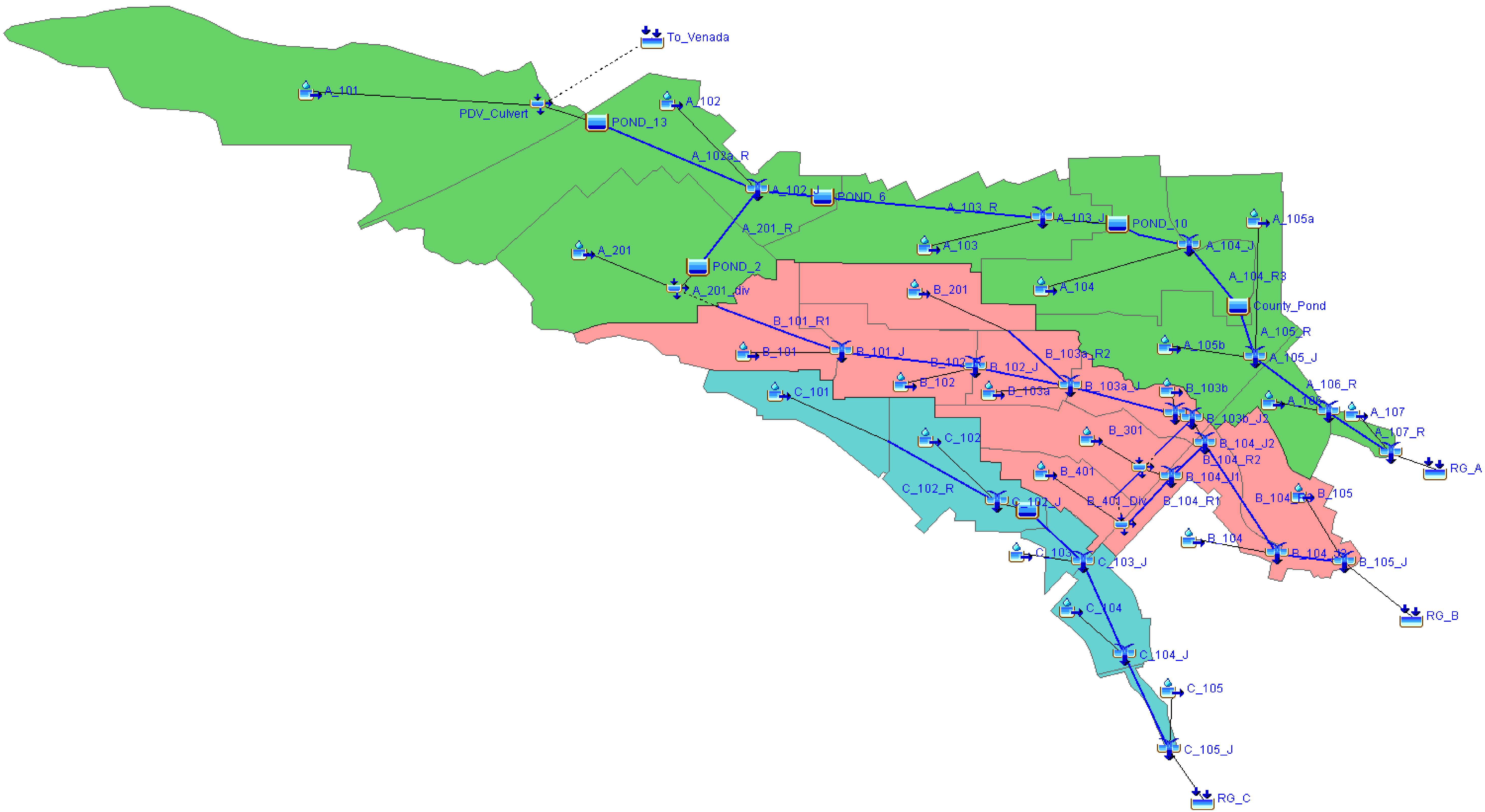
Date: February 2013

Map Tile 3 of 3

Path: H:\Watershed_Planning\WillowCreek_WMP\WCWMP_2012\WCWMP_2012_GIS\WCWMP_mxd\Tile03.mxd

Appendix C – Hydrology

Existing Conditions HEC-HMS Schematic



Existing Conditions Model Parameters

Subbasin	Area	Rainfall Loss: Initial Loss	Rainfall Loss: Constant Rate	Rainfall Loss: Impervious	Transform: Time of Concentration	Transform: Storage Coefficient
	(mi^2)	(in)	(in/hr)	(%)	(hr)	(hr)
A_101	0.334	0.58	1.46	5.4	0.330	0.401
A_102	0.215	0.50	1.26	14.3	0.319	0.346
A_103	0.145	0.51	1.29	24.4	0.245	0.256
A_104	0.151	0.51	1.27	31.9	0.133	0.135
A_105a	0.064	0.57	1.46	38.7	0.276	0.280
A_105b	0.100	0.56	1.42	27.6	0.142	0.150
A_106	0.045	0.48	1.18	52.6	0.133	0.125
A_107	0.011	0.53	1.33	0.4	0.133	0.170
A_201	0.192	0.57	1.44	17.8	0.220	0.244
B_101	0.084	0.58	1.47	11.2	0.173	0.201
B_102	0.075	0.55	1.40	9.1	0.133	0.155
B_103a	0.049	0.55	1.40	6.1	0.133	0.159
B_103b	0.038	0.57	1.45	7.0	0.133	0.159
B_104	0.043	0.41	1.00	57.3	0.162	0.145
B_105	0.072	0.47	1.16	44.2	0.159	0.152
B_201	0.075	0.50	1.25	28.4	0.236	0.241
B_301	0.073	0.53	1.33	13.2	0.149	0.166
B_401	0.041	0.53	1.33	14.3	0.133	0.147
C_101	0.057	0.52	1.29	12.3	0.182	0.201
C_102	0.085	0.52	1.32	11.1	0.166	0.186
C_103	0.020	0.44	1.08	56.3	0.133	0.122
C_104	0.046	0.41	1.01	54.7	0.133	0.121
C_105	0.009	0.49	1.22	51.8	0.133	0.126

Reach Routing Parameters										
Reach	Length	Slope	Manning's n	Shape	Diameter	Width	Side Slope	L.B. Manning's n	R.B. Manning's n	Cross Section Table
	(ft)	(ft/ft)			(ft)	(ft)	(xH:1V)			
A_102a_R	2562	0.0133	0.013	Circle	2.5					
A_102b_R	646	0.0155	0.013	Circle	5					
A_103_R	3653	0.0252	0.055	Eight Point				0.055	0.055	A_103_R
A_104_R1	636	0.022	0.055	Eight Point				0.055	0.055	A_104_R1
A_104_R2	694	0.0259	0.013	Circle	5					
A_104_R3	785	0.0331	0.018	Eight Point				0.03	0.03	A_104_R3
A_105_R	854	0.0141	0.055	Trapezoid		20	15			
A_106_R	1324	0.0196	0.03	Eight Point				0.03	0.03	A_106_R
A_107_R	915	0.0372	0.03	Eight Point				0.03	0.03	A_107_R
A_201_R	1308	0.0046	0.013	Circle	2.5					
B_101_R1	1341	0.007	0.017	Rectangle		30				
B_101_R2	594	0.02	0.055	Eight Point				0.055	0.055	B_101_R2
B_102_R	1957	0.027	0.055	Eight Point				0.055	0.055	B_102_R
B_103a_R1	1426	0.027	0.055	Eight Point				0.055	0.055	B_103a_R1
B_103a_R2	1340	0.031	0.055	Eight Point				0.055	0.055	B_103a_R2
B_103b_R	1991	0.026	0.055	Eight Point				0.055	0.055	B_103b_R
B_104_R1	737	0.015	0.013	Circle	3					
B_104_R2	734	0.012	0.013	Circle	4					
B_104_R3	2156	0.03	0.03	Eight Point				0.03	0.03	B_104_R3
B_105_R	1023	0.031	0.03	Eight Point				0.03	0.03	B_105_R
B_301_R1	644	0.019	0.03	Triangle			4			
B_301_R2	761	0.005	0.03	Triangle			4			
C_102_R	2199	0.03	0.055	Eight Point				0.055	0.055	C_102_R
C_103_R	1068	0.0337	0.013	Circle	2.5					
C_104_R	1480	0.0405	0.03	Eight Point				0.03	0.03	C_104_R
C_105_R	1438	0.0417	0.013	Circle	3					

Existing Conditions Model Results

Note: Elements are in alphabetical order

Hydrologic Element (1)	Drainage Area (2)	Peak Discharge (3)	Time of Peak (4)	Volume (5)
	(mi^2)	(cfs)		(AF)
A_101	0.33	255	01Jan2000, 01:42	14.9
A_102	0.22	220	01Jan2000, 01:42	13.6
A_102_J	0.74	220	01Jan2000, 01:42	22.7
A_102a_R	0.33	16	01Jan2000, 03:00	3.8
A_102b_R	0.74	220	01Jan2000, 01:42	22.7
A_103	0.15	183	01Jan2000, 01:36	10.4
A_103_J	0.89	256	01Jan2000, 01:57	31.9
A_103_R	0.74	178	01Jan2000, 02:00	21.5
A_104	0.15	297	01Jan2000, 01:30	12.4
A_104_J	1.04	338	01Jan2000, 01:33	44.3
A_104_R1	0.89	231	01Jan2000, 02:06	31.8
A_104_R2	0.89	230	01Jan2000, 02:06	31.8
A_104_R3	1.04	334	01Jan2000, 01:33	44.3
A_105_J	1.20	293	01Jan2000, 01:36	57.0
A_105_R	1.04	245	01Jan2000, 02:15	43.8
A_105a	0.06	82	01Jan2000, 01:39	5.7
A_105b	0.10	177	01Jan2000, 01:33	7.5
A_106	0.05	103	01Jan2000, 01:30	5.0
A_106_J1	1.25	373	01Jan2000, 01:36	62.0
A_106_R	1.20	293	01Jan2000, 01:39	57.0
A_107	0.01	17	01Jan2000, 01:33	0.5
A_107_J	1.26	382	01Jan2000, 01:36	62.4
A_107_R	1.25	368	01Jan2000, 01:36	62.0
A_201	0.19	239	01Jan2000, 01:36	11.9
A_201_div	0.19	225	01Jan2000, 01:36	11.9
A_201_R	0.19	22	01Jan2000, 02:27	5.2
B_101	0.08	113	01Jan2000, 01:33	4.4
B_101_J	0.08	113	01Jan2000, 01:33	4.5
B_101_R1	0.00	8	01Jan2000, 01:42	0.1
B_101_R2	0.00	7	01Jan2000, 01:48	0.1
B_102	0.08	120	01Jan2000, 01:30	3.9
B_102_J	0.16	201	01Jan2000, 01:36	8.4
B_102_R	0.08	112	01Jan2000, 01:39	4.5
B_103a	0.05	75	01Jan2000, 01:30	2.3
B_103a_J	0.28	349	01Jan2000, 01:39	16.5
B_103a_R1	0.16	198	01Jan2000, 01:39	8.4
B_103a_R2	0.08	101	01Jan2000, 01:39	5.8
B_103b	0.04	57	01Jan2000, 01:33	1.8
B_103b_J1	0.32	374	01Jan2000, 01:42	18.3
B_103b_J2	0.32	422	01Jan2000, 01:39	19.6

