Coronado Watershed Park Management Plan

May 2023

Southern Sandoval County
Arroyo Flood Control Authority
(SSCAFCA)

Management Plan Revision History

Version	*Date*	*Title*	*Prepared by*	*Notes*
v.1	2009	Unnamed Arroyo Watershed Management Plan	SSCAFCA, WHPacific	Initial release
v.2	2023	Coronado Watershed Park Management Plan	SSCAFCA	Updated model following SSCAFCA *Hydrology Manual v1.1*

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

Drainage facility alignments, conveyance treatments, corridors, locations, rights-of-way and cost estimates are conceptual only, and may be altered or revised based upon future project analysis, changed circumstances or otherwise. Land uses included in this document were assumed for the basis of hydrologic modeling only. This document does not grant free discharge from any proposed development. Naturalistic channel treatments and piped storm drains are to be used for conveyance stabilization, unless otherwise authorized by SSCAFCA.

To ensure public health, safety and welfare, SSCAFCA develops and maintains a regional hydrologic model for all watersheds within its jurisdiction. Updates and revisions are made and tracked by SSCAFCA, or their designee. A copy of the regional hydrology model is available for reference or use by others. Contact SSCAFCA to obtain copies of the model and see the SSCAFCA website for the watershed management plan status. Use of electronic media provided by SSCAFCA is solely at the user’s risk.

Southern Sandoval County Arroyo Flood Control Authority

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The Coronado Watershed Park Management Plan was accepted by the SSCAFCA Board of Directors on 5/18/2023.

5/18/2023	
Dave Gatterman, P.E. (Executive Engineer)	Date
Ronald Abramshe	May 18, 2023
Ronald Abramshe (Chair)	Date

Concurrence:

	6/8/2023
City of Rio Rancho	Date
	6/6/2023
Town of Bernalillo	Date

Contents

Appendices

1. Introduction

The Coronado Watershed Park Management Plan (COWMP) was prepared by the Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA). The main goals presented in the plan are:

- To document current and future improvements necessary to provide flood protection up to the 100-year storm for the public health, safety and welfare of residents and properties within its boundaries.
- To recognize the value of the land purchased or controlled for floodways as areas with multi-use potential.
- To manage sediment and erosion within the boundaries of the Flood Control Authority.
- To assist other entities within SSCAFCA's jurisdiction in the construction of flood control for the good of the public.
- To provide discharge guidelines for future development.
- To preserve the natural character of the arroyos where possible and,
- To propose improvements to mitigate the effect of developed flows (please refer to section 2.5 for a detailed discussion regarding developed conditions).

A regional hydrologic model and watershed management plan for the Coronado watershed (formerly known as Unnamed Arroyo) was first prepared in 2009 (SSCAFCA, 2009). The present plan updates the hydrologic conditions to reflect urbanization as of 2023. According to SSCAFCA policy, planning and design of flood control infrastructure is based on runoff from the 100-year (1% chance) storm. Hydrologic modeling was used in this study to provide runoff estimates for the 1% chance storm at all locations of interest throughout the watershed. The current hydrologic model and results used for this planning document are as accurate and precise as can be reasonably expected. As new information becomes available and is verified, it will be incorporated into the model to continue improving our modeling efforts.

The report, hydrologic model, and associated documentation underwent agency review (SSCAFCA, City of Rio Rancho, Town of Bernalillo, Sandoval County) as well as technical review by an independent engineering firm. Public comment was solicited from 4/20/2023-5/11/2023. All comments and responses are included in Appendix E.

1.1. Location

The Coronado watershed consists of a 0.45 square mile drainage basin that discharges to the Rio Grande just south of the US Highway 550 bridge (Figure 1.1). The upper reach of the watershed is located in the City of Rio Rancho, the lower reach in the Town of Bernalillo (see blue and yellow shading in Figure 1.1, respectively). A small portion of the watershed along its northern edge falls within the Pueblo of Santa Ana. The entire basin is within the jurisdiction of SSCAFCA except for the area within the Pueblo of Santa Ana boundary.

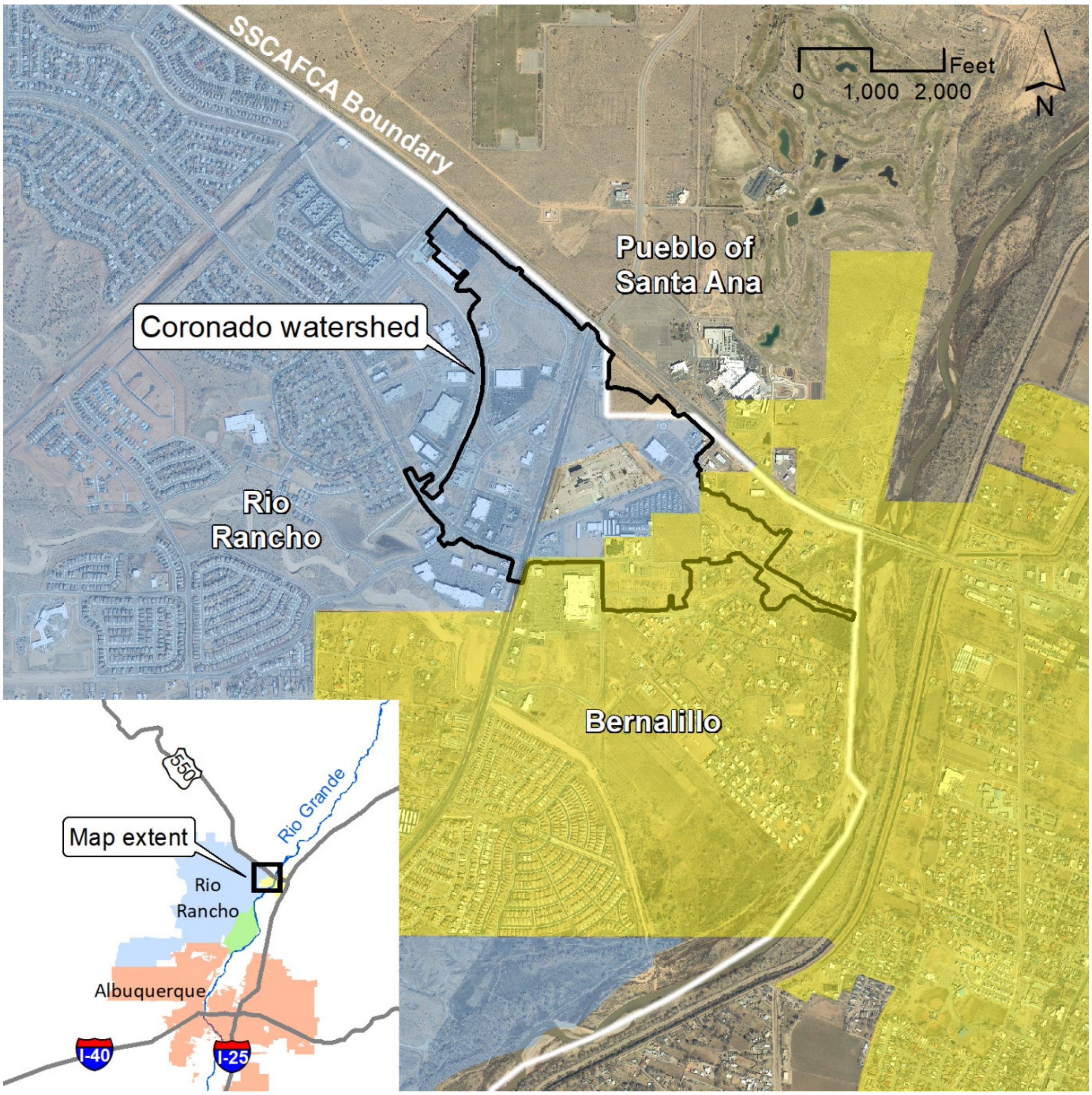

Figure 1.1: Overview map of the Coronado watershed and local municipalities.

1.2. Climate

The Coronado watershed is located west of the Rio Grande in the Middle Rio Grande valley, with elevations ranging from approximately 5,050 to 5,240 feet above sea level. The area has a mild, semiarid, continental climate characterized by low annual precipitation, low relative humidity, and large annual and diurnal temperature fluctuations (WRCC, 2021).

Based on 1991-2020 climate normal (Figure 1.2), average mean annual temperature for the area is 58 °F; average mean monthly temperatures range from 37 °F in January to 80 °F in July.

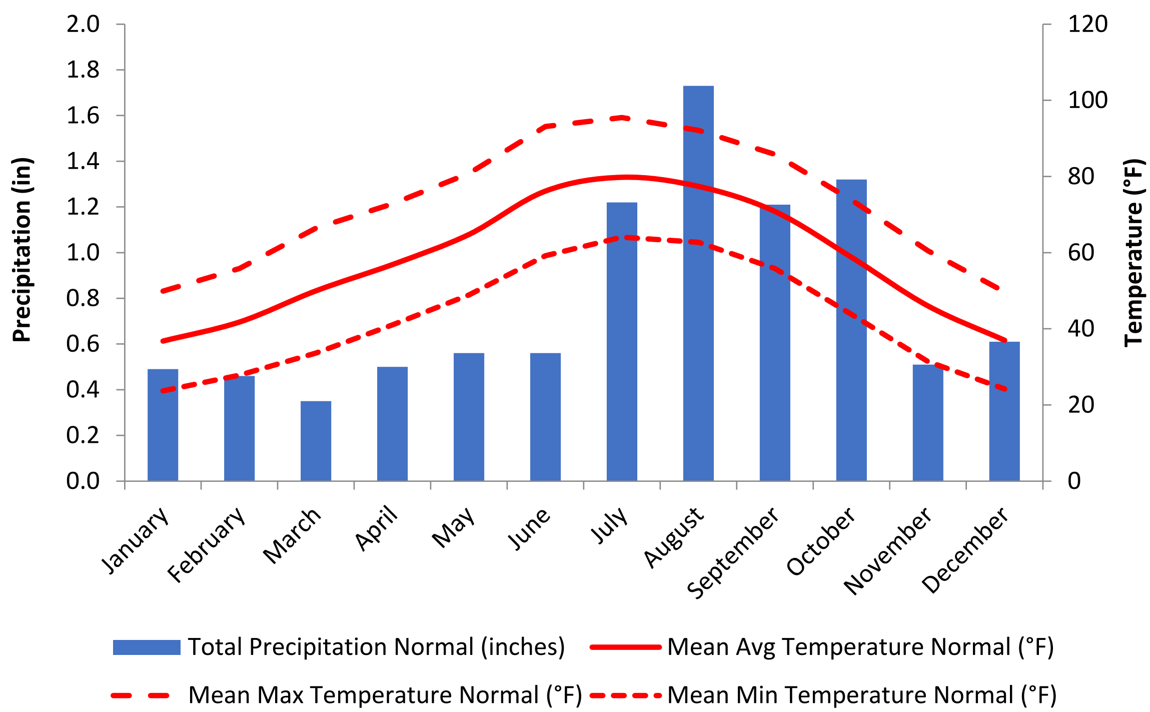

Figure 1.2: Monthly climate normal (1991-2020) for the Rio Rancho, NM area (source: NOAA, 2021).

Average annual precipitation in the Rio Rancho area is 9.5 inches, with values ranging from 4 to 16 inches. July through October are the months with highest rainfall totals (see Figure 1.2). Summer rain typically falls during brief, intense thunderstorms. Southeasterly circulation brings moisture for those storms from the Gulf of Mexico. Orographic lifting and surface heating causes air masses to rise and moisture to condensate (WRCC, 2021). Heavy rainfall associated with summer thunderstorms frequently leads to localized flash flooding (Adams and Comrie, 1997; Higgins et al., 1997). Winter precipitation is mainly related to frontal activity associated with storms from the Pacific Ocean.

1.3. Soils

According to the soil survey of Sandoval County (Hacker and Banet, 2008), near-surface soils in the Coronado watershed are predominantly loamy sands (Figure 1.3) and can be characterized as highly erosive. Loams can be found in the lowest portion of the watershed near the Rio Grande.

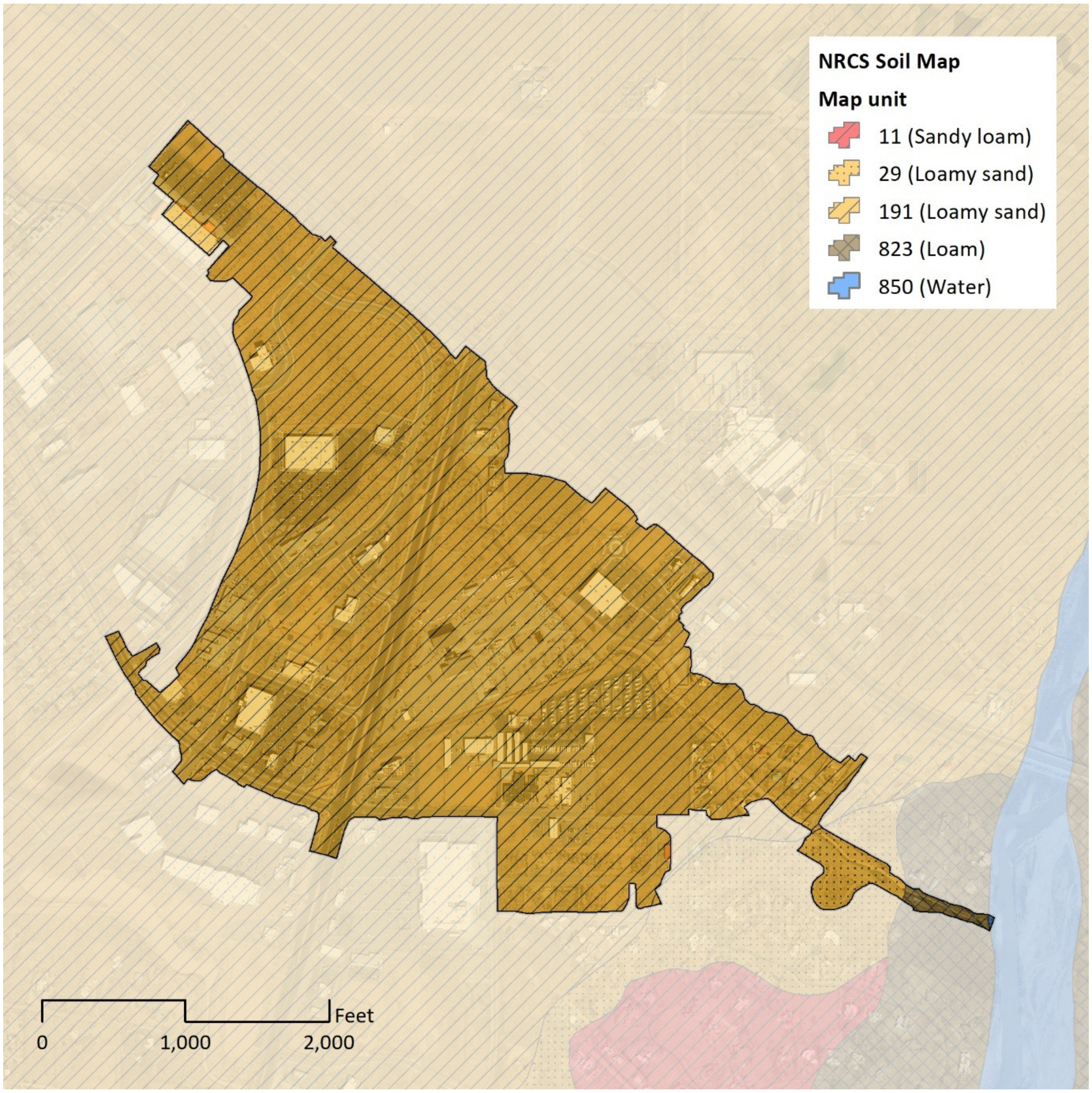

Figure 1.3: Near-surface soil textures found in the Coronado watershed based on NRCS soil map (shaded).

