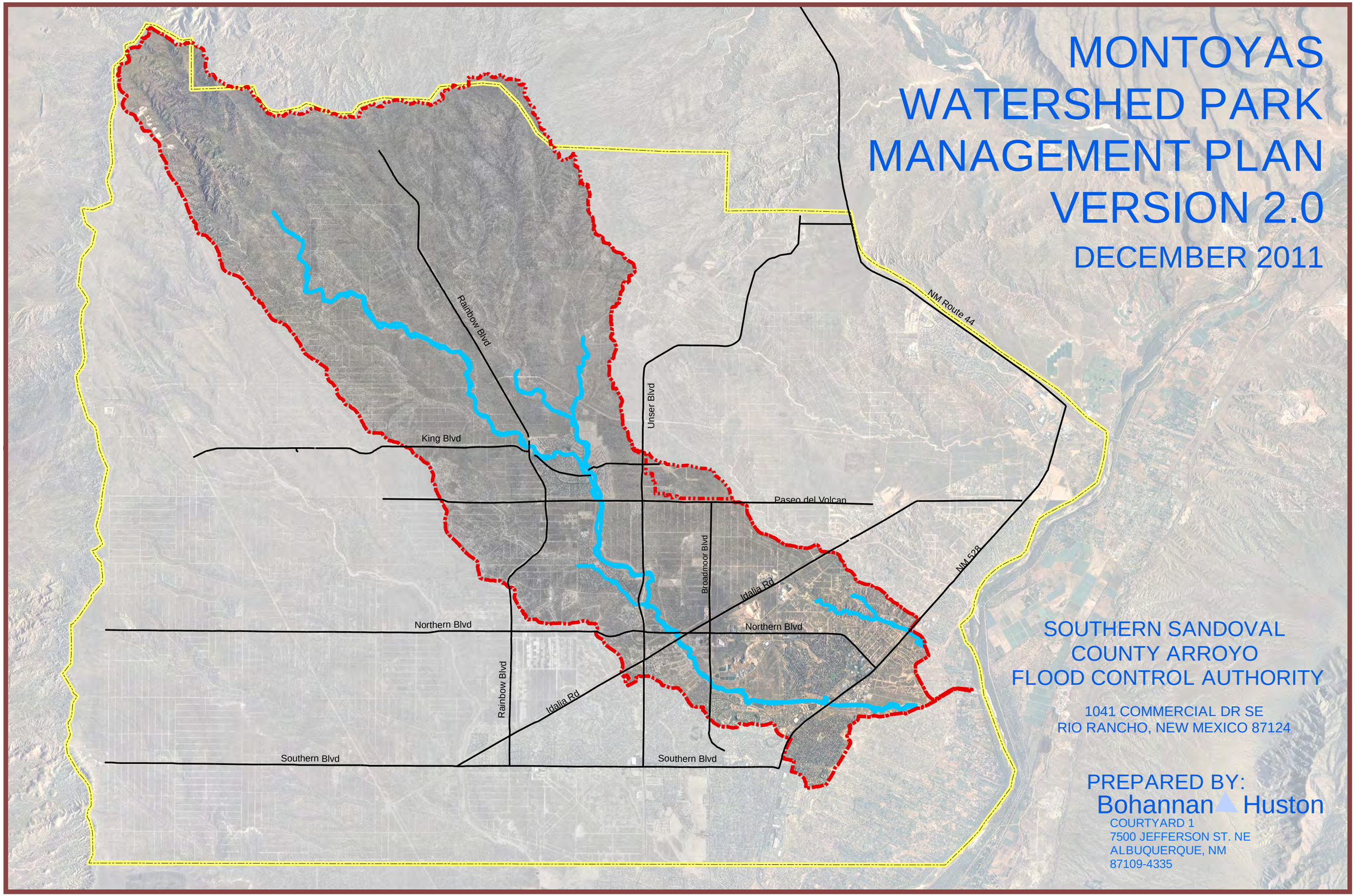
MONTOYAS WATERSHED PARK MANAGEMENT PLAN VERSION 2.0

DECEMBER 2011



SOUTHERN SANDOVAL COUNTY ARROYO FLOOD CONTROL AUTHORITY

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Montoyas Watershed Park Management Plan Version 2.0

I, Howard Stone, Registered Professional Engineer No. 9099, hereby certify that these documents were prepared by me, or directly under my supervision, and are true and correct to the best of my knowledge and belief.

Howard C. Stone, P.E.
New Mexico P.E. No. 9099

Southern Sandoval County Arroyo Flood Control Authority

MONTOYAS WATERSHED PARK MANAGEMENT PLAN VERSION 2.0 (MOWMPv2.0) December 2011

The SSCAFCA Montoyas Watershed Park Management Plan Version 2.0 REPLACES the Montoyas Arroyo Watershed Management Plan dated August 2002. This is a technical and structural update and incorporates development changes since the original 2002 MOWMP.

Accepted

By: _____ Date: December 8, 2011
Charles Thomas, P.E. Executive Engineer

CONCURRENCE:

_____ Date: 12/8/2011
City of Rio Rancho Title

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 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.

Montoyas Watershed Park Management Plan (MOWMP) Revision History

Verify that this is the correct version before use. Visit www.sscafca.com for latest version.

CURRENT THROUGH OCTOBER 2011

REVISION HISTORY							
Revision	Type	Title	Description of Change(s)	Prepared By	SSCAFCA MOWMP	Effective Date	SSCAFCA Approval
v.1	Initial Release	Montoyas Arroyo Watershed Management Plan	n/a	BHI	n/a	August 2002	See signature page
v.1.1	Addendum	Addendum No. 1 to Montoyas Arroyo Watershed Management Plan	This addendum proposed an additional dam on the Lomitas Negras Arroyo at the entrance to the Dulcelina Curtis Channel. The additional dam more efficiently mitigates the addition of the peak flows hydrograph from Lomitas Negras Arroyo on the main stem of the Montoyas Arroyo.	BHI	August 2002	July 2004	See signature page
v2.0	Re-release	Montoyas Watershed Park Management Plan Version 2.0	UPDATED: Conversion to HEC-HMS, existing hydrology to 2010 conditions (addition of > 40 developments since 2002, which added ~ 20 new basins), addition of Sportsplex Dam, added ~ 60 basins to comply with new maximum basin size (320 ac); diversion of City Center area in DEVEX and Ultimate models; FIXED: Minor adjustments for rainfall reduction factors, time to peak revisions	BHI/ SSCAFCA	December 2011	December 2011	See signature page

UNIFORM WATERSHED HYDROLOGY MAINTENANCE

A. To ensure public health, safety and welfare, SSCAFCA develops and maintains the adopted “Master” regional HEC-HMS 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” HEC-HMS 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.

C. Please refer to the Planning Document Hierarchy Policy (MARD 64) for questions about the hierarchy of different planning documents (i.e. watershed park management plans, facility plans, etc.).

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ABBREVIATIONS & DEFINITIONS

100-year Storm	-	A storm which has a 1% chance of being equaled or exceeded in any given year
2002 MOWMP	-	The original Montoyas Arroyo Watershed Management Plan accepted by SSCAFCA in September 2002
ac	-	Acre
AF	-	Acre-feet of runoff (volume of water that covers one acre one foot deep)
AHYMO	-	Arid Lands HYdrologic MOdel
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
BHI	-	Bohannan Huston, Inc.
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
CWD	-	Corrales Watershed District
CY	-	Cubic yard
Dam	-	Facility intended for sediment, erosion, and flood control, which is constructed more than 25 feet in height or can store more than 50 ac-ft of water. (Note that all dams may not require OSE permits)
DCC	-	Dulcelina Curtis Channel
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.
DEVEX	-	Fully developed watershed with existing drainage infrastructure.
DMP	-	Drainage Master Plan
DPM	-	SSCAFCA 2009 Development Process Manual Chapter 22
Drainage Basin	-	Runoff areas, which flow to a specific location or 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 address the drainage environment
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
Existing Facility	-	An existing drainage facility (does not include proposed improvements)
Existing Conditions Hydrology	-	Hydrology resulting from existing conditions development with existing infrastructure with the exception of assuming proposed conditions development and proposed infrastructure for all areas for which a valid drainage report or facility plan has been approved by SSCAFCA as of the date of the WMP in effect at the time
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 within a WMP area. More detailed than a WMP
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 developments, including any undeveloped areas.
GIS	-	Geographic Information System
Hard Lined Conveyance	-	Constructed channel, storm drain or other conveyance system with non-pervious lining (concrete, soil cement, etc.)
HJC		Harvey Jones Channel

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 defines a jurisdictional dam as 25 feet or greater in height and storing more than 15 acre-feet or a dam that stores 50 acre-feet 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
MOWMP	-	Montoyas Watershed Park Management Plan
MO	-	Two letter identifier for the Arroyo de Los Montoyas Watershed
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 have 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 have 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
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 the 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 ac-ft of water
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 from the most severe combination of critical meteorological and hydrologic conditions that is possible on a particular watershed
Proposed Facility	-	A new recommended drainage facility
Q	-	Flow rate, CFS
RCP	-	Reinforced Concrete Pipe
Regional Stormwater Detention Facility	-	See Major Facilities
ROW	-	Right-of-way
Retention	-	Collection and storage of runoff without release
RRPW	-	Rio Rancho Public Works
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
Ultimate Conditions	-	Fully developed watershed including all existing facilities and approved/accepted facility- or other plan improvements along with anticipated future drainage infrastructure
USACE	-	United States Army Corps of Engineers
USGS	-	United States Geological Survey
Watershed	-	A comprehensive drainage area usually incorporating several drainage 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 Management Plan	-	A comprehensive study of the drainage characteristics of a watershed establishing the plan for managing drainage within the watershed. (also referred to as Drainage Management Plan)
WMP	-	Watershed Management Plan
Facility ID YY_MO_ZZX	-	Facility Identifier YY – Section Number MO – Watershed Id ZZ Facility Number with Section YY X – Type of Facility A – Arroyo C – Channel D – Dam E – Environmental P – Pond R – Rain Gauge S – Storm Drain X – Crossing Structure Y – Playa

Montoyas Watershed Park Management Plan Version 2.0

EXECUTIVE SUMMARY

In August 2002, the Montoyas Arroyo Watershed Management Plan (MOWMP), prepared by Bohannan Huston, Inc. (BHI), was accepted by the Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA). The MOWMP was amended in July 2004 to address stormwater flows in the Lomitas Negros Arroyo, a major tributary to the Dulcelina Curtis channel. This current update to the MOWMP was performed to allow a public domain model, HEC-HMS, to be utilized in the watershed and to incorporate all development that occurred since 2002/2004. This MOWMPv2.0 continues to serve as a planning tool for future regional drainage improvements and to plan for the effects of anticipated urban development in the Montoyas Watershed Park. Since the publication of the 2002 MOWMP and the 2004 addendum, a series of changes has occurred in the watershed, including:

- Construction of Montoyas Arroyo Sportsplex Dam
- Construction of Loma Colorado Subdivision
- Construction of additional portions of Northern Meadows
- Construction of Cielo Norte Subdivision
- Edinburgh Facility Plan (Accepted by SSCAFCA, but not constructed yet)
- Sierra Vista West Facility Plan (Accepted by SSCAFCA, but not constructed yet)
- Construction of dozens of other small developments within the watershed.

The primary revisions and updates to the 2002 MOWMP include:

- Conversion of the hydrology computational procedure from AHYMO to HEC-HMS including:
    - HEC-HMS v3.4 with NOAA Atlas 14 rainfall
    - Updates to sub-basin parameters and routing characteristics.
    - Re-defining a large number of sub-basins to restrict the modeled basin size to greater than 40 acres (with minor exceptions), less than 320 acres, and with a length to width ratio less than 4.
- Incorporation of 2009 SSCAFCA Development Process Manual (DPM) Chapter 22 criteria
- Update the DEVEX condition with existing platting and existing drainage facilities to 2010 conditions.
- Incorporation of the Montoyas Arroyo Sportsplex Dam and the other changes listed above.
- Diversion of flows from the City Center site for the DEVEX and Ultimate conditions hydrology.

A copy of the "Master" HEC-HMS model will be available for reference or use by others. Please contact SSCAFCA for the HEC-HMS model status and the process to obtain copies of the model. Use of electronic media provided by SSCAFCA is solely at the user's risk.

The study area of the MOWMPv2.0 encompasses two major arroyos: the Montoyas Arroyo and the Lomitas Negras Arroyo. Both are located on the west side of the Rio Grande within the limits of the City of Rio Rancho, the Village of Corrales, and Sandoval County. The Montoyas Arroyo has two named tributaries, the Ponce de Leon and Tortugas Arroyos, while the Lomitas Negras has none. Even though there are two separate watersheds being investigated, the term "watershed" will, in general, pertain to both. The combined watershed area is approximately 60 square miles.

Approximately 2/3 of the watershed was platted in the 1960's as commercial and residential lots as part of the Rio Rancho Estates. Lots in the Rio Rancho Estates range in size from 1/8-acre lots to large commercial parcels. The major arroyos were reserved as arroyos/open space and some are still in private ownership. Major developments that presently exist in the Montoyas Watershed include: North Hills Subdivision, Country Club Hills, The Greens, Panorama Heights, Ridges, Cascades, Stonehenge Estates, Broadmoor, Rolling Hills, City of Rio Rancho Wastewater Treatment Plant No. 2, Northern Meadows Subdivision, Rio Rancho Industrial Park, High Resort, Vista Hills Subdivision, Rio Rancho High School, and Loma Colorado. At the present time the only major future developments that are known are Mariposa and Northern Skies.

A number of drainage reports have been previously prepared for areas within the watershed. The more notable drainage reports were produced by the Soil Conservation Service (SCS – now renamed to Natural Resource Conservation Service (NRCS), US Army Corps of Engineers (USACE), and the Federal Emergency Management Agency (FEMA). The combined efforts of the NRCS and Corrales Watershed District (CWD) culminated in the construction of the Harvey Jones and Dulcelina Curtis Channels, which provided a concrete channel outfall to the Rio Grande through the Village of Corrales. According to the NRCS report, the Harvey Jones Channel (HJC) has a capacity of 8,000 cubic feet per second (cfs). Controversy has revolved around this channel between the NRCS and USACE at the Corrales Road Bridge crossing of the HJC. The USACE determined that due to a constriction at the crossing, the capacity of the channel at this location is only 5,000 cfs. The hydraulics of the HJC, and in particular the Corrales Bridge crossing, were evaluated in a report entitled "Harvey Jones Channel Hydraulic Capacity Analysis", by BHI, July 22,1999, which reaffirmed the capacity of Harvey Jones Channel is approximately 5,000 cfs. A later report entitled "Evaluation of Alternatives for Raising Harvey Jones Bridge at Corrales Road", by BHI, Sept. 2003 evaluated options to increase the capacity of the Harvey Jones Channel at the Corrales Bridge.