Hydrologic Element (1)	Drainage Area (2)	Peak Discharge (3)	Time of Peak (4)	Volume (5)
	(mi^2)	(cfs)		(AF)
B_103b_R	0.28	345	01Jan2000, 01:42	16.5
B_104	0.04	95	01Jan2000, 01:33	5.1
B_104_J1	0.11	115	01Jan2000, 01:33	5.4
B_104_J2	0.44	519	01Jan2000, 01:39	25.0
B_104_J3	0.48	578	01Jan2000, 01:42	30.2
B_104_R1	0.04	70	01Jan2000, 01:33	2.4
B_104_R2	0.11	114	01Jan2000, 01:33	5.4
B_104_R3	0.44	517	01Jan2000, 01:42	25.1
B_105	0.07	142	01Jan2000, 01:33	7.1
B_105_J	0.55	668	01Jan2000, 01:42	37.3
B_105_R	0.48	577	01Jan2000, 01:42	30.2
B_201	0.08	103	01Jan2000, 01:36	5.8
B_301	0.07	118	01Jan2000, 01:33	4.2
B_301_Div	0.07	45	01Jan2000, 01:27	3.0
B_301_R1	0.00	0	01Jan2000, 01:36	0.0
B_301_R2	0.00	69	01Jan2000, 01:36	1.3
B_401	0.04	71	01Jan2000, 01:30	2.4
B_401_Div	0.04	70	01Jan2000, 01:30	2.4
C_101	0.06	81	01Jan2000, 01:33	3.3
C_102	0.09	126	01Jan2000, 01:33	4.7
C_102_J	0.14	187	01Jan2000, 01:36	8.0
C_102_R	0.06	81	01Jan2000, 01:39	3.3
C_103	0.02	46	01Jan2000, 01:30	2.3
C_103_J	0.16	163	01Jan2000, 01:45	10.3
C_103_R	0.14	142	01Jan2000, 01:45	8.0
C_104	0.05	108	01Jan2000, 01:30	5.2
C_104_J	0.21	200	01Jan2000, 01:48	15.5
C_104_R	0.16	161	01Jan2000, 01:48	10.3
C_105	0.01	21	01Jan2000, 01:30	1.0
C_105_J	0.22	207	01Jan2000, 01:48	16.5
C_105_R	0.21	199	01Jan2000, 01:48	15.5
County_Pond	1.04	246	01Jan2000, 02:12	43.8
CP_lower	0.14	144	01Jan2000, 01:45	8.0
PDV_Culvert	0.33	30	01Jan2000, 01:51	5.2
POND_10	0.89	231	01Jan2000, 02:06	31.8
POND_13	0.33	16	01Jan2000, 02:57	3.8
POND_2	0.19	22	01Jan2000, 02:24	5.2
POND_6	0.74	179	01Jan2000, 01:51	21.5
RG_A	1.26	382	01Jan2000, 01:36	62.4
RG_B	0.55	668	01Jan2000, 01:42	37.3

Hydrologic Element (1)	Drainage Area (2)	Peak Discharge (3)	Time of Peak (4)	Volume (5)
	(mi^2)	(cfs)		(AF)
RG_C	0.22	207	01Jan2000, 01:48	16.5
To_Venada	0.00	225	01Jan2000, 01:42	9.8

Notes:

(1) Element name from HEC-HMS model; examples:

A_102	subbasins
A_102_J	junction in subbasin A_102
A_102_R	routing reach in subbasin A_102
A_102_Div	diversion in subbasin A_102
POND_6	Pond

(2) Total area draining to corresponding model element

(3) Peak discharge in cubic feet per second; for ponds, only peak outflow is reported

(4) Time of peak discharge; model run starts at 01 Jan 2000, 00:00

(5) Total runoff volume in acre-feet; please note that for ponds, this equals the total volume passing through the pond over the course of the simulation run; for peak storage values , pleas consult detailed pond results

Existing Conditions Reservoir Storage, Inflow and Outflow Results

Summary Results for Reservoir "POND_13"

Project: WCWMP
Simulation Run: WC_ex_100yr24hr Reservoir: POND_13

Start of Run:	01Jan2000, 00:00	Basin Model:	WillowCreek_ex
End of Run:	02Jan2000, 00:00	Meteorologic Model:	100yr24hr
Compute Time:	26Oct2012, 14:12:12	Control Specifications:	24hour

Volume Units: IN (•) AC-FT

Computed Results

Peak Inflow :	30.0 (CFS)	Date/Time of Peak Inflow :	01Jan2000, 01:51
Peak Outflow :	15.7 (CFS)	Date/Time of Peak Outflow :	01Jan2000, 02:57
Total Inflow :	5.2 (AC-FT)	Peak Storage :	3.1 (AC-FT)
Total Outflow :	3.8 (AC-FT)	Peak Elevation :	5339.0 (FT)

Print Close

Summary Results for Reservoir "POND_6"

Project: WCWMP
Simulation Run: WC_ex_100yr24hr Reservoir: POND_6

Start of Run:	01Jan2000, 00:00	Basin Model:	WillowCreek_ex
End of Run:	02Jan2000, 00:00	Meteorologic Model:	100yr24hr
Compute Time:	26Oct2012, 14:12:12	Control Specifications:	24hour

Volume Units: IN (•) AC-FT

Computed Results

Peak Inflow :	219.6 (CFS)	Date/Time of Peak Inflow :	01Jan2000, 01:42
Peak Outflow :	179.3 (CFS)	Date/Time of Peak Outflow :	01Jan2000, 01:51
Total Inflow :	22.7 (AC-FT)	Peak Storage :	3.3 (AC-FT)
Total Outflow :	21.5 (AC-FT)	Peak Elevation :	9.1 (FT)

Print Close

Summary Results for Reservoir "POND_2"

Project: WCWMP
Simulation Run: WC_ex_100yr24hr Reservoir: POND_2

Start of Run:	01Jan2000, 00:00	Basin Model:	WillowCreek_ex
End of Run:	02Jan2000, 00:00	Meteorologic Model:	100yr24hr
Compute Time:	26Oct2012, 14:12:12	Control Specifications:	24hour

Volume Units: IN (•) AC-FT

Computed Results

Peak Inflow :	225.0 (CFS)	Date/Time of Peak Inflow :	01Jan2000, 01:36
Peak Outflow :	21.9 (CFS)	Date/Time of Peak Outflow :	01Jan2000, 02:24
Total Inflow :	11.9 (AC-FT)	Peak Storage :	9.1 (AC-FT)
Total Outflow :	5.2 (AC-FT)	Peak Elevation :	5306.3 (FT)

Print Close

Summary Results for Reservoir "POND_10"

Project: WCWMP
Simulation Run: WC_ex_100yr24hr Reservoir: POND_10

Start of Run:	01Jan2000, 00:00	Basin Model:	WillowCreek_ex
End of Run:	02Jan2000, 00:00	Meteorologic Model:	100yr24hr
Compute Time:	26Oct2012, 14:12:12	Control Specifications:	24hour

Volume Units: IN (•) AC-FT

Computed Results

Peak Inflow :	255.7 (CFS)	Date/Time of Peak Inflow :	01Jan2000, 01:57
Peak Outflow :	231.3 (CFS)	Date/Time of Peak Outflow :	01Jan2000, 02:06
Total Inflow :	31.9 (AC-FT)	Peak Storage :	2.7 (AC-FT)
Total Outflow :	31.8 (AC-FT)	Peak Elevation :	4.4 (FT)

Print Close

Summary Results for Reservoir "County_Pond"

Project: WCWMP
Simulation Run: WC_ex_100yr24hr Reservoir: County_Pond

Start of Run:	01Jan2000, 00:00	Basin Model:	WillowCreek_ex
End of Run:	02Jan2000, 00:00	Meteorologic Model:	100yr24hr
Compute Time:	26Oct2012, 14:12:12	Control Specifications:	24hour

Volume Units: IN (•) AC-FT

Computed Results

Peak Inflow :	334.1 (CFS)	Date/Time of Peak Inflow :	01Jan2000, 01:33
Peak Outflow :	245.8 (CFS)	Date/Time of Peak Outflow :	01Jan2000, 02:12
Total Inflow :	44.3 (AC-FT)	Peak Storage :	8.6 (AC-FT)
Total Outflow :	43.8 (AC-FT)	Peak Elevation :	6.5 (FT)

Print Close

Summary Results for Reservoir "CP_lower"

Project: WCWMP
Simulation Run: WC_ex_100yr24hr Reservoir: CP_lower

Start of Run:	01Jan2000, 00:00	Basin Model:	WillowCreek_ex
End of Run:	02Jan2000, 00:00	Meteorologic Model:	100yr24hr
Compute Time:	26Oct2012, 14:12:12	Control Specifications:	24hour

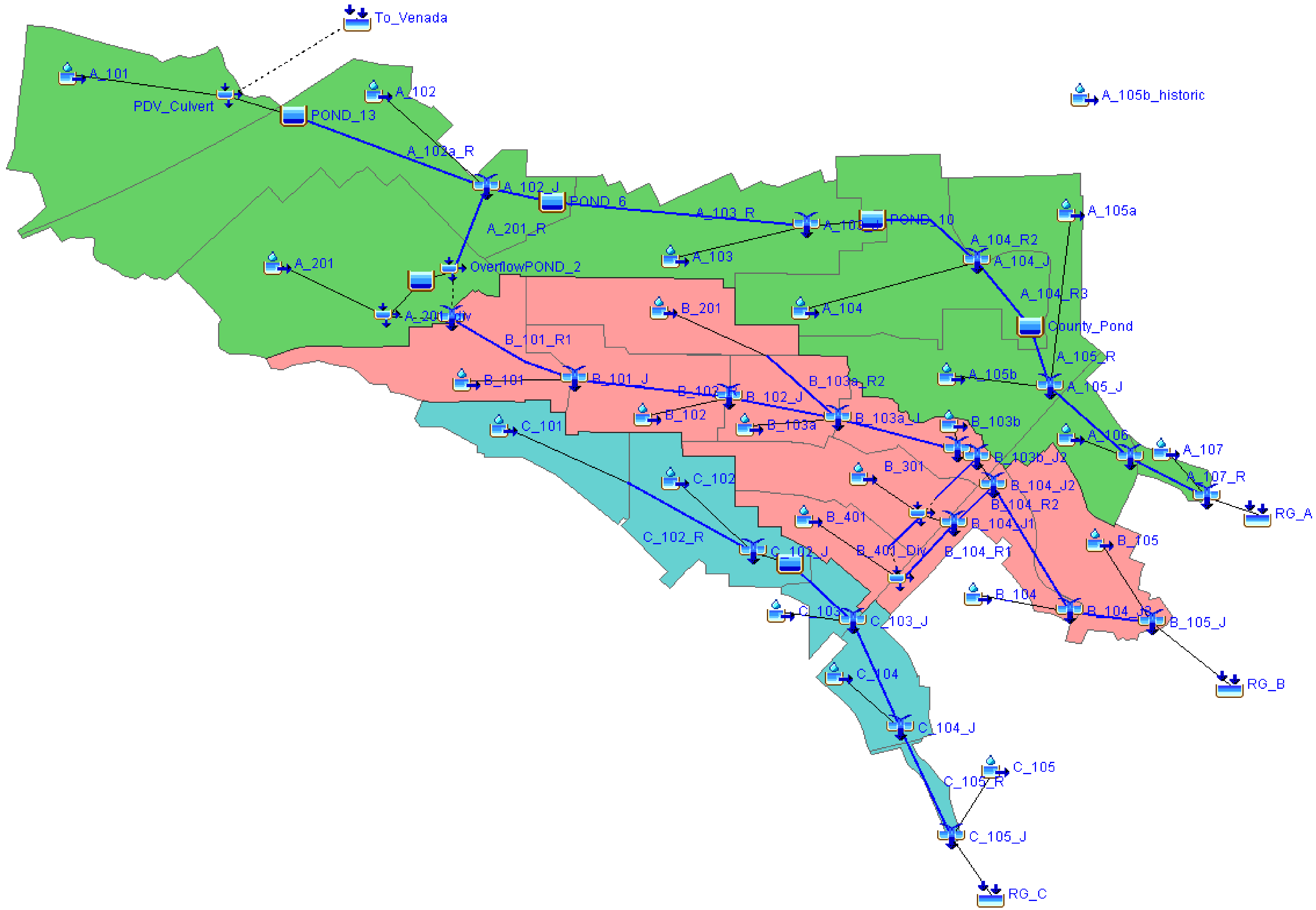
Volume Units: IN (•) AC-FT

Computed Results

Peak Inflow :	186.8 (CFS)	Date/Time of Peak Inflow :	01Jan2000, 01:36
Peak Outflow :	143.8 (CFS)	Date/Time of Peak Outflow :	01Jan2000, 01:45
Total Inflow :	8.0 (AC-FT)	Peak Storage :	3.0 (AC-FT)
Total Outflow :	8.0 (AC-FT)	Peak Elevation :	8.3 (FT)