Table 1.1 shows descriptions and typical profiles for soil map units found in the Coronado watershed. The majority of near-surface soils fall into the loamy sand texture class.

Table 1.1: Map unit symbols, descriptions, and typical soil texture profile for soils found in the Coronado watershed.

Map Unit	Description	Typical Profile	
11	Trail fine sandy loam, 0 to 1 percent slopes	0 to 9 in 9 to 36 in 36 to 60 in	fine sandy loam stratified loamy sand to sandy loam sandy loam
29	Trail loamy sand, 0 to 1 percent slopes	0 to 6 in 6 to 60 in	loamy sand stratified loamy sand to sandy loam
191	Sheppard loamy fine sand, 3 to 8 percent slopes	0 to 60 in	loamy fine sand
823	Gilco loam, 1 to 4 percent slopes	0 to 8 in 8 to 60 in	loam stratified fines sandy loam to loam to silt loam

1.4. References

Adams, D.K. and Comrie, A.C., 1997. The north American monsoon. Bulletin of the American Meteorological Society, 78(10), pp.2197-2214.

Hacker, L., Banet, C., 2008. Soil Survey of Sandoval County Area, New Mexico, Parts of Los Alamos, Sandoval, and Rio Arriba Counties. Natural Resources Conservation Service, U.S. Department of Agriculture, U.S. Govt. Print Office, Washington, D.C.

Higgins, R.W., Yao, Y. and Wang, X.L., 1997. Influence of the North American monsoon system on the US summer precipitation regime. Journal of Climate, 10(10), pp.2600-2622.

NOAA (National Oceanic and Atmospheric Administration), (2021). Monthly Climate Normals (1991-2020) – Rio Rancho, NM. https://w2.weather.gov/climate/xmacis.php?wfo=abq (Accessed 11/04/2021).

SSCAFCA (Southern Sandoval County Arroyo Flood Control Authority) (2009). Unnamed Arroyo Watershed Management Plan. Rio Rancho, NM.

WRCC (Western Regional Climate Center) (2021). Climate of New Mexico. https://wrcc.dri.edu/Climate/narratives.php (Accessed 11/04/2021).

2. Watershed Hydrology

All hydrologic modeling was carried out using the U.S. Army Corps of Engineers HEC-HMS software version 4.10.

2.1. Basin Delineation

Orthophotography used for this project consists of tiled images which depict color digital aerial photographs acquired in the spring of 2020 during leaf-off conditions. Lidar-derived elevation data (2018) was used to delineate subbasins as well as for calculating hydrologic parameters. Both orthophotography and elevation data are part of the Mid-Region Council of Governments (MRCOG) digital orthophotography and elevation data project.

Initial watershed and subbasin boundary delineation was accomplished using the GIS tools available in HEC-HMS based on a digital elevation model (DEM) created from 2018 MRCOG lidar data. Boundaries were modified to accommodate desired analysis points and achieve basins with relatively uniform land use characteristics. Analysis points were selected for tributary confluences, major existing culverts and road crossings, and existing pond locations. Questionable boundaries were verified in the field, especially at locations where the dominant flow path was not immediately obvious from the DEM. An overview map of basin boundaries can be seen in Figure 2.1.

2.2. Reach Routing

The Muskingum-Cunge method was used for routing flows through storm drains and open channels in HEC-HMS. Routing reaches were delineated, and slopes estimated in ArcGIS based on the 2018 DEM. Circular and idealized trapezoidal cross-sections were used to simulate open channel flow. Roughness coefficients (Manning's n-values) were estimated based on orthoimagery and field investigations (see Table 2.1). Please note that routing reaches containing storm drain (such as CO_101_R1 and CO_501_R1) may experience pressure flow. The HEC-HMS model can only simulate open channel flow conditions. Results for pipe routing should therefore be interpreted as approximations of real-world conditions.

Table 2.1: Roughness coefficients for routing reaches.

Surface Type	Manning's n-value
Concrete pipe	0.013
Road (asphalt)	0.017
Corrugated metal pipe	0.025
Major arroyo, sandy bed and vertical banks	0.020 – 0.025
Natural channel, moderate to heavy vegetation in channel bed and along banks	0.025 – 0.035

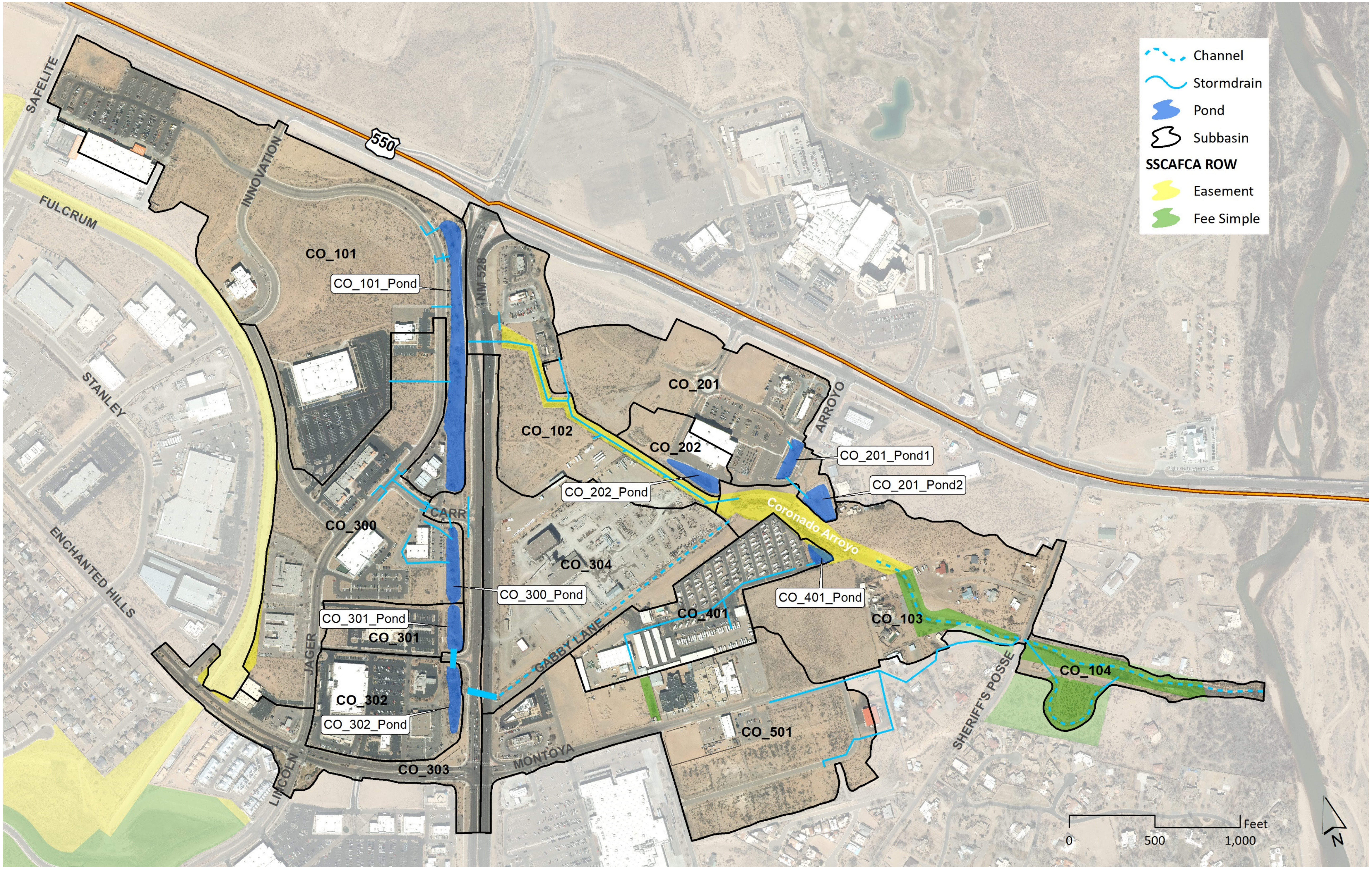

Figure 2.1: Overview map showing subbasin boundaries, ponds, stormdrain and SSCAFCA rights-of-way in the Coronado watershed.

2.3. Existing Land Use

In 2023, a large portion of the Coronado watershed is either developed or impacted by grading and compaction. Most of the urban development consists of commercial and industrial areas. Land use was quantified by manual digitization using orthoimagery and based on GIS data obtained from the City of Rio Rancho (https://rrnm.gov/2334/GIS-Data-Download). Figure 2.2 shows the extent of urbanization and major land use categories.

2.4. Existing Conditions Loss Parameters

In accordance with SSCAFCA's Hydrology Manual (SSCAFCA, 2021), the curve number method was used to compute precipitation loss and excess. Curve numbers for pervious areas were estimated based on 2023 land use conditions in the Coronado Watershed (see Figure 2.2). Table 2.2 lists land use types and associated curve numbers. NRCS soil mapping (Figure 1.3) indicates that most of the near-surface soils are loamy sands. We therefore selected a curve number of 74 for all open space areas as well as the undisturbed portion of residential yards. Directly connected impervious areas (DCIA) were specified explicitly for each subbasin rather than including them in a composite loss calculation. Major sources of DCIA such as commercial areas and paved roads (Figure 2.2, red) were digitized manually.

Table 2.2: Land use categories and associated curve numbers used in the Barranca model.

Land Use	Curve Number
Unconnected Impervious Area	98
Graded/ Disturbed	86
Industrial	88
Open Space	74

2.5. Projected Future Land Use

In order to develop our models for watershed planning, assumptions need to be made about how land will develop within the watershed. To anticipate future runoff from the watershed, SSCAFCA builds a developed conditions model scenario based on the best available land use information. We acknowledge that the underlying land development assumptions may change therefore, the plan should be updated regularly. Future conditions models are used as a planning tool. Model results help to identify potential areas of flooding and plan for appropriate mitigation strategies such as land acquisition and future drainage infrastructure needs.

Figure 2.3 shows a map of anticipated future land use in the basin. Land use projections for developed conditions were based on the following assumptions:

- The majority of the Coronado basin lies within the City of Rio Rancho. City zoning information indicates special use or commercial zoning for most areas within City limits that are currently undeveloped. In accordance with historic development patterns, those areas were assumed to become commercial development (see Figure 2.3, dark red).
- The industrial area in the center of the basin was assumed to remain unchanged (see Figure 2.3, yellow).
- A square section of open space located in the Town of Bernalillo was assumed to develop as a residential subdivision with a density of 6 dwelling units per acre (du/ac) (see Figure 2.3, dark blue).
- A small number of residential lots north of the Coronado Arroyo in the lower part of the basin were assumed to develop as single-family residential lots with a density of 2 du/ac.

The future conditions model should be updated if urban development differs from the assumptions listed above, particularly if development occurs at higher densities than anticipated.

2.6. Developed Conditions Loss Parameters

Loss parameters for the developed conditions hydrologic model were estimated based on projected future land use (see Figure 2.3). Table 2.3 shows land use categories and associated parameters for future commercial areas and residential development of varying densities. Composite curve numbers and % DCIA listed in Table 2.3 were adopted from the Arroyo de la Barranca Watershed Park Management Plan (SSCAFCA, 2022).

Table 2.3: Land use categories and associated loss parameters for single family residential lots.