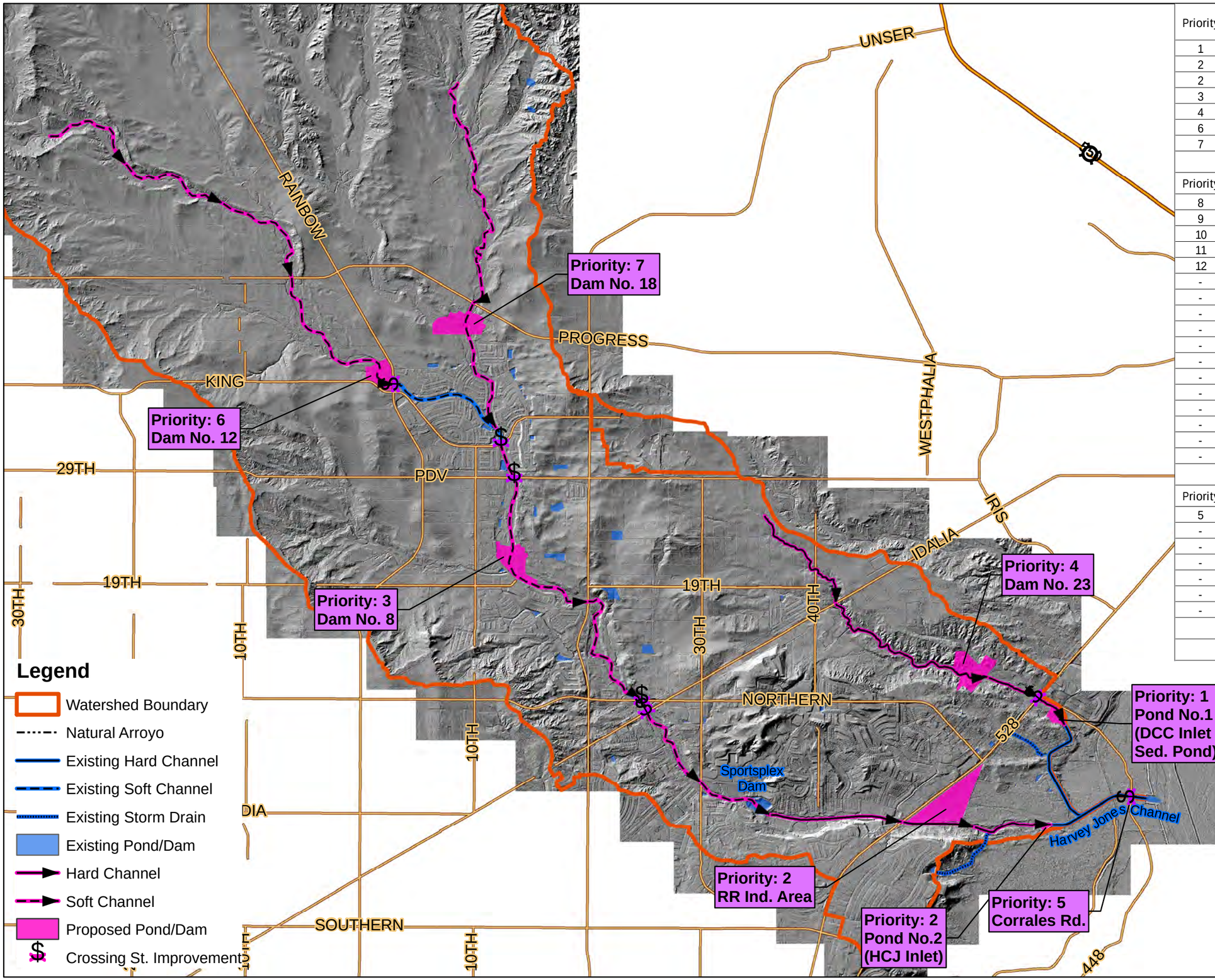
This MOWMPv2.0 evaluated the stormwater runoff from the 100-yr return event that would result from existing (2010), and two future scenarios: DEVEX conditions, and ultimate conditions. For this MOWMPv2.0, DEVEX conditions refers to a future scenario where all land area is assumed to be developed with existing drainage infrastructure. The ultimate conditions hydrology model assumes a fully developed watershed with all existing drainage infrastructure, proposed drainage infrastructure included in approved drainage reports or facility plans, and the all recommended regional stormwater detention facilities from this MOWMPv2.0.

The MOWMPv2.0 recommends a number of improvements in the Montoyas Watershed Park. The improvements include construction of regional stormwater detention facilities, road crossing structure improvements, and channel improvements. All proposed improvements are summarized on Exhibit 7 and on the detailed watershed drainage maps in Appendix B.

Regional Stormwater Detention Facilities – Options investigated for this report included a number of regional stormwater detention facilities to reduce flows from the DEVEX model to meet the capacity of the HJC. In addition, a brief discussion is included about the potential option of modifications to the Corrales Road / Bridge, to mitigate the capacity concerns due to sediment plugging as occurred in 2006.

Road Crossing Structure Improvements – A number of existing structures (including existing dip sections) will need to be improved in the future. Timing of the construction of these facilities should coincide with future development and roadway construction.

Channel Improvements – This MOWMPv2.0 evaluates the capacity and condition of the major arroyos including the Montoyas, the Lomitas Negras, and the Ponce de Leon. Recommendations for future improvements range from the construction of channels (e.g. concrete or soil cement) to naturalistic channels. Naturalistic channels leave the majority of the arroyo natural with grade control structures and bank protection constructed at various locations to mitigate the degradation and lateral migration of the arroyo bottom and banks.



Priority	Stormwater Detention Facilities/ Regional Improvements	Cost Estimate
1	Pond No. 1 (DCC Inlet Sediment Basin)	$ 1,800,000
2	Ind. Area Drainage Improvements	$ -
2	Pond No. 2 (HJC Inlet Water Quality Pond)	$ 2,800,000
3	Dam No. 8	$ 9,425,000
4	Dam No. 23	$ 8,477,000
6	Dam No. 12	$ 8,586,000
7	Dam No. 18	$ 13,225,000
	Subtotal:	$ 44,313,000
Priority	**Conveyance Improvements**	**Cost Estimate**
8	Straightened Section to NM528	$ 2,192,000
9	NM 528 to Saratoga	$ 1,644,000
10	HJC Inlet to Straightened Section	$ 4,958,000
11	NM528 to Sportsplex Dam	$ 2,200,000
12	Saratoga to Idalia	$ 5,754,000
-	Inlet DCC to NM528	$ 1,206,000
-	Idalia to upstream end of arroyo	$ 2,192,000
-	Sportsplex Dam to Broadmoor	$ 831,000
-	Broadmoor to Northern	$ 1,872,000
-	Northern to Unser	$ 3,336,000
-	Unser to King	$ 4,037,000
-	Rainbow to Progress	$ 2,048,000
-	Progress to Sheba	$ 1,142,000
-	Sheba to Serenade	$ 913,000
-	Serenade to Cybele	$ 685,000
-	King to Progress	$ 1,723,000
-	Progress to end of arroyo	$ 3,476,000
	Subtotal:	$ 40,209,000
Priority	**Crossing Structures**	**Cost Estimate**
5	Corrales Rd. & HJC	$ 2,100,000
-	NM528 & Lomitas Negras	$ 760,000
-	Idalia Rd. & Montoyas Arroyo	$ 830,000
-	PDV & Montoyas Arroyo	$ 830,000
-	Northern Blvd. & Montoyas Arroyo	$ 880,000
-	King Blvd. & Montoyas Arroyo	$ 130,000
-	Rainbow Blvd. & Montoyas Arroyo	$ 710,000
	Subtotal:	$ 6,240,000
	TOTAL:	$ 90,762,000

1:60,000

1 inch = 5,000 feet

0 0.5 1 Miles

Montoyas Arroyo Watershed Management Plan Version 2.0

Proposed Facilities

Date: December 2011

Executive Summary

I. INTRODUCTION

A. Background

This Montoyas Watershed Park Management Plan (MOWMPv2.0) has been prepared by Bohannan Huston, Inc. (BHI) for the Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA). The MOWMPv2.0 is intended to serve as a planning tool for future regional drainage improvements and to plan for the effects of anticipated urban development. As more areas become urbanized, if no additional drainage management is provided, stormwater runoff will increase in both rate and volume resulting in a greater likelihood of flooding within the watershed and erosion of the natural drainage ways. The primary purpose of this MOWMPv2.0 is to develop a public domain stormwater runoff hydrology model (HEC-HMS) for the 100-year return event that would result from existing (2010), DEVEX, and ultimate conditions.

B. Vision and Goals

The goals presented in the 2002 MOWMP for the Montoyas 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 Harvey Jones Channel (HJC) and provide discharge guidelines for future development outfalls into unlined arroyos.
6. Preserve the natural character of the arroyos where possible and provide improvements to mitigate the affect of developed flows.

The MOWMPv2.0 provides opportunities to establish natural or naturalistic arroyo corridors that allows for:

1. The safe passage of stormwater flows, while also allowing for:
2. Preservation of flora and fauna,
3. Recreational facilities,
4. Protection of the public from the damaging effects of flooding and associated sediment erosion and deposition,
5. Ground water recharge,
6. Stormwater quality, and
7. Open spaces and view sheds.

II. WATERSHED OVERVIEW

A. Jurisdictions

The SSCAFCA jurisdiction covers primarily the southern portion of Sandoval County, west of the Rio Grande. The major watersheds within SSCAFCA's jurisdictional area are the Calabacillas, Montoyas, Black, Barranca, and Venada Watershed Parks. The Montoyas Watershed Park is completely contained within the jurisdictional limits of SSCAFCA. Major governmental entities within the confines of the Montoyas Watershed Park include: SSCAFCA, the City of Rio Rancho, the Village of Corrales, and Sandoval County.

B. Study Area

The study area of the MOWMPv2.0 encompasses two major arroyos: the Montoyas Arroyo and the Lomitas Negras Arroyo. The Montoyas Arroyo has two named tributaries, the Ponce de Leon and Tortugas Arroyos, while the Lomitas Negras has none. The two watersheds were combined in the late 1980's when the Soil Conservation Service (SCS, currently known as the Natural Resource Conservation Service, NRCS), built the Harvey Jones and Dulcelina Curtis Channels to control flooding in Corrales. The Dulcelina Curtis Channel diverts the Lomitas Negras Arroyo into the Harvey Jones Channel along the Montoyas Arroyo, thus providing one outlet to the Rio Grande. Due to the diversion into the Montoyas arroyos, the two separate watersheds are now combined and the term "watershed", in general, pertains to both.

C. References

Applicable drainage regulations as well as available reports and plans were assembled and reviewed as part of this Watershed Park Management Plan. These reference documents are shown in the text as MARD XX and are listed in the tables opposite of Figure 2 and Figure 3 in Appendix A.

D. History of Flooding

The City of Rio Rancho and the Village of Corrales have experienced flooding as a result of brief, intense thunderstorms that occur during the summer and early fall. Historical information (Flood Insurance Study, July 16, 1996) indicates that damaging floods have occurred in 1904, 1919, 1921, 1929, 1941, 1961, 1976, 1991 and 2006. A major flood occurred in 1976, when runoff in the Montoyas Arroyo created a flash flood in Corrales, even though no rain fell in the Corrales area (all rainfall occurred in the upper reaches of the Montoyas Watershed). Flood depths in the valley reached three feet and the peak discharge was estimated to be 9,540 cfs, with a recurrence interval of approximately 170 years. In 2006 a storm event deposited significant amounts of sediment in the HJC and nearly plugged the box culverts at the Corrales Road crossing. The sediment buildup can be seen in Photo 1: Sediment in Harvey Jones Channel.

Photo 1: Sediment in Harvey Jones Channel after a storm event in 2006, looking upstream to the Corrales Road crossing of the Harvey Jones Channel.

E. Watershed Characteristics

1. Montoyas Arroyo

The Montoyas Arroyo is approximately 17 miles long. Detailed characteristics of the arroyo are described in the Geomorphic Analysis Report (Mussetter, 2000). The arroyo bed material generally consists of sand and fine gravel with maximum sizes up to 1½". In general, the gradation is fairly consistent from downstream to upstream within the arroyo. The bed material also contains silt varying from 3 to 10%. The bed material is highly erosive in some reaches. As can be seen in Photo 2: Montoyas Arroyo – Side Channel Erosion, isolated attempts have been made to reduce the bed degradation through the use of concrete rubble. Table 1 (Page 6) describes – moving from downstream to upstream – the geometry of different segments of the Montoyas Arroyo.

Photo 2: Montoyas Arroyo – Side Channel Erosion near North Hills

Photo 3: Montoyas Arroyo – Upper Reach, upstream of King Boulevard

Photo 4: Montoyas Arroyo – Middle Reach looking East from Broadmoor

Photo 5: Montoyas Arroyo – Lower Reach, looking West to NM 528

Table 1: Montoyas Arroyo Geometry

Location	Length (ft)	Approx. Bottom Width (ft)	Bank Height (ft)	Slope (ft/ft)
HJC Inlet to Straightened Section	3,978	200	10	0.013
Straightened Section to NM 528	3,671	100	15	0.014
NM 528 to Sportsplex Dam	6,806	150	10	0.015
Sportsplex Dam to Broadmoor	4,560	200	8	0.011
Broadmoor to Northern	5,966	150	7	0.013
Northern to Unser	7,091	125	6	0.014
Unser to King	11,606	125	6	0.011
Ponce de Leon Confluence to Rainbow	6,917	130	8	0.011
Rainbow to Progress	9,031	100	5	0.014
Progress to Sheba	6,840	100	5	0.011
Sheba to Serenade	6,109	100	5	0.016
Serenade to Upstream End of Arroyo	5,706	100	5	0.013

Photo 6: Lomitas Negras Arroyo, looking West to NM 528 from the Dulcelina Curtis Channel Inlet

2. Lomitas Negras Arroyo

The Lomitas Negras Arroyo is approximately 2.5 miles long, as measured from the Dulcelina Curtis Channel inlet. Aside from the diversion into the Montoyas Arroyo, there have been no major realignments or channelization of the arroyo. Table 2: Lomitas Negras Arroyo Geometry (below) identifies the length, bottom width, bank height, and slope for different segments of the arroyo. Photo 6 and Photo 7 provide recent images of this area.

Table 2: Lomitas Negras Arroyo Geometry

Location	Length (ft)	Approx. Bottom Width (ft)	Bank Height (ft)	Slope (ft/ft)
Inlet of Dulcelina Curtis Channel to NM 528	1,427	150	10	0.018
NM 528 to Saratoga	2,300	120	10	0.021
Saratoga to Idalia	10,877	100	10	0.016
Idalia to End	7,040	50	10	0.014

Photo 7: Lomitas Negras Arroyo, at the inlet to Dulcelina Curtis Channel

3. Playas

In the lower half of the watershed, two playas that drain about 0.75 square mile (see Appendix B, Watershed Map No. 15 and 18). This area is now part of the Dos Amigos Facility Plan, which has been accepted by SSCAFCA. The storage volume of the existing playas is 70 acre-feet, which is greater than the 100-year runoff volume reaching it, and thus would contain all of the flows. In the 2002 MOWMP, the drainage area to the playa was considered as non-contributing to the watershed flows downstream of the playa. However, the approved Dos Amigos Facility Plan indicates that this area now drains into the Montoyas Arroyo, and therefore this area was modeled as such in this report.

F. Land Use

The majority of the watershed (approximately 75 percent) is undeveloped, covered with typical desert vegetation. In the upper portion of the watershed, junipers and Cholla cactus are evident. Vegetation cover is estimated at 20 percent to 50 percent.

There are some residential, industrial and commercial areas in the watershed, namely along major roadway corridors. The major subdivisions are Vista Hills, Gleneagles, North Hills, Northern Meadows, and Loma Colorado.

As can be seen on the Watershed Drainage Maps in Appendix B, a network of dirt roads was graded in the 1960's over a large majority of the undeveloped portions of the watershed. These graded roads are all part of the Rio Rancho Estates subdivision, that defined not only a road network, but also zoning for the entire subdivision. The network extends all the way to the northern boundaries with the Zia and Santa Ana Reservations and Mariposa. Rio Rancho Estates falls entirely within Sandoval County limits, but only partly within the Rio Rancho City limits. The grading of dirt roads occurred prior to developmental regulations prohibiting such action, and now this entire area has platted residential lots (mainly 1/8 to 3.5 acres) and commercial tracts. Public utilities or paved roads not have been extended to these lots. There are also minimal drainage easements.

