Arroyo de la Barranca Watershed Park Management Plan

August 2022

Southern Sandoval County
Arroyo Flood Control Authority
(SSCAFCA)

Management Plan Revision History

Version	*Date*	*Title*	*Prepared by*	*Notes*
v.1	2006	La Barranca Watershed Management Plan	ASCG Inc.	Initial release
v.2	2010	Barranca Watershed Park Management Plan	WHPacific	Updated model from *AHYMO* to *HEC-HMS*
v.3	2022	Barranca Watershed Park Management Plan	SSCAFCA	Followed updated SSCAFCA *Hydrology Manual*

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.

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The Arroyo de la Barranca Watershed Park Management Plan was accepted by the SSCAFCA Board of Directors on 8/18/2022.

Dave Gatterman, P.E. (Executive Engineer) — Date: 8/18/22

James F. Fahey Jr. (Chair) — Date: 8/18/22

Concurrence:

City of Rio Rancho — Date: 9/6/22

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1. Introduction

The Arroyo de la Barranca Watershed Park Management Plan (BAWMP) 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 Barranca watershed was first prepared in 2006 (SSCAFCA, 2006) and updated in 2010 (SSCAFCA, 2010). The present plan updates the hydrologic conditions to reflect urbanization as of 2022. The hydrologic model and associated documentation were reviewed by ESP Associates. 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.

1.1. Location

The Barranca watershed consists of a 12.7 square mile drainage basin that discharges to the Rio Grande just north of the City of Albuquerque (Figure 1.1). The watershed lies completely within the City of Rio Rancho, as well as the jurisdiction of SSCAFCA.