Land Use	% DCIA	Composite Pervious CN
Commercial	85	86
Residential 6du/ac	25	85
Residential 2du/ac	10	81

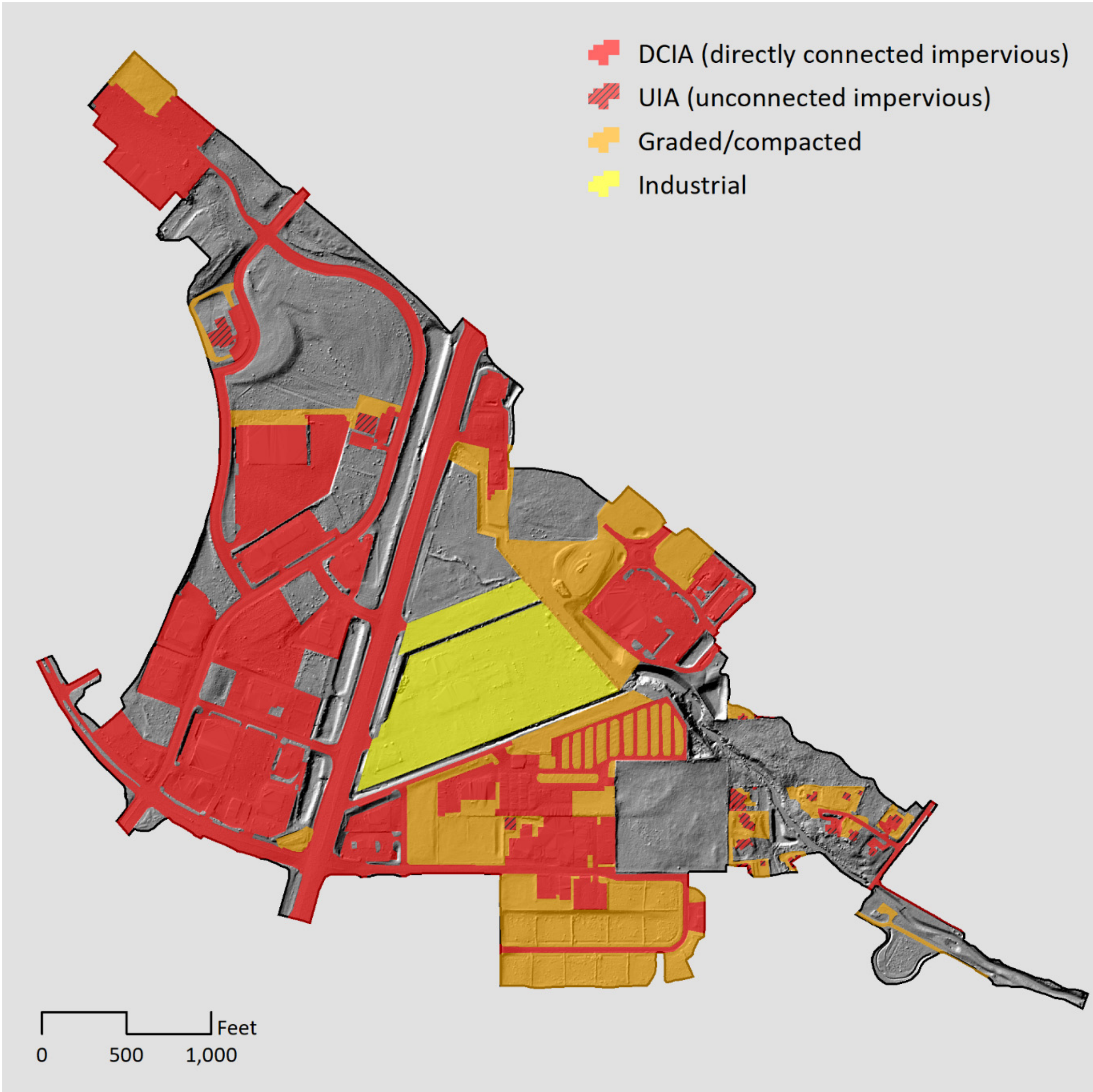

Figure 2.2: Overview map of the Coronado Watershed and major land use types in 2023.

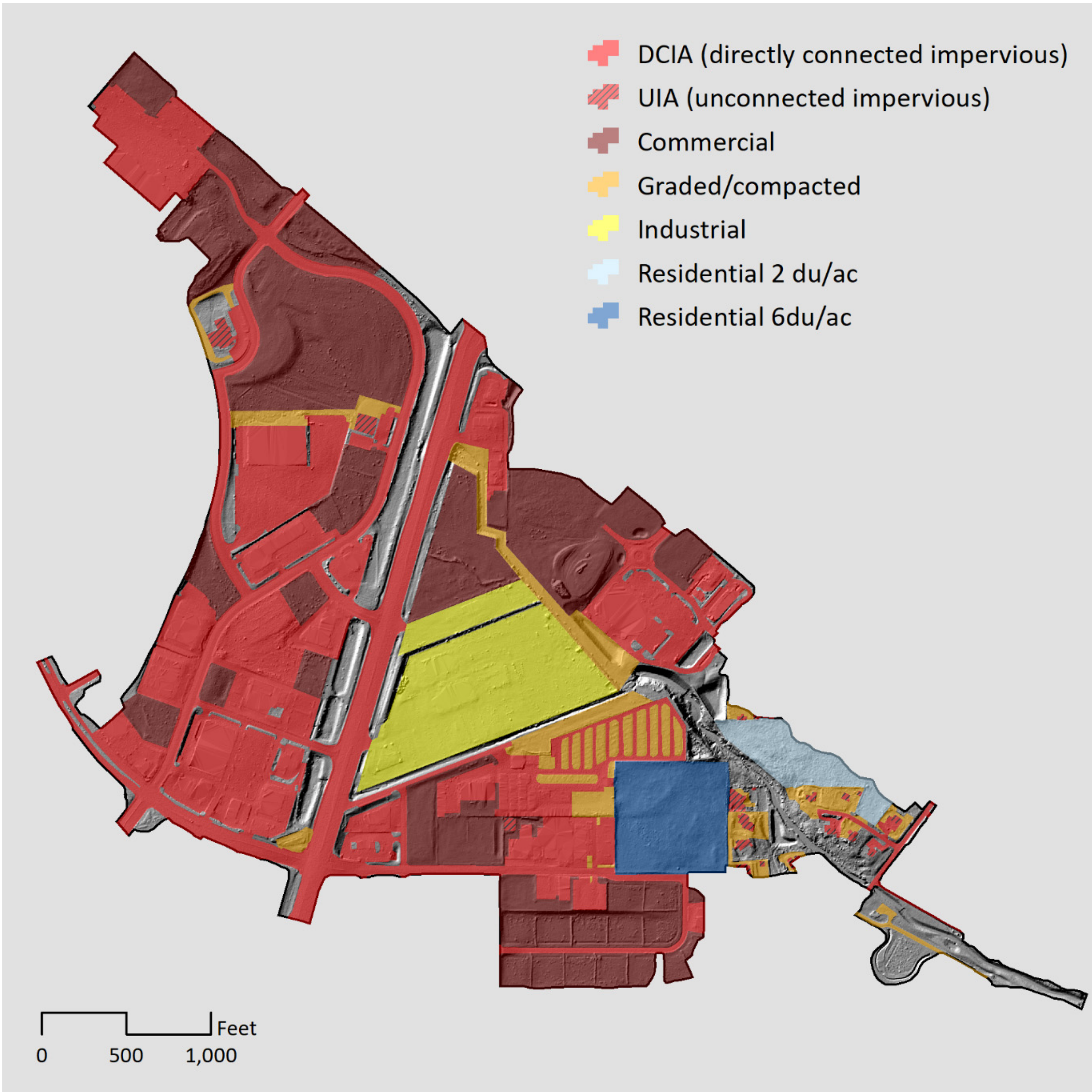

Figure 2.3: Anticipated future land use in the Coronado watershed.

2.7. Transform Method

In HEC-HMS, the SCS unit hydrograph method was selected to transform excess precipitation into a runoff hydrograph for each subbasin. Times of concentration were estimated in ArcGIS based on the watershed DEM using the velocity method outlined in TR-55 (NRCS, 1986). A list of model parameters for subbasins and routing reaches is contained in Appendix A.

2.8. Sediment Bulking

Based on SSCAFCA's Hydrology Manual, sediment bulking factors of 18% for natural areas and 6% for urbanized areas were added as flow ratios to clearwater discharges in HEC-HMS to account for the increase in runoff volume due to suspended sediment in storm flows. Area-average bulking factors were used for subbasins containing both urbanized and natural areas.

2.9. Existing Ponds

The Coronado watershed model contains eight ponds that attenuate runoff ranging from less than 1 ac-ft to approximately 4 ac-ft in storage volume. Ponds are shown in Figure 2.1 and listed in Appendix B. Four linear ponds are located along the west side of NM 528 and intercept runoff from the Enchanted Hills commercial and industrial development. Grading of CO_101_Pond was modified during reconstruction of the US 550/NM 528 intersection, and the original outlet structure was replaced with a 7-ft wide concrete weir. Pond routing was simulated using the information contained in the "Final Drainage Report for US 550 Roadway Reconstruction" (SSCAFCA project number CO_P0004). Outflow from CO_101_Pond flows east through the existing storm drain and discharges into the Coronado Arroyo at the upstream end of subbasin CO_103. CO_300_Pond, CO_301_Pond and CO_302_Pond are inter-connected and drain across NM 528 through a set of four elliptical corrugated metal pipes (42 in wide x 30 in tall). Runoff is then conveyed east through an unimproved channel following the south-eastern side of subbasin CO_304 and discharges into the Coronado Arroyo at the upstream end of subbasin CO_103. Three ponds north of the Arroyo (CO_201_Pond1&2, CO_202_Pond) fall under the jurisdiction of Santa Ana Pueblo. They have no principal spillway and are designed to retain all stormwater. CO_401_Pond receives flow from subbasin CO_401, which includes an RV park and self-storage, and discharges into the Coronado Arroyo in the upstream portion of basin CO_103. In HEC-HMS, pond routing was simulated using elevation-storage curves in conjunction with outlet structures. Since engineering documents and corresponding record drawings could not be located for most ponds, elevations-storage curves were estimated based on 2018 lidar data. Pond depths (i.e. the vertical difference between the lowest point of the flood pool and the embankment) and outlet dimensions were verified in the field. Ponds were assumed to be dry at the start of each simulation.

2.10. Design Storm

In accordance with SSCAFCA policy, the 100-year 24-hour design storm was used to evaluate deficiencies in the Coronado watershed. It is a hypothetical storm event based on point precipitation frequency estimates from the NOAA Atlas 14 (NOAA, 2023). Precipitation estimates representative of the centroid of the Coronado watershed and are displayed in Table 2.4.

Table 2.4: Point precipitation frequency estimates for different recurrence intervals and durations in the Coronado watershed.

	Point precipitation estimate (in)				
Duration	2-yr	10-yr	50-yr	100-year	500-year
5-min	0.224	0.359	0.504	0.570	0.735
15-min	0.423	0.678	0.951	1.080	1.390
1-h	0.706	1.130	1.590	1.790	2.310
2-h	0.803	1.270	1.790	2.030	2.640
3-h	0.861	1.340	1.870	2.110	2.750
6-h	0.992	1.500	2.040	2.300	2.920
12-h	1.100	1.630	2.190	2.440	3.040
24-h	1.260	1.840	2.440	2.710	3.360

The design storm was modeled in HEC-HMS using the built-in frequency storm option with an intensity position of 25 percent and an intensity duration of five minutes. Temporal and spatial patterns of real-world storm events will likely differ from the design storm and induce a different watershed response.

2.11. Existing and Developed Conditions Results

Figure 2.5 shows design storm peak flow rates at selected analysis points for existing and developed conditions. A detailed list of model results is contained in Appendix C. It is important to note that simulation results only provide a best estimate of the watershed runoff response from the design storm for current and projected future land use conditions. Model results are intended to be used for planning and design of flood control infrastructure but need to be interpreted with the underlying uncertainty in mind. Also contained in Figure 2.5 are mapped FEMA flood zones.

2.12. Major Deficiencies

2.12.1. Road Crossing Structures

Structure capacities for major road crossings at NM 528 and Sheriff's Posse Road were analyzed based on existing and developed conditions model runs. Structure capacities were estimated for planning purposes only to establish approximate maximum allowable flow rates at each location. Capacity calculations are based on field investigations (see Appendix D).

The road crossing of NM 528 immediately downstream of CO_101_Pond, which ties directly to a storm drain system described in plan set "Unit 20 Industrial Park Storm Drain Improvement Plans" (see SSCAFCA project file CO_P0004), is close to capacity under developed conditions. Record drawings indicate that the storm drain is designed for a peak flow rate of 70 cfs at the upstream end. Developed conditions outflow from CO_101_Pond is estimated at 66 cfs. Additional upstream peak flow attenuation may therefore be required with additional urbanization in subbasin CO_101. One option may be to increase the capacity of CO_101_Pond, along with modification of the principal spillway.

In addition to crossing structures, existing ponds were evaluated for deficiencies based on existing and developed conditions model runs. A detailed table with results for all ponds included in the hydrologic model is contained in Appendix B.

2.12.2. CO_201 Pond2

CO_201_Pond2, located on the north bank of the Coronado Arroyo, is designed to retain the 100-year runoff volume and has no principal spillway. An emergency spillway (40-ft long notch in the concrete block wall) is provided and, if activated, would direct any overflow into the Coronado Arroyo. Under developed conditions, the pond appears to be at capacity; flow over the emergency spillway would likely cause substantial erosion and headcutting in the steep arroyo bank. Since storage is at (but not exceeding) capacity, and discharge over the emergency spillway would flow directly back into the Coronado Arroyo, this is considered a low concern.