The mass grading of the dirt road network has altered the historic drainage patterns in this area of the watershed. Many roads act as miniature conveyance channels for runoff. Instead of curb and gutter, the runoff is contained in the roadways by soil piled along the sides that were created when the roads were graded. Dip sections exist at arroyo crossings. The bladed roads have also increased runoff and therefore erosion in the watershed and, in turn, increased the amount of sediment being deposited into the Montoyas Arroyo. Photo 11 (Page 9) shows an existing dip section. Notice also the existing development close to the arroyo.

G. Existing Drainage Facilities

Below is a list of the existing major drainage facilities in the watershed.

1. Channels

- Harvey Jones Channel (HJC) – Photo 8 shows the entrance to the HJC. The HJC is 40 feet wide and approximately 10 feet high. The HJC crosses underneath Corrales Road with 2 – 23' X 8' concrete boxes. The tops of the boxes are 4.3 feet below the top of the channel and thus cause a flow constriction and hydraulic jump in the 100-year storm event (see Section III.A.5).
- Dulcelina Curtis Channel – Photo 9 shows the entrance to the DCC. The channel is approximately 15 feet wide and 9 feet high. The Dulcelina Curtis Channel enters the Harvey Jones Channel about 1,500 feet downstream from the inlet of the HJC.
- Northern Meadows Channel – "Naturalistic Channel" built with the Northern Meadows Subdivision. The channel is approximately 300 feet wide and 6 feet high. The channel is a combination of grade control structures and rock groin outcrops.

Photo 8: Harvey Jones Channel, looking East from the inlet.

Photo 9: Dulcelina Curtis Channel, looking Southeast from the inlet.

2. Sediment Ponds

Four sedimentation ponds, designed to drop out sediment, but not intended to reduce flow peaks, exist along the Montoyas Arroyo. One pond is located at the Northern Boulevard crossing, one pond at the inlet to the Dulcelina Curtis Channel, and one pond at both the inlet and outlet of the Harvey Jones Channel. The purpose of the Northern Boulevard facility is to reduce the amount of sediment in the lower reaches of the arroyo. The sediment ponds at the Harvey Jones and Dulcelina Curtis Channels help to further reduce the sediment load that reaches the Rio Grande.

3. Stormwater Detention Facilities

Because the existing subdivisions were designed to meet SSCAFCA and City of Rio Rancho drainage policies, a number of small detention ponds have been constructed to attenuate the discharge in or around each subdivision. As part of this MOWMPv2.0 all known ponds over 2 ac-ft in size were incorporated into the hydrology models. In locations were multiple ponds are in series, a generalized pond was created and included in the hydrology models. A total of 23 other known subdivision ponds are, at present, not modeled because of their small size and the fact that they are privately owned and, therefore, not maintained by SSCAFCA.

The Corrales Heights Dam No.1, which collects runoff from the Urban Center Watershed, outfalls to the Montoyas Arroyo. The 54-inch outfall pipe enters the Montoyas Arroyo approximately 3,500 feet upstream of the inlet to the Harvey Jones Channel. The 84.9 ac-ft dam captures runoff from 0.87 square miles and includes the discharge from a 90-inch storm drain originating at the intersection of Sabana Grande and Dolores Hidalgo. The peak discharge from Dam No.1 is 257 cfs for the 100-year event. The area draining to Dam No. 1 was added to the Montoyas Watershed Park HEC-HMS models. It was obtained from Wilson & Company as presented in their report, "Dam No. 4 to Dam No.1 Final Design Report", dated November 1998. Portions of the escarpment between Rio Rancho and Corrales (in the vicinity of Corrales Heights Dam No. 1) drain to the Dam 1 Outfall pipeline. The existing conditions for the escarpment area are included in all three hydrology models developed for this MOWMPv2.0.

The Sportsplex Dam is a regional stormwater detention facility proposed in the 2002 MOWMP and constructed by SSCAFCA in 2008. It includes a water quality facility to drop out sediment and floatables.

Photo 10: Sportsplex Dam

4. Road Crossing Structures

There are twelve major existing crossing structures in the watershed, nine along the Montoyas Arroyo and three along the Lomitas Negras Arroyo. These crossings structures are shown on Exhibit 1.

Photo 11: Dip Section in the Montoyas Arroyo, looking East from Idalia Road.

H. Existing Utilities

The majority of the upper Montoyas Watershed Park is at present undeveloped and therefore there are not likely underground utility crossings. Underground utilities that can be found in the more developed areas include: sanitary sewer, water, gas, electricity (both underground and above-ground), and telephone (both underground and above-ground). Of all the underground utilities, sanitary sewer is the most constrained vertically.

Figure 8 (Appendix A) shows the existing sewer parallel to the Montoyas arroyo. One line begins at Northern Meadows and outlets to the Rio Rancho Water Treatment Plant (WWTP No. 2). The second line carries the treated water from WWTP No. 2 to the Rio Grande. The majority of the line is 12 to 15 inches in diameter. Sanitary sewer manholes are located within the arroyo north of the Rio Rancho Sportsplex, about 1,000 feet downstream of 30th Street and 1,000 feet downstream of Northern Boulevard. As shown in Photo 12 due to arroyo bed degradation and lateral migration a number of the existing manhole rims are now above the arroyo bottom. As shown in the photo, in some cases the rims are as high as 4 feet above the arroyo bottom.

Photo 12: Existing sanitary sewer manhole in the Montoyas Arroyo.

Where the sanitary sewer line is close or in the arroyo, it will have a large impact on the types of drainage improvements recommended, since all recommendations must provide for protection of the existing sewer line. The depth of the sewer line is not known at this time, however. As the arroyo bed continues to degrade and move laterally, the pipeline will eventually be exposed. The structural integrity of the exposed manholes is also at risk.

This sewer line has been broken a number of times as a result of runoff from summer thunderstorms. The most recent breaks occurred in 2006 (2 breaks) and 2010 (2 breaks).

III. HYDROLOGY

A. Criteria and Assumptions

1. Mapping & Topography

The imagery used for this project was generated from aerial photography taken in 2008 and 2010. In addition, topography data from Sandoval County mapping at 4' contours (2003) was used to support the analyses in this MOWMPv2.0. The orthotopo mapping is in digital format and is based on the New Mexico State Plane Coordinate system and North American Datum 1983 (NAD83). The mapping is included in the Watershed Drainage Maps, Appendix B.

2. Hydrologic Methodology

The methodology utilized in this study is based on SSCAFCA's Development Process Manual (DPM), Chapter 22, Drainage, Flood Control and Erosion Control (Revised April 2010), and the HEC-HMS 3.4 computer program. The 100-year design storm has been analyzed for existing, DEVEX, and ultimate conditions. The subbasin delineation for all models is shown on Figure 6 in Appendix A.

3. Parameters

This section discusses the input parameters used in the hydrologic analyses.

a) Sediment Bulking

Sediment bulking factors are applied to the clean water flows in order to account for the increase in runoff volume due to sediment. In accordance with the DPM, a 6 percent sediment bulking factor was used for developed areas of the watershed, and an 18 percent sediment bulking factor was used for undeveloped areas of the watershed for all models. Photo 13: Sediment Deposition, taken at Lomitas Negras Arroyo and NM 528, illustrates the significant amount of sediment that is presently transported through the arroyos.

Photo 13: Sediment Deposition in Lomitas Negras Arroyo, looking East to NM 528.

b) Initial and Constant Loss Parameters

The initial and constant loss parameters were calculated for each basin using the procedure outlined in the DPM. The land treatment types were modified from the DPM, and a list of the land treatments used in this analysis is included in Appendix C. The area of each land treatment type was calculated for each subbasin. This was done using the Excel pivot table option to extract the area of each described parcel from the GIS attribute table of a shape file that was produced from unioning the parcel shape file and a subbasin shape file. The parcel shapefile was created by spatially joining four parcel shape files (obtained from the City of Rio Rancho and Sandoval County): parcels in the northern half of the City of Rio Rancho, parcels in the southern half of the City of Rio Rancho, parcels in the platted portion of Sandoval County, and a shape file of the area of the watershed outside of the platted portion of the County.

However, the boundaries of the two City parcel shape files did not match, and neither of them matched the county parcels. In general the shape files were spatially moved to provide a common boundary between the shape files. However, even after the manual matching there were a few minor areas not accounted for in any shape file. The uncounted area was insignificant when compared to the overall area of the watershed. The county shape file had empty space where there should be roads and arroyos. This empty space was filled in and assigned a DPM description of “arroyo”, “developed roadway corridor” or “undeveloped roadway corridor” based on aerial imagery to calculate the land treatments. The area of each land treatment type for each subbasin was taken from the pivot tables and entered into a spreadsheet for each model. The existing conditions, DEVEX, and ultimate model parameters are included in Appendices C, D, and E respectively. The initial loss (initial abstraction), constant rate (infiltration), and percent impervious were calculated for each subbasin using the procedures outlined in the SSCAFCA DPM. In the DEVEX and ultimate models, the land treatments for known future major developments (Mariposa West and Northern Skies) were modeled as undeveloped, assuming that these two developments will discharge at pre-development rates.

c) Clark Unit Hydrograph Transform Parameters

The Clark Unit Hydrograph parameters were calculated for each basin using the procedure outlined in the DPM. The time of concentration was calculated for each subbasin for which the longest flow path changed as a result of new development or as a result of splitting subbasins to meet the maximum area and length to width ratio criteria. The longest flow paths were drawn in a shape file. The storage coefficient was calculated for all basins based on the updated initial and constant loss parameters and the updated times of concentration using the procedure outlined in the DPM.

d) Routing Parameters

The new basins that were added to the model as a result of the new developments had to be routed. New routes were created where appropriate, and existing routes from the 2002 MOWMP models were revised where appropriate. These routes were drawn in a GIS shape file. Depending on the shape of the route, average characteristics were determined from aerial photography and drainage reports. For all routes, the length, average slope and average Manning’s n were determined from aerial photography and 4-ft contours produced from a 2003 orthophoto of the area. The appropriate Manning’s n was selected from Table E-7 in the DPM. For circular routes (such as storm drains), the diameter was taken from the applicable drainage reports. For trapezoidal channels, the side slope was determined from the 2003 contours.

e) Ponds

A number of new ponds were added to the model. All known subdivision detention ponds over 2 ac-ft in size were included in the model. Ponds in close proximity, acting in series were added as one idealized pond. Ponds less than 2 ac-ft in size were not modeled. For new subdivisions with only one pond, the storage-discharge curve was inserted directly into the model. For some of these ponds, the peak outflows differed from the preliminary results from the models. Therefore the storage-discharge curve was modified until the peak outflow was within 10% of the approved hydrology. For new subdivisions that only had idealized ponds, a storage-discharge curve was created to make the idealized pond have a peak outflow within 10% of the peak outflow of the farthest downstream of the combined ponds. A list of the ponds included in this analysis can be seen opposite Figure 7 in Appendix A.

f) Rainfall

Upstream of the Sportsplex Dam, a new depth-area reduction factor was applied to the 100-yr, 24-hr storm. This depth-area reduction factor was found on Figure F-1 in the DPM. The total 100-yr, 24-hr rainfall depth upstream of the Sportsplex Dam is 2.755 inches. The existing conditions model now contains two100-yr, 24-hr rainfall events. In the ultimate conditions model, there is a separate depth-area reduction factor for each proposed dam.

4. Development Scenarios

In the 2002 MOWMP, three different development scenarios were analyzed. Scenario 1 assumed developed conditions based on current existing development patterns. Scenario 2 assumed developed conditions based on existing platting conditions. Scenario 3 assumed developed conditions based on high density with free discharge. The 2002 MOWMP recommended regional drainage improvements based on Scenario 2 and this scenario was approved by the SSCAFCA board on April 17, 2001. Since Scenario 2 still seems the most probable, Scenario 2 was used for future developed conditions in MOWMPv2.0.

The DEVEX and ultimate conditions analysis were therefore based on current development, plus full development for all currently undeveloped land (as defined in the current City and County records) for the existing Rio Rancho Estates platted areas, with three exceptions: Northern Skies, Mariposa West and the Del Norte Gun Club. These areas were all modeled to discharge at pre-development rates. Both Northern Skies and Mariposa West are anticipated to include drainage infrastructure, which will reduce the discharge to match pre-development rates. While the Del Norte Gun Club is platted as a commercial development, the land treatment percentages for commercial development are not representative of the development that has occurred at the site. Therefore, this area was assigned the same land treatment percentages as the unplatted County areas. There are numerous large parcels (>5 acres) in the platted portion of the County that do not include a current zoning code. In order to complete the model, an assumption was made regarding the future land use of these areas. Eighty percent of these lots were assumed to be commercial/Industrial, ten percent were assumed to be parks/recreation, and ten percent were assumed to be schools/churches. The unplatted areas found in the County are assumed to discharge at their pre-development flow rates. An overview of the land use density assumptions for both the DEVEX and ultimate conditions models is contained in Appendix G - Calculations.

Throughout the development of the MOWMPV2.0, it was assumed that a portion of the Montoyas Arroyo Watershed will be diverted into the future PdV Dam, within the Barranca Watershed. This diversion is in agreement with the City Center Facility Plan, which was accepted by SSCAFCA in April of 2010. This diversion area is shown on Figure 6 in Appendix A and is slightly less than one square mile in size. This diversion assumption has been incorporated by SSCAFCA as part of the Sierra Vista East Facility Plan. The Sierra Vista East Facility Plan proposes taking the entire outfall from the PdV Dam (which includes approximately 4 square miles that were historically part of the Barranca Watershed) and conveying it in a storm drain that would outfall into the Lomitas Negras Arroyo. Keeping the one square mile area from the City Center Facility Plan, and diverting the additional 4 square miles from the Barranca Watershed upstream of PdV Dam, into the Montoyas Watershed Park would increase the flow and volume of runoff to the Lomitas Negras Arroyo which ultimately outfalls to the Montoyas Arroyo Watershed. This diversion will be modeled in an update to the MOWMPv2.0.

While the ultimate development scenario provides regional protection for full development, as described by existing platting, it does not provide protection for areas that are unplatted or replatted. Any future replatting to increase densities and any development on unplatted land would require further analysis and local remediation. Development in this manner must comply with SSCAFCA's Drainage Policy.

5. Corrales Bridge/Harvey Jones Channel Constraint

The existing Corrales Road crossing (two 23'x8' concrete box culverts) was constructed over the HJC with the low chord 4.3 feet lower than the top of the channel walls as shown in Photo 14: Corrales Road. Because the bridge was set into the channel, a hydraulic constriction occurs for the 100-year flow. The result of the constriction is that a hydraulic jump can occur and the flow would overtop the channel walls. Raising the bridge a total of four feet would remove this constriction, however, doing so would affect the existing roadway on both sides of the channel for about 800 feet (the approximate distance to rejoin existing road grade). The raising of the bridge may impact the surrounding properties, driveway access, and access to the existing roads on both sides of the HJC. The hydraulic capacity limitation is compounded by the fact that the HJC includes a depressed channel invert in the vicinity of the bridge. This was intentionally designed to drop out sediment from the runoff before entering the Rio Grande. While a good goal, this design has been so effective that the channel has actually been susceptible to plugging due to sediment build up. This occurred most recently in 2006 when the entire channel was completely filled with sediment. As a result the hydraulic capacity of the channel was essentially reduced to 0 cfs. Therefore runoff reaching this area was forced to flow over the top of the Corrales Road Bridge causing flooding over the top of the boxes. Due to this on-going problem, potential options for future improvements in the watershed must include modifications to the HJC and/or Corrales Bridge – even if regional detention dams can be built to reduce the anticipated ultimate conditions flows below the design capacity of 5,000 cfs at this location.