Print Close

DEVEX Conditions HEC-HMS Schematic



DEVEX Conditions Model Parameters

		Rainfall Loss			Transform	
Subbasin	Area	Initial Loss	Constant Rate	Impervious	Time of Concentration	Storage Coefficient
	(mi2)	(in)	(in/hr)	(%)	(hr)	(hr)
A_101	0.148	0.46	1.15	38.6	0.241	0.233
A_102	0.215	0.42	1.03	27.6	0.291	0.283
A_103	0.145	0.48	1.19	29.7	0.245	0.246
A_104	0.151	0.45	1.10	42.5	0.133	0.127
A_105a	0.064	0.35	0.83	84.7	0.276	0.227
A_105b	0.100	0.42	1.01	72.6	0.142	0.124
A_105b_historic	0.100	0.60	1.54	20.9	0.142	0.157
A_106	0.045	0.48	1.18	52.6	0.133	0.125
A_107	0.011	0.53	1.33	0.4	0.133	0.170
A_201	0.192	0.46	1.14	37.4	0.220	0.214
B_101	0.084	0.45	1.11	49.6	0.173	0.162
B_102	0.075	0.46	1.13	46.7	0.133	0.126
B_103a	0.049	0.48	1.18	42.9	0.133	0.128
B_103b	0.038	0.45	1.12	64.7	0.133	0.120
B_104	0.043	0.41	1.00	57.3	0.162	0.145
B_105	0.072	0.47	1.16	44.2	0.159	0.152
B_201	0.075	0.46	1.13	34.4	0.236	0.230
B_301	0.073	0.46	1.15	42.4	0.149	0.143
B_401	0.041	0.47	1.17	45.6	0.133	0.127
C_101	0.057	0.48	1.19	33.8	0.182	0.180
C_102	0.085	0.49	1.23	27.8	0.166	0.169
C_103	0.020	0.44	1.07	56.7	0.133	0.121
C_104	0.046	0.41	1.01	54.7	0.133	0.121
C_105	0.009	0.49	1.22	51.8	0.133	0.126

Reach Routing Parameters										
Reach	Length	Slope	Manning's n	Shape	Diameter	Width	Side Slope	L.B. Manning's n	R.B. Manning's n	Cross Section Table
	(ft)	(ft/ft)			(ft)	(ft)	(xH:1V)			
A_102a_R	2562	0.0133	0.013	Circle	2.5					
A_102b_R	646	0.0155	0.013	Circle	5					
A_103_R	3653	0.0252	0.055	Eight Point				0.055	0.055	A_103_R
A_104_R1	636	0.022	0.055	Eight Point				0.055	0.055	A_104_R1
A_104_R2	694	0.0259	0.013	Circle	5					
A_104_R3	785	0.0331	0.018	Eight Point				0.03	0.03	A_104_R3
A_105_R	854	0.0141	0.055	Trapezoid		20	15			
A_106_R	1324	0.0196	0.03	Eight Point				0.03	0.03	A_106_R
A_107_R	915	0.0372	0.03	Eight Point				0.03	0.03	A_107_R
A_201_R	1308	0.0046	0.013	Circle	2.5					
B_101_R1	1341	0.007	0.017	Rectangle		30				
B_101_R2	594	0.02	0.055	Eight Point				0.055	0.055	B_101_R2
B_102_R	1957	0.027	0.055	Eight Point				0.055	0.055	B_102_R
B_103a_R1	1426	0.027	0.055	Eight Point				0.055	0.055	B_103a_R1
B_103a_R2	1340	0.031	0.055	Eight Point				0.055	0.055	B_103a_R2
B_103b_R	1991	0.026	0.055	Eight Point				0.055	0.055	B_103b_R
B_104_R1	737	0.015	0.013	Circle	3					
B_104_R2	734	0.012	0.013	Circle	4					
B_104_R3	2156	0.03	0.03	Eight Point				0.03	0.03	B_104_R3
B_105_R	1023	0.031	0.03	Eight Point				0.03	0.03	B_105_R
B_301_R1	644	0.019	0.03	Triangle			4			
B_301_R2	761	0.005	0.03	Triangle			4			
C_102_R	2199	0.03	0.055	Eight Point				0.055	0.055	C_102_R
C_103_R	1068	0.0337	0.013	Circle	2.5					
C_104_R	1480	0.0405	0.03	Eight Point				0.03	0.03	C_104_R
C_105_R	1438	0.0417	0.013	Circle	3					

DEVEX Conditions Model Results

Note: Elements are in alphabetical order

Hydrologic Element (1)	Drainage Area (2)	Peak Discharge (3)	Time of Peak (4)	Volume (5)
	(mi2)	(cfs)		(AF)
A_101	0.15	220	01Jan2000, 01:36	13.5
A_102	0.22	285	01Jan2000, 01:39	18.0
A_102_J	0.56	285	01Jan2000, 01:39	31.9
A_102a_R	0.15	14	01Jan2000, 02:39	4.9
A_102b_R	0.56	283	01Jan2000, 01:39	31.9
A_103	0.15	194	01Jan2000, 01:36	11.4
A_103_J	0.70	344	01Jan2000, 01:54	42.0
A_103_R	0.56	244	01Jan2000, 01:57	30.6
A_104	0.15	325	01Jan2000, 01:30	14.7
A_104_J	0.85	372	01Jan2000, 01:33	56.6
A_104_R1	0.70	290	01Jan2000, 02:06	41.9
A_104_R2	0.70	290	01Jan2000, 02:06	41.9
A_104_R3	0.85	369	01Jan2000, 01:33	56.6
A_105_J	1.02	402	01Jan2000, 02:03	78.7
A_105_R	0.85	315	01Jan2000, 02:12	56.0
A_105a	0.06	118	01Jan2000, 01:39	9.4
A_105b	0.10	240	01Jan2000, 01:30	13.3
A_105b_historic	0.10	148	01Jan2000, 01:33	5.9
A_106	0.05	103	01Jan2000, 01:30	5.0
A_106_J1	1.06	476	01Jan2000, 01:36	83.6
A_106_R	1.02	402	01Jan2000, 02:03	78.6
A_107	0.01	17	01Jan2000, 01:33	0.5
A_107_J	1.07	489	01Jan2000, 01:36	84.1
A_107_R	1.06	474	01Jan2000, 01:36	83.6
A_201	0.19	301	01Jan2000, 01:36	17.3
A_201_div	0.19	225	01Jan2000, 01:30	16.3
A_201_J	0.00	76	01Jan2000, 01:36	1.4
A_201_R	0.19	40	01Jan2000, 02:27	8.9
B_101	0.08	163	01Jan2000, 01:33	8.8
B_101_J	0.08	190	01Jan2000, 01:39	10.3
B_101_R1	0.00	73	01Jan2000, 01:39	1.5
B_101_R2	0.00	71	01Jan2000, 01:42	1.5
B_102	0.08	162	01Jan2000, 01:30	7.5
B_102_J	0.16	287	01Jan2000, 01:36	17.8
B_102_R	0.08	187	01Jan2000, 01:45	10.3
B_103a	0.05	103	01Jan2000, 01:30	4.6
B_103a_J	0.28	460	01Jan2000, 01:39	28.9
B_103a_R1	0.16	284	01Jan2000, 01:39	17.8
B_103a_R2	0.08	109	01Jan2000, 01:39	6.4
B_103b	0.04	90	01Jan2000, 01:30	4.6

Hydrologic Element (1)	Drainage Area (2)	Peak Discharge (3)	Time of Peak (4)	Volume (5)
	(mi2)	(cfs)		(AF)
B_103b_J1	0.32	510	01Jan2000, 01:39	33.5
B_103b_J2	0.32	596	01Jan2000, 01:39	35.8
B_103b_R	0.28	455	01Jan2000, 01:42	28.9
B_104	0.04	95	01Jan2000, 01:33	5.1
B_104_J1	0.11	115	01Jan2000, 01:33	8.7
B_104_J2	0.44	703	01Jan2000, 01:39	44.5
B_104_J3	0.48	774	01Jan2000, 01:39	49.6
B_104_R1	0.04	70	01Jan2000, 01:33	3.9
B_104_R2	0.11	115	01Jan2000, 01:33	8.7
B_104_R3	0.44	702	01Jan2000, 01:39	44.5
B_105	0.07	142	01Jan2000, 01:33	7.1
B_105_J	0.55	867	01Jan2000, 01:39	56.7
B_105_R	0.48	760	01Jan2000, 01:42	49.6
B_201	0.08	110	01Jan2000, 01:36	6.4
B_301	0.07	144	01Jan2000, 01:33	6.9
B_301_Div	0.07	45	01Jan2000, 01:30	4.8
B_301_R1	0.00	16	01Jan2000, 01:33	0.1
B_301_R2	0.00	107	01Jan2000, 01:36	2.3
B_401	0.04	87	01Jan2000, 01:30	4.0
B_401_Div	0.04	70	01Jan2000, 01:27	3.9
C_101	0.06	96	01Jan2000, 01:33	4.8
C_102	0.09	144	01Jan2000, 01:33	6.5
C_102_J	0.14	219	01Jan2000, 01:36	11.3
C_102_R	0.06	95	01Jan2000, 01:39	4.8
C_103	0.02	46	01Jan2000, 01:30	2.3
C_103_J	0.16	214	01Jan2000, 01:42	13.5
C_103_R	0.14	189	01Jan2000, 01:42	11.2
C_104	0.05	108	01Jan2000, 01:30	5.2
C_104_J	0.21	257	01Jan2000, 01:45	18.7
C_104_R	0.16	209	01Jan2000, 01:45	13.5
C_105	0.01	21	01Jan2000, 01:30	1.0
C_105_J	0.22	264	01Jan2000, 01:45	19.7
C_105_R	0.21	254	01Jan2000, 01:45	18.7
County_Pond	0.85	316	01Jan2000, 02:09	56.0
CP_lower	0.14	194	01Jan2000, 01:42	11.2
OverflowPOND_2	0.19	40	01Jan2000, 02:06	8.9
PDV_Culvert	0.15	30	01Jan2000, 01:21	6.4
POND_10	0.70	291	01Jan2000, 02:03	41.9
POND_13	0.15	14	01Jan2000, 02:36	4.9
POND_2	0.19	58	01Jan2000, 02:12	9.4

Hydrologic Element (1)	Drainage Area (2)	Peak Discharge (3)	Time of Peak (4)	Volume (5)
	(mi2)	(cfs)		(AF)
POND_6	0.56	246	01Jan2000, 01:48	30.7
RG_A	1.07	489	01Jan2000, 01:36	84.1
RG_B	0.55	867	01Jan2000, 01:39	56.7
RG_C	0.22	264	01Jan2000, 01:45	19.7
To_Venada	0.00	190	01Jan2000, 01:36	7.1

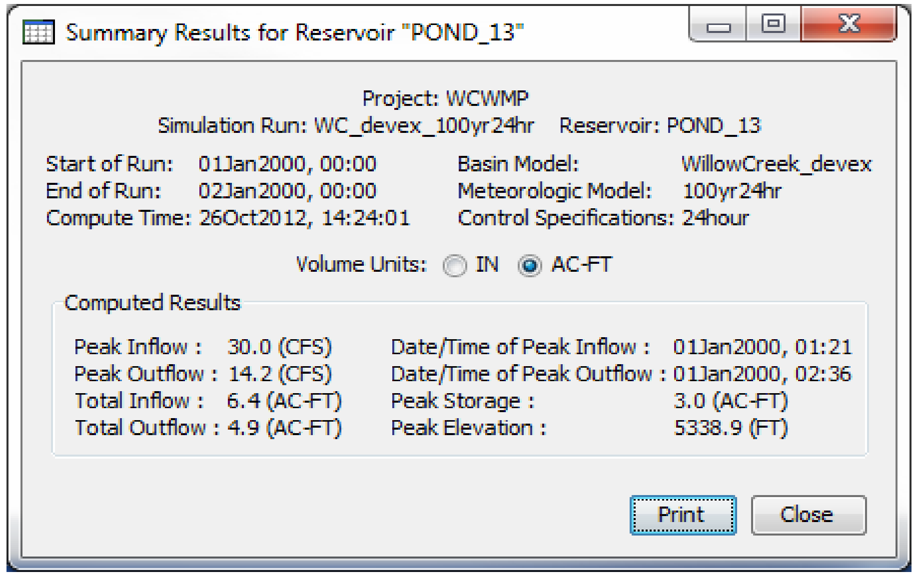
Notes:

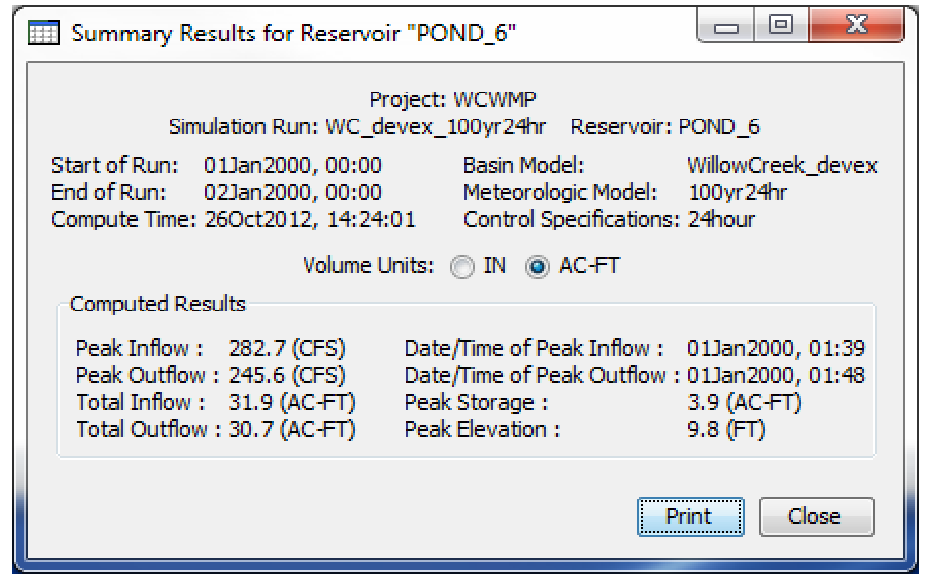
(1) Element name from HEC-HMS model; examples:

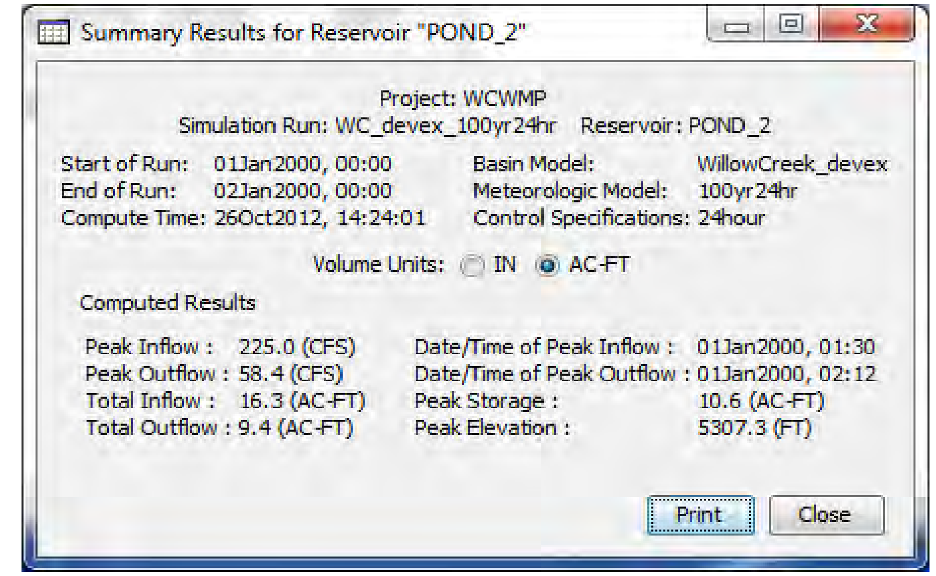
A_102	subbasins
A_102_J	junction in subbasin A_102
A_102_R	routing reach in subbasin A_102
A_102_Div	diversion in subbasin A_102
POND_6	Pond

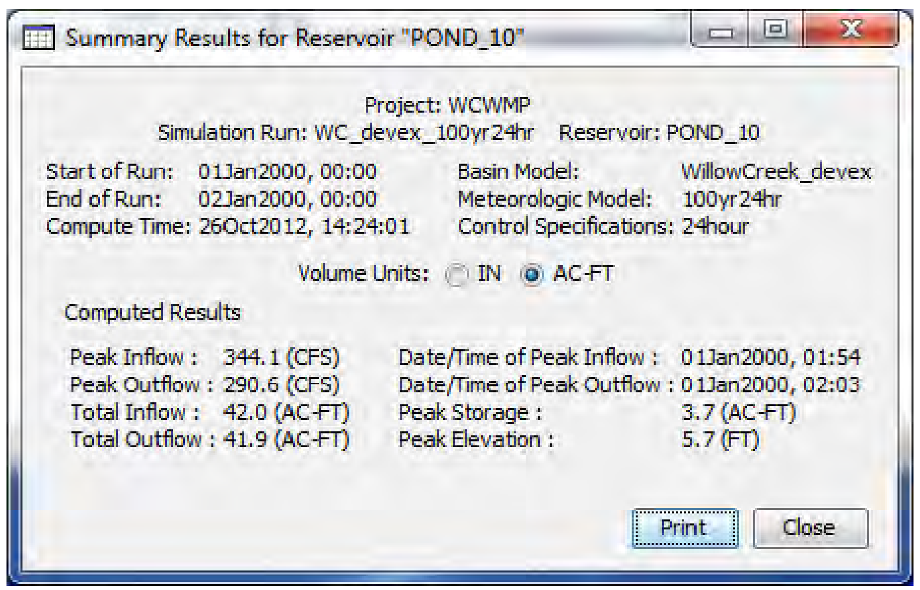
(2) Total area draining to corresponding model element
(3) Peak discharge in cubic feet per second; for ponds, only peak outflow is reported
(4) Time of peak discharge; model run starts at 01 Jan 2000, 00:00
(5) Total runoff volume in acre-feet; please note that for ponds, this equals the total volume passing through the pond over the course of the simulation run; for peak storage values , pleas consult detailed pond results

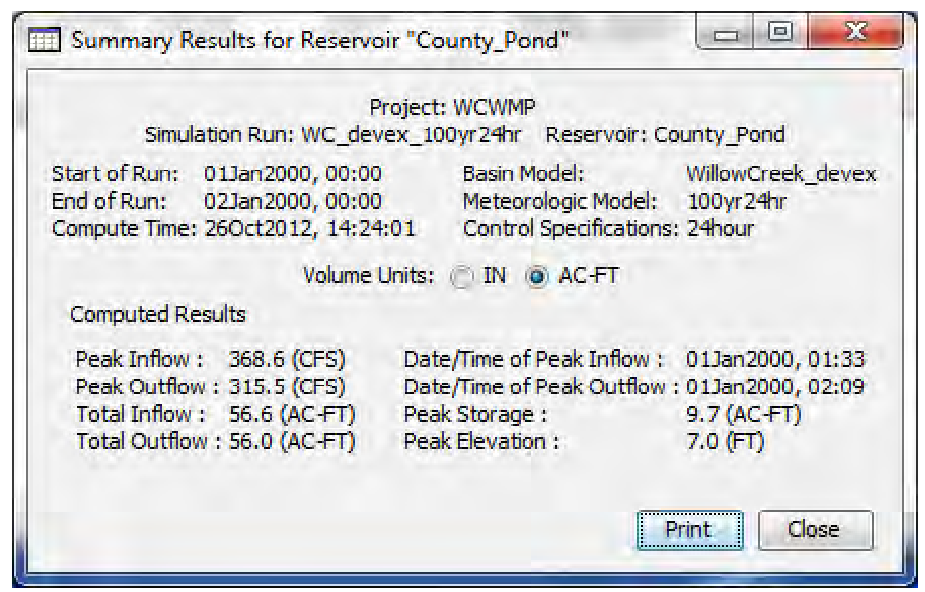
DEVEX Conditions Reservoir Storage, Inflow and Outflow Results