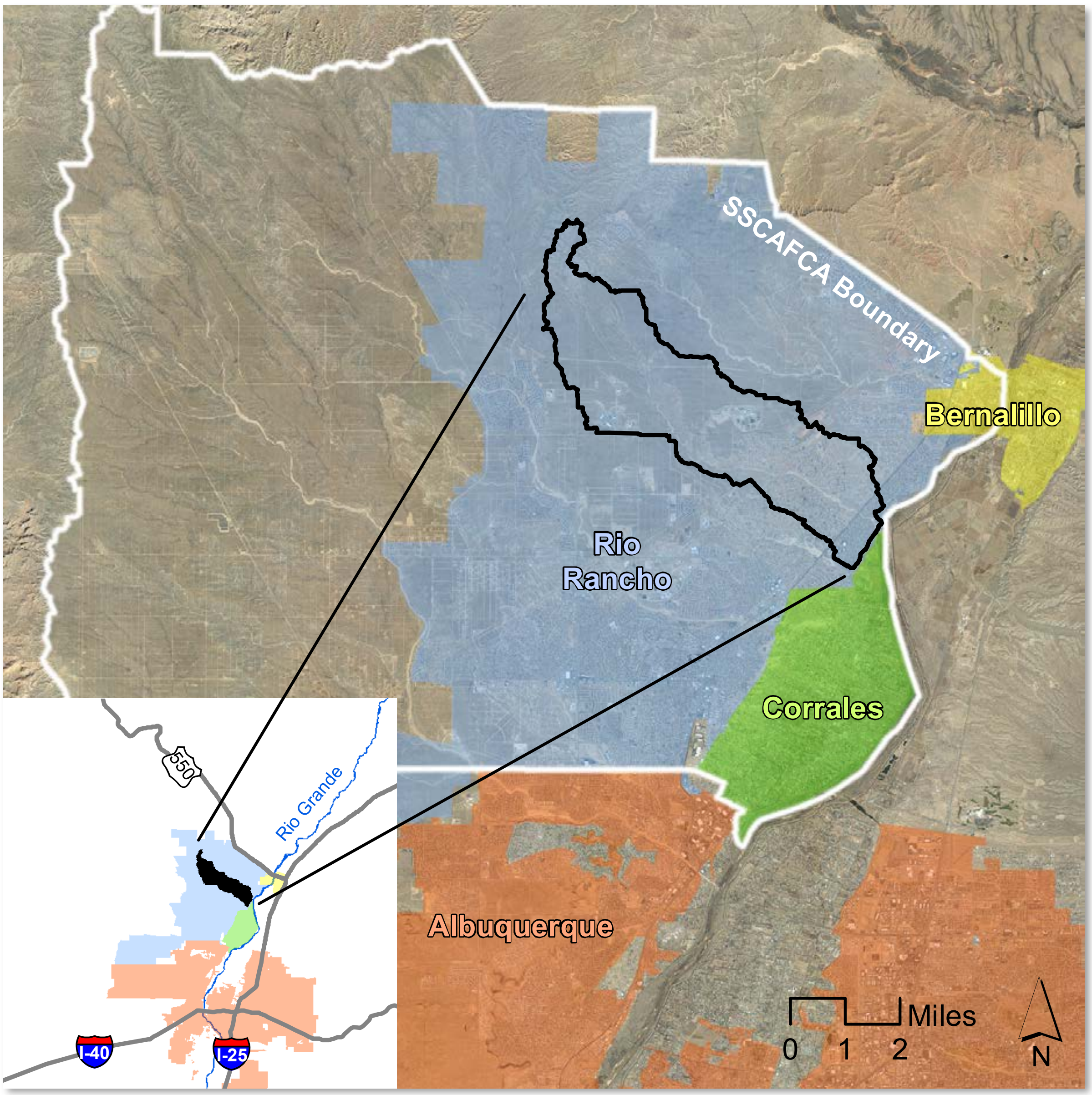

Figure 1.1: Overview map of the Barranca watershed and local municipalities.

1.2. Climate

The Barranca watershed is located west of the Rio Grande in the Middle Rio Grande valley, with elevations ranging from approximately 5,000 to 6,100 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, 2019).

Based on 1991-2020 climate normals (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.

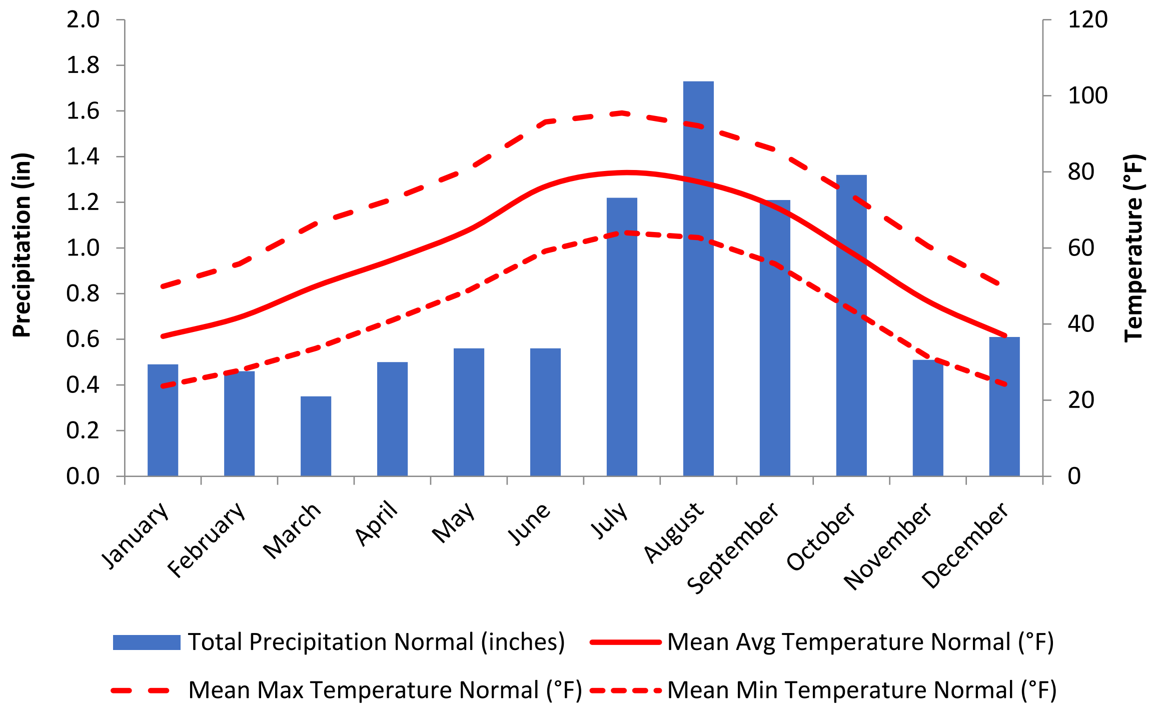

Figure 1.2: Monthly climate normal (1991-2020) for the Rio Rancho, NM area (source: NOAA, 2021).

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, 2019). 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. Much of the winter precipitation falls as snow in the mountains outside of the Barranca watershed.

1.3. Soils

According to the soil survey of Sandoval County (Hacker and Banet, 2008), near-surface soils in the Barranca watershed are predominantly sandy loams and loamy sands (Figure 1.3) and can be characterized as highly erosive. In some locations, sandy clay loams can be found starting at a depth of 7-33 inches.