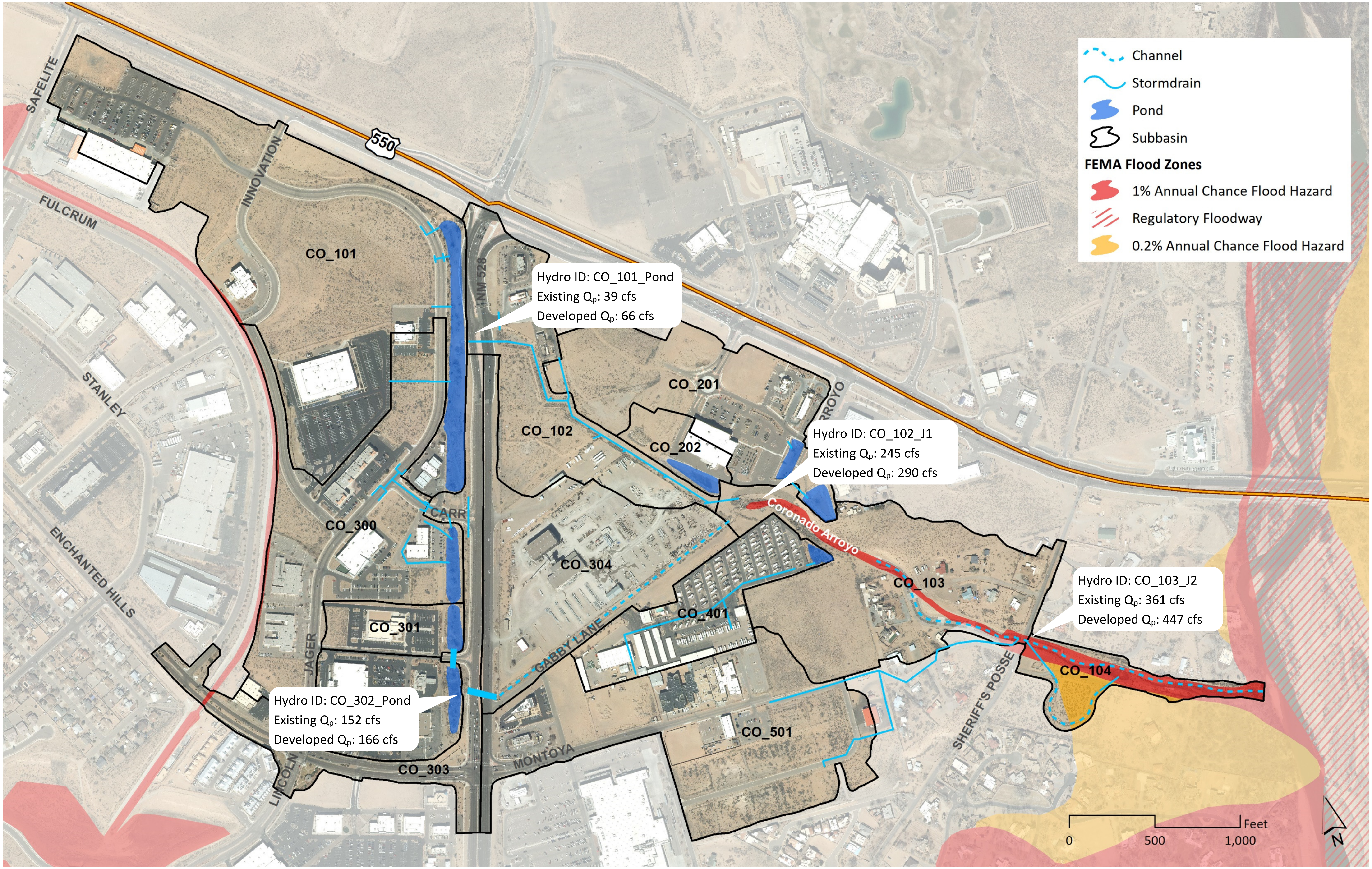

Figure 2.5: FEMA flood zones and peak flow rates from this study for existing and developed conditions at selected analysis points.

2.12.3. CO_301_Pond

CO_301_Pond, at the northwest corner of NM 528 and Jager Way, is at capacity under existing conditions and exceeds capacity for developed conditions. The pond does not have an emergency spillway, and runoff in excess of the pond capacity would spill over the embankment in the south-east corner and onto NM 528 (see Figure 2.6). This is considered a low concern under existing conditions (pond at capacity), but a high concern for developed conditions because runoff spilling onto NM 528 is expected to significantly impact traffic. CO_301_Pond is owned and operated by the City of Rio Rancho.

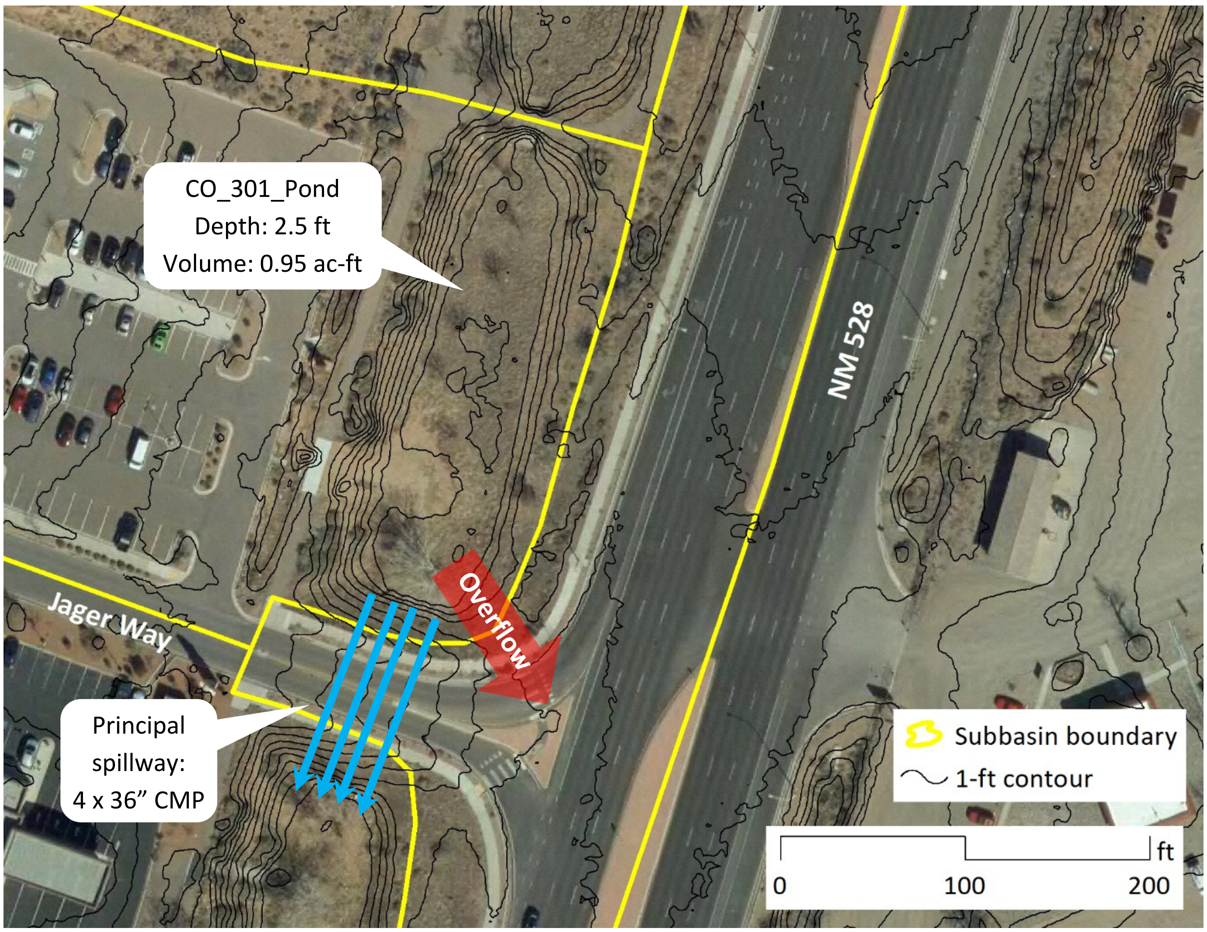

Figure 2.6: Map of CO_301_Pond adjacent to NM 528 showing 1-ft elevation contours.

2.12.4. CO_302_Pond

The principal spillway of CO_302_Pond at the southwest corner of NM 528 and Jager Way is a 20-ft wide broad-crested concrete weir (see Figure 2.7). Once runoff leaves the pond, it flows through a set of four elliptical (42 in wide by 30 in tall) corrugated metal pipes under NM 528. During low flows, the broad crested weir governs outflow from the pond. When depths in the pond exceed approximately 2.0 ft, outflow is dictated by the culvert crossing. At a ponding depth of approximately 2.5 ft, water will spill onto the roadway. Under existing conditions, ponding depth is estimated at 2.1 ft. The ponding depth of 2.5 ft under developed conditions is considered a high concern because runoff spilling onto NM 528 is expected to significantly impact traffic. CO_302_Pond is owned and operated by the City of Rio Rancho.

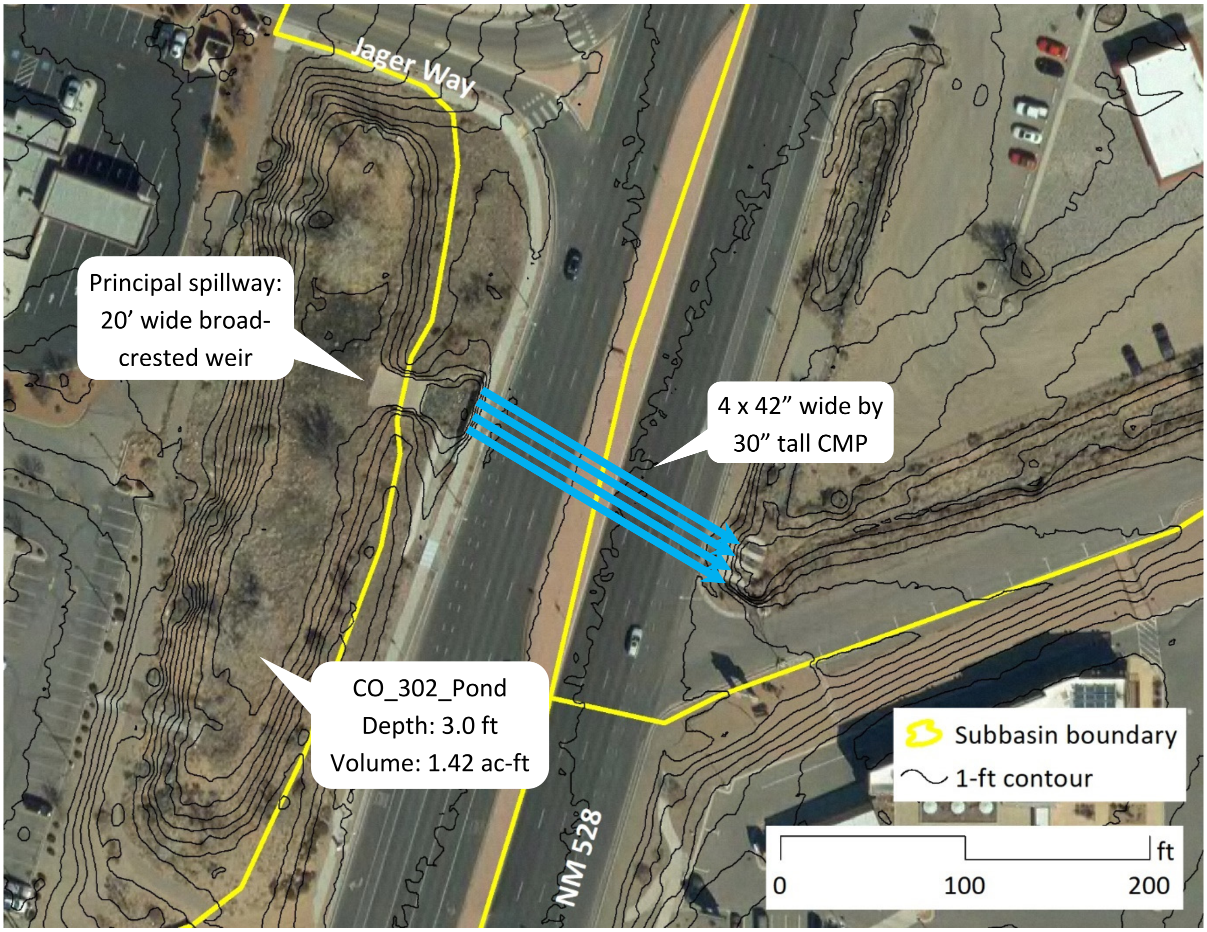

Figure 2.7: Map of CO_302_Pond adjacent to NM 528 showing 1-ft elevation contours.

2.12.5. CO_401_Pond

CO_401_Pond is located at the downstream end of subbasin CO_401, immediately adjacent to the Coronado Arroyo (Figure 2.8). The pond receives runoff from the RV park and self-storage that occupies the majority of the contributing basin through a system of storm drain pipes. The pond outlet, a 12-inch ductile iron pipe, discharges into the Coronado Arroyo. Several concerns are associated with Pond CO_401:

- At the point of discharge, the invert of the outlet pipe is several feet above the channel invert. Discharge from the pipe is causing a head cut visible in Figure 2.8.

- The interior of the pond is overgrown with vegetation, and the inlet of the principal spillway could not be located. It is possible that the pipe inlet is partially or entirely clogged.
- Even if the principal spillway functions properly, the pond does not have sufficient capacity to safely detain the 100-year runoff volume under both existing and developed conditions.
- No emergency spillway exists. Flow over the unprotected pond embankment would likely lead to rapid failure of the embankment, particularly due to the steep slope downstream. This may lead to flooding and sediment deposition in the downstream system.

CO_401_Pond is privately owned and is considered a high concern both under existing and developed conditions.