Photo 14: Corrales Road crossing of the Harvey Jones Channel, looking East.

B. Hydrology Model Results

1. Watershed Outlet and Capacity

The Montoyas Arroyo Watershed discharges to the Rio Grande through the Harvey Jones Channel. The capacity of the HJC has been disputed over the years between the US Army Corps of Engineers (USACE) and the Soil Conservation Service (SCS, currently known as the Natural Resource Conservation Service, NRCS). The channel was designed and constructed by the SCS in 1988. Their analysis indicated that the capacity of the channel is 8,000 cfs.

The USACE conducted an independent analysis in 1992. The results of their study showed the capacity to be 5,000 cfs. The Corrales Bridge, near the confluence with the Rio Grande, was identified by the USACE as a constriction point in the channel capacity. The USACE analysis indicated that the HJC was undersized and Corrales Road would be overtopped during a large magnitude storm event. During the course of the controversy, SSCAFCA requested that the two agencies get together to review their results and reach a conclusion. The agencies identified reasons the results were different (i.e. different assumptions and methodologies), but were unable to reach consensus about the capacity of the HJC.

As part of the scope of work for the 2002 MOWMP, SSCAFCA authorized BHI to conduct an independent analysis of the channel capacity. The findings were presented in a report entitled, "Harvey Jones Channel Hydraulic Capacity Analysis, dated July 27, 1999. That report, in general, concurred with the USACE in finding that the channel capacity is 5,000 cfs, not 8,000 cfs. By acceptance of that report in 1999, SSCAFCA recognized the maximum capacity of the Harvey Jones Channel is 5,000 cfs, due to the constrictions of the box culverts at Corrales Road.

2. Comparison of Model Results (TR-20, HEC-1, AHYMO & HEC-HMS)

In accordance with the SSCAFCA DPM, the HEC-HMS (Version 3.4) computer program was used for hydrologic modeling in this watershed management plan. Table 3 (below) summarizes the existing conditions flow results at the outlet of the watershed for other major studies conducted previously in the watershed:

Table 3: 100-Year Existing Conditions Flow Comparison

Hydrologic Model	SCS (1986)* TR-20 cfs	USACE(1992) HEC-1 cfs	FEMA (1996) HEC-1 cfs	EAI (1999) AHYMO cfs	BHI (2000) AHYMO cfs	BHI (2010) HEC-HMS cfs
Inlet to Harvey Jones Channel	8,000	13,800	5,542	--	5,860	8,822
Inlet to Dulcelina Curtis Channel	1,577	2,000	776	--	1,200	3,156
Total Flow into the Rio Grande	8,000	15,000	6,074	6,790**	6,850	9,118
Capacity	8,000	5,000			5,000	

* Flows represent developed conditions

** Flow does not include Lomitas Negras

SCS (1986) = Design Engineers Report, Corrales Watershed Floodwater Diversion No. 1, Final Hydraulic Design, July 1986, USDA SCS
USACE (1992) = In-Progress Review Rio Rancho Reconnaissance Study, December 1992
FEMA (1996) = Flood Insurance Study for Sandoval County, New Mexico and Incorporated Areas, July 16, 1996, Federal Emergency Management Agency
EAI (1999) = Northern Meadows Phase 2 Drainage Master Plan, Unit 22, July 1999, Easterling & Associates, Inc
BHI (2000) = Montoyas Arroyo Watershed Management Plan – Existing Conditions Report.

These previous studies used different hydrologic methodologies than were used for this study and different development assumptions as well. As shown in Table 3, two previous studies used HEC-1, one used TR-20, and two used AHYMO. In addition, the USACE report used an expected probability adjustment in the calculation of the 100-year flow. This adjustment factor essentially acts as a factor of safety that increases flow rates.

As seen in Table 3, the existing conditions flow rates in the 2010 BHI HEC-HMS model are about 40 to 70 percent higher than the existing conditions flow rates in the 2000 BHI AHYMO model. This is due to several factors. In the last 10 years, there are over 40 new subdivisions that have been developed in the watershed. Also, the Montoyas Sportsplex Dam was built in 2007. The SSCAFCA DPM requires rainfall reduction factors for large watershed areas controlled by dams. The rainfall reduction factor applied upstream of the Montoyas Sportsplex Dam is smaller than the rainfall reduction factor applied to the rest of the watershed, so the percentage of point precipitation applied to the majority of the watershed is actually higher in the 2010 BHI HEC-HMS model than in the 2000 BHI AHYMO model. The new maximum basin size of 320 acres and the additional routes in the model also have an impact on the flow rates in the watershed. Finally, HEC-HMS uses a different algorithm to solve the Muskingum-Cunge routing procedure than AHYMO does.

3. Existing Conditions Flows

The existing conditions 2010 hydrology, as defined in this MOWMPv2.0, includes the effects of over 40 new subdivisions that have either been constructed or have had a drainage report or facility plan approved since the 2002 MOWMP. It is important to note that the existing conditions 2010 hydrology model assumes that all of the approved subdivisions or facility plans are already constructed. In reality, some of these have not yet been implemented. However, since the plans are approved, these developments are permitted for construction as per their respective plans. Therefore it is imperative that this MOWMPv2.0 includes these subdivisions as constructed to account for the drainage impacts on the watershed.

Table 4 (Page 15) shows the 100-year flow rates from the current existing conditions 2010 model at key analysis points. Most key analysis points are defined as major roadway crossings of the arroyos. The input parameters and summary output of the HEC-HMS runs are presented in Appendix C. Table 4 (Page 15) also includes the calculated capacity for existing crossing structures. The comparison of existing flow rate to the calculated structure capacity provides an analysis of the adequacy of the crossing structure to safely pass the 100-year flow. Note that the capacity analysis was based on field measurements of available headwater.

4. DEVEX Conditions Flows

Urban development, with its marked increase in impervious surfaces (roads, rooftops, drive pads, parking lots, etc.) will increase peak discharge and runoff volume throughout the Montoyas Arroyo Watershed. Urbanization also has the potential to increase flow velocities, scour, and the rate of degradation and aggradation.

The DEVEX conditions model assumes a fully developed watershed with existing infrastructure (as well as proposed infrastructure that was included in approved drainage reports or facility plans). The input parameters and complete summary output of the HEC-HMS DEVEX model are presented in Appendix D. The DEVEX conditions 100-year flow rates at key analysis points are summarized in Table 4 (Page 15). Note that the flow rates shown for the DEVEX conditions do not include any of the drainage improvements proposed in this watershed management plan.

5. Ultimate Conditions Flows

The ultimate conditions hydrology model assumes a fully developed watershed with all existing drainage infrastructure, proposed drainage infrastructure included in approved drainage reports or facility plans, and the all recommended regional stormwater detention facilities from this MOWMPv2.0. Appendix E provides the model input and output. The recommended improvements to detain increased flows and to alleviate flooding risks at the Corrales Bridge include five new regional stormwater detention facilities. These facilities can be seen on Exhibit 7. The location of the dams was chosen as described in Section V.C of this report. An idealized stage-storage-discharge curve was used in the model to represent each dam. The ultimate conditions 100-year flow rates at key analysis points are summarized in Table 4 (Page 15).

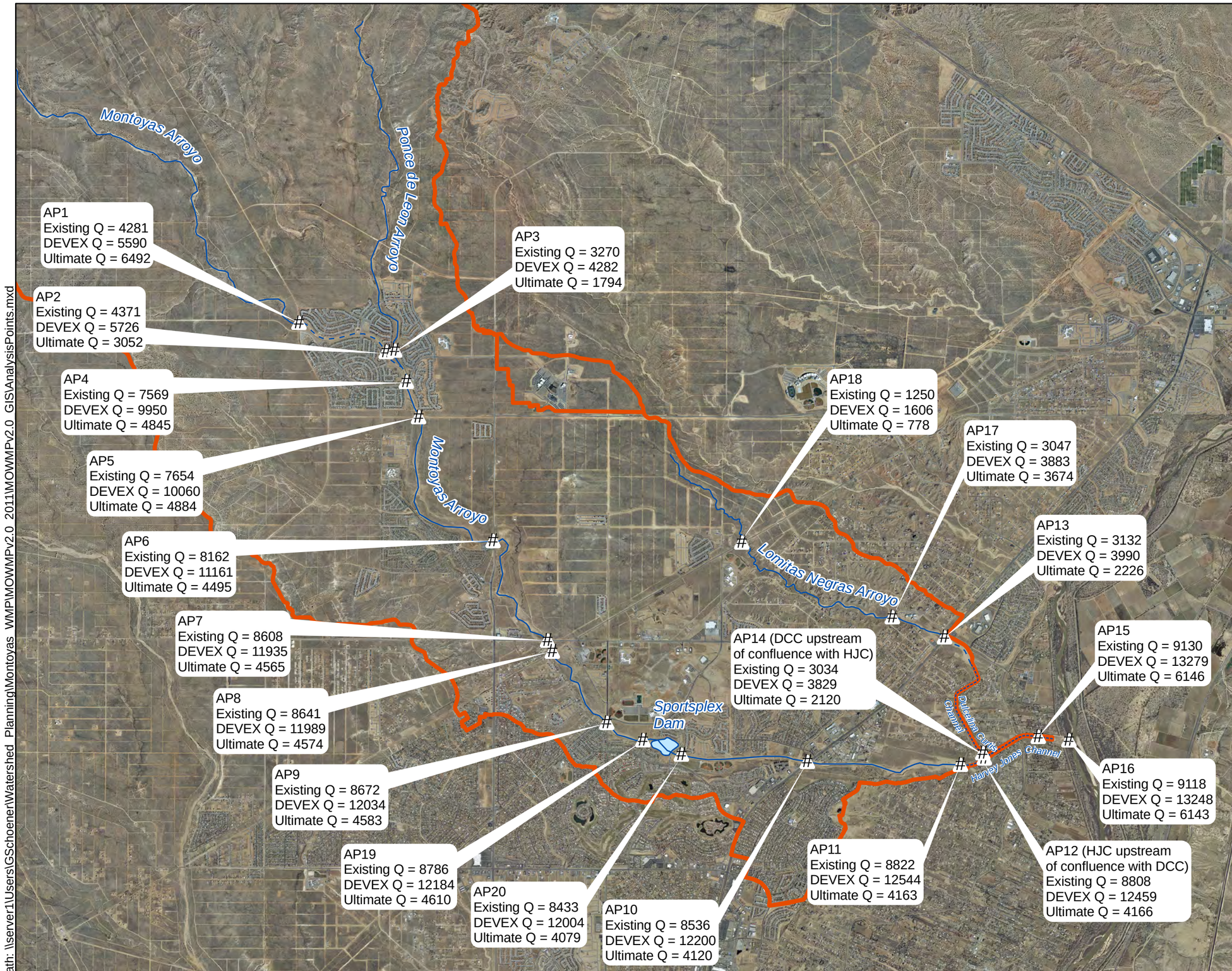


Exhibit 1: Hydrologic Model Results - Existing 2010, DEVEX, and Ultimate Conditions Peak Flow Rates for Selected Analysis Points.

Legend

- Watershed Boundary
- Natural Arroyo
- Hard Channel
- Soft Channel
- # Analysis Point

1:60,000

1 inch = 5,000 feet

0 0.5 1 Miles

Montoyas Arroyo Watershed Management Plan Version 2.0

Analysis Points

Date: December 2011

Exhibit 1

Path: \\server1\Users\GSchoener\Watershed Planning\Montoyas WMP\MOWMPv2.0 2011\MOWMPv2.0 GIS\AnalysisPoints.mxd

Table 4: Existing 2010, DEVEX and Ultimate Conditions Flow and Capacity Summary

Analysis Point	Location	Existing Structure Description	HEC-HMS Element	Drainage Area (mi^2)	Existing 2-year Peak Flow (cfs)	Existing 10-year Peak Flow (cfs)	Existing 50-year Peak Flow (cfs)	Existing 100-year Peak Flow (cfs)	DEVEX 100-year Peak Flow (cfs)	Ultimate 100-year Peak Flow (cfs)	Structure Capacity (cfs)
AP01	Rainbow Blvd.	At-Grade Crossing	M14.100UP	21.01	98	959	2840	4281	5590	6492	
AP02	Upstream of confluence w/ Ponce de Leon Arroyo		POND3UP	21.86	101	1010	2910	4371	5726	3052	
AP03	Upstream of confluence w/ Montoyas Arroyo		OP-6TOT	14.94	112	773	2344	3270	4282	1794	
AP04	King Blvd.	5 - 10'x8' CBC's	P14.100ATOT	36.80	212	1772	5217	7569	9950	4845	4800
AP05	Paseo del Volcan	At-Grade Crossing	P14.102TOT	37.66	230	1835	5284	7654	10060	4884	
AP06	Unser Blvd.	6 - 10'x8' CBC's	M20.100UP	44.40	402	2052	5879	8162	11161	4495	5770
AP07	Northern Blvd.	6 - 8'x8' CBC's	EdinburghTOT	47.88	518	2160	6201	8608	11935	4565	4615
AP08	Idalia Rd.	At-Grade Crossing	M20.104UP	48.44	526	2165	6221	8641	11989	4574	
AP09	Broadmoor Blvd.	7 - 10'x8' CBC's	M20.108UP	49.40	574	2172	6236	8672	12034	4583	6730
AP10	NM 528 & Montoyas Arroyo	7 - 10'x10' CBC's	M20.116UP	53.22	721	2218	5109	8536	12200	4120	8700
AP11	Inlet Harvey Jones Channel		M20.118UP	54.65	928	2324	5270	8822	12544	4163	
AP12	HJC upstream of confluence with DCC		M20.120TOT	55.03	932	2326	5260	8808	12459	4166	
AP13	NM 528 & Lomitas Negras Arroyo		L2.107UP	5.13	501	1327	2503	3132	3990	2226	
AP14	DCC upstream of confluence with HJC		L2TOT	6.36	511	1311	2441	3034	3829	2120	
AP15	Corrales Bridge	2 - 23'x8' CBC's	TOTFLOW	61.39	1395	2970	5373	9130	13279	6146	5000
AP16	Total flow at the Rio Grande		RTTOTFLOW	61.39	1391	2955	5366	9118	13248	6143	
AP17	Saratoga Rd.		L2.106TOT	4.78	494	1297	2433	3047	3883	3674	
AP18	Idalia Rd.	3 - 60" CMP's	RTL2.102UP	1.39	300	634	1051	1250	1606	778	915
AP19	Upstream of Sportsplex Dam		M20.112TOT	50.56	665	2200	6315	8786	12184	4610	
AP20	Downstream of Sportsplex Dam		RTM20.112UP	50.56	512	2151	5021	8433	12004	4079	

Notes:
1. All peak flow rates in this table are from HEC-HMS output files. For the complete output files for Existing, DEVEX and Ultimate conditions, please refer to the technical appendices at the end of this report.
2. Since peak flow rates occur at different times, the peak flow upstream of a given tributary plus the peak flow from the tributary itself do not necessarily total the peak flow downstream of the confluence.
3. HEC-HMS elements are lables for junctions and routes in HEC-HMS models.

IV. WATERSHED MANAGEMENT STRATEGIES

A. Conveyance Strategies

Arroyos in a semi-arid environment remain dry for most of the year and in general transport runoff in response to intense summer thunderstorms. In fact, it has been observed that runoff from less intense storms often does not make it to the outlet of a watershed because the flow permeates into the arroyo bed. This is due to the high permeability of the arroyo bed that generally remains devoid of vegetation and the arroyo bed sediments remain in a loose uncompacted state.