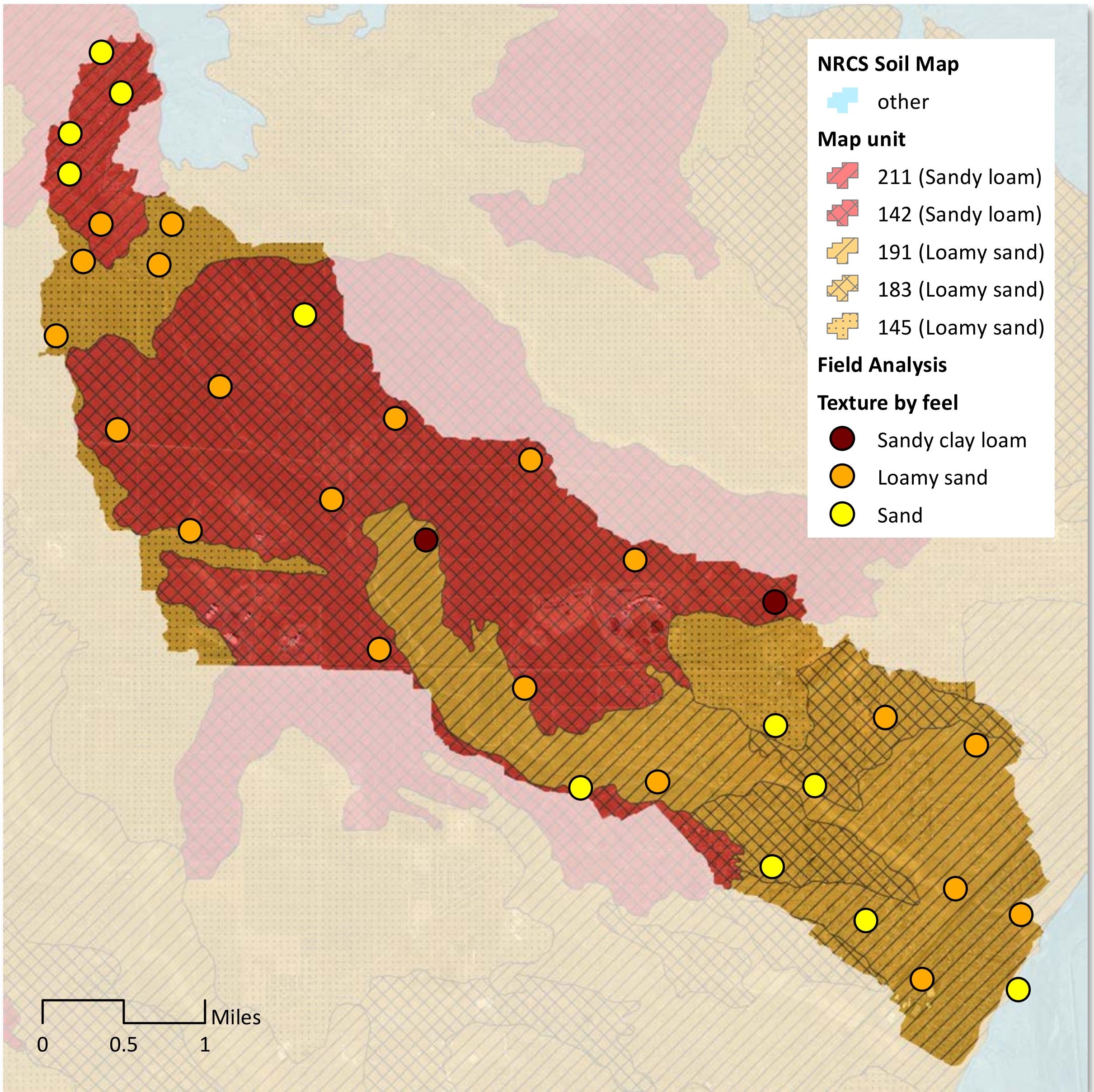

Figure 1.3: Near-surface soil textures found in the Barranca watershed based on NRCS soil map (shaded) and field assessment conducted by SSCAFCA at 33 sites (circles).

Table 1.1 shows descriptions and typical profiles for all soil map units found in the Barranca watershed. Soil texture of the upper 4 inches of the soil profile was analyzed by SSCAFCA staff in the field at 33 locations using the Natural Resources Conservation Service *Guide to Texture by Feel* method (NRCS, 2021). Results are represented as circles in Figure 1.3. The majority of near-surface soils fell into the loamy sand texture class.

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

Map Unit	Description	Typical Profile	
142	Grieta fine sandy loam, 1 to 4 percent slopes	0 to 11 in 11 to 48 in 48 to 60 in	fine sandy loam sandy clay loam loamy sand
145	Grieta-Sheppard loamy fine sands, 2 to 9 percent slopes	0 to 7 in 7 to 21 in 21 to 60 in	loamy fine sand sandy clay loam coarse sandy loam
183	Sheppard loamy fine sand, 8 to 15 percent slopes	0 to 60 in	loamy fine sand
191	Sheppard loamy fine sand, 3 to 8 percent slopes	0 to 60 in	loamy fine sand
211	Zia-Clovis association, 2 to 10 percent slopes	0 to 33 in 33 to 46 in 46 to 60 in	sandy loam sandy clay loam sandy loam

1.4. Vegetation and Wildlife

With elevations ranging from 5,000 to 6,100 feet, the study area features semi-desert shrub and grasslands. Few juniper trees (Juniperus spp.) can be found in the higher elevations along ephemeral channels and at the toe of hillslopes where they receive increased runoff. Typical shrubs include big sagebrush (Artemisia tridentata), and fourwing saltbush (Atriplex canescens). Grama grasses (Bouteloua spp.) form important understory forage plants (Allison and Ashcroft, 2011). Cacti (Oppuntia spp. and Cylindropuntia spp.) are also commonly found in the area. Distribution of plant species has been affected by a combination of over-grazing and drought over the past century (Allison and Ashcroft, 2011).