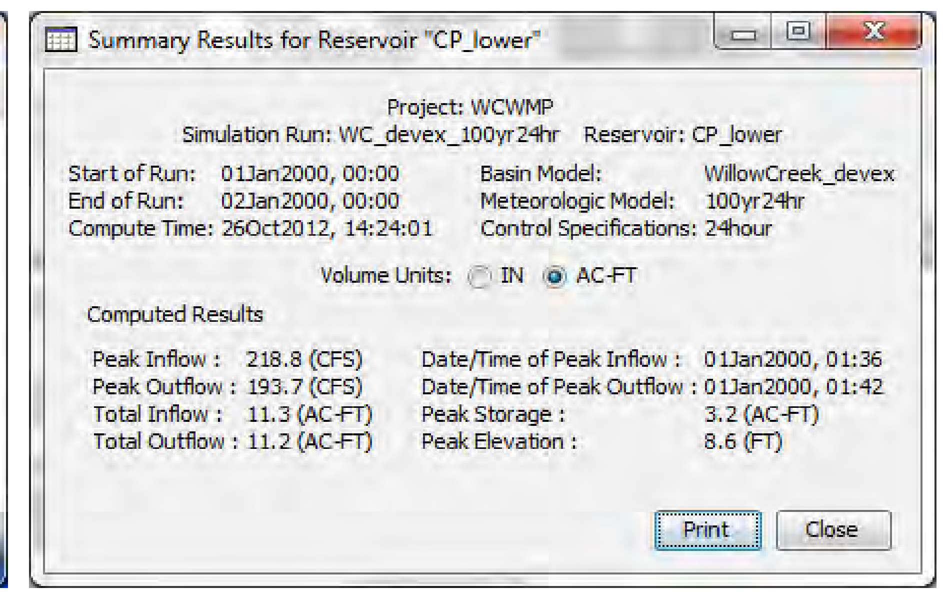




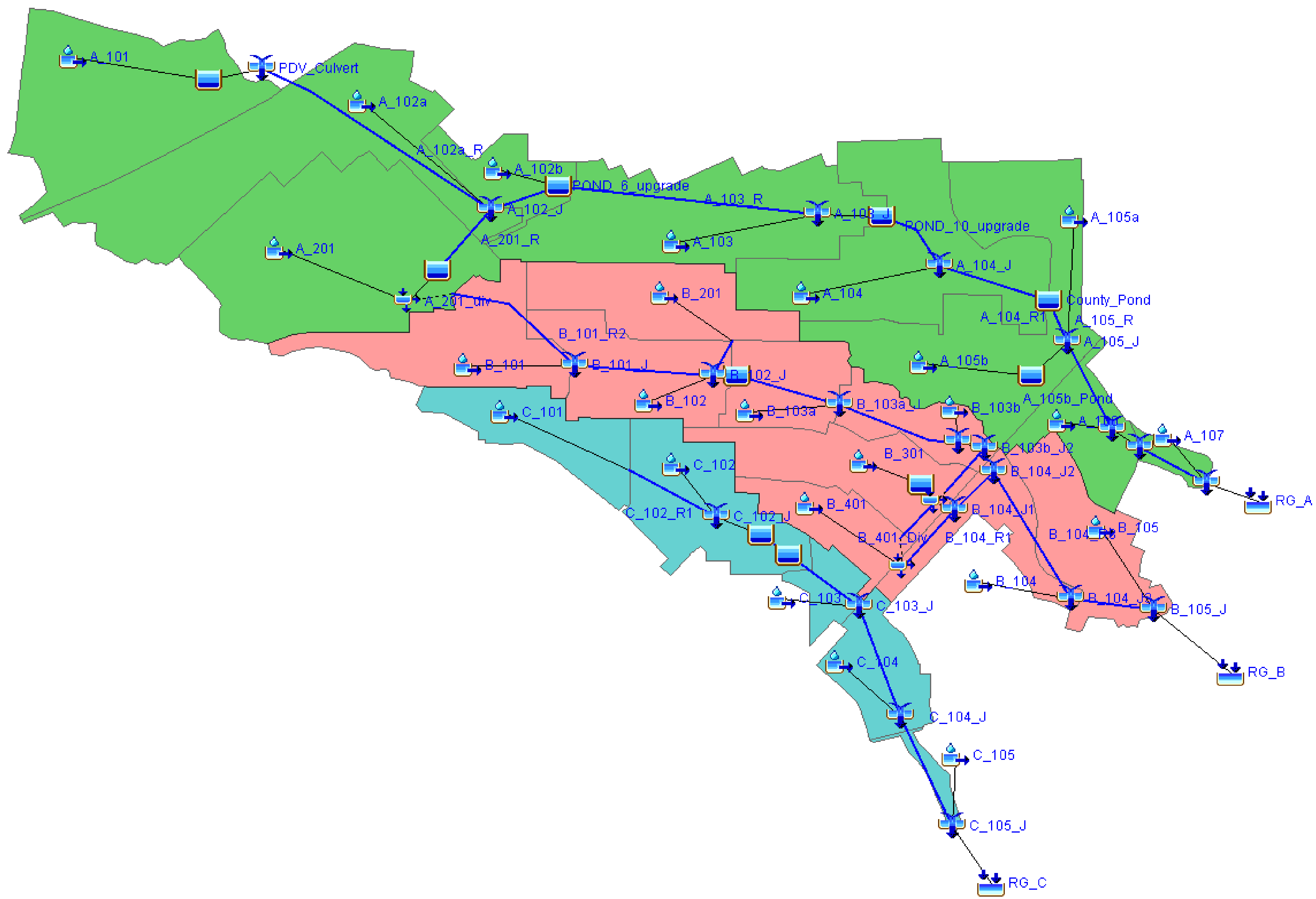








Ultimate Conditions HEC-HMS Schematic



Ultimate Conditions Model Parameters

		Rainfall Loss			Transform	
Subbasin	Area	Initial Loss	Constant Rate	Impervious	Time of Concentration	Storage Coefficient
	(mi2)	(in)	(in/hr)	(%)	(hr)	(hr)
A_101	0.148	0.46	1.15	38.6	0.241	0.233
A_102a	0.179	0.41	1.01	27.7	0.288	0.279
A_102b	0.036	0.46	1.15	26.6	0.149	0.150
A_103	0.145	0.48	1.19	29.7	0.245	0.246
A_104	0.151	0.45	1.10	42.5	0.133	0.127
A_105a	0.064	0.35	0.83	84.7	0.276	0.227
A_105b	0.100	0.42	1.01	72.6	0.142	0.124
A_106	0.045	0.48	1.18	52.6	0.133	0.125
A_107	0.011	0.53	1.33	0.4	0.133	0.170
A_201	0.192	0.46	1.14	37.4	0.220	0.214
B_101	0.084	0.45	1.11	49.6	0.173	0.162
B_102	0.075	0.46	1.13	46.7	0.133	0.126
B_103a	0.049	0.48	1.18	42.9	0.133	0.128
B_103b	0.038	0.45	1.12	64.7	0.133	0.120
B_104	0.043	0.41	1.00	57.3	0.162	0.145
B_105	0.072	0.47	1.16	44.2	0.159	0.152
B_201	0.075	0.46	1.13	34.4	0.236	0.230
B_301	0.073	0.46	1.15	42.4	0.149	0.143
B_401	0.041	0.47	1.17	45.6	0.133	0.127
C_101	0.057	0.48	1.19	33.8	0.182	0.180
C_102	0.085	0.49	1.23	27.8	0.166	0.169
C_103	0.020	0.44	1.07	56.7	0.133	0.121
C_104	0.046	0.41	1.01	54.7	0.133	0.121
C_105	0.009	0.49	1.22	51.8	0.133	0.126

Reach Routing Parameters										
Reach	Length	Slope	Manning's n	Shape	Diameter	Width	Side Slope	L.B. Manning's n	R.B. Manning's n	Cross Section Table
	(ft)	(ft/ft)			(ft)	(ft)	(xH:1V)			
A_102a_R	2562	0.0133	0.013	Circle	2.5					
A_102b_R	646	0.0155	0.013	Circle	5					
A_103_R	3653	0.0252	0.055	Eight Point				0.055	0.055	A_103_R
A_104_R1	636	0.022	0.055	Eight Point				0.055	0.055	A_104_R1
A_104_R2	694	0.0259	0.013	Circle	5					
A_104_R3	785	0.0331	0.018	Eight Point				0.03	0.03	A_104_R3
A_105_R	854	0.0141	0.055	Trapezoid		20	15			
A_106_R	1324	0.0196	0.03	Eight Point				0.03	0.03	A_106_R
A_107_R	915	0.0372	0.03	Eight Point				0.03	0.03	A_107_R
A_201_R	1308	0.0046	0.013	Circle	2.5					
B_101_R1	1341	0.007	0.017	Rectangle		30				
B_101_R2	1562	0.005	0.013	Circle	5					
B_102_R1	2134	0.024	0.013	Circle	5					
B_102_R2	391	0.018	0.013	Circle	4					
B_103a_R	1577	0.03	0.013	Circle	4					
B_103b_R1	1690	0.017	0.013	Circle	7					
B_103b_R2	482	0.031	0.013	Circle	7					
B_104_R1	737	0.015	0.013	Circle	3					
B_104_R2	734	0.012	0.013	Circle	4					
B_104_R3	2156	0.03	0.03	Eight Point				0.03	0.03	B_104_R3
B_105_R	1023	0.031	0.03	Eight Point				0.03	0.03	B_105_R
B_301_R1	644	0.019	0.03	Triangle			4			
B_301_R2	761	0.005	0.03	Triangle			4			
C_102_R1	1634	0.032	0.013	Circle	4					
C_102_R2	518	0.025	0.013	Circle	3					
C_103_R	1068	0.0337	0.013	Circle	2.5					
C_104_R	1480	0.0405	0.03	Eight Point				0.03	0.03	C_104_R
C_105_R	1438	0.0417	0.013	Circle	3					
PDV_connect	1007	0.014	0.013	Circle	2.5					

Ultimate Conditions Model Results

Note: Elements are in alphabetical order

Hydrologic Element (1)	Drainage Area (2)	Peak Discharge (3)	Time of Peak (4)	Volume (5)
	(mi2)	(cfs)		(AF)
A_101	0.15	220	01Jan2000, 01:36	13.5
A_102_J	0.52	276	01Jan2000, 01:39	42.4
A_102a	0.18	242	01Jan2000, 01:39	15.2
A_102a_R	0.15	21	01Jan2000, 02:33	11.2
A_102b	0.04	66	01Jan2000, 01:33	2.8
A_102b_R	0.52	274	01Jan2000, 01:39	42.4
A_103	0.15	194	01Jan2000, 01:36	11.4
A_103_J	0.70	196	01Jan2000, 01:36	55.4
A_103_R	0.56	128	01Jan2000, 02:27	44.0
A_104	0.15	325	01Jan2000, 01:30	14.7
A_104_J	0.85	345	01Jan2000, 01:33	69.6
A_104_R1	0.70	136	01Jan2000, 02:42	54.9
A_104_R2	0.70	136	01Jan2000, 02:42	54.9
A_104_R3	0.85	344	01Jan2000, 01:33	69.6
A_105_J	1.02	331	01Jan2000, 01:54	91.3
A_105_R	0.85	183	01Jan2000, 02:00	69.0
A_105a	0.06	118	01Jan2000, 01:39	9.4
A_105b	0.10	240	01Jan2000, 01:30	13.3
A_105b_Pond	0.10	76	01Jan2000, 01:54	12.9
A_106	0.05	103	01Jan2000, 01:30	5.0
A_106_J1	1.06	357	01Jan2000, 01:54	96.2
A_106_J2	1.06	357	01Jan2000, 01:54	96.2
A_106_R	1.02	331	01Jan2000, 01:54	91.3
A_107	0.01	17	01Jan2000, 01:33	0.5
A_107_J	1.07	360	01Jan2000, 01:54	96.7
A_107_R	1.06	357	01Jan2000, 01:54	96.2
A_201	0.19	301	01Jan2000, 01:36	17.3
A_201_div	0.19	225	01Jan2000, 01:30	16.3
A_201_R	0.19	46	01Jan2000, 02:18	16.0
B_101	0.08	163	01Jan2000, 01:33	8.8
B_101_J	0.08	191	01Jan2000, 01:39	9.8
B_101_R1	0.00	73	01Jan2000, 01:39	1.0
B_101_R2	0.00	68	01Jan2000, 01:42	1.0
B_102	0.08	162	01Jan2000, 01:30	7.5
B_102_J	0.23	413	01Jan2000, 01:33	23.7
B_102_R1	0.08	185	01Jan2000, 01:42	9.8
B_102_R2	0.08	109	01Jan2000, 01:36	6.4
B_103a	0.05	103	01Jan2000, 01:30	4.6
B_103a_J	0.28	171	01Jan2000, 01:33	28.0
B_103a_R	0.23	116	01Jan2000, 02:03	23.4

Hydrologic Element (1)	Drainage Area (2)	Peak Discharge (3)	Time of Peak (4)	Volume (5)
	(mi2)	(cfs)		(AF)
B_103b	0.04	90	01Jan2000, 01:30	4.6
B_103b_J1	0.32	249	01Jan2000, 01:33	32.7
B_103b_J2	0.32	249	01Jan2000, 01:33	32.7
B_103b_R1	0.28	169	01Jan2000, 01:36	28.0
B_103b_R2	0.28	168	01Jan2000, 01:36	28.0
B_104	0.04	95	01Jan2000, 01:33	5.1
B_104_J1	0.11	114	01Jan2000, 01:33	10.8
B_104_J2	0.44	360	01Jan2000, 01:33	43.5
B_104_J3	0.48	440	01Jan2000, 01:36	48.6
B_104_R1	0.04	70	01Jan2000, 01:33	3.9
B_104_R2	0.11	111	01Jan2000, 01:36	10.8
B_104_R3	0.44	354	01Jan2000, 01:36	43.5
B_105	0.07	142	01Jan2000, 01:33	7.1
B_105_J	0.55	559	01Jan2000, 01:36	55.7
B_105_R	0.48	431	01Jan2000, 01:36	48.6
B_201	0.08	110	01Jan2000, 01:36	6.4
B_301	0.07	144	01Jan2000, 01:33	6.9
B_301_Div	0.07	44	01Jan2000, 01:33	6.9
B_301_R1	0.00	16	01Jan2000, 01:33	0.1
B_301_R2	0.00	0	01Jan2000, 00:00	0.0
B_401	0.04	87	01Jan2000, 01:30	4.0
B_401_Div	0.04	70	01Jan2000, 01:27	3.9
C_101	0.06	96	01Jan2000, 01:33	4.8
C_102	0.09	144	01Jan2000, 01:33	6.5
C_102_J	0.14	237	01Jan2000, 01:33	11.3
C_102_R1	0.06	94	01Jan2000, 01:36	4.8
C_102_R2	0.14	101	01Jan2000, 01:51	11.1
C_103	0.02	46	01Jan2000, 01:30	2.3
C_103_J	0.16	98	01Jan2000, 02:06	13.3
C_103_R	0.14	91	01Jan2000, 02:06	11.0
C_104	0.05	108	01Jan2000, 01:30	5.2
C_104_J	0.21	150	01Jan2000, 01:33	18.5
C_104_R	0.16	97	01Jan2000, 02:06	13.3
C_105	0.01	21	01Jan2000, 01:30	1.0
C_105_J	0.22	169	01Jan2000, 01:33	19.5
C_105_R	0.21	149	01Jan2000, 01:33	18.5
Campeche_Pond	0.23	116	01Jan2000, 02:00	23.4
County_Pond	0.85	183	01Jan2000, 01:57	69.0
CP_lower	0.14	91	01Jan2000, 02:06	11.0
CP_upper	0.14	101	01Jan2000, 01:51	11.1

Hydrologic Element (1)	Drainage Area (2)	Peak Discharge (3)	Time of Peak (4)	Volume (5)
	(mi2)	(cfs)		(AF)
PDV_connect	0.15	21	01Jan2000, 02:30	11.3
POND_10_upgrade	0.70	136	01Jan2000, 02:39	54.9
POND_12	0.15	21	01Jan2000, 02:27	11.3
POND_2_upgrade	0.19	46	01Jan2000, 02:15	16.0
POND_6_upgrade	0.56	129	01Jan2000, 02:15	44.0
RG_A	1.07	360	01Jan2000, 01:54	96.7
RG_B	0.55	559	01Jan2000, 01:36	55.7
RG_C	0.22	169	01Jan2000, 01:33	19.5
Tampico_Pond	0.07	35	01Jan2000, 01:57	6.8

Notes:

(1) Element name from HEC-HMS model; examples:

A_102	subbasins
A_102_J	junction in subbasin A_102
A_102_R	routing reach in subbasin A_102
A_102_Div	diversion in subbasin A_102
POND_6	Pond

(2) Total area draining to corresponding model element

(3) Peak discharge in cubic feet per second; for ponds, only peak outflow is reported

(4) Time of peak discharge; model run starts at 01 Jan 2000, 00:00

(5) Total runoff volume in acre-feet; please note that for ponds, this equals the total volume passing through the pond over the course of the simulation run; for peak storage values , pleas consult detailed pond results

Ultimate Conditions Reservoir Storage, Inflow and Outflow Results

Summary Results for Reservoir "POND_12"

Project: WCWMP
Simulation Run: WC_ult Reservoir: POND_12

Start of Run:	01Jan2000, 00:00	Basin Model:	WillowCreek_ult
End of Run:	02Jan2000, 00:00	Meteorologic Model:	100yr24hr
Compute Time:	26Oct2012, 14:26:43	Control Specifications:	24hour

Volume Units: IN (•) AC-FT

Computed Results

Peak Inflow :	220.0 (CFS)	Date/Time of Peak Inflow :	01Jan2000, 01:36
Peak Outflow :	20.7 (CFS)	Date/Time of Peak Outflow :	01Jan2000, 02:27
Total Inflow :	13.5 (AC-FT)	Peak Storage :	9.4 (AC-FT)
Total Outflow :	11.3 (AC-FT)	Peak Elevation :	2.6 (FT)

Print Close

Summary Results for Reservoir "POND_6_upgrade"

Project: WCWMP
Simulation Run: WC_ult Reservoir: POND_6_upgrade

Start of Run:	01Jan2000, 00:00	Basin Model:	WillowCreek_ult
End of Run:	02Jan2000, 00:00	Meteorologic Model:	100yr24hr
Compute Time:	26Oct2012, 14:26:43	Control Specifications:	24hour

Volume Units: IN (•) AC-FT

Computed Results

Peak Inflow :	321.1 (CFS)	Date/Time of Peak Inflow :	01Jan2000, 01:39
Peak Outflow :	128.5 (CFS)	Date/Time of Peak Outflow :	01Jan2000, 02:15
Total Inflow :	45.2 (AC-FT)	Peak Storage :	10.7 (AC-FT)
Total Outflow :	44.0 (AC-FT)	Peak Elevation :	7.8 (FT)

Print Close

Summary Results for Reservoir "POND_2_upgrade"

Project: WCWMP
Simulation Run: WC_ult Reservoir: POND_2_upgrade

Start of Run:	01Jan2000, 00:00	Basin Model:	WillowCreek_ult
End of Run:	02Jan2000, 00:00	Meteorologic Model:	100yr24hr
Compute Time:	26Oct2012, 14:26:43	Control Specifications:	24hour

Volume Units: IN (•) AC-FT

Computed Results

Peak Inflow :	225.0 (CFS)	Date/Time of Peak Inflow :	01Jan2000, 01:30
Peak Outflow :	45.5 (CFS)	Date/Time of Peak Outflow :	01Jan2000, 02:15
Total Inflow :	16.3 (AC-FT)	Peak Storage :	9.3 (AC-FT)
Total Outflow :	16.0 (AC-FT)	Peak Elevation :	5306.5 (FT)

Print Close

Summary Results for Reservoir "POND_10_upgrade"

Project: WCWMP
Simulation Run: WC_ult Reservoir: POND_10_upgrade

Start of Run:	01Jan2000, 00:00	Basin Model:	WillowCreek_ult
End of Run:	02Jan2000, 00:00	Meteorologic Model:	100yr24hr
Compute Time:	26Oct2012, 14:26:43	Control Specifications:	24hour

Volume Units: IN (•) AC-FT

Computed Results

Peak Inflow :	196.2 (CFS)	Date/Time of Peak Inflow :	01Jan2000, 01:36
Peak Outflow :	135.9 (CFS)	Date/Time of Peak Outflow :	01Jan2000, 02:39
Total Inflow :	55.4 (AC-FT)	Peak Storage :	6.4 (AC-FT)
Total Outflow :	54.9 (AC-FT)	Peak Elevation :	8.4 (FT)

Print Close

Summary Results for Reservoir "County_Pond"

Project: WCWMP
Simulation Run: WC_ult Reservoir: County_Pond

Start of Run:	01Jan2000, 00:00	Basin Model:	WillowCreek_ult
End of Run:	02Jan2000, 00:00	Meteorologic Model:	100yr24hr
Compute Time:	26Oct2012, 14:26:43	Control Specifications:	24hour

Volume Units: IN (•) AC-FT

Computed Results

Peak Inflow :	344.4 (CFS)	Date/Time of Peak Inflow :	01Jan2000, 01:33
Peak Outflow :	183.0 (CFS)	Date/Time of Peak Outflow :	01Jan2000, 01:57
Total Inflow :	69.6 (AC-FT)	Peak Storage :	7.5 (AC-FT)
Total Outflow :	69.0 (AC-FT)	Peak Elevation :	5.9 (FT)

Print Close

Summary Results for Reservoir "Campeche_Pond"

Project: WCWMP
Simulation Run: WC_ult Reservoir: Campeche_Pond

Start of Run:	01Jan2000, 00:00	Basin Model:	WillowCreek_ult
End of Run:	02Jan2000, 00:00	Meteorologic Model:	100yr24hr
Compute Time:	26Oct2012, 14:26:43	Control Specifications:	24hour

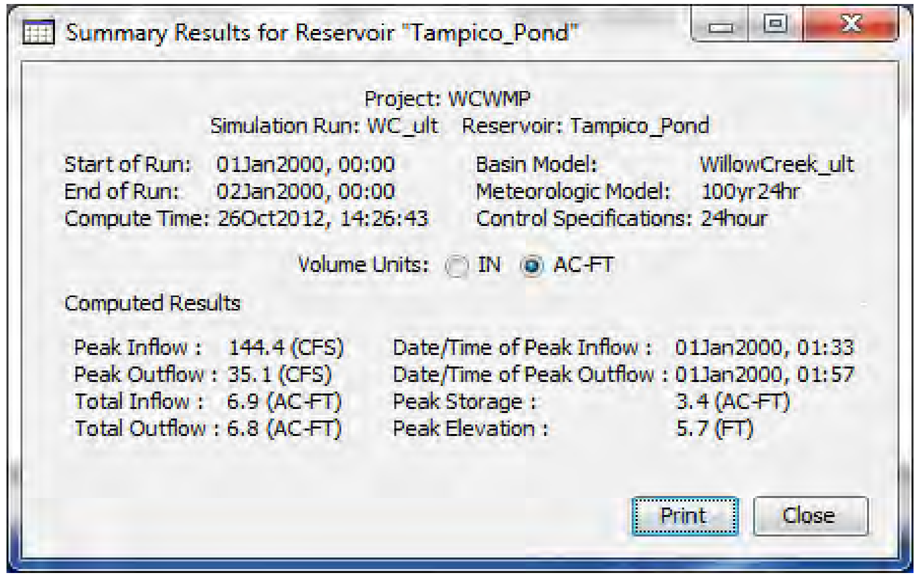
Volume Units: IN (•) AC-FT

Computed Results

Peak Inflow :	413.3 (CFS)	Date/Time of Peak Inflow :	01Jan2000, 01:33
Peak Outflow :	115.8 (CFS)	Date/Time of Peak Outflow :	01Jan2000, 02:00
Total Inflow :	23.7 (AC-FT)	Peak Storage :	11.5 (AC-FT)
Total Outflow :	23.4 (AC-FT)	Peak Elevation :	5240.0 (FT)

Print Close

Ultimate Conditions Reservoir Storage, Inflow and Outflow Results



Summary Results for Reservoir "Tampico_Pond"

Project: WCWMP
Simulation Run: WC_ult Reservoir: Tampico_Pond

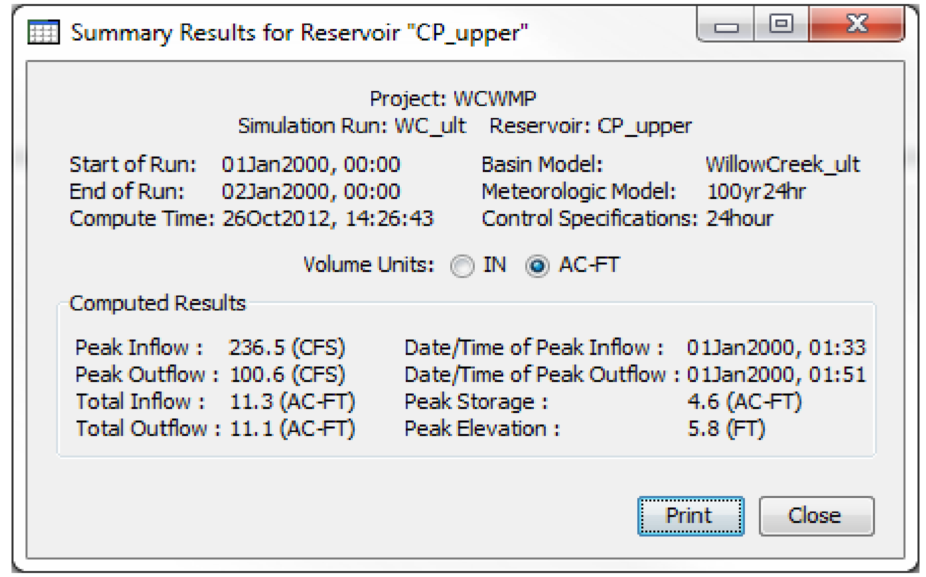
Start of Run: 01Jan2000, 00:00 Basin Model: WillowCreek_ult
End of Run: 02Jan2000, 00:00 Meteorologic Model: 100yr24hr
Compute Time: 26Oct2012, 14:26:43 Control Specifications: 24hour

Volume Units: IN AC-FT

Computed Results

Peak Inflow : 144.4 (CFS) Date/Time of Peak Inflow : 01Jan2000, 01:33
Peak Outflow : 35.1 (CFS) Date/Time of Peak Outflow : 01Jan2000, 01:57
Total Inflow : 6.9 (AC-FT) Peak Storage : 3.4 (AC-FT)
Total Outflow : 6.8 (AC-FT) Peak Elevation : 5.7 (FT)

Print Close



Summary Results for Reservoir "CP_upper"

Project: WCWMP
Simulation Run: WC_ult Reservoir: CP_upper

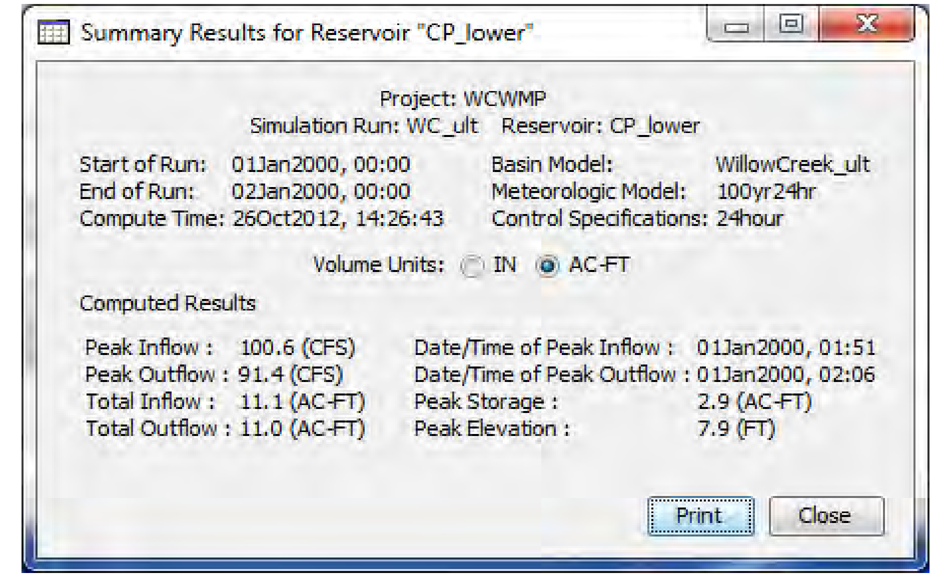
Start of Run: 01Jan2000, 00:00 Basin Model: WillowCreek_ult
End of Run: 02Jan2000, 00:00 Meteorologic Model: 100yr24hr
Compute Time: 26Oct2012, 14:26:43 Control Specifications: 24hour