1. Natural Arroyos

Preserving arroyos in their natural state in an urban environment is often difficult to accomplish. Arroyos move over time in response to sediment transport, which results in erosion and deposition and lateral migration of the arroyo banks. The rate of lateral migration can change over time due to such factors as climatic changes, urban development, ranching, etc. Urban development produces runoff that is more frequent, more "sediment hungry" due to lower sediment concentrations, and has larger volumes due to increased impervious surfaces. Urbanization often results in an increase in arroyo lateral migration. Often, development pressure is such that buildings are constructed too close to the arroyo banks, which eventually requires bank stabilization or channelization to prevent the at-risk structures from being undermined and destroyed from arroyo bank failure.

If an arroyo is to be left natural in an urban setting then there must be sufficient land dedicated on both sides of the arroyo to allow the arroyo to move uninhibited over time. The best way to allow for this is by creating a "lateral erosion envelope".

2. Lateral Erosion Envelope

A lateral erosion envelope is a method that has been developed by analyzing the behavior of arroyos over time. Natural arroyos erode and migrate laterally over time. Bends or meanders in the arroyo, in addition to its slope, cause the runoff to gain or lose energy, thus allowing the channel bed to degrade or aggrade. Rather than completely protecting an arroyo from this natural process, restricting development from occurring next to an arroyo allows the arroyo to erode and migrate. Determining the maximum lateral distance that an arroyo is likely to erode uses a method called the lateral erosion envelope. This method defines limits which can then be used to maintain a minimum setback for development along side an arroyo. This method is presented in the SSCAFCA Sediment and Erosion Guide.

The establishment of a lateral erosion envelope for a natural arroyo is not a physical improvement. Determining this envelope, however, may be an acceptable "treatment", provided sufficient land can be set aside adjacent to the arroyo to allow these natural processes to occur. The anticipated changes in bank alignment occurring over time, based on the erosion analysis, are then used to limit the proximity of development next to the arroyo. When erosion effects reach the erosion envelope limit, structural measures are then required to protect adjacent property. Protection could be in the form of grade control, limited bank stabilization, or channel lining.

Since the lateral erosion method was developed by observing the behavior of arroyos in non-urban settings, applying the method in an urban setting is problematic. In urban areas, flow rates or volumes are substantially increased, and thus the erosion process is also likely to accelerate dramatically. Therefore applying the erosion envelope method in urban areas will require more monitoring and time could require structural stabilization of reaches of the arroyo.

The lateral erosion envelope is estimated based on the maximum deviation (Δmax) from a straight line down the center of the arroyo and channel width (Wd), which are both related to the dominant discharge (Qd), which represents a combination of storm frequency of occurrence and quantity of flow rate and slope (S) of the arroyo.

The lateral erosion envelopes for the Montoyas and Lomitas Negras Arroyos are given in Table 5, with an average width shown on the Watershed Drainage Maps in Appendix B. The calculated lateral erosion envelope is based on development Scenario 2 flows from the 2002 MOWMP without regional improvements, which produces larger values and thus provides higher buffer from lateral migration for the public. If policy decisions are to be based on these LEE lines, they should be updated to reflect the current DEVEX model results from this MOWMPv2.0.

Table 5: Lateral Erosion Envelope (Without Regional Improvements)

Location	HEC-HMS Element	2002 MOWMP Q_{100} (cfs)	Q_d (cfs)	S (ft/ft)	Δ_{max} (feet)	W_d (feet)	Lateral Erosion Envelope Width (feet)
Montoyas Arroyo							
Unser to King	M16.102up	9,538	1907.6	0.012	336.5	95.7	769
	M20.100TOT	9,552	1910.4	0.012	337.8	96	772
Northern to Unser	M20.102TOT	9,704	1940.8	0.013	336.4	95.4	768
	M20.104up	9,781	1956.2	0.012	341.9	96.9	781
Broadmoor to Northern	M20.108up	9,852	1970.4	0.013	338	95.7	772
Sportsplex Dam to Broadmoor	M20.110up	10,207	2041.4	0.011	355	100.1	810
	M20.112up	9,913	1982.6	0.015	335.3	95.9	766
NM 528 to Sportsplex Dam	M20.114up	9,970	1994	0.014	336.3	96.1	769
	M20.116up	9,973	1994.6	0.014	336.3	96.1	769
HJC Inlet to NM528	M20.118TOT	10,154	2030.8	0.013	343.1	96.8	783
Lomitas Negras Arroyo							
Idalia to End	L2.102up	869	173.8	0.012	97	38.5	236
Saratoga to Idalia	L2.104TOT	1,877	875.4	0.014	141.9	50.7	334
	L2.106TOT	2,422	484.4	0.023	157.4	54.6	369
NM 528 to Saratoga	L2.107up	2,518	503.6	0.017	160.8	55.4	377

Note: Formulas from SSCAFCA Sediment Erosion Design Guide

Assumptions:

1) Approximate method based on optimal bend shape

2) Dominant Discharge = $Q_d = 0.2*Q_{100}$

3) Maximum lateral erosion distance (Δ_{max}) varies due to Q_d and S

4) Total Erosion Width = $2*(\Delta_{max}+0.5*W_d)$

5) Presence of lateral controls not considered

6) Critical bank height not considered

7) 100-year flood zone not considered

8) Flows obtained from developed conditions AHYMO model: Alt2Rev.hym

3. Naturalistic Arroyos

A primary goal of this MOWMPv2.0 is to leave the arroyos as natural as possible. Although SSCAFCA owns a large portion of arroyo bottom property, most of the property located in the lateral erosion envelopes is currently in private ownership. Since it is difficult to leave a large enough buffer between development and arroyo banks, structural improvements will be required. The improvements, however, will be localized and are not intended to channelize the arroyo. Therefore much of the arroyo bed and banks are left natural.

Structural measures to stabilize arroyos in a naturalistic manner may include both hard lined (i.e. concrete or soil cement) and soft lined (i.e. riprap rock or vegetation) techniques. Types of structures that can be utilized to help minimize lateral migration and degradation include:

- Grade control structures / Equilibrium slopes
- Bank stabilization
- Detention dams
- Runoff volume reduction

Where possible, the overall goal of this management plan is to leave the arroyos in as naturalistic state as possible. However it must be recognized that in an urban environment it is not realistic to expect that arroyos can be left in a completely natural state. The major arroyos and tributaries in the watershed (Montoyas, Lomitas Negras, and Ponce de Leon) are already being affected by urbanization. Examples of factors that are affecting these arroyos include utilities, roadways (both earthen and paved), housing, and off-road vehicles driving in the arroyo bed.

For an in-depth analysis of naturalistic treatment strateges for arroyo corridors, please refer to SSCAFCA's Comprehensive Management Strategy for Arroyo Corridors (MARD 63).

4. Grade Control Structures

To prevent degradation of the downstream arroyo channel and to reduce sediment transport in runoff generated by developed conditions, grade-control structures should be installed throughout the arroyo system. Grade control structures are a common tool used to help control channel incision and to help reduce lateral migration by creating a milder bed slope and dropping the arroyo bed in a controlled fashion at each grade control structure. Such a structure provides a vertical control point for the degrading arroyo bottom. Grade control structures can be constructed from many different types of materials, such as concrete, grouted rock, gabions, stabilized boulders, riprap, and soil cement. The selection of the material used depends on land use, cost, aesthetics, and maintenance among other factors, but the primary function is to provide sufficient hydraulic performance. To achieve this result, grade control structures must be designed to prevent seepage uplift, scour on the downstream side, and flanking around the outside edges. Photo 15 through Photo 18 show examples of different grade control structures.

Photo 15: Rock pinned grade control structure, High Desert Subdivision

Photo 16: Concrete grade control structure, Loma Colorado Subdivision

Photo 17: Grouted rock grade control structure

Photo 18: Gabion grade control structure

5. Equilibrium Slope

To estimate the amount of degradation an arroyo will experience, the existing channel slope is compared to the equilibrium slope. The equilibrium slope analysis is based on the concept that an arroyo system has a stable (or equilibrium) slope where the bed will not significantly aggrade or degrade. Over time the arroyo will degrade until it meets its equilibrium slope. The analysis presented in this report was originally included in the 2002 MOWMP and utilizes the Approximate Method for Equilibrium Slope Calculation as presented in the AMAFCA Sediment and Erosion Design Guide (1994).

The equilibrium slopes were compared against typical existing slopes in these areas and the spacing of grade control structures was calculated. Table 6 shows an example of how grade control structure spacing can vary with flow and slope, when using the equilibrium slope procedure. Note that the spacing is intended only to give a sense of what will be required in the arroyo as the site develops. The channel improvement recommendations listed in Section VI.A.2 estimate the number of grade control structures for each arroyo segment, but a more detailed analysis should be performed at the design phase.

Table 6: Equilibrium Slope Example

100-Year Peak Flow (cfs)	Dominant Discharge (cfs)	Equivalent Slope (ft/ft)	Existing Slope		
			0.01	0.02	0.03
			Grade Control Structure Spacing (ft)		
100	20	0.02456	NR – 2872	NR – 1054	230 – 918
500	100	0.01982	NR – 1501	NR – 375	214 – 491
1,000	200	0.01808	NR – 1276	359 – 3601	209 – 419
2,500	500	0.01600	NR – 1083	342 – 1251	203 – 357
5,000	1000	0.01459	982 – 5361	331 – 925	199 – 325

NOTE: Spacing based on a drop height per structure of 5 feet. Any other drop height would affect spacing.
NR = Not required

6. Channel and Bank Protection

Bank protection is required at channel bends where there are increased risks to nearby structures. In a naturalistic arroyo, bank protection is utilized at isolated locations and is not contiguous along the arroyo reach. Table 7Table 7 lists several available treatment options. Often, the final selection of a material type is based on costs; arroyos bed alluvium characteristics, and aesthetics. Example of bank protection can be seen in Photo 19 through Photo 21.

Photo 19: Bank protection through Northern Meadows Subdivision, looking west 500 ft downstream of King Blvd.

Table 7: Typical Bank Protection/Channel Linings

Lining Type	Pros	Cons
Riprap Lined	-Provides more stable bank protection -Can withstand high velocities associated with steeper slopes -More natural-looking than smooth linings, can support limited vegetation -Side slopes can be steeper	-Labor-intensive and expensive to construct -Has velocity limitations -Requires maintenance -Subject to vandalism -Collects debris/trash
Soil Cement Lined	-Provides very stable bank protection -Can withstand high velocities associated with steeper slopes -Structurally stable for steeper side slopes -Can be tinted to blend with the surrounding environment -Low maintenance -Lower right-of-way requirements	-Not as aesthetically pleasing -Cannot support vegetation -Requires a larger mass of soil cement
Concrete Lined	-Provides very stable bank protection -Can withstand higher velocities than other types of linings -Structurally stable for steeper side slopes -Can be tinted to blend with the surrounding environment -Low maintenance -Lower right-of-way requirements	-Not aesthetically pleasing -Cannot support vegetation -Requires safety measures due to higher velocities
Combination Lining	-Provides more stable bank protection -Can withstand high velocities associated with steeper slopes -More aesthetically-pleasing than smooth linings, can support vegetation on benches -Side slopes can be steeper -Lower right-of-way requirements	-More labor-intensive and expensive to construct -Has velocity limitations -Requires maintenance

Photo 20: Soil cement channel, San Antonio Arroyo looking west.

Photo 21: Shotcrete channel, Cabezon subdivision in Rio Rancho.

7. Pipe Systems

One viable alternative to open conveyances are pipe systems that convey the outflow from regional stormwater detention facilities into existing, hard lined channels or directly into the Rio Grande. Advantages of such storm drain systems include the drastic reduction of peak flows in arroyos. One disadvantage are potentially high costs for design and construction.

8. Storm Drain Outfalls

Storm drain outfalls deliver runoff into a receiving arroyo. If the storm drain outlets to an arroyo, the design of the storm drain must incorporate consideration of effects on the arroyo. Typically, the flow coming out of a storm drain has higher velocities than those in the arroyo or channel. The higher velocities can result in an increase in degradation of the arroyo bed and destabilization of the arroyo banks causing increased lateral migration. In order to mitigate these affects, storm drain outlets into natural or naturalistic arroyos must meet the following criteria:

- Velocities in the storm drain must be decreased to match the velocity in the receiving arroyo.
- Where velocity reduction is required, an energy dissipater must be constructed at the storm drain outlet.
    - An impact wall type energy dissipater should be constructed where flows are less than 400 cfs.
    - For flows greater than 400 cfs the engineer shall supply to SSCAFCA a proposed energy dissipater along with supporting calculations. Construction of these facilities shall occur prior to construction of the homes.

B. Regional Stormwater Detention Facilities

Regional stormwater detention facilities can be used in a naturalistic arroyo system to reduce the peak flows and resulting flow velocities. Based on criteria from the State Engineer, dams are required to drain within 96 hours, but most flood control dams drain in less time.

Regional facilities will have impacts on the surrounding areas and on the arroyo itself. The objective, however, is to minimize those impacts as much as possible. Because of the large mass of detention dams, the impacts are often visual; therefore, efforts to enhance the aesthetics of dams are considered in the design and placement of a dam. When multi-use purposes are going to be incorporated in a dam's design, the aesthetics will follow its intended use, such as a landscaped ball field or walking trail. Dam design and construction will be performed so as to limit the impacts on the surrounding areas and with the goal of making the facility less intrusive. Issues to be considered in the construction of a dam include:

- Visual height of dam embankment on surrounding neighbors,
- Overall cost of dam construction and right-of-way acquisition,
- Variation in the crest of the dam embankment to make it appear more natural,
- Variation of side slopes and centerline alignment of the embankment to make it appear more "natural",
- Incorporation a variety of native plantings to reestablish existing vegetation, and
- Scour-evaluation and mitigate downstream arroyo bed degradation due to cleaner water (more sediment hungry) discharging from the dam.
- Downstream embankment slope steepness

Regional stormwater detention facilities are efficient sediment traps. Typically, flows released downstream of such a facility have a lower concentration of sediment than the water entering the facility. This "sediment-hungry" water can increase erosion in the downstream arroyo. Arroyo bed and bank protection and energy dissipation devices will be required in the downstream arroyo or channel to mitigate these affects. The extent and distance of arroyo protection can vary based on such factors as bed slope, soil conditions, flow rates, arroyo size, bed grain size, and flow frequency. The amount and length of treatment needs to be designed in conjunction with the detention dams and submitted to SSCAFCA for approval.

Photo 22: Montoyas Sportsplex Dam, shows an example of using "naturalistic" grading techniques to lessen the impact of the size of the dam on the surrounding developments.

Photo 22: Montoyas Sportsplex Dam, looking north along the berm.

C. Stormwater Quality

While water quality management was not historically 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, the Authority's dedication to watershed stewardship, and the increasing regulatory attention to water quality management have expanded the role of the Authority to include water quality management responsibilities. 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, which include the flora and fauna of these riparian and arroyo corridors.

It is widely recognized that as land use changes because of urbanization, stormwater runoff quality is adversely impacted. Nearly all of the associated problems result from one underlying cause: loss of the water-retaining and evapotranspirating functions of the soil and vegetation in the urban landscape. Increases in impervious cover result in increases in runoff volume and frequency, which transports ever greater quantities of pollution 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 virtually all 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, the Authority is authorized to discharge municipal stormwater runoff to waters of the United States by an NPDES permit issued by the Environmental Protection Agency. Under the conditions of the NPDES permit, the Authority must conduct certain stormwater quality management activities that seek to reduce pollutant levels in stormwater runoff to the maximum extent practicable. The particular pollutants of concern are established by the New Mexico Environment Department and are indicated as impairments when the state-established water quality standard is exceeded. The current water quality impairments in the middle Rio Grande include bacterial contamination, low dissolved oxygen, elevated temperature and PCB contamination.