The Barranca watershed and its ephemeral channels provide habitat for a variety of animal species. Examples include the burrowing owl (Athene cunicularia) and bank swallow (Riparia riparia), both migratory species that nest in vertical arroyo banks.

1.5. References

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2. Watershed Hydrology

All hydrologic modeling was carried out using the U.S. Army Corps of Engineers *HEC-HMS* software version 4.7.1.

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 watersheds and sub-basins 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 *HEC Geo-HMS* software with 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 and proposed pond locations. Questionable boundaries were verified in the field, especially at locations where graded roads influence flow paths, and where a dominant flow path was not immediately obvious from the DEM. An overview map of basin boundaries can be seen in Figure 2.1; major tributaries are shaded in different colors.

2.2. Reach Routing

Routing reaches were delineated, and slopes estimated in *ArcGIS* based on the 2018 DEM. Roughness coefficients (Manning's n-values) were estimated based on orthoimagery and field investigations. The following n-values were used in the model (Table 2.1):

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

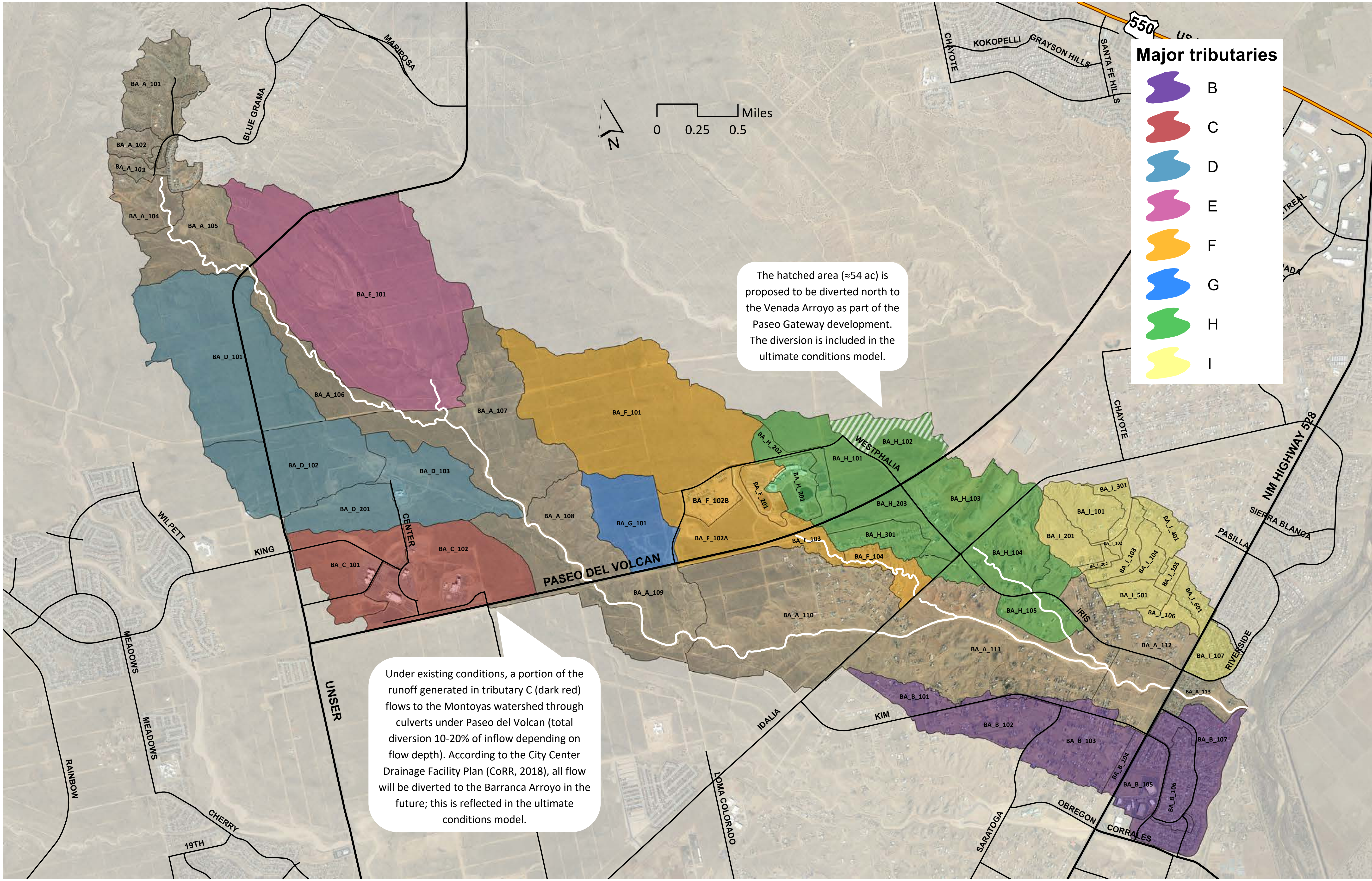

Figure 2.1: Subbasin overview map