Volume Units: IN AC-FT

Computed Results

Peak Inflow : 236.5 (CFS) Date/Time of Peak Inflow : 01Jan2000, 01:33
Peak Outflow : 100.6 (CFS) Date/Time of Peak Outflow : 01Jan2000, 01:51
Total Inflow : 11.3 (AC-FT) Peak Storage : 4.6 (AC-FT)
Total Outflow : 11.1 (AC-FT) Peak Elevation : 5.8 (FT)

Print Close



Summary Results for Reservoir "CP_lower"

Project: WCWMP
Simulation Run: WC_ult Reservoir: CP_lower

Start of Run: 01Jan2000, 00:00 Basin Model: WillowCreek_ult
End of Run: 02Jan2000, 00:00 Meteorologic Model: 100yr24hr
Compute Time: 26Oct2012, 14:26:43 Control Specifications: 24hour

Volume Units: IN AC-FT

Computed Results

Peak Inflow : 100.6 (CFS) Date/Time of Peak Inflow : 01Jan2000, 01:51
Peak Outflow : 91.4 (CFS) Date/Time of Peak Outflow : 01Jan2000, 02:06
Total Inflow : 11.1 (AC-FT) Peak Storage : 2.9 (AC-FT)
Total Outflow : 11.0 (AC-FT) Peak Elevation : 7.9 (FT)

Print Close

Appendix D – Calculations

Location	NM528 & Idalia (350' south of Idalia)
Date	1/6/2012

		Data Source
Invert Upstream	5121	2010 DEM
Invert Downstream	5112	2010 DEM
Length	220	2010 DEM
Shape	round	Field
Material	CMP	Field
Number	2	Field
Size (ft)	5	Field
Manning's n	0.025	DPM
Entrance	mitered to slope	Field
Cover (ft)	2	Field

Comments	

Culvert Calculator Report
NM528 & Idalia

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	5,128.00	ft	Headwater Depth/Height	1.40	
Computed Headwater Eleva	5,128.00	ft	Discharge	335.79	cfs
Inlet Control HW Elev.	5,128.00	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	5,127.76	ft	Control Type	Inlet Control	

Grades

Upstream Invert	5,121.00	ft	Downstream Invert	5,112.00	ft
Length	220.00	ft	Constructed Slope	0.040909	ft/ft

Hydraulic Profile

Profile	S2		Depth, Downstream	2.83	ft
Slope Type	Steep		Normal Depth	2.83	ft
Flow Regime	Supercritical		Critical Depth	3.71	ft
Velocity Downstream	14.65	ft/s	Critical Slope	0.018897	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.025	
Section Material	CMP		Span	5.00	ft
Section Size	60 inch		Rise	5.00	ft
Number Sections	2				

Outlet Control Properties

Outlet Control HW Elev.	5,127.76	ft	Upstream Velocity Head	1.79	ft
Ke	0.70		Entrance Loss	1.25	ft

Inlet Control Properties

Inlet Control HW Elev.	5,128.00	ft	Flow Control	Transition	
Inlet Type	Mitered to slope		Area Full	39.3	ft²
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

Project Engineer: gschoener
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Location	NM528 & Basin B (1450' south of Idalia)
Date	1/6/2012

		Data Source
Invert Upstream	5142	2010 DEM
Invert Downstream	5141	2010 DEM
Length	135	2010 DEM
Shape	round	Field
Material	CMP	Field
Number	3	Field
Size (ft)	5	Field
Manning's n	0.025	DPM
Entrance	mitered to slope	Field
Cover (ft)	1	Field

Comments	Culverts 1/2 full of sediment

Culvert Calculator Report
NM528 - 1450' s of Idalia

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	5,148.00 ft	Headwater Depth/Height	1.20
Computed Headwater Eleva	5,148.00 ft	Discharge	421.75 cfs
Inlet Control HW Elev.	5,147.44 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	5,148.00 ft	Control Type	Outlet Control

Grades

Upstream Invert	5,142.00 ft	Downstream Invert	5,141.00 ft
Length	135.00 ft	Constructed Slope	0.007407 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	3.40 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	3.40 ft
Velocity Downstream	9.90 ft/s	Critical Slope	0.016645 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.025
Section Material	CMP	Span	5.00 ft
Section Size	60 inch	Rise	5.00 ft
Number Sections	3		

Outlet Control Properties

Outlet Control HW Elev.	5,148.00 ft	Upstream Velocity Head	0.89 ft
Ke	0.70	Entrance Loss	0.62 ft

Inlet Control Properties

Inlet Control HW Elev.	5,147.44 ft	Flow Control	Unsubmerged
Inlet Type	Mitered to slope	Area Full	58.9 ft²
K	0.02100	HDS 5 Chart	2
M	1.33000	HDS 5 Scale	2
C	0.04630	Equation Form	1
Y	0.75000		

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Location	**NM528 & Christopher Pointe**	
Date	**1/6/2012**	

		Data Source
Invert Upstream	**5166 (ground elevation - 14')**	2010 DEM
Invert Downstream	**5162**	2010 DEM
Length	**180**	2010 DEM
Shape	**round**	Field
Material	**CMP**	Field
Number	1	Field
Size (ft)	**3**	Field
Manning's n	**0.025**	DPM
Entrance	**drop inlet**	Field
Cover (ft)	**11**	Field

Comments	

Culvert Calculator Report
NM528 & Christopher Pointe

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	5,180.00 ft	Headwater Depth/Height	4.67
Computed Headwater Elev:	5,180.00 ft	Discharge	87.61 cfs
Inlet Control HW Elev.	5,173.86 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	5,180.00 ft	Control Type	Outlet Control

Grades

Upstream Invert	5,166.00 ft	Downstream Invert	5,162.00 ft
Length	180.00 ft	Constructed Slope	0.022222 ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile	Depth, Downstream	2.83 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	2.83 ft
Velocity Downstream	12.68 ft/s	Critical Slope	0.055173 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.025
Section Material	CMP	Span	3.00 ft
Section Size	36 inch	Rise	3.00 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	5,180.00 ft	Upstream Velocity Head	2.39 ft
Ke	0.50	Entrance Loss	1.19 ft

Inlet Control Properties

Inlet Control HW Elev.	5,173.86 ft	Flow Control	Submerged
Inlet Type	Headwall	Area Full	7.1 ft²
K	0.00780	HDS 5 Chart	2
M	2.00000	HDS 5 Scale	1
C	0.03790	Equation Form	1
Y	0.69000		

Location	NM528 & Basin B (2880' south of Idalia)	
Date	1/6/2012	

		Data Source
Invert Upstream	5159	2010 DEM
Invert Downstream	5152	2010 DEM
Length	195	2010 DEM
Shape	round	Field
Material	CMP	Field
Number	1	Field
Size (ft)	3	Field
Manning's n	0.025	DPM
Entrance	mitered to slope	Field
Cover (ft)	4	Field

Comments	

Culvert Calculator Report
NM528 - 2880 ft south of Idalia

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	5,166.00	ft	Headwater Depth/Height	2.33	
Computed Headwater Elev:	5,166.00	ft	Discharge	71.03	cfs
Inlet Control HW Elev.	5,166.00	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	5,165.07	ft	Control Type	Inlet Control	

Grades

Upstream Invert	5,159.00	ft	Downstream Invert	5,152.00	ft
Length	195.00	ft	Constructed Slope	0.035897	ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile		Depth, Downstream	2.67	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	2.67	ft
Velocity Downstream	10.68	ft/s	Critical Slope	0.037276	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.025	
Section Material	CMP		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	1				

Outlet Control Properties

Outlet Control HW Elev.	5,165.07	ft	Upstream Velocity Head	1.57	ft
Ke	0.70		Entrance Loss	1.10	ft

Inlet Control Properties

Inlet Control HW Elev.	5,166.00	ft	Flow Control	Submerged	
Inlet Type	Mitered to slope		Area Full	7.1	ft²
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

Location	NM528 & Basin B (2250' south of Idalia)
Date	1/6/2012

		Data Source
Invert Upstream	5147	2010 DEM
Invert Downstream	5145	2010 DEM
Length	145	2010 DEM
Shape	round	Field
Material	CMP	Field
Number	1	Field
Size (ft)	3	Field
Manning's n	0.025	DPM
Entrance	mitered to slope	Field
Cover (ft)	1	Field

Comments	Partially full of sediment (20%)

Culvert Calculator Report
NM528 - 2250 ft south of Idalia

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	5,151.00 ft	Headwater Depth/Height	1.33
Computed Headwater Eleva	5,151.00 ft	Discharge	45.65 cfs
Inlet Control HW Elev.	5,150.95 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	5,151.00 ft	Control Type	Outlet Control

Grades

Upstream Invert	5,147.00 ft	Downstream Invert	5,145.00 ft
Length	145.00 ft	Constructed Slope	0.013793 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	2.20 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	2.20 ft
Velocity Downstream	8.21 ft/s	Critical Slope	0.021948 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.025
Section Material	CMP	Span	3.00 ft
Section Size	36 inch	Rise	3.00 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	5,151.00 ft	Upstream Velocity Head	0.67 ft
Ke	0.70	Entrance Loss	0.47 ft

Inlet Control Properties

Inlet Control HW Elev.	5,150.95 ft	Flow Control	Transition
Inlet Type	Mitered to slope	Area Full	7.1 ft²
K	0.02100	HDS 5 Chart	2
M	1.33000	HDS 5 Scale	2
C	0.04630	Equation Form	1
Y	0.75000		

Location	**Willow Creek & Basin A (between Spruce Mountain & Shavano Peak)**
Date	**1/6/2012**

		Data Source
Invert Upstream	**5084**	2010 DEM
Invert Downstream	**5080**	2010 DEM
Length	**123**	2010 DEM
Shape	**round**	Field
Material	**CMP**	Field
Number	1	Field
Size (ft)	**5.5**	Field
Manning's n	**0.025**	DPM
Entrance	**headwall**	Field
Cover (ft)	**4**	Field

Comments	

Culvert Calculator Report
Willow Creek & Basin A

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	5,093.50 ft	Headwater Depth/Height	1.73
Computed Headwater Elev:	5,093.50 ft	Discharge	293.77 cfs
Inlet Control HW Elev.	5,093.50 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	5,092.99 ft	Control Type	Inlet Control

Grades

Upstream Invert	5,084.00 ft	Downstream Invert	5,080.00 ft
Length	123.00 ft	Constructed Slope	0.032520 ft/ft

Hydraulic Profile

Profile	S2	Depth, Downstream	4.21 ft
Slope Type	Steep	Normal Depth	4.21 ft
Flow Regime	Supercritical	Critical Depth	4.73 ft
Velocity Downstream	15.06 ft/s	Critical Slope	0.026236 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.025
Section Material	CMP	Span	5.50 ft
Section Size	66 inch	Rise	5.50 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	5,092.99 ft	Upstream Velocity Head	2.84 ft
Ke	0.50	Entrance Loss	1.42 ft

Inlet Control Properties

Inlet Control HW Elev.	5,093.50 ft	Flow Control	Submerged
Inlet Type	Headwall	Area Full	23.8 ft²
K	0.00780	HDS 5 Chart	2
M	2.00000	HDS 5 Scale	1
C	0.03790	Equation Form	1
Y	0.69000		

Location	Willow Creek & Basin B (between Withington Peak & Sierra Blanca)	
Date	1/6/2012	

		Data Source
Invert Upstream	5077	2010 DEM
Invert Downstream	5072	2010 DEM
Length	121	2010 DEM
Shape	round	Field
Material	CMP	Field
Number	1	Field
Size (ft)	6	Field
Manning's n	0.025	DPM
Entrance	headwall	Field
Cover (ft)	4	Field

Comments	

Culvert Calculator Report
Willow Creek & Basin B

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	5,087.00	ft	Headwater Depth/Height	1.67	
Computed Headwater Eleva	5,087.00	ft	Discharge	355.28	cfs
Inlet Control HW Elev.	5,087.00	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	5,086.58	ft	Control Type	Inlet Control	

Grades

Upstream Invert	5,077.00	ft	Downstream Invert	5,072.00	ft
Length	121.00	ft	Constructed Slope	0.041322	ft/ft