Entities responsible for stormwater quality generally fall into three categories of responsibility:

I. Regional-level control measures and programs
II. Discharges to regional facilities from commercial, industrial, residential land development
III. The actions and practices of individual citizens

Measures to control stormwater pollution generally fall into three categories of Strategies:

A. Education and Outreach
B. Engineering and Systems
C. Enforcement and Regulation

Application in the Montoyas Park Watershed:

Entity I / Strategy B
Many permanent regional best management practices (BMPs) have been constructed or are planned for construction in the watershed to help reduce potential sediment and pollutants in the stormwater runoff. The following is a brief discussion of some BMPs that have been or are planned to be incorporated into the Montoyas Arroyo Watershed. A more detailed discussion on BMPs can be found in the "Urban Storm Drainage Criteria Manual, Volume 3- Best Management Practices" by the Urban Drainage and Flood Control District, Denver, Colorado.

- In-Channel BMP's
  - Wetlands: Constructed in-channel wetlands consist of dense natural vegetation, such as rushes, willows, cattails, and reeds, to slow down runoff and enhance stormwater quality. The advantages of a wetland include its natural aesthetic qualities, potential wildlife habitat, erosion control, and pollutant removal. The use of wetlands for treatment will depend on access to a continuous base flow to sustain vegetation.
  - Stormwater Detention Facilities: Water quality treatment mechanisms are incorporated into existing and future flood control detention facilities with the express purpose of reducing sediment and gross pollutants/floatables (litter, trash, debris, etc.). Bacterial destruction also occurs from exposure to ultra violet radiation (sunlight) during extended detention of the stormwater in the facility.

- Sediment/Erosion Control Measures
  - Undeveloped Areas:
    - Contouring - grading contours on the side of hills to help slow the water down as is goes down the slope.
    - Check-dams - placing check dams in the smaller arroyos to help slow down the water velocity and decrease erosion and bed degradation.
    - Earthen Spreaders – a series of berms that have offset openings for the purpose of making the runoff move in a more circuitous path. This also helps enhance infiltration of water into the soil matrix.
  - Urban Areas:
    - Pervious Pavement or Modular Block Porous Pavement - constructing pervious pavement or parking lot which leads to a decrease in the amount of runoff being generated.
    - Depression Landscape Strips and Medians- direct runoff from roadways or parking lots drain into depressions, which will retain some portion of the runoff and encourage infiltration into the soil matrix.

Entity II / Strategy B
SSCAFCA has implemented a policy that requires residential, commercial and industrial developments to provide on-site treatment, operation and maintenance of stormwater quality facilities that 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.

Entity I, II, III / Strategy A, B, C
Runoff Reduction Program: Catching, interrupting flow path, and/or storage of precipitation at the location where it falls reduces the volume of water transported to the Rio Grande, which in turn reduces the mass quantity of pollutants entrained in the storm flow. Low Impact Development/Green Infrastructure practices throughout the watershed will be integral to a successful program of reducing stormwater pollution. Techniques include pervious surfaces, such as those indicated above and Rain Water Harvesting as indicated in Part D of Section IV.

Entity III / Strategy C
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.keeptheriograng.org

Entity I / Strategy A, B, C
Habitat Preservation / Land Banking Program: SSCAFCA has engaged in selected acquisition of land along arroyos to limit the adverse impact of development encroachment on natural arroyo systems. Improvements in stormwater quality have been demonstrated where buffer areas are provided to reduce pollutant loading before reaching the arroyo. This approach also provides opportunities for outdoor education, open space recreation corridors, habitat and foraging area for native flora and fauna, and increased capacity for flood flow conveyance.

D. Rainwater Harvesting

Rainwater harvesting is a low impact development technique that intercepts, holds and uses all or a portion of the precipitation on the individual lot where it falls. SSCAFCA has been investigating this concept, and has determined that rainwater harvesting – if implemented on a basin-wide scale – has the potential of reducing the volume and frequency of runoff events and thus erosion. Some of the potential benefits of rainwater harvesting include:

- Increased protection of public safety and property in the proximity of arroyos
- Cost savings for SSCAFCA and the public by reducing costly sediment cleanup and emergency repairs
- More naturalist conveyance options and integration with SSCAFCA's watershed park concept
- Potential benefits to stormwater quality by reducing pollutants that reach the Rio Grande
- Reduction of dependence on groundwater

Please refer to SSCAFAC's Rainwater Harvesting Guide (MARD 64) for more information. Photo 23 and Photo 24 show examples for rainwater harvesting at SSCAFCA's office building.

Photo 23: Three cisterns with a total capacity of about 15,000 gallons capture roof runoff at SSCAFCA's office building

Photo 24: Rainwater from a small roof area at SSCAFCA's office building is diverted directly into a planter

E. Quality of Life

As part of its stormwater management mission, SSCAFCA recognizes its opportunities to encourage other agencies and entities to utilize its land for multiple, value-added purposes. In 2006, SSCAFCA adopted the Quality of Life Master Plan for Watershed Parks (MARD 61), which contains strategies for realizing the vision of a comprehensive, connected system of joint use improvements along the arroyos in Southern Sandoval County.

Figure 10 in Appendix A shows existing and proposed Watershed Park components in the Montoyas Watershed Park. Existing components include:

- Trails in Northern Meadows, at SSCAFCA's Sportsplex Dam (see Photo 25), South of the Loma Colorado Subdivision and along portions of the Dulcelina Curtis Channel;
- Existing trailheads;
- Open Space, consisting of natural or naturalistic stretches of arroyo in public ownership; these areas feature native vegetation and provide wildlife habitat;
- City parks providing opportunities for sports and other recreational activities;

Other elements were incorporated in the development of this MOWMPv.2.0

- A network of trails connecting the existing trails to each other, thereby forming a continuous trail system throughout the Montoyas Watershed Park and linking it to other, neighboring watershed parks;
- Trailheads in strategic locations, particularly where trails cross major roads;
- A disc golf course as part of the planned Dulcelina Curtis Inlet Sediment Pond ;
- Preservation of existing wildlife corridors, wherever feasible;
- Multi-use components to be included in the design of regional stormwater detention facilities (see Photo 26 and Photo 27);

Photo 25: Walking and bike trail at SSCAFCA's Sportsplex Dam

Photo 26: Trail and rock art energy dissipator at Sunset Pond

Photo 27: Soccer field and wetland at Roskos Field Pond

V. PROPOSED IMPROVEMENTS

All of the proposed facilities are summarized in Table 9 (Page 31) and on the overview map on page 30. Details of existing and proposed facilities are shown on the drainage facility maps, Figures x through x in Appendix A. Technical data is presented in the Facility Data Tables opposite each facility map.

Please note that each facility is assigned a unique identifier based on the location and type of the facility. These facility IDs are listed in the summary tables, on the detailed drainage facility maps and on the corresponding facility data tables. The facility ID is an abbreviated version of the unique identification system in the SSCAFCA Geographical Information System (GIS).

A. Addressing Capacity Constraints at the Watershed Outlet

The outlet of the Montoyas Arroyo Watershed, as described in Section III.B.1, has a hydraulic constraint of 8,000 cfs for the Harvey Jones Channel and 5,000 cfs at Corrales Road Bridge. The hydrologic analyses show that peak flow rates for existing and DEVEX conditions (Section III.B) exceed the capacity constraints. To reduce peak flow rates at the watershed outlet, this watershed management plan proposes a number of regional stormwater detention facilities, which have the ability to detain large amounts of runoff and release it at a controlled flow rate.

B. Regional Improvement Options Considered During Development of the 2002 MOWMP

In the 2002 MOWMP, three different regional improvement scenarios were discussed to address existing and future capacity issues at the outlet of the Montoyas Arroyo. The first scenario assumed developed conditions based on existing development. Scenario 2 assumed developed conditions based on existing platting conditions. Scenario 3 assumed developed conditions based on high density with free discharge. The 2002 MOWMP recommended regional drainage improvements based on Scenario 2. Scenario 2 also included 3 different options – which were essentially combination of different dam sites and raising of the Corrales Bridge. Since that scenario is still considered the most likely development scenario the following discussion in this MOWMPv2.0 is limited to that approach, i.e. locating proposed dam sites and modifications to the Corrales Road crossing as discussed below.

C. Selection Criteria

The analysis of potential regional dams was based on the DEVEX flows, and the goal was to determine a combination of dams that meet the 96-hr drain rule and reduce the flows below the capacity constraints at the outlet of the watershed and/or modify the Corrales Road Crossing of the Harvey Jones Channel.

The arroyos were initially reviewed using topographic mapping overlaid with land use. The initial screening in the 2002 MOWMP produced a total of twenty-two candidate regional dam sites. Twenty-one sites were on the Montoyas Arroyo, including the Ponce de Leon, and one site was on the Lomitas Negras Arroyo. All twenty-two candidate sites and a detailed summary of the pros and cons of each site are contained in Appendix G – Calculations.

Issues that were considered in evaluating the sites were:

- Location within the watershed:

  A dam too far upstream in the watershed, typically the upper 1/3 of the watershed, captures too small an area and is too hydraulically distant to affect the peak flows at the outfall of the watershed. The dam would also be significantly smaller than regional facilities located downstream.

- Proximity to developing urban areas:

  When locating a dam, the distance to existing residential developments was evaluated. Specifically, dam sites located on the upstream side of an existing development were given a lower weighting, since this would impact the visual horizon of existing residents.

- Major road crossings:

  Road crossings were selected as possible dam sites because the road could serve as access for construction and maintenance and also help reduce costs by utilizing the roadway as part of the emergency spillway. The road could also serve as part of the downstream embankment. Some of the road crossings have existing culverts in place that could be modified to achieve the desired outflow. Utilizing the existing culverts and the existing roadway, as well as having easy access to the facility, offer opportunities to reduce overall project costs.

- Size of arroyo/drainage right-of-way area:

  Potential dam sites were considered more favorable when wider platting of the existing arroyo was allowed for in Rio Rancho Estates. Although the arroyos are designated as “Drainage/Flood Control” on the Rio Rancho Estate plat, many of them are not at present dedicated as public lands and are still in private ownership.

- Conceptual grading:
  Each potential dam site was then evaluated in detail with the contours superimposed on the platting so that conceptual configurations and grading could be investigated. To help establish vegetation on the embankments, all dams were assumed to have 6:1 side slopes. The existing bed of the arroyos was not altered with the grading of the regional dams.

D. Recommended Regional Stormwater Detention Facilities

Based on the selection criteria described above, the following regional stormwater detention facilities and improvements are recommened:

1. Pond No.1 – Dulcelina Curtis Channel Inlet Sediment Basin (15_MO_16P)

Pond No. 1 (Exhibit 2) will be located at the same location where the 2002 MOWMP proposed Regional Pond No. 1, at the inlet to the Dulcelina Curtis Channel on the Lomitas Negras Arroyo. At the time this report was written, this pond was already being planned. This pond is primarily intended for sediment control, and will only store about 30 ac-ft of water. No additional right-of-way is required for this project.

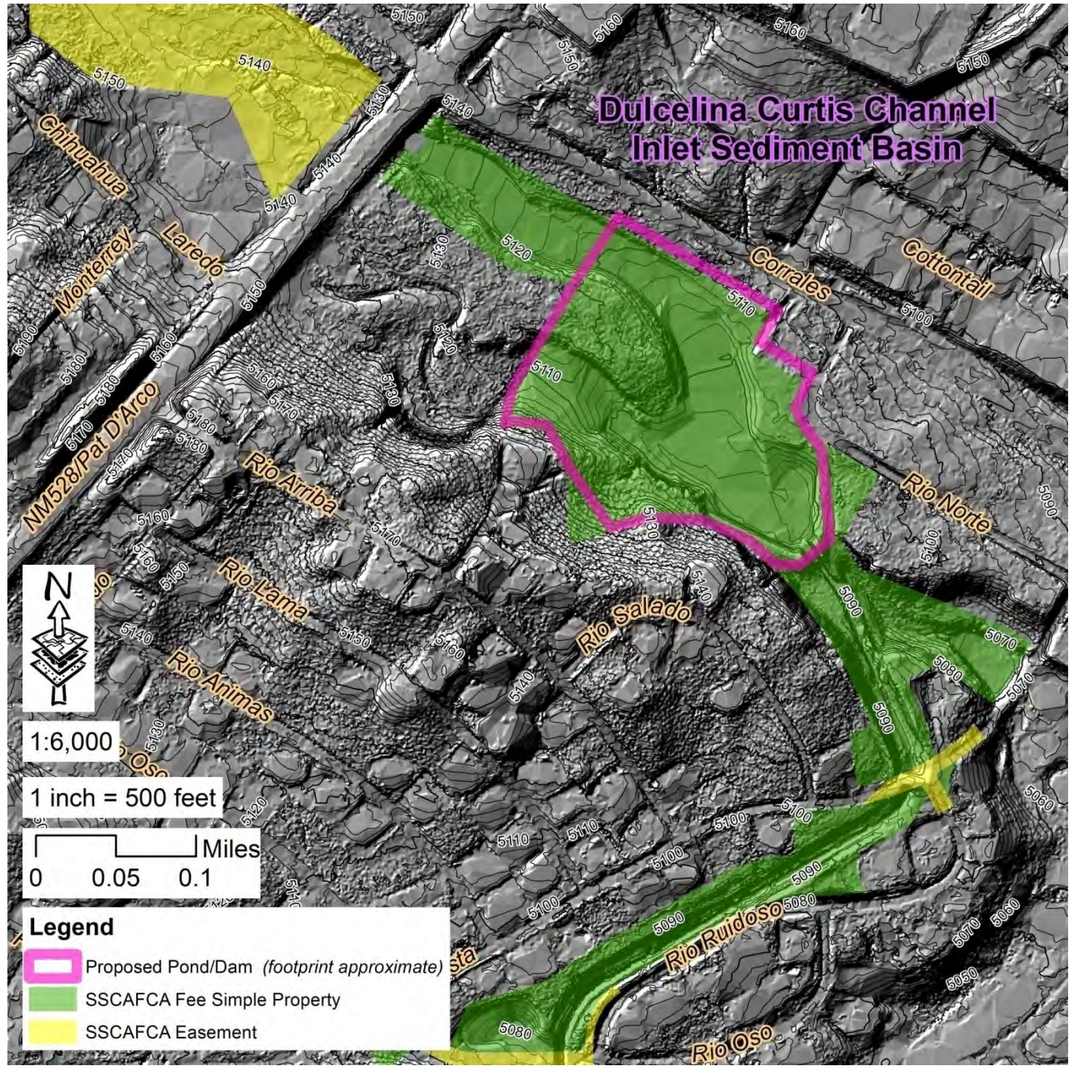


Exhibit 2: Topography at the proposed Dulcelina Curtis Channel Inlet Sediment Basin

2. Dam No. 8 (03_MO_05P)

Dam No. 8 (Exhibit 3) will be located on the Montoyas Arroyo directly adjacent to the North Hills subdivision, although the development is situated on higher ground. There is no road crossing of the arroyo in this area. SSCAFCA owns the arroyo bottom in fee simple, but approximately 33 acres of additional right-of-way is needed. The proposed storage capacity is 397 acre-feet.