Channel reaches with a clearly defined floodplain were modeled using 8-point cross sections. Figure 2.2 shows an example for one routing reach (BA_A_106_R2). Cross section data extracted from the DEM is displayed as a dotted black line, the idealized cross section is shown in red. 8-point cross sections were used along the mainstem of the Barranca Arroyo, as well as the lower sections of some of the major tributaries. All other routing reaches were modeled using idealized shapes that most closely resembled the natural geometry of the reach (trapezoidal and rectangular).

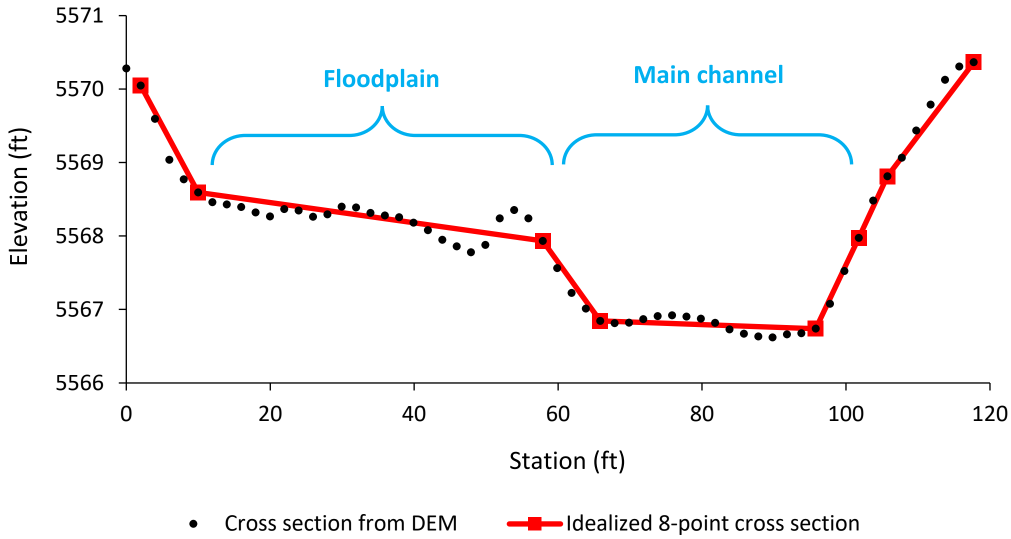

Figure 2.2: Example 8-point cross section, reach BA_A_106_R2.

2.3. Existing Land Use

The Barranca watershed lies entirely within the City of Rio Rancho (Figure 1.1), one of the fastest growing cities in the southwestern US. The city was incorporated in 1981 with a population of approximately 10,000 residents. Figure 2.3 shows population growth since 1980. The growth rate slowed following the housing market crash of 2008 but shows a substantial increase since 2019.

In 2022, a large portion of the Barranca watershed is undeveloped. Figure 2.4 shows the extent of urbanization and major land use categories. Urbanization is focused in the lower and central portion of the watershed. Most of the urban development consists of residential subdivisions (blue) and scattered residential development (purple). 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).