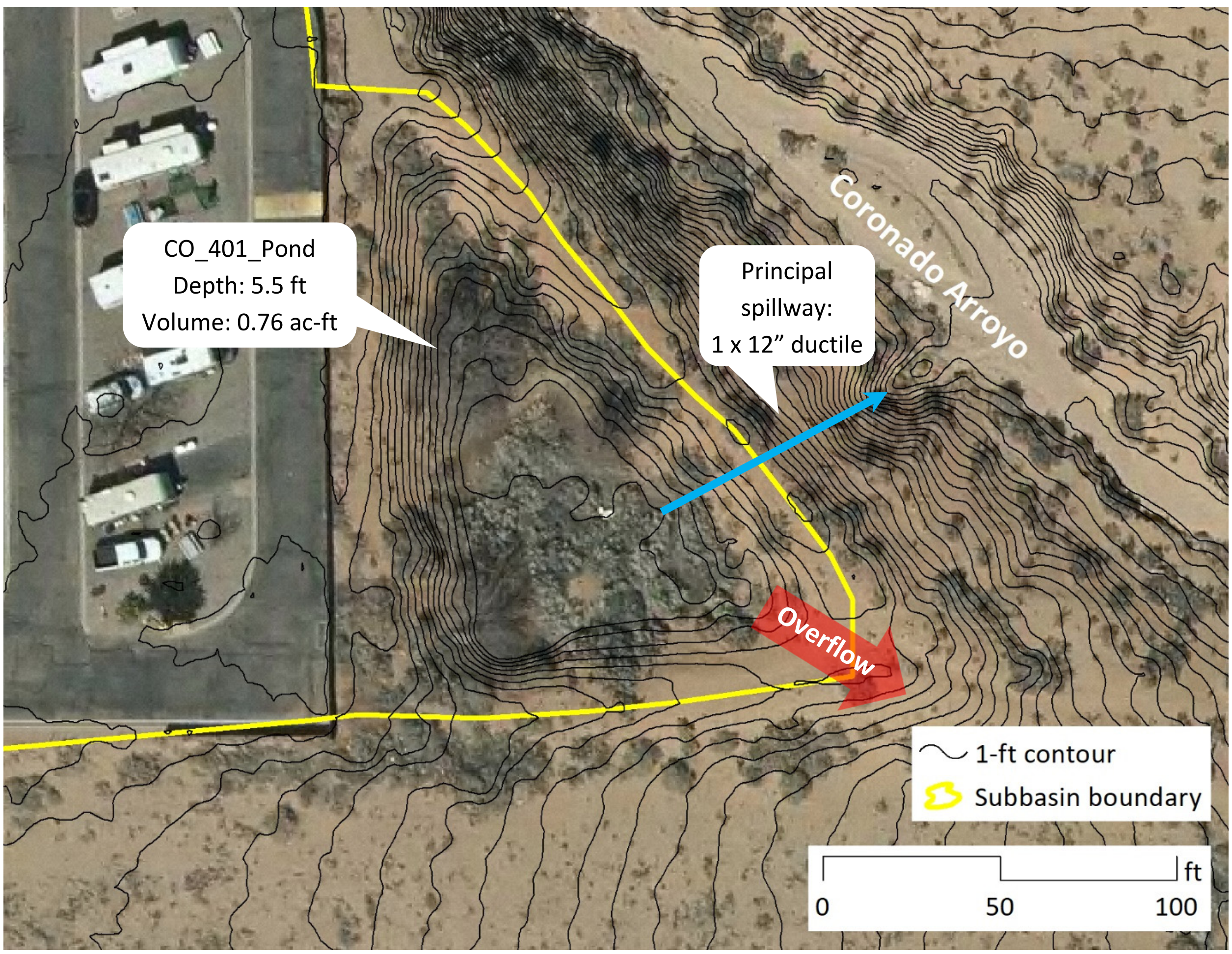

Figure 2.8: Map of CO_401_Pond adjacent to the Coronado Arroyo showing 1-ft elevation contours.

2.12.6. Channel along Gabby Lane

The earthen channel on the southern edge of subbasin CO_304 along Gabby Lane conveys outflow from CO_302_Pond along with runoff from subbasin CO_304 to the Coronado Arroyo (see Figure 2.10).

Figure 2.9: Picture of the storm drain inlet at the end of the Gabby Lane Channel, just before the confluence with the Coronado Arroyo. The inlet frequently clogs, leading to flow spilling over the channel sides and creating a head cut in the steep bank of the Coronado Arroyo.

The need for channel improvements was identified in the previous version of the watershed management plan, and improvements are still needed:

- The channel is overgrown with vegetation and likely has insufficient capacity to safely convey the 100-year peak discharge.
- Near the end of the channel adjacent to the Coronado Arroyo, runoff in the channel is intercepted by a 4-foot diameter reinforced concrete storm drain (see Figure 2.9). This pipe connects to the storm drain trunkline that discharges into the Coronado Arroyo at the upstream end of subbasin CO_103 (see Figure 2.10). Eyewitness statements from

area residents confirm that during storm events, the storm drain inlet (see Figure 2.9) frequently clogs with debris and sediment. This leads to runoff spilling out of the channel, affecting adjacent properties, and generating a head cut in the steep bank of the Coronado Arroyo (see Figure 2.10).

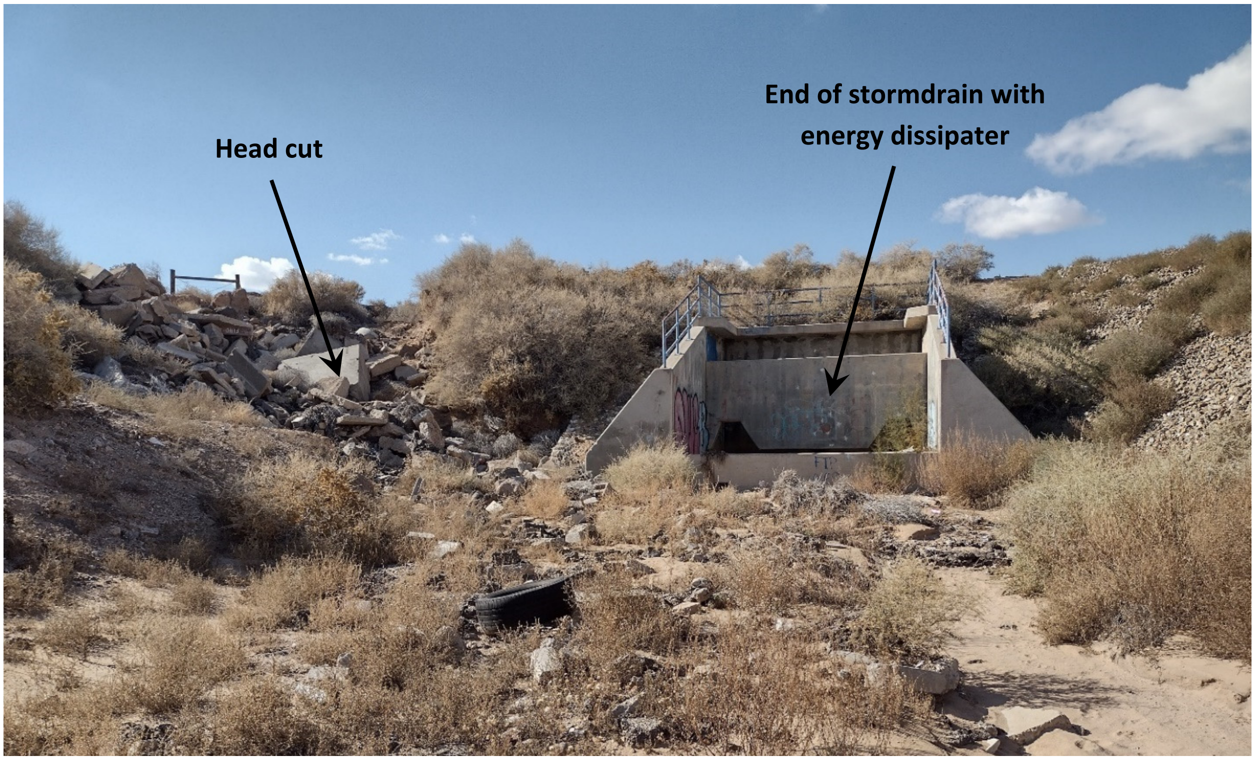

Figure 2.10: Photo of the energy dissipater at the end of the stormdrain that starts at the outlet of CO_101_Pond (right), and head cut caused by flow from the Gabby Lane Channel, filled with concrete rubble and trash from illegal dumping.

2.13. Lateral Erosion Envelope

Lateral Erosion Envelopes (LEEs) are typically calculated in areas where the 100-year storm event exceeds 500 cfs. As most of the Coronado Arroyo watershed is below 500 cfs during this storm event, LEEs have not been calculated for this watershed. However, despite the absence of a LEE designation, areas adjacent to the Coronado Arroyo may experience erosion.

2.14. References

NOAA (National Oceanic and Atmospheric Administration), (2023). NOAA atlas 14 point precipitation frequency estimates: NM. https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html (Accessed 1/9/2023).

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3. Proposed Improvements and Recommendations

Flash flooding during the summer monsoon season is a natural phenomenon in the semi-arid southwestern U.S. and is an integral part of the dynamics of ephemeral water courses. In urbanizing landscapes, flash flooding can cause considerable damage to property, public infrastructure, and endanger lives, especially if insufficient space is provided for the safe passage of floodwaters, or if drainage infrastructure is not designed and sized appropriately. This section discusses proposed solutions to drainage deficiencies described in this study and identifies needs for additional analysis.

3.1. Projects Completed since the last WMP Update

Two regional projects identified in the previous Watershed Management Plan have been completed: the Bosque de Bernalillo Phase I and II projects. Both are briefly described below.

3.1.1. Bosque de Bernalillo Phase I – Water Quality and Channel Improvement

The Bosque de Bernalillo phase I project was designed by SSCAFCA's in-house design team and completed in 2017. The project accomplishes two goals:

(1) The lower Coronado Arroyo between Sheriff's Posse Road and the Rio Grande, previously an unstable natural channel without sufficient capacity to safely convey the 100-year peak discharge, was re-designed with a trapezoidal cross-section to increase capacity. Channel banks were stabilized with riprap armoring, and grade control structures provide protection from vertical degradation. The project also provided maintenance access where none existed previously.

(2) A water quality channel featuring a natural, sandy bottom and gabion basket side walls diverts flows from subbasin CO_501 out of the main channel at the Sheriff's Posse Road crossing. The channel is designed to infiltrate runoff from the urbanized contributing area during small, frequent storm events.

An aerial view of the project area after completion can be seen in Figure 3.1. More details about the project are available on SSCAFCA's website (https://www.sscafca.org/projects/).

Figure 3.1: Aerial view of the completed Bosque de Bernalillo Phase I project looking east towards the Sandia Mountains.

3.1.2. Bosque de Bernalillo Phase II –Channel Improvements

The Bosque de Bernalillo Phase II project is located just upstream of Sheriff's Posse Road and was completed in 2020. Similar to the Phase I project, it was designed by SSCAFCA's in-house design team and involved re-design of the channel to provide sufficient conveyance for the 100-year storm. Lateral and vertical movement of the channel are constrained by riprap bank protection and shotcrete grade control structures. The project also provides maintenance access. Figure 3.2 shows an image of the completed project looking upstream from Sheriff's Posse Road.

Figure 3.2: Aerial view of the completed Bosque de Bernalillo Phase II project looking west.

3.2. Required Drainage Improvements

Despite the substantial progress made in the watershed since the last watershed management plan was issued, several drainage concerns remain; they are addressed in detail below.

3.2.1. Coronado Arroyo Improvements

Upstream of the Bosque de Bernalillo Phase II project, a short segment of the Coronado Arroyo – approximately 850 ft in length – remains unimproved (see Figure 3.3). Vertical stability of the Arroyo in this reach is compromised by the discharge of relatively sediment-deprived stormwater from urbanized basins upstream. Continued lateral migration may threaten existing infrastructure to the north and south. Channel improvements including bank protection and grade control structures should therefore be implemented in this reach. Additionally, this segment of the Coronado Arroyo has experienced decades of illegal dumping and is littered with construction debris such as broken concrete (including rebar), steel and concrete pipe segments, along with a host of other assorted urban trash. For aesthetic, environmental and safety reasons, trash cleanup and subsequent fencing should be seen as a priority. The land is owned by the City of Rio Rancho, with a drainage easement held by SSCAFCA.

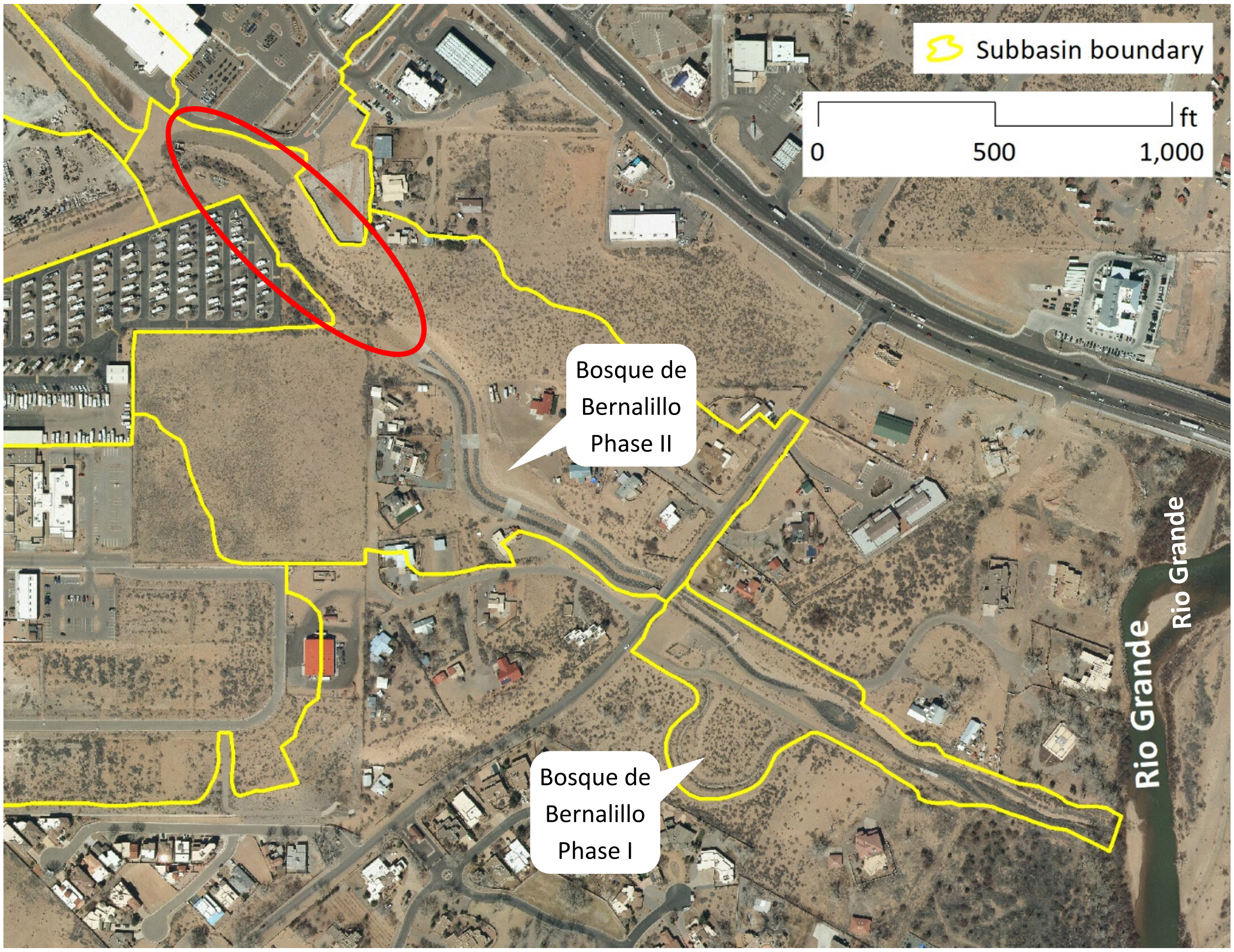

Figure 3.3: Aerial image of the lower Coronado watershed with subbasin boundaries indicated in yellow. Outlined in red is the portion of the arroyo requiring lateral and vertical stabilization.