Hydraulic Profile

Profile	S2		Depth, Downstream	4.08	ft
Slope Type	Steep		Normal Depth	4.04	ft
Flow Regime	Supercritical		Critical Depth	5.10	ft
Velocity Downstream	17.37	ft/s	Critical Slope	0.024511	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.025	
Section Material	CMP		Span	6.00	ft
Section Size	72 inch		Rise	6.00	ft
Number Sections	1				

Outlet Control Properties

Outlet Control HW Elev.	5,086.58	ft	Upstream Velocity Head	2.99	ft
Ke	0.50		Entrance Loss	1.49	ft

Inlet Control Properties

Inlet Control HW Elev.	5,087.00	ft	Flow Control	Submerged	
Inlet Type	Headwall		Area Full	28.3	ft²
K	0.00780		HDS 5 Chart	2	
M	2.00000		HDS 5 Scale	1	
C	0.03790		Equation Form	1	
Y	0.69000				

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Location	**Willow Creek & Basin C (between Agua Fria & Riverside)**
Date	**1/6/2012**

		Data Source
Invert Upstream	**5099**	2010 DEM
Invert Downstream	**5040**	2010 DEM
Length	**1500**	2010 DEM
Shape	**round**	Field
Material	**RCP**	Field
Number	1	Field
Size (ft)	**3**	Field
Manning's n	**0.013**	DPM
Entrance	**headwall**	Field
Cover (ft)	**4**	Field

Comments	

Culvert Calculator Report
Willow Creek & Basin C

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	5,106.00 ft	Headwater Depth/Height	2.33
Computed Headwater Elev:	5,106.00 ft	Discharge	91.00 cfs
Inlet Control HW Elev.	5,106.00 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	5,105.06 ft	Control Type	Inlet Control

Grades

Upstream Invert	5,099.00 ft	Downstream Invert	5,040.00 ft
Length	1,500.00 ft	Constructed Slope	0.039333 ft/ft

Hydraulic Profile

Profile	S2	Depth, Downstream	1.83 ft
Slope Type	Steep	Normal Depth	1.83 ft
Flow Regime	Supercritical	Critical Depth	2.85 ft
Velocity Downstream	20.17 ft/s	Critical Slope	0.016127 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	3.00 ft
Section Size	36 inch	Rise	3.00 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	5,105.06 ft	Upstream Velocity Head	2.67 ft
Ke	0.20	Entrance Loss	0.53 ft

Inlet Control Properties

Inlet Control HW Elev.	5,106.00 ft	Flow Control	Submerged
Inlet Type	Groove end w/headwall	Area Full	7.1 ft^2
K	0.00180	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	2
C	0.02920	Equation Form	1
Y	0.74000		

	SAD 5 Pond 10 Outlet	
Date	1/6/2012	

		Data Source
Invert Upstream	5191	2010 DEM
Invert Downstream	5190	2010 DEM
Length	73	2010 DEM
Shape	round	Field
Material	CMP	Field
Number	3	Field
Size (ft)	4	Field
Manning's n	0.025	DPM
Entrance	mitered to slope	Field
Cover (ft)	2	Field

Comments	Left-most culvert is blocked with steel plates on both ends

Rating Table Report
SAD 5 Pond 10 Outlet

Range Data:

	Minimum	Maximum	Increment	
Allowable HW E	5,191.00	5,197.00	0.50	ft

HW Elev. (ft)	Discharge (cfs)
5,191.00	0.00
5,191.50	3.78
5,192.00	14.30
5,192.50	31.04
5,193.00	53.36
5,193.50	80.41
5,194.00	111.63
5,194.50	147.46
5,195.00	186.59
5,195.50	227.53
5,196.00	266.95
5,196.50	287.67
5,197.00	301.55

Project Engineer: gschoener
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	SAD 6 Pond #6 Outlet
Date	**1/6/2012**

		Data Source
Invert Upstream	**5289**	2010 DEM
Invert Downstream	**5286**	2010 DEM
Length	**106**	2010 DEM
Shape	**round**	Field
Material	**RCP**	Field
Number	2	Field
Size (ft)	**4.5**	Field
Manning's n	**0.013**	DPM
Entrance	**protruding**	Field
Cover (ft)	**0**	Field

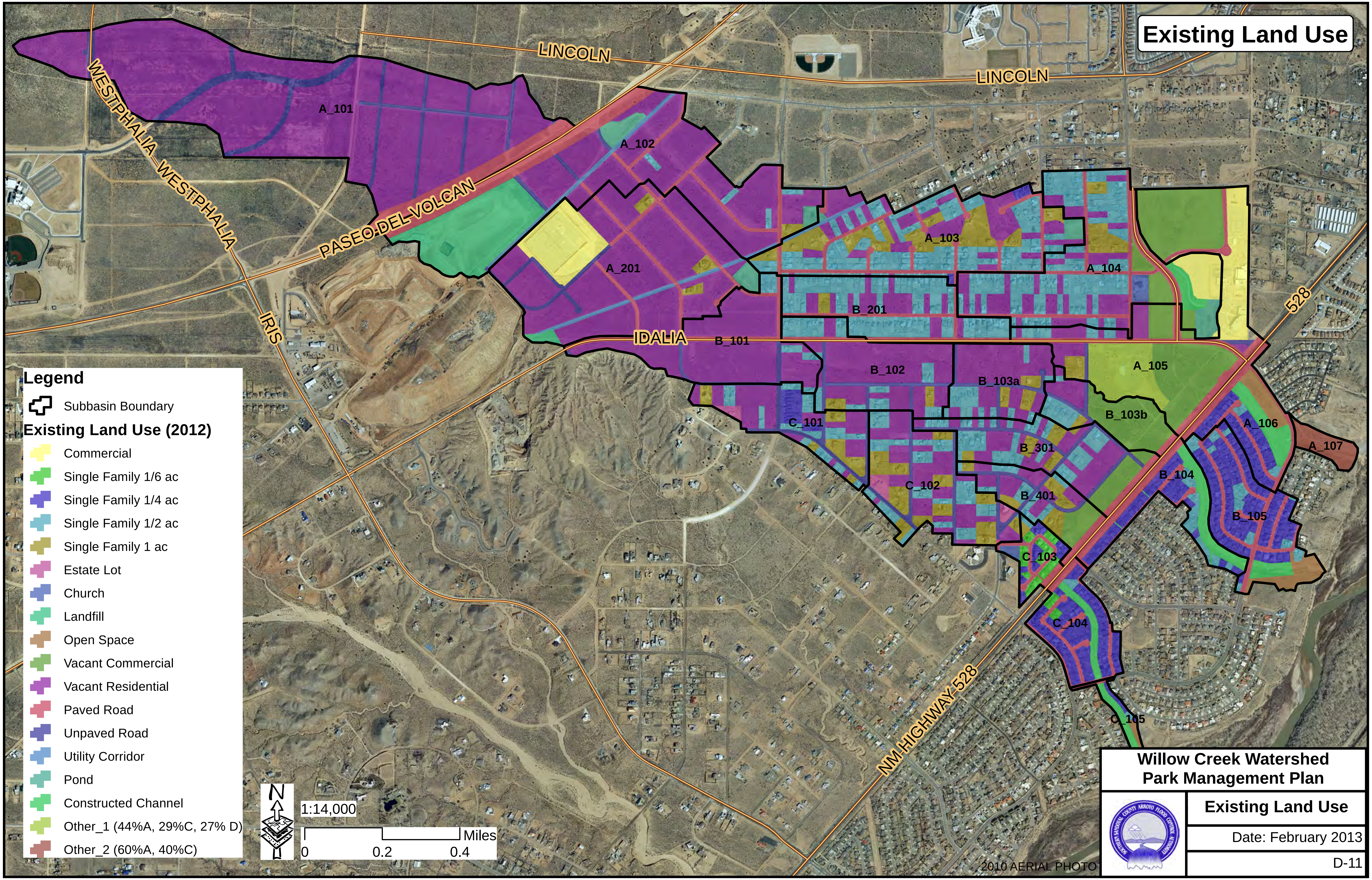
Comments	

Rating Table Report
SAD 6 Pond 6 Outlet

Range Data:

	Minimum	Maximum	Increment	
Allowable HW E	5,289.00	5,293.50	0.50	ft

HW Elev. (ft)	Discharge (cfs)
5,289.00	0.00
5,289.50	3.26
5,290.00	12.68
5,290.50	27.73
5,291.00	47.83
5,291.50	72.38
5,292.00	100.72
5,292.50	132.18
5,293.00	166.02
5,293.50	201.49



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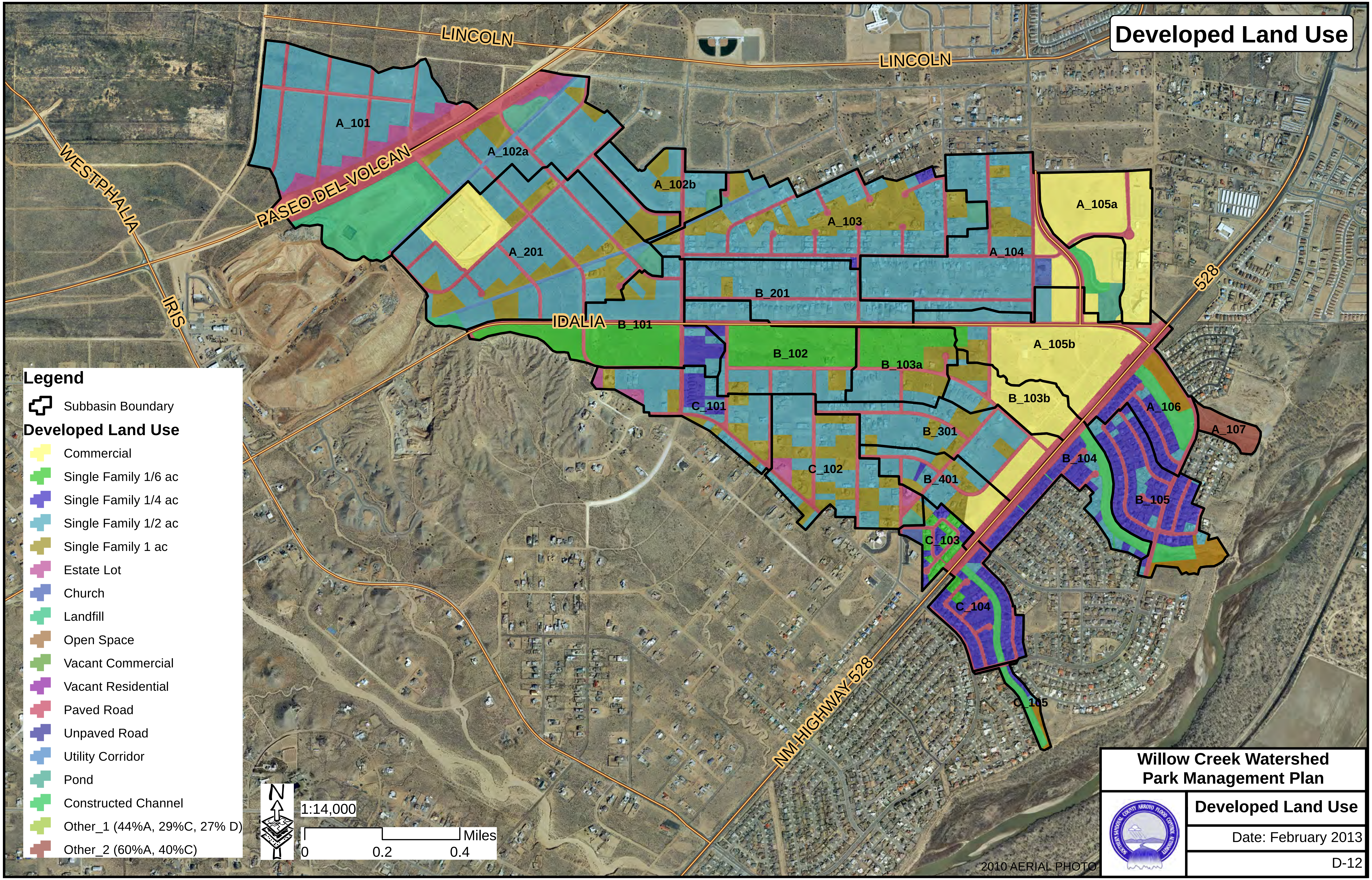

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