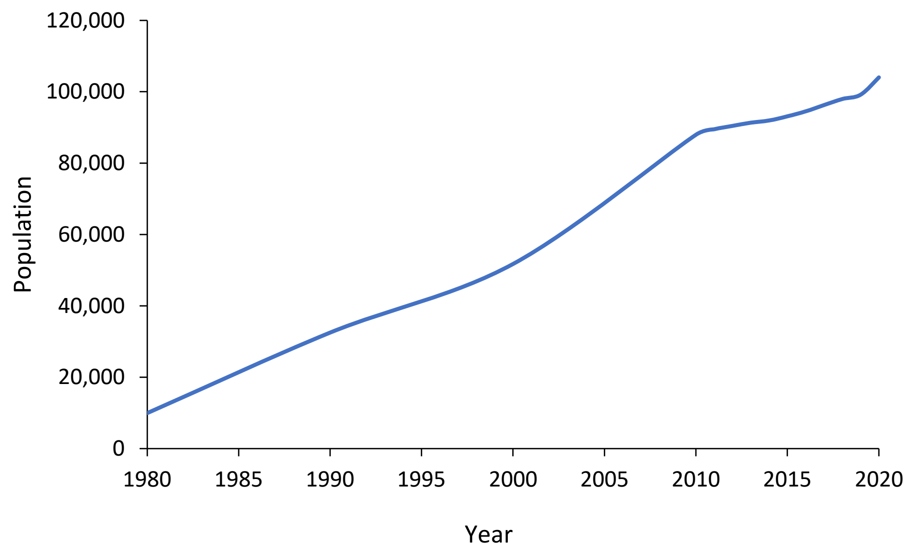

Figure 2.3: Population growth in the City of Rio Rancho. Data source: U.S. Census Bureau (https://www.census.gov/data.html).

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 2022 land use conditions in the Barranca Watershed (see Figure 2.4). Table 2.2 lists land use types and associated curve numbers. Although NRCS soil mapping (Figure 1.3) shows approximately half of the watershed is comprised of sandy loams and loamy sands, respectively, field investigation indicates that most of the near-surface soils are loamy sands. In accordance with SSCAFCA's *Hydrology Manual*, we therefore selected a curve number of 74 for open space and the undisturbed portion of residential yards on estate lots.

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

Land Use	Curve Number
Unconnected Impervious Area	98
Graded/ Disturbed	86
Unpaved Road	82
Park/Lawn	68
Residential Yard, Subdivision	80
Residential Yard, Estates Lot	74
Open Space	74