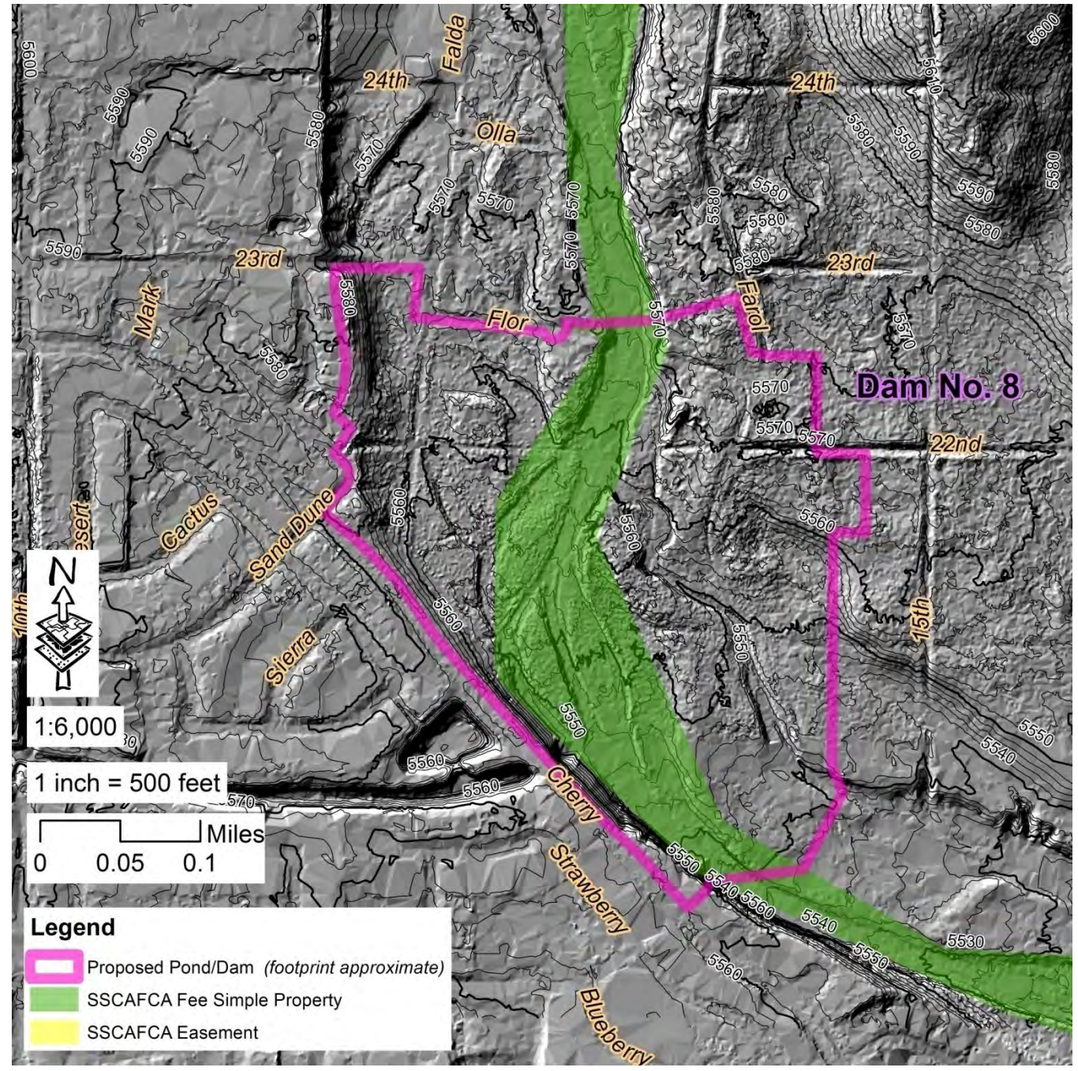


Exhibit 3: Topography at the proposed Dam No. 8

3. Dam No. 23 (09_MO_01P)

The capacity of the Dulcelina Curtis channel is approximately 2,200 cfs. In order to reduce the flow in the channel, a dam is required upstream of the inlet. Dam No. 23 (Exhibit 4) will be located just to the west of Saratoga Drive on the Lomitas Negras Arroyo. Approximately 63 acres of right-of-way are required for this facility. The proposed storage capacity is 84 acre-feet. Changes to peak flow rates and runoff volumes due to the proposed diversion from the Barranca Arroyo (see Sierra Vista East Facility Plan) will be taken into consideration when designing this facility.

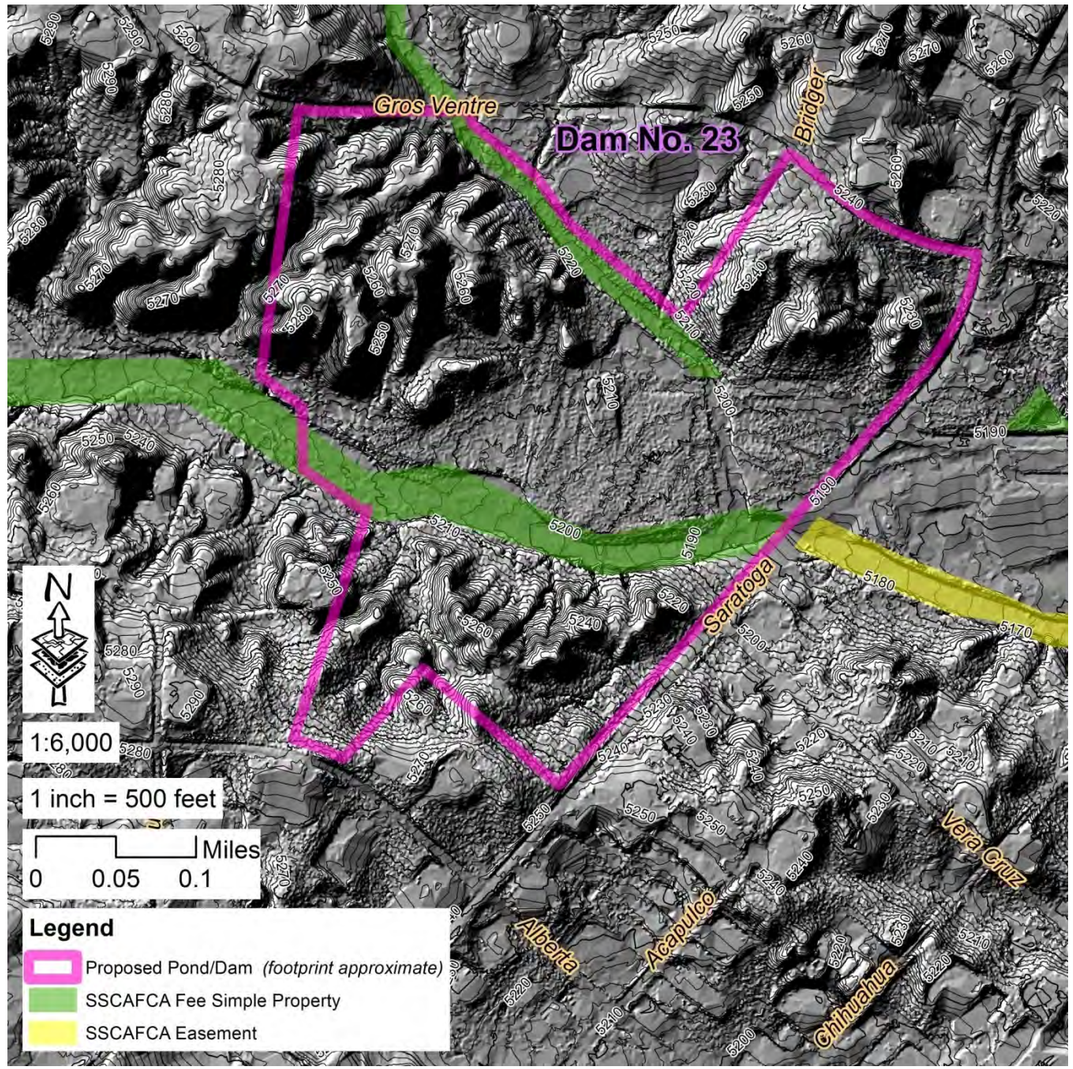


Exhibit 4: Topography at the proposed Dam No. 23

4. Dam No. 12 (28_MO_01P)

Dam No. 12 (Exhibit 5) will be located at Rainbow Boulevard immediately to the west of Northern Meadows. Approximately 26 acres of right-of-way are required for this facility. The proposed storage capacity is 386 acre-feet.

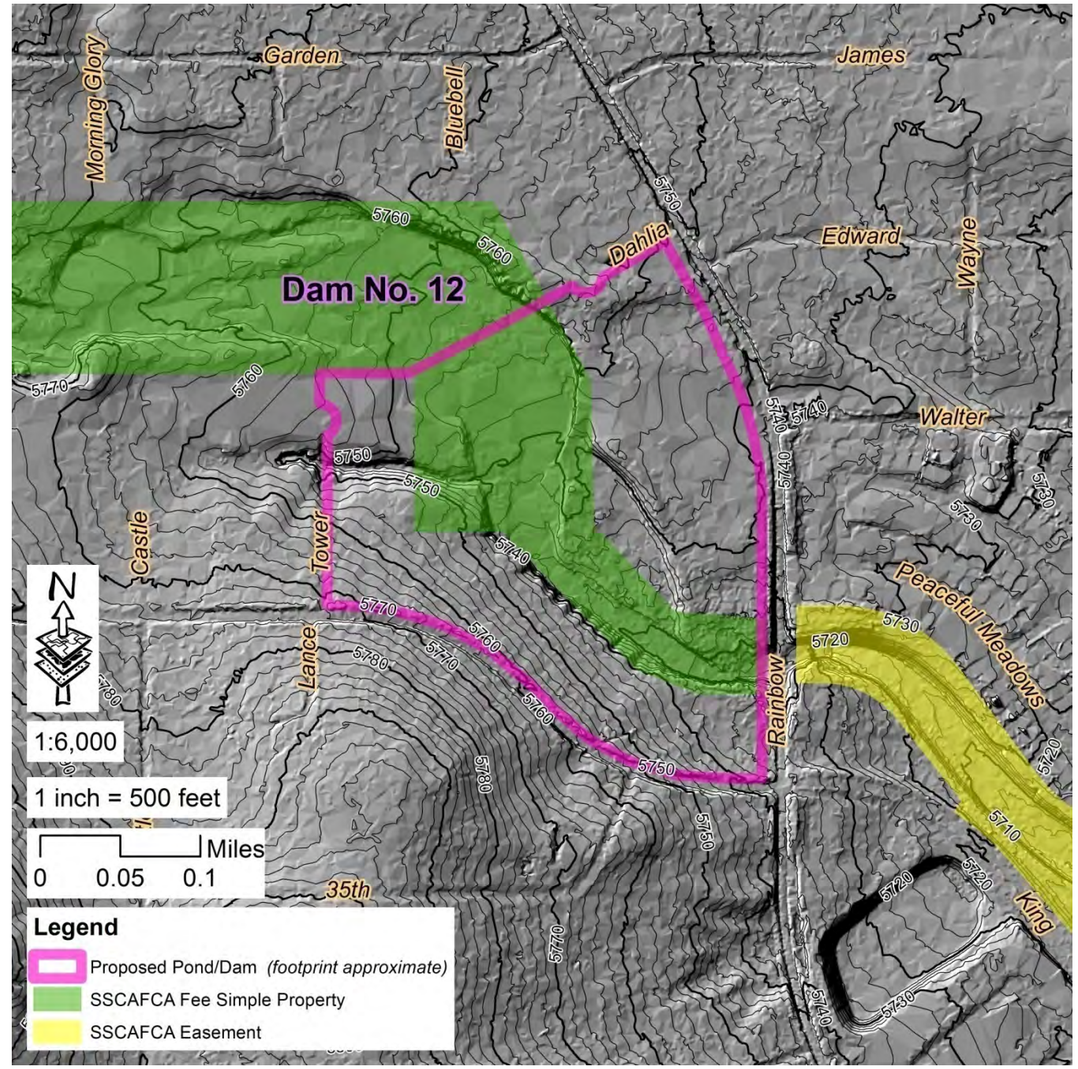


Exhibit 5: Topography at the proposed Dam No. 12

5. Dam No. 18 (27_MO_05P)

Dam No. 18 (Exhibit 6) will be located at the confluence of the east and west branch of the Ponce de Leon Arroyo. This proposed dam site was eliminated in the 2002 MOWMP because of poor topography, requiring extensive off-site fill on the east side involving multiple owners. In addition, the contributing arroyo would require realignment. That site also runs adjacent to a power easement containing overhead lines. This may prevent the raising of a dam. If the dam is to be raised, the overhead power lines may need to be relocated. A reduction in flow on the Ponce de Leon is required in the future, so this location is now proposed. Approximately 68 acres of right-of-way are required for this facility. The proposed storage capacity is 392 acre-feet.

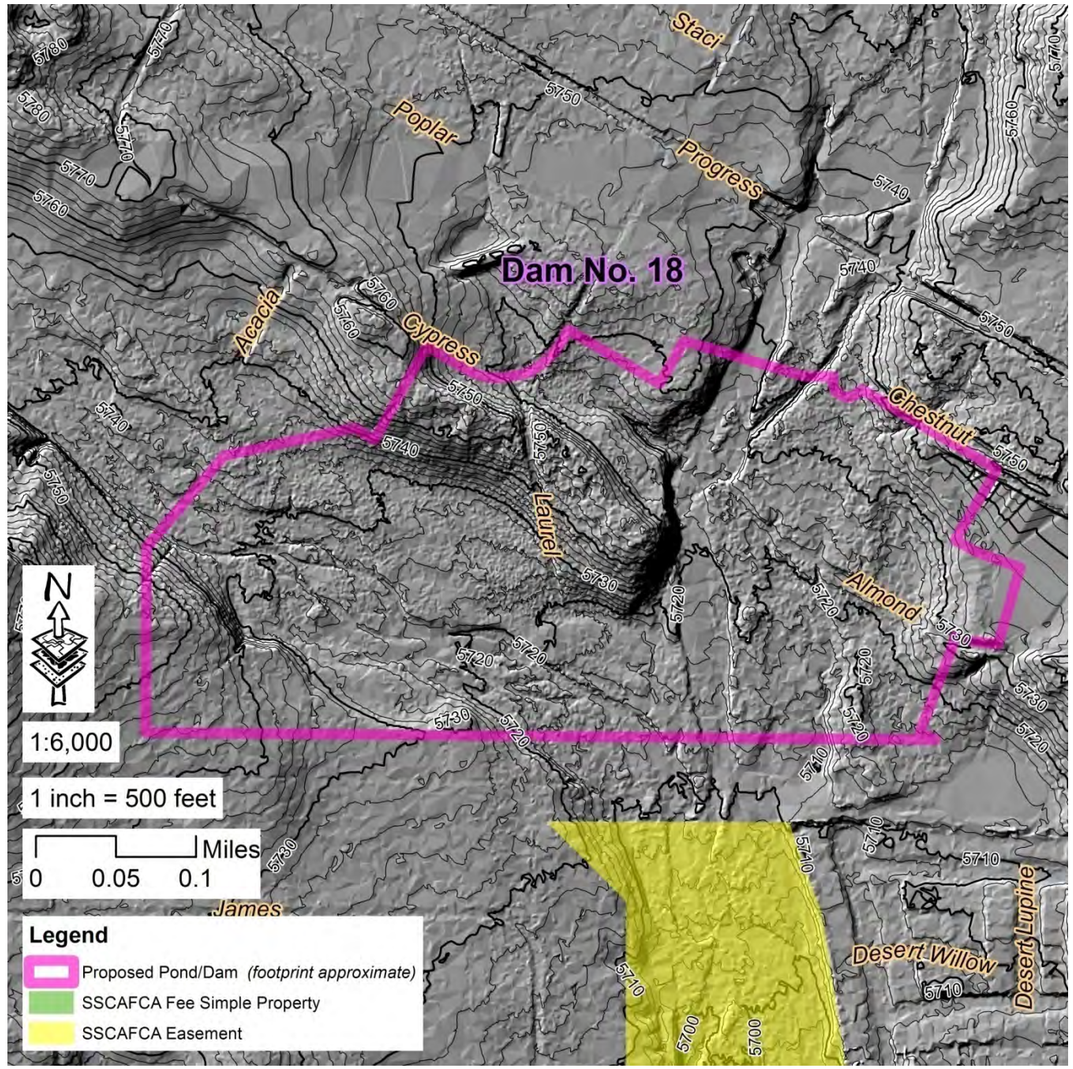


Exhibit 6: Topography at the proposed Dam No. 18

E. Recommended Facility Plans - Rio Rancho Industrial Area (21_MO_01M)

The drainage patterns in the Rio Rancho Industrial Area are affected by a number of exterior and interior storm drain pipes. It is clear that the culverts under NM528 were installed prior to development occurring in the area. This has caused constraints on the flow patterns and in some cases it is clear there are capacity problems from just a visual inspection. Flows from these offsite culverts and the flow generated in the Industrial Area presently drain to the east into the Tortugas Arroyo, which continues to the east into Corrales. The uncontrolled flows from this site have caused flooding problems downstream in Corrales in the past. It is proposed to develop a facility plan for the Rio Rancho Industrial Area in order to address these drainage related issues. These improvements are ranked with the second highest priority (see Error! Reference source not found.) because at the time this plan was written, the New Mexcio Department of Transportation (NMDOT) was in the process of planning improvements to NM528. This provides a unique opportunity for collaboration between two agencies to construct needed drainage improvements in an efficient and cost saving manner.