3.2.2. Gabby Lane Channel Improvements

The channel alongside Gabby Lane, a private road, conveys runoff from CO_302_Pond and NM 528 to the Coronado Arroyo. The channel is privately owned and not maintained regularly. Regardless of ownership, this channel must continue to convey stormwater at the level identified in this document. Channel capacity to safely convey the 100-year discharge should be verified using hydraulic modeling. Additionally, the end of the channel should be re-designed, possibly with an armored rundown into the Coronado Arroyo or a modified stormdrain inlet structure that avoids clogging.

3.2.3. CO_301_Pond Improvements

Due to the capacity constraints identified in this report and potential impacts for NM 528, it is recommended that the storage volume of CO_301_Pond be increased. This could be accomplished by raising the embankment in the south-east corner of the pond by approximately 2 feet.

3.2.4. CO_302_Pond Improvements

Given the capacity constraints under developed conditions, and the possibility of runoff ponding in NM 528, it is recommended that CO_302_Pond be modified to decrease peak discharge during the 100-year storm. This could be accomplished by modification of the principal spillway in conjunction with a slight increase in pond storage volume.

3.2.5. CO_401_Pond Improvements

Given the concerns relating to CO_401_Pond discussed in section 2.12.5 above, the following modifications are recommended:

- Re-design of the principal spillway, including an inlet structure resistant to clogging; ideally, this should coincide with proposed channel improvements to determine the best location and elevation for the point of discharge into the Coronado Arroyo.
- Construction of an armored emergency spillway to safely convey any overflow into the Coronado Arroyo and reduce the risk of catastrophic pond failure.
- Clarification of ownership and maintenance responsibilities.

3.3. Arroyo Preservation

In December 2021, the SSCAFCA Board of Directors adopted a resolution to include conservation of natural arroyo beds as corridors of infiltration and groundwater recharge as an integral component of flood control systems owned and operated by the agency (SSCAFCA, 2021). The resolution is based on research showing that focused infiltration in ephemeral channels in a crucial source of groundwater recharge in many dryland watersheds (Goodrich et al., 2018; Shanafield and Cook, 2014; Constantz et al., 2002; Coes and Pool, 2005). Major arroyos within SSCAFCA's jurisdiction likely provide this important ecosystem service (Schoener, 2022) and should therefore be protected wherever feasible. Preservation of ephemeral channels requires foresight and planning. In urbanizing areas, land is a finite and valuable resource. If seen as mere conduits for runoff, ephemeral streams will likely be transformed into concrete channels or pipes, the hydraulically most "efficient" means for moving water downstream while occupying the smallest possible footprint. Strategies for preserving focused infiltration in ephemeral channels include designation of a buffer zone to allow space for lateral migration. In cases where existing infrastructure is already encroaching, strategic use of bank armoring and grade control structures to limit lateral and vertical movement is preferrable to channel lining. In the Coronado watershed, the Bosque de Bernalillo Phase I and II projects were designed to preserve natural, permeable channel beds by using bank armoring and grade control structures to stabilize the channel vertically and laterally. It is recommended that improvements for the remaining, unimproved segment of the arroyo (see Figure 3.3) be designed in a similar manner.

3.4. Water Quality

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

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

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

SSCAFCA, along with the City of Rio Rancho, Town of Bernalillo and Sandoval County, were identified as regulated entities under the NPDES in 2006. SSCAFCA submitted the latest Stormwater Management Plan (SWMP) on November 27, 2019. Under the permit, SSCAFCA is requested to:

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

These requirements are accomplished through six minimum control measures:

- Public education and outreach
- Public participation/involvement
- Illicit discharge detection and elimination
- Construction site runoff control
- Post-construction runoff control
- Pollution prevention/good housekeeping

Details of the requirements and activities completed by SSCAFCA under the permit can be found on our website, www.sscafca.org. Regional best management practices planned in the Coronado watershed to help reduce potential sediment and pollutants in stormwater runoff include:

- SSCAFCA, in cooperation with the City of Rio Rancho (CoRR), has implemented a policy that requires subdivision-scale residential as well as commercial and industrial developments to provide operation and maintenance of on-site stormwater quality facilities to treat the runoff from a 0.6 in, 6-hour storm event prior to discharge to a public facility (see SSCAFCA/CoRR Development Process Manual and CoRR Chapter 153 Ordinance for details).
- Naturalistic channel treatments (unlined channels, stabilized with bank protection and drop structures where necessary) have been and will continue to be utilized wherever feasible to slow down the velocity of stormwater runoff and promote infiltration into the soil.

In addition, several existing structures provide water quality treatment in the watershed. The Bosque de Bernalillo Phase I project (see section 3.1.1 above) provides water quality improvement for a portion of the watershed (subbasin CO_501). Ponds intercepting runoff from commercial areas northeast of the Coronado Arroyo are designed to retain stormwater and will not discharge to the arroyo during storm events up to the 100-year event (CO_201_Pond and CO_202_Pond). To further improve water quality in the basin, it is recommended that ponds located along NM 528 (CO_101_Pond and CO_302_Pond) are retrofitted with outlet structures designed to remove trash and floatable debris.

3.5. References

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SSCAFCA (Southern Sandoval County Arroyo Flood Control Authority) (2021). Resolution 2022-05, Arroyo bed conservation policy. Rio Rancho, NM.

Appendix A

Model Parameters

Subbasin Parameters			Loss Model Parameters				Unit Hydrograph Parameters	
Basin ID	Area		Existing Conditions	Existing Cond. Impervious	Developed Conditions	Developed Cond. Impervious	Time of concentration	Lag [a]
	(ac)	(mi^2)	(CN)	(%)	(CN)	(%)	(h)	(min)
CO_101	63	0.0980	76	35.5	80	75.8	0.43	15
CO_102	21	0.0323	80	26.8	84	54.5	0.25	9
CO_103	30	0.0476	77	4.0	81	12.7	0.30	11
CO_104	7	0.0105	75	2.4	75	2.4	0.15	5
CO_201	22	0.0347	80	34.3	79	78.9	0.37	13
CO_202	4	0.0065	86	36.2	86	72.6	0.13	5
CO_300	32	0.0498	74	63.0	78	86.3	0.24	9
CO_301	6	0.0087	74	66.0	75	78.4	0.13	5
CO_302	12	0.0185	74	81.5	74	81.5	0.16	6
CO_303	17	0.0267	75	71.9	75	71.9	0.46	17
CO_304	28	0.0437	85	12.8	85	13.7	0.20	7
CO_401	13	0.0209	85	55.3	85	62.2	0.26	9
CO_501	35	0.0554	85	36.9	84	84.5	0.47	17

[a] Lag = 0.6 * T_c

Routing Reach ID	Length	Slope	Manning's n			Shape	Index Flow (Existing)	Index Flow (Developed)	Diam.	Width	Side Slope
	(ft)	(ft/ft)	Main	Left	Right		(cfs)	(cfs)	(ft)	(ft)	(xH : 1V)
CO_101_R1	2055	0.0090	0.013			Circle	19	33	4		
CO_102_R1	968	0.0140	0.025			Trapezoid	123	145		25	2.5
CO_102_R2	1000	0.0025	0.025			Trapezoid	137	161		16	3
CO_103_R1	620	0.0120	0.025			Trapezoid	181	223		15	3
CO_103_R2	810	0.0120	0.025			Trapezoid	194	238		15	3
CO_104_R1	260	0.0100	0.024			Circle	14	15	2		
CO_104_R2	661	0.0046	0.030			Rectangle	14	15		6	
CO_104_R3	120	0.0117	0.025			Circle	14	15	2		
CO_303_R1	1730	0.0080	0.025			Trapezoid	76	83		7	3
CO_501_R1	1370	0.0200	0.013			Circle	41	54	4		

Appendix B

Ponds

Hydro ID	*Source*	**Compiled by**	*Date*	*Drainage area (mi^2)*	*Emergency spillway (ft)* [a]	*V_{EmSp} (ac-ft)*	*Top of embankment (ft)* [a]	*V_{TOP} (ac-ft)*	*Existing peak depth (ft)* [a]	*Developed peak depth (ft)* [a]	*Note*
CO_101_Pond	Final Drainage Report for US 550 Roadway Reconstruction, NMDOT CN A301232	SSCAFCA	Jul-18	0.0980			3.0	8.09	1.6	2.3	
CO_201_Pond1	2018 LiDAR & field investigation	SSCAFCA	Dec-22	0.0347			5.0	1.47	4.6	4.9	
CO_201_Pond2	2018 LiDAR & field investigation	SSCAFCA	Dec-22	0.0347	10.0	3.47	12.0	4.57	7.3	10.0	No principal spillway (retention only)
CO_202_Pond	2018 LiDAR & field investigation	SSCAFCA	Dec-22	0.0065			7.0	2.31	3.1	3.6	No principal spillway (retention only)
CO_300_Pond	2018 LiDAR & field investigation	SSCAFCA	Dec-22	0.0498			3.0	1.63	1.7	2.0	
CO_301_Pond	2018 LiDAR & field investigation	SSCAFCA	Dec-22	0.0585			2.5	0.95	2.5	2.7	
CO_302_Pond	2018 LiDAR & field investigation	SSCAFCA	Dec-22	0.1037			3.0	1.42	2.1	2.5	Flow is projected to spill onto NM 528 at a depth of approximately 2.5 ft
CO_401_Pond	2018 LiDAR & field investigation	SSCAFCA	Dec-22	0.0209			5.5	0.76	5.9	5.9	

[a] Depth vaule relative to pond invert

No concern
Low concern
High Concern

Hydro ID: **CO_101_Pond**

Pond rating curve based on:

Final Drainage Report for US 550 Roadway Reconstruction

NMDOT CN A301232, July 2018

	Depth ft	Storage ac-ft	Discharge cfs	
Pond bottom and principal spillway invert	0.00	0.0000	0.0	7ft wide concrete weir
	0.25	0.6335	2.3	
	0.50	1.2642	5.5	
	0.75	1.9018	12.0	
	1.00	2.5366	18.5	
	1.25	3.1841	25.8	
	1.50	3.8501	33.9	
	1.75	4.5146	42.7	
	2.00	5.2075	52.2	
	2.25	5.9001	62.3	
	2.50	6.6133	72.9	
	2.75	7.3472	84.1	
Top of embankment	3.00	8.0919	95.8	

Hydro ID: **CO_201_Pond1**

Pond rating curve based on:
2018 LiDAR-derived digital elevation model
and field investigation

			Volume		
	Depth	Area [1]	Incremental	Cumulative	
	ft	ac	ac-ft	ac-ft	
	0.0	0.052	0.000	0.000	
	1.0	0.253	0.152	0.152	
	2.0	0.298	0.276	0.428	
	3.0	0.332	0.315	0.743	
Principal spillway	4.0	0.363	0.347	1.090	32ft broad crested concrete weir
	5.0	0.399	0.381	1.471	

[1] based on 2018 LiDAR-derived digital elevation model

Hydro ID: **CO_201_Pond2**

Pond rating curve based on:
2018 LiDAR-derived digital elevation model
and field investigation

			Volume	
	Depth	Area [1]	Incremental	Cumulative
	ft	ac	ac-ft	ac-ft
	0.0	0.156	0.000	0.000
	1.0	0.206	0.181	0.181
	2.0	0.245	0.225	0.407
	3.0	0.280	0.262	0.669
	4.0	0.315	0.298	0.967
	5.0	0.348	0.332	1.298
	6.0	0.382	0.365	1.663
	7.0	0.416	0.399	2.063
	8.0	0.451	0.434	2.497
	9.0	0.486	0.469	2.965
Emergency spillway	10.0	0.520	0.503	3.468
	11.0	0.549	0.534	4.003
	12.0	0.576	0.562	4.565

[1] based on 2018 LiDAR-derived digital elevation model

Hydro ID: **CO_202_Pond**

Pond rating curve based on:
2018 LiDAR-derived digital elevation model
and field investigation

	Depth	Area [1]	Volume Incremental	Volume Cumulative	
	ft	ac	ac-ft	ac-ft	
	0.0	0.033	0.000	0.000	no outlet
	1.0	0.206	0.120	0.120	
	2.0	0.268	0.237	0.357	
	3.0	0.317	0.293	0.649	
	4.0	0.365	0.341	0.990	
	5.0	0.414	0.390	1.380	
	6.0	0.465	0.440	1.820	
Top of embankment	7.0	0.514	0.490	2.309	
	8.0	0.564	0.539	2.849	
	9.0	0.614	0.589	3.438	

[1] based on 2018 LiDAR-derived digital elevation model

Hydro ID: **CO_300_Pond**

Pond rating curve based on:
2018 LiDAR-derived digital elevation model
and field investigation

			Volume		
	Depth ft	Area [1] ac	Incremental ac-ft	Cumulative ac-ft	
Pond bottom and principal spillway invert	0.0	0.200	0.000	0.000	15ft wide concrete weir
	1.0	0.509	0.355	0.355	
	2.0	0.651	0.580	0.935	
Top of embankment	3.0	0.740	0.696	1.630	

[1] based on 2018 LiDAR-derived digital elevation model

Hydro ID: **CO_301_Pond**

Pond rating curve based on:
2018 LiDAR-derived digital elevation model
and field investigation

	Depth	Area [1]	Volume Incremental	Volume Cumulative	
	ft	ac	ac-ft	ac-ft	
Pond bottom and principal spillway invert	0.0	0.289	0.000	0.000	4x 36" CMP
	0.5	0.327	0.154	0.154	
	1.0	0.365	0.173	0.327	
	1.5	0.396	0.190	0.518	
	2.0	0.428	0.206	0.724	
Top of embankment	2.5	0.460	0.222	0.946	
	3.0	0.493	0.238	1.184	
	3.5	0.526	0.255	1.439	