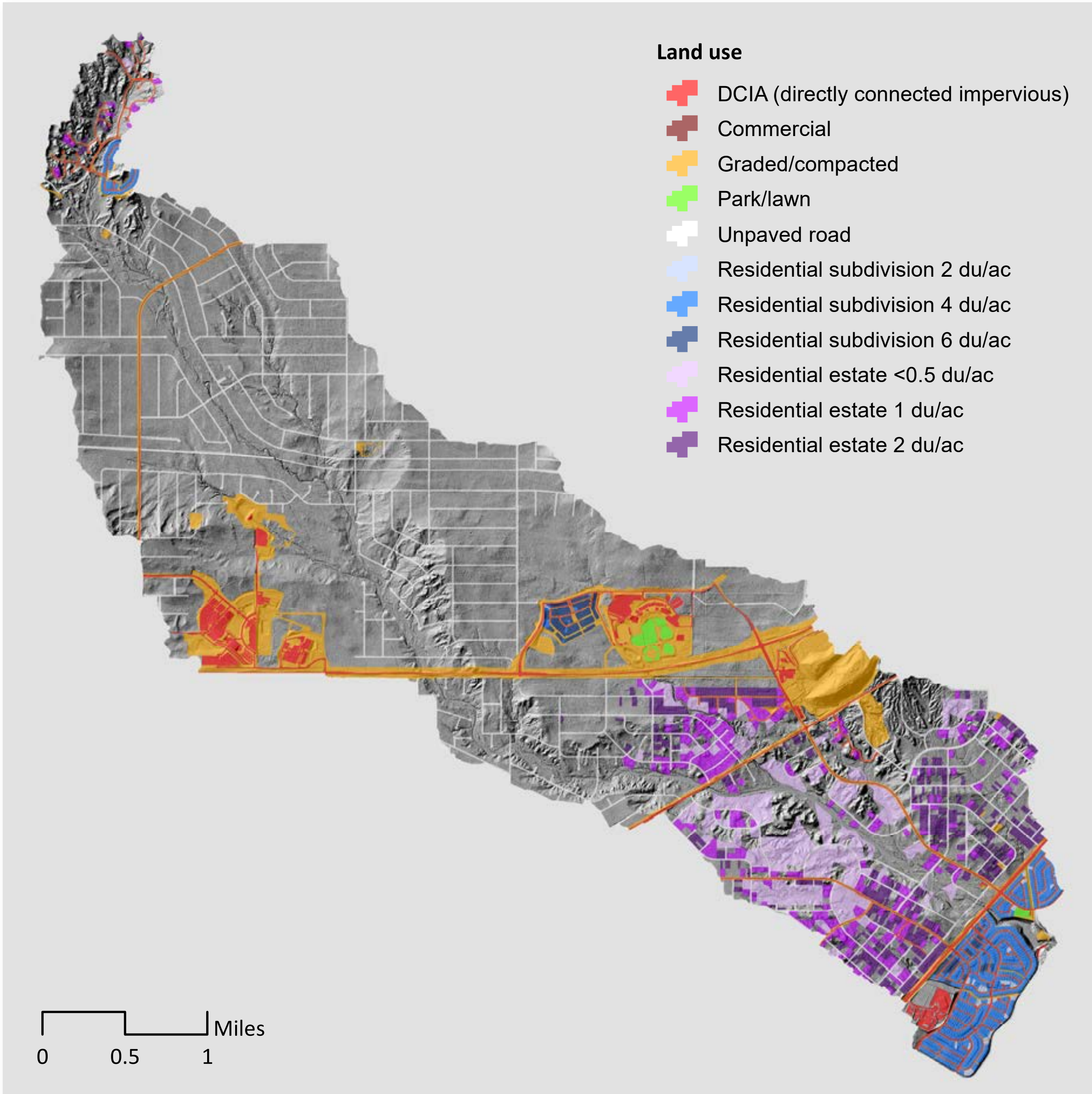

Figure 2.4: Overview map of the Barranca Watershed and major land use types in 2022.

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 2.4, red) were digitized manually.

Table 2.3 contains land use categories and corresponding loss model parameters for single family residential lots of varying sizes in the Barranca Watershed. Lots in subdivisions are distinguished from estate lots; the main difference is that subdivisions are mass-graded at the time of development. Due to the resulting soil compaction, the portion of each lot characterized as *residential yard* was therefore modeled with curve number 80. Estate lots, on the other hand, usually develop individually. We therefore determined the typical extent of disturbed area (compacted by driving, vegetation removed) and assigned it a curve number of 86. The remainder of residential yards was treated equivalent to open space (curve number 74). Land use percentages for different lot sizes reported in Table 2.3 were determined from a sample of developed properties in the Barranca Watershed. The driveway and 50% of the building footprint were assumed to be DCIA; the remaining 50% of the building footprint was modeled as unconnected impervious area (UIA, CN=98).

Table 2.3: Land use categories for single family residential lots in the Barranca Watershed.

	Building Footprint [a]	Driveway [b]	Disturbed [c]	Unconnected Impervious Area [d]	Residential Yard [e]	% DCIA	Composite CN
Subdivision 6du/ac	35%	7%	0%	4%	54%	25%	85
Subdivision 4du/ac	28%	5%	0%	4%	63%	19%	84
Subdivision 2du/ac	17%	3%	0%	4%	76%	12%	83
Estates 2du/ac	13%	3%	30%	3%	51%	10%	81
Estates 1du/ac	9%	1%	25%	2%	63%	6%	79
Estates <= 0.5du/ac	3%	1%	20%	1%	75%	3%	77

[a] 50% DCIA, 50% UIA; [b] 100% DCIA; [c] CN=86 [d] CN=98

[e] subdivision: CN=80; estate lots: CN=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. Nearly the entire Barranca watershed area has been platted and zoned, with most of the zoning comprised by single family residential lots held by a multitude of private owners. One of the challenges in planning for future flood control needs is that it is difficult to predict how areas will urbanize. If, for example, a sufficient number of adjacent lots can be accumulated by one private landowner to construct a master-planned subdivision, the developer is responsible for design and construction of drainage infrastructure to restrict peak flow to pre-developed conditions per City of Rio Rancho ordinance. Examples for master planned subdivisions include Cleveland Heights north of Paseo del Volcan, and Mariposa at the top of the watershed. Other areas urbanize one lot at a time when individual landowners construct houses on their property. This type of urbanization is typically less dense; at the same time, individual landowners are not required to construct public drainage infrastructure to support their development. Scattered development is widespread in Unit 17 in the lower portion of the watershed west of NM 528. 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; the plan should therefore be updated regularly. Future conditions models are used as a planning tool and help to identify potential areas of flooding and plan for appropriate mitigation strategies such as land acquisition and future drainage infrastructure needs. Two future conditions model scenarios are included in this plan: DEVEX (developed conditions existing infrastructure) assumes an urbanized watershed with existing drainage infrastructures as of the date of the report. The ultimate conditions model also assumes a fully urbanized watershed but includes proposed future drainage infrastructure.

Figure 2.5 shows a map of anticipated future land use in the basin. Land use projections for developed conditions were based on the following assumptions:

- Areas covered by specific area plans (SAP) or Master Plans (MP) will develop as indicated in the planning document, specifically: Sierra Vista SAP (CoRR, 2008), Paseo Gateway West SAP (CoRR, 2010a), La Barranca SAP (CoRR, 2010b), Paseo Gateway MP (CoRR, 2019), Mariposa MP (CoRR, 2002), and Campus Centre Master Plan (CoRR, 2006).
- The remainder of platted lots in the watershed will develop in accordance with current City of Rio Rancho zoning and the City's Comprehensive Plan (CoRR, 2010c).
- Land owned by SSCAFCA was assumed to remain open space.