F. Corrales Road Crossing of the Harvey Jones Channel (23_MO_04X)

The raising of the Corrales Bridge by four feet is required not only from a capacity perspective but also due to the existing sediment trap at, and downstream of, the bridge that remains expensive to clean out and when full of sediment reduces the capacity of the Harvey Jones Channel at the bridge. With the upstream improvements constructed as described above, the flow capacity of the channel at the bridge will need to be 6,143 cfs.

G. Other Proposed Crossing Structure Improvements

Table 9 summarizes all proposed crossing structure improvements. All estimates for proposed crossings are based on drainage culvert crossings. None of the recommendations changed from the 2002 MOWMP. The construction costs listed in Table 9 are based on a current cost / CY of concrete.

H. Proposed Channel Improvements

Table 9 provides a summary of recommended channel improvements. In general the arroyo reaches in the lower parts of the system are recommended to receive treatment due to several factors including proximity of development, utility installations in the arroyo bed, limited right-of-way, and high unstable bank heights. The Lomitas Negras Arroyo is narrow and steep; therefore, concrete or soil cement channel are recommended. Arroyo sections in the lower reach of the Montoyas Arroyo are wider, and channels can be constructed out of soil cement, which appears more naturalistic. Grade control structures with localized bank stabilization are recommended treatment options for Montoyas Arroyo upstream of Sportsplex Dam as well as for the Ponce de Leon Arroyo. Costs for these recommendations were determined based on similar prior construction projects and increased soft costs.

I. Proposed Environmental Facilities

This plan proposes the incorporation of stormwater quality treatment into all stormwater detention facilities. In addition, commercial and industrial developments should be required to construct, operate and maintain water quality facilities.

VI. RECOMMENDATIONS AND BUDGET

A. Prioritization Plan

A key element of a Watershed Management Plan is the prioritization and implementation of the different mitigative components of the plan. In order to benefit most from the incorporation of a Watershed Management Plan, the managing entity must consider each improvement as a step towards the completed system. Therefore, the initial implementation steps must include structures or facilities whose hydraulic capacities are not dependent upon other components of the ultimate system. Consequently, for the MOWMPv2.0, implementation will concentrate initially on detention facilities and improvements at the Corrales Road crossing, and then on erosion protection and other channel crossing structure development.

1. Regional Stormwater Detention Facilities and Improvements

Regional stormwater detention facilities along the Montoyas, Lomitas Negras and Ponce de Leon Arroyos will provide the backbone of the drainage management effort. By making these facilities a priority, erosion problems within the channels and the overtopping of street crossings will be minimized before they are mitigated on a site-by-site basis. This approach will yield the highest benefit/cost ratio for all projects throughout the management plan implementation. The regional facilities discussed earlier are intended to address the ultimate conditions 100-year peak flows at the outlet of the Montoyas Watershed. The sequence of construction of these facilities, along with modifications to the Rio Rancho Industrial Area and the Corrales Bridge as discussed above, was evaluated to determine the proposed priority list (see Table 9). It is anticipated that this priority list will be reviewed on a periodic basis to determine if adjustments need to be made to the list.

2. Channel Improvements

The existing arroyos were evaluated to determine the order of improvements. The recommended priorities are based on a number of factors, including height of existing vertical cut bank and proximity to existing development. (see Table 9).

3. Crossing Structures

No prioritization has been established for crossing structure improvements, with the exception of the Corrales Road Bridge Crossing of the Harvey Jones Channel (Priority 5, see Table 9). All other improvements should coincide with roadway construction.

The City of Rio Rancho is planning and upgrade to the existing crossing structure at Northern Blvd. (13_MO_02X) in conjunction with the planned Northern Blvd, widening project.

B. Financial Summary

Table 8 (below) includes budget estimates for all proposed facilities. The total estimated cost is approximately $90,762,000. Please note that these numbers are rough estimates and are not based on site or project specific analyses.

Table 8: Budget Estimate Summary

Drainage Improvement	Budget Estimate
Stormwater Detention Facilities	$44,313,000
Conveyance Improvements	$40,209,000
Crossing Structure Improvements	$6,240,000
TOTAL:	$90,762,000

C. MOWMP Reviews and Updates

As the watershed develops overtime this MOWMPv2.0 will be updated to review the effect of new developments and to determine if the proposed drainage improvements described in this report need to be updated or modified. If development occurs at greater than anticipated levels, by either replatting the currently platted areas to a greater density of development or developing the currently unplatted areas, it will be necessary to reanalyze what effects this additional urban growth poses on any downstream regional facilities. Full development in the watershed could potentially take over 50 years. Any projected analysis based on conditions that far in the future is difficult. However, due to the unknowns associated with this long-term horizon, it is imperative to begin planning now (with appropriate considerations for the unknown). This report describes a prioritization of construction of drainage facilities assuming the development will in general proceed from downstream to upstream.

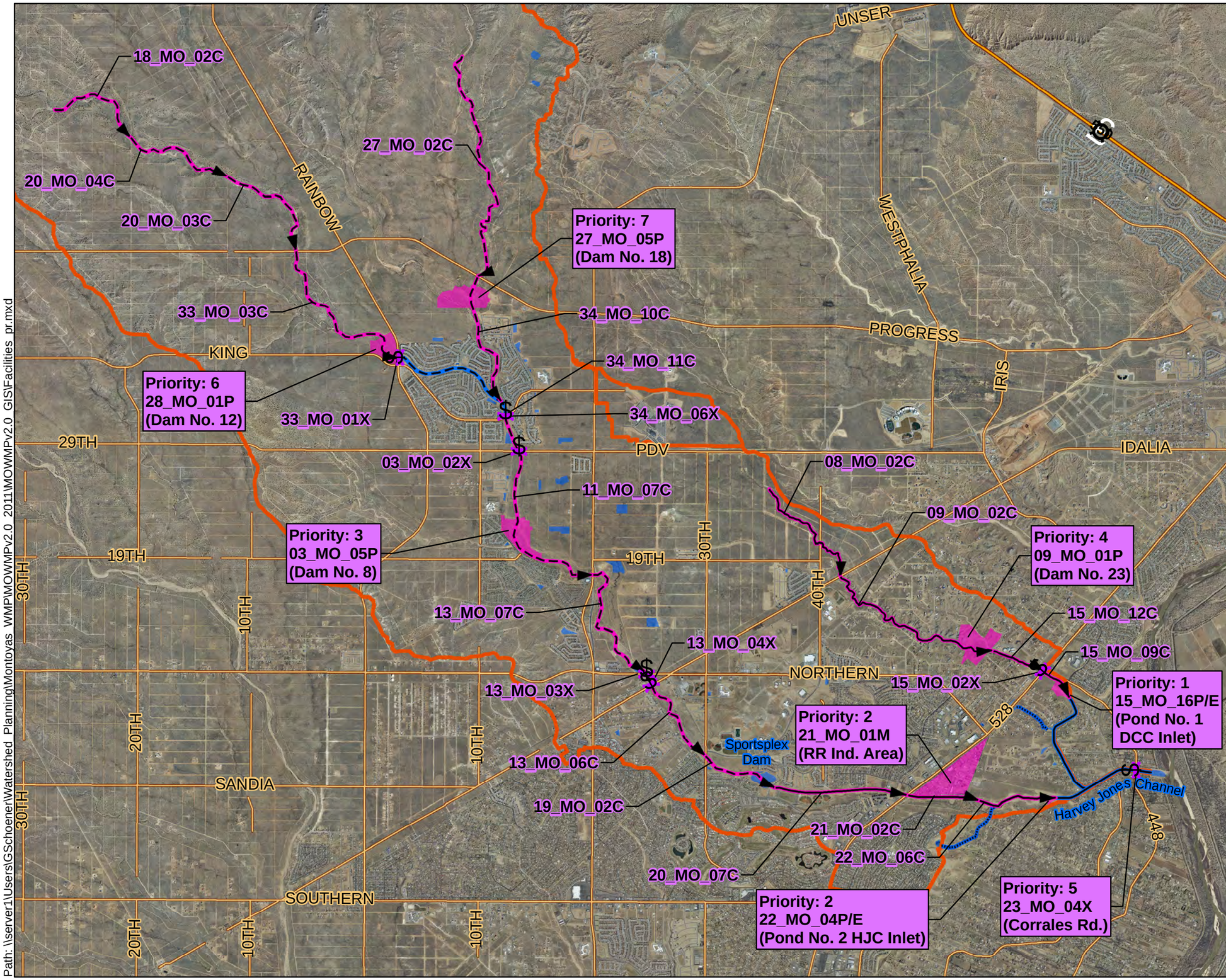


Exhibit 7: Summary Map Showing all Facilities Proposed in the MOWMP V2.0

Legend

- Watershed Boundary
- Natural Arroyo
- Existing Hard Channel
- Existing Soft Channel
- Existing Storm Drain
- Existing Pond/Dam
- Hard Channel
- Soft Channel
- Proposed Pond/Dam
- Crossing St. Improvement

1:60,000

1 inch = 5,000 feet

0 0.5 1 Miles

Montoyas Arroyo Watershed Management Plan Version 2.0

Proposed Facilities

Date: December 2011

Exhibit 7

Path: \\server1\Users\GSchoener\Watershed Planning\Montoyas WMP\MOWMPv2.0 2011\MOWMPv2.0 GISFacilities pr.mxd

Table 9: Summary of all Proposed Facilities (Please see drainage map tiles in Appendix B for more details)

Proposed Stormwater Detention Facilities and other Regional Improvements

Priority	Facility ID	Arroyo/Tributary	Location	Proposed Improvement	Estimated Cost
1	15_MO_16P/E	Lomitas Negras	Inlet to Dulcelina Curtis Channel	Pond No. 1 (DCC Inlet Sediment Basin)	$ 1,800,000
2	21_MO_01M	Montoyas	Rio Rancho Industrial Area	Ind. Area Drainage Improvements	$ -
2	22_MO_04P/E	Montoyas	HJC Inlet	Pond No. 2 (HJC Inlet Water Quality Pond)	$ 2,800,000
3	03_MO_05P	Montoyas	Montoyas Arroyo adjacent to North Hills Subd.	Dam No. 8	$ 9,425,000
4	09_MO_01P	Lomitas Negras	Saratoga & Lomitas Negras Arroyo	Dam No. 23	$ 8,477,000
6	28_MO_01P	Montoyas	Montoyas Arroyo & Rainbow Blvd.	Dam No. 12	$ 8,586,000
7	27_MO_05P	Ponce de Leon	Confluence of East and West Branch, Ponce de Leon	Dam No. 18	$ 13,225,000
				Subtotal:	**$ 44,313,000**

Proposed Conveyance Improvements

Priority	Facility ID	Arroyo/Tributary	Location	Proposed Improvement	Estimated Cost
8	21_MO_02C	Montoyas	Straightened Section to NM528	75ft Channel	$ 2,192,000
9	15_MO_12C	Lomitas Negras	NM 528 to Saratoga	15ft Channel	$ 1,644,000
10	22_MO_06C	Montoyas	HJC Inlet to Straightened Section	75ft Channel	$ 4,958,000
11	20_MO_07C	Montoyas	NM528 to Sportsplex Dam	75ft Channel	$ 2,200,000
12	09_MO_02C	Lomitas Negras	Saratoga to Idalia	15ft Channel	$ 5,754,000
-	15_MO_09C	Lomitas Negras	Inlet DCC to NM528	15ft Channel	$ 1,206,000
-	08_MO_02C	Lomitas Negras	Idalia to upstream end of arroyo	15ft Channel	$ 2,192,000
-	19_MO_02C	Montoyas	Sportsplex Dam to Broadmoor	8 Grade Control Structures	$ 831,000
-	13_MO_06C	Montoyas	Broadmoor to Northern	10 Grade Control Structures	$ 1,872,000
-	13_MO_07C	Montoyas	Northern to Unser	12 Grade Control Structures	$ 3,336,000
-	11_MO_07C	Montoyas	Unser to King	20 Grade Control Structures	$ 4,037,000
-	33_MO_03C	Montoyas	Rainbow to Progress	14 Grade Control Structures	$ 2,048,000
-	20_MO_03C	Montoyas	Progress to Sheba	10 Grade Control Structures	$ 1,142,000
-	20_MO_04C	Montoyas	Sheba to Serenade	9 Grade Control Structures	$ 913,000
-	18_MO_02C	Montoyas	Serenade to Cybele	1 Grade Control Structures	$ 685,000
-	34_MO_10C	Ponce de Leon	King to Progress	9 Grade Control Structures	$ 1,723,000
-	27_MO_02C	Ponce de Leon	Progress to end of arroyo	17 Grade Control Structures	$ 3,476,000
				Subtotal:	**$ 40,209,000**

Proposed Crossing Structure Improvements

Priority	Facility ID	Arroyo/Tributary	Location	Proposed Improvement	Estimated Cost
5	23_MO_04X	Harvey Jones Channel	Corrales Rd. & HJC	2 - 23'x10' CBC's	$ 2,100,000
-	15_MO_02X	Lomitas Negras	NM528 & Lomitas Negras	6 - 8'x8' CBC's	$ 760,000
-	13_MO_04X	Montoyas	Idalia Rd. & Montoyas Arroyo	6 - 10'x8' CBC's	$ 830,000
-	13_MO_03X	Montoyas	Northern Blvd. & Montoyas Arroyo	6 - 10'x8' CBC's	$ 880,000
-	03_MO_02X	Montoyas	PDV & Montoyas Arroyo	6 - 10'x8' CBC's	$ 830,000
-	34_MO_06X	Montoyas	King Blvd. & Montoyas Arroyo	6 - 10'x8' CBC's	$ 130,000
-	33_MO_01X	Montoyas	Rainbow Blvd. & Montoyas Arroyo	6 - 8'x8' CBC's	$ 710,000
				Subtotal:	**$ 6,240,000**
				TOTAL:	**$ 90,762,000**