[1] based on 2018 LiDAR-derived digital elevation model

Hydro ID: **CO_302_Pond**

Pond rating curve based on:

2018 LiDAR-derived digital elevation model

and field investigation

	Depth	Area [1]	Volume Inc.	Volume Cum.	Discharge [2]	
	ft	ac	ac-ft	ac-ft	cfs	
Pond bottom and principal spillway invert	0.0	0.320	0.000	0.000	0.0	20ft wide concrete weir
	0.5	0.380	0.175	0.175	18.7	
	1.0	0.439	0.205	0.380	53.0	
	1.5	0.481	0.230	0.610	97.4	
	2.0	0.523	0.251	0.861	149.9	
	2.5	0.561	0.271	1.132	166.9	overflow onto NM 528
Top of embankment	3.0	0.599	0.290	1.422	177.6	

[1] based on 2018 LiDAR-derived digital elevation model

[2] based on broad crested weir and culvert discharge, whichever is smaller

Broad crested weir	
L (ft)	20
C	2.65

Elevatior	Depth	Weir discharge
ft	ft	cfs
5141.5		
5142.0		
5142.5		
5143.0		
5143.5	0.0	0.0
5144.0	0.5	18.7
5144.5	1.0	53.0
5145.0	1.5	97.4
5145.5	2.0	149.9
5146.0	2.5	209.5
5146.5	3.0	275.4

NM528 culvert

Head	Culvert discharge
ft	
0.0	0
0.5	25
1.0	48
1.5	70
2.0	90
2.5	109
3.0	125
3.5	141
4.0	155
4.5	167
5.0	178

Hydro ID: **CO_401_Pond**

Pond rating curve based on:
2018 LiDAR-derived digital elevation model
and field investigation

			Volume	
	Depth ft	Area [1] ac	Incremental ac-ft	Cumulative ac-ft
Pond bottom and principal spillway invert	0.0	0.042	0.000	0.000
	0.5	0.068	0.027	0.027
	1.0	0.093	0.040	0.068
	1.5	0.107	0.050	0.118
	2.0	0.121	0.057	0.175
	2.5	0.135	0.064	0.239
	3.0	0.149	0.071	0.310
	3.5	0.161	0.077	0.387
	4.0	0.172	0.083	0.470
	4.5	0.186	0.090	0.560
	5.0	0.200	0.097	0.656
Top of embankment	5.5	0.217	0.104	0.761
	6.0	0.234	0.113	0.874
	6.5	0.251	0.121	0.995

[1] based on 2018 LiDAR-derived digital elevation model

Appendix C

Design Storm Model Results

Notes:

(1) Model results reported in this table are for the 100-year design storm without a depth-area reduction factor.

(2) Q_p and V values for ponds correspond to peak outflow and outflow volume, respectively. For detailed pond routing including peak inflow, peak storage and peak elevation values, please consult the HEC-HMS model.

Existing Conditions			
HMS ID	Area (mi^2)	Q_p (cfs)	V (ac-ft)
CO_101	0.098	125	8.8
CO_101_Pond	0.098	39	8.5
CO_101_R1	0.098	39	8.5
CO_102	0.032	54	2.8
CO_102_J1	0.284	245	27.7
CO_102_R1	0.284	245	27.7
CO_102_R2	0.340	270	30.1
CO_103	0.048	46	2.8
CO_103_J1	0.340	273	30.2
CO_103_J2	0.443	361	34.7
CO_103_R1	0.443	361	34.7
CO_103_R2	0.443	388	38.7
CO_104	0.011	12	0.5
CO_104_J1	0.443	388	38.7
CO_104_R1	0.000	28	4.0
CO_104_R2	0.000	28	4.0
CO_104_R3	0.000	28	4.0
CO_201	0.035	52	3.3
CO_201_Pond1	0.035	39	2.2
CO_201_Pond2	0.035	0	0.0
CO_202	0.007	17	0.7
CO_202_Pond	0.007	0	0.0
CO_300	0.050	108	5.8
CO_300_Pond	0.050	90	5.7
CO_301	0.009	25	1.0
CO_301_Pond	0.059	91	6.7
CO_302	0.019	56	2.5
CO_302_Pond	0.104	152	12.6
CO_303	0.027	45	3.4
CO_303_R1	0.104	152	12.6
CO_304	0.044	86	3.8
CO_401	0.021	48	2.5
CO_401_Pond	0.021	30	2.5
CO_501	0.055	82	5.8
CO_501_div	0.055	54	1.8
CO_501_R1	0.055	81	5.8
RioGrande	0.453	392	39.2

Notes:

(1) Model results reported in this table are for the 100-year design storm without a depth-area reduction factor.

(2) Q_p and V values for ponds correspond to peak outflow and outflow volume, respectively. For detailed pond routing including peak inflow, peak storage and peak elevation values, please consult the HEC-HMS model.

Developed Conditions			
HMS ID	Area (mi^2)	Q_p (cfs)	V (ac-ft)
CO_101	0.098	189	12.9
CO_101_Pond	0.098	66	12.5
CO_101_R1	0.098	66	12.5
CO_102	0.032	73	3.8
CO_102_J1	0.284	290	34.0
CO_102_R1	0.284	290	34.0
CO_102_R2	0.340	316	36.7
CO_103	0.048	63	3.6
CO_103_J1	0.340	322	36.7
CO_103_J2	0.443	447	43.2
CO_103_R1	0.443	446	43.2
CO_103_R2	0.443	475	48.1
CO_104	0.011	12	0.5
CO_104_J1	0.443	476	48.1
CO_104_R1	0.000	30	5.0
CO_104_R2	0.000	30	5.0
CO_104_R3	0.000	30	5.0
CO_201	0.035	74	4.7
CO_201_Pond1	0.035	71	3.6
CO_201_Pond2	0.035	0	0.1
CO_202	0.007	21	0.9
CO_202_Pond	0.007	0	0.0
CO_300	0.050	133	7.0
CO_300_Pond	0.050	112	7.0
CO_301	0.009	27	1.1
CO_301_Pond	0.059	116	8.1
CO_302	0.019	56	2.5
CO_302_Pond	0.104	166	13.9
CO_303	0.027	45	3.4
CO_303_R1	0.104	166	13.9
CO_304	0.044	87	3.9
CO_401	0.021	50	2.6
CO_401_Pond	0.021	33	2.6
CO_501	0.055	108	7.8
CO_501_div	0.055	78	2.9
CO_501_R1	0.055	108	7.8
RioGrande	0.453	480	48.6

Appendix D

Structure Capacities

This Document contains capacity analyses of culvert crossings in the Coronado watershed at major road crossings for the 100-year storm event. Please note that this analysis was performed for planning purposes only to establish approximate maximum allowable flow rates at each location. Culvert dimensions were measured during field visits in the winter of 2022/2023 and estimated in GIS using 2018 LiDAR-derived elevation data. Capacities were estimated using HY-8 software version 7.5. The analysis was based on the following assumptions:

- Culverts are free of sediment and debris unless otherwise noted in the data tables; actual capacities may be less than those reported due to sediment accumulation, vegetation, and debris caught at culvert entrances.
- For simplicity, downstream channels were assumed to be trapezoidal with a bottom width and slope equal to that of the culvert crossing and a Manning's value of 0.025.
- Overtopping of roadways was not modeled in HY-8. Maximum capacities correspond to maximum upstream water levels before flow starts overtopping the road or break out of the channel upstream of the crossing.

CO_01 (CO_101_Pond outlet and NM 528)

BA_01, upstream.

Number of barrels	Diameter (in)	Material	Entrance
1	60	CMP [a]	Mitered to slope

[a] Corrugated metal pipe.

This culvert is tied directly to a storm drain system described in plan set: “Unit 20 Industrial Park Storm Drain Improvement Plans” (see SSCAFCA project file CO_P0004). According to the record drawings, the storm drain is designed for a peak flow rate of 70 cfs at the upstream end. The COWMP model indicates peak discharge at the culvert inlet of 39 cfs for existing conditions and 66 cfs for developed conditions.

CO_02 (CO_302_Pond outlet and NM 528)

CO_02, upstream

CO_02, downstream

Number of barrels	Height (in)	Width (in)	Material	Entrance	Length (ft)	Slope (ft/ft)	Allowable headwater (ft)
4	29	42	CMP [a]	Headwall	180	0.008	3

[a] Corrugated metal pipe.

Crossing Data - Coronado

Crossing Properties

Name: Coronado

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	Minimum, Design, and Maximum	
Minimum Flow	50.000	cfs
Design Flow	178.000	cfs
Maximum Flow	300.000	cfs
TAILWATER DATA		
Channel Type	Trapezoidal Channel	
Bottom Width	10.000	ft
Side Slope (H:V)	5.000	_:1
Channel Slope	0.0050	ft/ft
Manning's n (channel)	0.025	
Channel Invert Elevation	5141.000	ft
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.000	ft
Crest Length	260.000	ft
Crest Elevation	5147.500	ft
Roadway Surface	Paved	
Top Width	130.000	ft

Culvert Properties

NM528_at_Pond_302

Add Culvert

Duplicate Culvert

Delete Culvert

Parameter	Value	Units
CULVERT DATA		
Name	NM528_at_Pond_302	
Shape	Pipe Arch	
Material	Steel or Aluminum	
Size	Define...	
Span	42.000	in
Rise	29.000	in
Embedment Depth	0.000	in
Manning's n	0.025	
Culvert Type	Straight	
Inlet Configuration	Headwall	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	ft
Inlet Elevation	5142.500	ft
Outlet Station	180.000	ft
Outlet Elevation	5141.000	ft
Number of Barrels	4	

Help | Click on any icon for help on a specific | Low Flow | AOP | Energy Dissipation | Analyze Crossing | OK | Cancel

Summary of Flows at Crossing - Coronado

Headwater Elevation (ft)	Total Discharge (cfs)	NM528_at_Pond_302 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5143.89	50.00	50.00	0.00	1
5144.29	75.00	75.00	0.00	1
5144.67	100.00	100.00	0.00	1
5145.13	125.00	125.00	0.00	1
5146.07	150.00	150.00	0.00	1
5147.37	175.00	175.00	0.00	1
5147.50	178.00	177.41	0.04	48
5147.65	225.00	180.11	44.46	6
5147.70	250.00	180.62	68.83	4
5147.74	275.00	181.59	93.16	4
5147.78	300.00	182.32	116.93	3
5147.50	177.38	177.38	0.00	Overtopping

CO_03 (Coronado Arroyo & Sheriff's Posse Road)

CO_03, upstream with a flood of tumbleweeds. A concrete wall blocks upstream flows from entering the cell on the right.

CO_03, downstream

Number of barrels	Height (ft)	Width (ft)	Material	Entrance	Length (ft)	Slope (ft/ft)	Allowable headwater (ft)
1 [b]	6	8	CBC [a]	Headwall	42	0.014	2

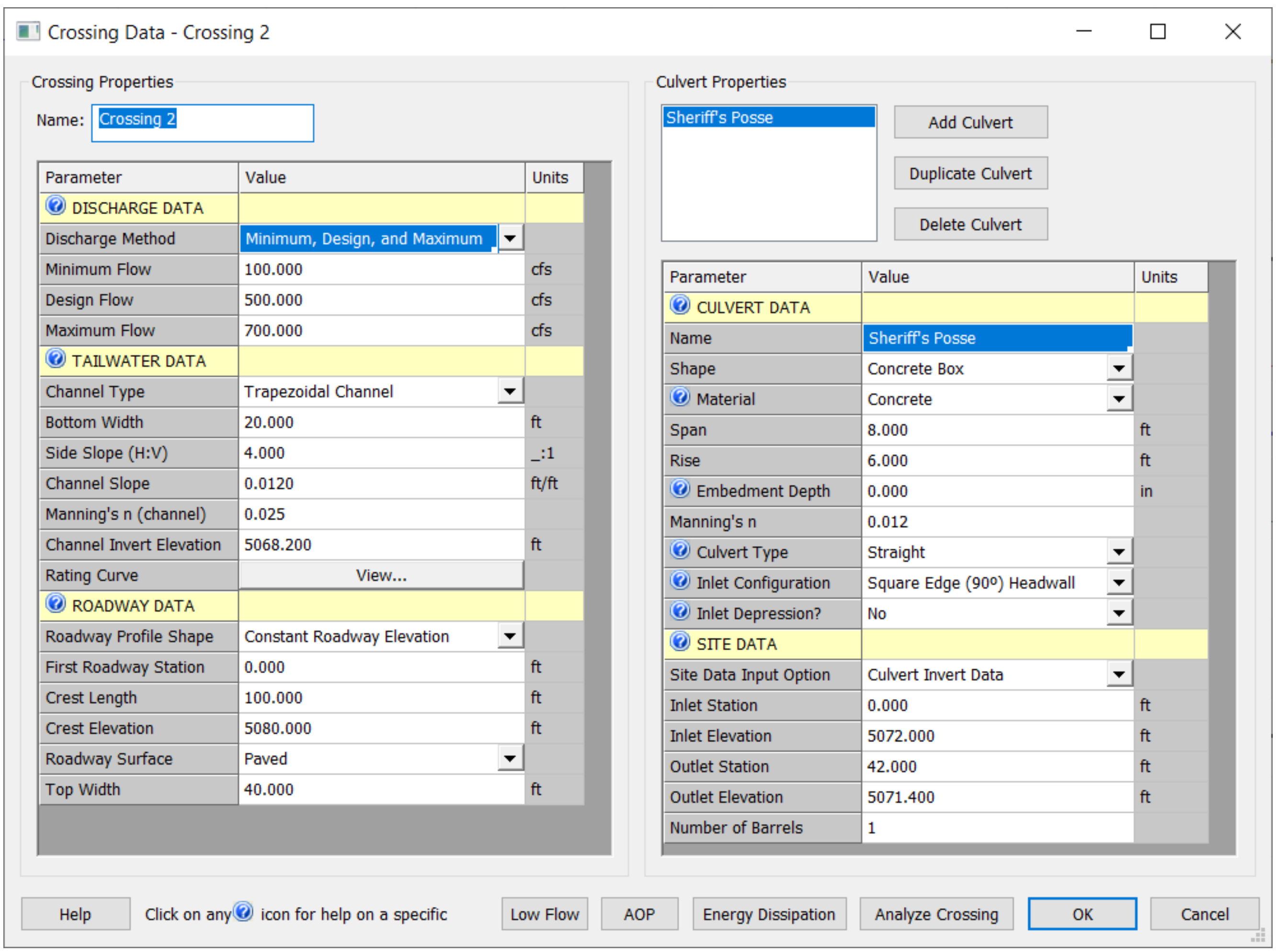
[a] Corrugated metal pipe.

[b] The crossing structure originally consisted of two 6-ft high by 8-ft wide concrete box culverts (CBC); as part of the Bosque de Bernalillo Phase II project, flow through the cell on the right was blocked at the upstream end with a 6-ft tall concrete wall. This was done to prevent clogging of the diversion pipe (located just downstream of the crossing) that channels low flows from subbasin CO_501 into the water quality structure (Bosque de Bernalillo Phase I).

Estimated maximum flow through the left culvert is 440 cfs. This exceeds the developed conditions peak discharge of approximately 447 cfs at this location. However, the barrier blocking the right CBC cell is open at the top and would allow flow to enter the right CBC barrel if flow depth at the upstream end exceeded 6 ft. Using the broad crested weir equation to estimate flow over the wall, assuming a coefficient C = 3.2, length L = 21.5 ft, and head H = 2.0 ft:

$$Q = C\,L\,H^{\frac{3}{2}} = 3.2 \cdot 21.5 \cdot 2.0^{\frac{3}{2}} = 195\;cfs$$

The total capacity of the structure is therefore estimated at 635 cfs, sufficient to safely convey the developed conditions 100-year peak flow.



Summary of Flows at Crossing - Crossing 2

Headwater Elevation (ft)	Total Discharge (cfs)	Sheriff's Posse Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5074.87	100.00	100.00	0.00	1
5075.90	160.00	160.00	0.00	1
5076.80	220.00	220.00	0.00	1
5077.65	280.00	280.00	0.00	1
5078.50	340.00	340.00	0.00	1
5079.37	400.00	400.00	0.00	1
5080.12	460.00	447.77	12.08	7
5080.27	500.00	457.23	42.60	6
5080.51	580.00	471.20	108.60	5
5080.65	640.00	479.89	159.65	4
5080.79	700.00	487.79	211.87	4
5080.00	440.35	440.35	0.00	Overtopping

Appendix E

Review

External review: ESP Associates Inc.

No	Page	Review Comment	SSCAFCA Response
1	n/a	The draft WMP has been reviewed and comments have been saved within the pdf file. This file has been attached to the email response.	Comments from the WMP document and SSCAFCA responses are listed separately below (see comments 9-35)
2	n/a	Understanding that the goal of the WMP is to document improvements necessary to protect the public from a 100-year storm event, is there a need to analyze the 500-year event for emergency spillways that fall under the jurisdiction of SSCAFCA? This would reveal any emergency spillways that do not meet the expected capacity as outlined in the SSCAFCA Hydrology Manual.	SSCAFCA currently does not own or maintain any ponds in the Coronado watershed. Since the emergency spillway requirements are specific to SSCAFCA-owned and operated facilities, the 500-year event was not included in this analysis. The 500-year storm could easily be added to the model should the need arise in the future.
3	2-1	For the two reaches that use a circular shape channel, please note that this shape is not supposed to be used to represent pressure flow or pipe networks, such as CO_101_R1 and CO_501_R1. For planning purposes, this approximation may be acceptable.	The following statement was included in the text under section 2.2 (reach routing): "Please note that routing reaches containing storm drain (such as CO_101_R1 and CO_501_R1) may experience pressure flow. The HEC-HMS model can only simulate open channel flow conditions. Results for pipe routing should therefore be interpreted as approximations of real-world conditions."
4	n/a	Within the existing and developed conditions HEC-HMS basin models, CO_302_Pond outlets do not seem to be modeled appropriately. It appears that the only outlet modeled was the primary spillway. This spillway is 20-ft wide and free flows from the pond. This approach fails to consider the impacts of NM 528 to the east. It seems a more appropriate approach would likely ignore the primary spillway and model the more restrictive culverts listed in the WMP as 4 elliptical CMPs (42 in wide and 30 in tall). Additionally, the highest elevations along NM 528 could be modeled as a spillway to reflect any flow not captured by the culverts.	Based on this comment, we have revised pond routing for CO_302_Pond. We computed a stage-discharge curve for the principal spillway (using the broad-crested weir equation based on a width of 20 ft and a discharge coefficient C=2.65). We then calculated a rating curve for the culvert crossing (4 elliptical CMPs).Outflow from the pond for a given stage was modeled using the smaller of the two values. During low stages (less than approximately 2.0 ft depth in the pond), the concrete weir controls outflow, while the culvert crossing control outflow when ponding depth exceeds 2.0 ft. This leads to runoff spilling onto NM 528 under developed conditions. A new section (2.12.4) discussing this issue was added to the revised report.

No	Page	Review Comment	SSCAFCA Response
5	n/a	The spillway width for CO_101_Pond does not seem to match aerial imagery. From aerial imagery, the spillway width seems to measure at 15-ft across, but it is modeled at a 7-ft length. Please verify this dimension. Additionally, this may increase the flow to the downstream storm drain. Comment 3 discusses the concern for representing storm drains as circular channels in HEC-HMS, so the capacity of the storm drain may need to be considered for whether the model reasonably represents planning level flows.	Grading of CO_101_Pond was modified with redesign of the intersection of US 550 and NM 528, and the pond outlet structure was rebuild as a 7-ft wide concrete weir. Those changes are not reflected in the orthophoto used to produce the exibits contained in the first draft of the Coronado WMP. The capacity estimate of the storm drain system downstream of the CO_101_Pond outlet was based on record drawings rather than HEC-HMS model resuls.
6	n/a	The WMP describes the CO_401_Pond outlet pipe as a ductile iron pipe. This is modeled with a CMP chart and scale and manning's n-value, but a ductile iron pipe might be better represented with n-values closer to concrete (approx. 0.012).	Outlet parameters have been changed to Chart 1: Concrete Pipe Culvert with an associated Manning's n-value of 0.012.
7	n/a	Basin delineation for CO_103 is consistent with the DEM provided, but does not seem to match the most recent Bosque de Bernalillo Phase II project. From section 2.1 of the WMP, it seems the intent was to use the DEM and only field verify areas where the DEM was not clear, so this is understandable. The change in hydrologic parameters would likely be insignificant, but may bring up questions later in the review process.	The boundary of subbasin CO_103 has been modified as indicated in the comment based on most recent orthoimagery. This increased subbasin size by 0.0006 mi^2. The text, models and appendices have been updated accordingly.
8	n/a	It is possible that the reach routing length values for CO_102_R1 and CO_102_R2 have been switched. Difficult to tell from the data provided, but the refined channel following the Bosque de Bernalillo Phase II project measures right around 1,000 feet in length (the length used for the upstream CO_102_R1 reach), while the upstream reach measures closer to the 885 feet modeled for CO_102_R2. At the same time, the trapezoidal channel shape selected for CO_102_R2 matches the measured bottom width of the Bosque de Bernalillo Phase II project channel.	Reach routing parameters for reaches CO_102_R1 and CO_102_R2 have been adjusted based on the newest orthoimagery, which became available after the draft report was written, and record drawings for the Bosque de Bernalillo Phase II project.
9	Title page	Update month as needed once complete.	Month will be updated to reflect SSCAFCA Board approval date once review process is complete.
10	i	Chapter 3 should re-start numbering with 3-1	Page numbering for chapter 3 has bee corrected.

No	Page	Review Comment	SSCAFCA Response
11	i	Update month in footer as needed as well.	Month will be updated to reflect SSCAFCA Board approval date once review process is complete.
12	1-1	Can remove hyphen from "1% chance-storm"	Hyphen has been removed
13	1-2	Labels are placed beneath the polygons representing the jurisdictional boundaries, and may look better moved in front of these features.	Labels have been modified accordingly.
14	Table 1.1	The depth column has gotten shifted so far left it doesn't read as part of the "Typical Profile" section of the table.	The table has been re-formatted to improve readability.
15	2-1	Change drain to plural "drains".	The text has been changed accordingly.
16	2-1	For the reach routing section, there was no discussion on the shape of channel used. Have used 8-point XS in the past but used Trapezoid and Circular channels here and may want to add a statement on that.	The following statement has been added to the reach routing section: "Circular and idealized trapezoidal cross-sections were used to simulate open channel flow."
17	Table 2.2	Associate should be "associated".	Typo has been corrected.
18	2-5	"units per acre"	Typo has been corrected.
19	2-7	Arroyo de la Barranca	Typo has been corrected.
20	2-7	Within this section, consider using HMS element names here (e.g. CO_300_Pond, CO_301_Pond, etc.)	All instances throughout the report where the text refers to an element of the HMS model have been modified to reflect the exact HMS element name.
21	2-7	Possibly revise to "the existing storm drain".	Revision has been incorporated.
22	Figure 2.4	Consider moving this figure after it is mentioned in the report (so it would be pushed back one page).	Figure placement has been revised accordingly.
23	2-10	Add commas at either end of "located on the north bank of the Coronado Arroyo".	Commas have been added.
24	2-10	Refer to this as its element name "CO_301_Pond, at the corner of NM 528 and Jager Way, is at..."	Recommendation has been incorporated.
25	2-11	"through"	Typo has been corrected.
26	2-13	This could just be a printing error, but text on this page almost looks bold compared to other pages.	Verified that text on the corresponding page is not bold.
27	Figure 2.8	Consider moving these arrows to point more directly to their intended reference points.	Arrows have been modified.
28	2-14	Unless the signature page will spell out who is in responsible charge for this plan, it may be better to state that "SSCAFCA, therefore, does not propose to delineate LEE..."	A statement explaining why LEE were not delineated for this watershed has been added to the report.
29	3-16	Page numbers need to start at 3-1.	Page number formatting has been corrected.
30	3-19	Remove comma.	Comma has been removed.

No	Page	Review Comment	SSCAFCA Response
31	3-20	For the rest of the document, the text seems to have changed. Could just be an issue with the print to PDF software.	The cause for this must lie in the export from word to pdf; care will be taken when exporting the final version of the report.
32	3-20	Bosque "de" Bernalillo	Typo has been corrected.
33	3-22	Northeast does not need a hyphen.	Hyphen has been removed.
34	3-22	Misspelling "trash"	Typo has been corrected.
35	3-22	Is this a note to remove before finalizing the plan? If not, then maybe reword as mentioned in the LEE section.	The corresponding section of the report has been removed.

Agency review: SSCAFCA, City of Rio Rancho, Town of Bernalillo, Sandoval County

No	Page	Review Comment	SSCAFCA Response
1	1-2	Does the area [north of the Coronado Arroyo] even discharge to SSCAFCA due to the Pueblo's retention ponds?	The area in question does not discharge to the Coronado Arroyo during storms up to the 100-year event due to retention ponds installed by Santa Ana pueblo. During a larger event, any overflow from the pond would spill into the Coronado Arroyo; the areas was therefore included in the model.
2	1-2	add: "… except for the area within the Pueblo of Santa Ana boundary."	This addition as been incorporated.
3	2-7	change "subdivision" to "commercial and industrial development.	Change has been made.
4	2-10	C-501 drains directly to the water quality oxbow east of Sheriff's Posse road. The storm drain empties into the south barrel of the crossing structure and the south barrel is cut off from upstream flows.	Figures in the report have been updated to reflect those drainage patterns (see Figures 2.1 and 2.4). Additionally, the diversion of flow at the Sheriff's Posse Road box culvert through the water quality structure has been included in the HEC-HMS model.
5	2-10	Does the Walmart parking lot drain to the water quality feature?	We have verified that the basin boundaries are correct, the Walmat parking lot does not drain to the Coronado Arroyo.
6	2-14	Lateral Erosion Envelopes (LEEs) are typically calculated in areas where the 100-year storm event exceeds 500 cfs. As most of the Coronado Arroyo watershed is below 500 cfs during this storm event, LEEs have not been calculated for this watershed. The absence of a LEE designation does not mean the property will not be affected by erosion.	This statement has been added.
7	3-18	Should modification of CO 101 pond (as part of the US550-NM528 interchange project) be included as Section 3.1.3? With the project, the pond was regraded to accommodate a curve of the southbound merging lane. It can be discussed in the pond section of the document instead. I think the field measurement/rating table for Pond CO_101closely matches with the WHPacific's drainage analysis report.	Discussion of pond regrading and outlet structure modifications has been included in the revised manuscript under section 2.9 (Existing Ponds), along with a reference to the appropriate report. Since this regrading of the pond occurred after 2018 (the year of SSCAFCA's latest lidar data acquisition), pond routing was modified and uses the stage-storage-discharge information contained in the report.

No	Page	Review Comment	SSCAFCA Response
8	3-19	"Ownership of this important drainage feature should be transferred to a public entity" verify statement	The statement has been rephrased as follows: "Regardless of ownership, this channel must continue to convey stormwater at the level identified in this document."
9	3-22	Quality of Life (QOL) - The QOL Master Plan ends with the Venada watershed, therefore, a QOL Section is not required for the Coronado WMP.	QOL section has been removed.
10	1-2	The map boundaries are accurate for TOB	The jurisdictional boundary map (Figure 1.1) has been finalized.
11	2-3	Section 2.5 suggested revision of line 5 to read… “We acknowledge that the underlying land development assumptions may change therefore, the plan should be updated regularly.”	This proposed change has been incorporated.
12	2-3	Revise last sentence since it slightly runs on.	The sentence has been revised (split into two).
13	2-4	Bullet #3… the word “acre” is spelled incorrectly.	Typo has been corrected.
14	2-15	Section 2.13, add the word “However,” before the last sentence.	This change has been incorporated.
15	3-7	Bullet #1 mid-page, spell out City of Rio Rancho (instead of CoRR) or provide acronym definitions elsewhere in document.	"City of Rio Rancho" has been spelled out, with the acronym in parentheses.
16	n/a	Include FEMA Flood Hazard Zones that exist within the watershed	Mapped FEMA flood zones for the study area have been included in Figure 2.5 and references in section 2.11.