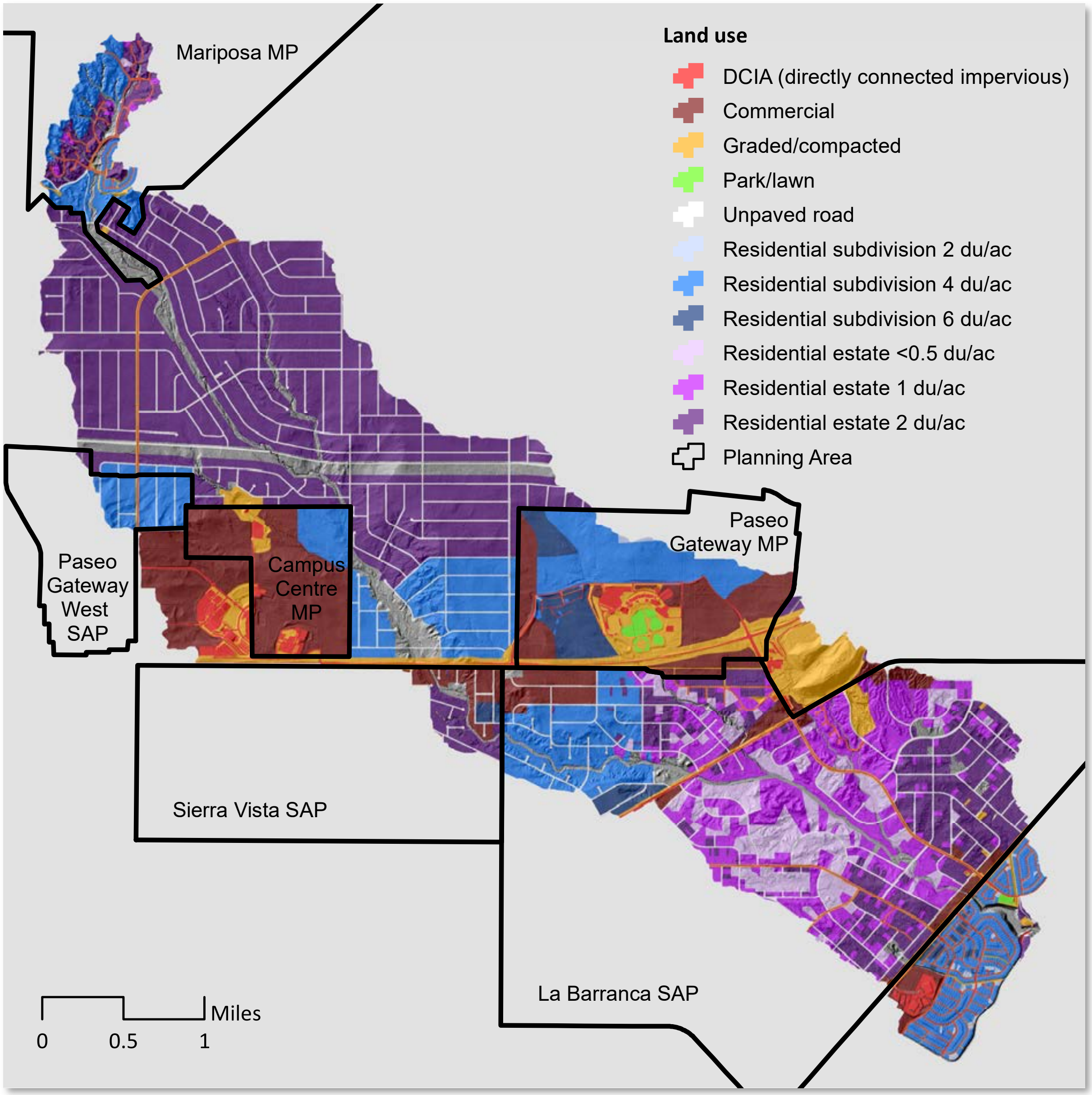

Figure 2.5: Anticipated future land use in the Barranca watershed.

2.6. Developed Conditions Loss Parameters

Loss parameters for the developed conditions hydrologic models were estimated based on projected future land use (see Figure 2.5). Table 2.4 shows land use categories and associated parameters for future commercial areas and residential development of varying densities. Composite curve numbers for each land use were calculated as an area-weighted average based on the percentages reported in Table 2.3 and CN-values from Table 2.2.

Table 2.4: Land use categories and associated loss parameters for single family residential lots.

Land Use	% DCIA	Composite Pervious CN
Commercial	85	86
Subdivision 6du/ac	25	85
Subdivision 4du/ac	19	84
Subdivision 2du/ac	12	83
Estates 2du/ac	10	81
Estates 1du/ac	6	79
Estates <= 0.5du/ac	3	77

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 averaged bulking factors were used for subbasins containing both urbanized and natural areas.

2.9. Existing Ponds and Diversions

The Barranca watershed model contains nine ponds that attenuate runoff ranging from less than 1 ac-ft to more than 33 ac-ft in storage volume (see Appendix B). Pond parameters and dimensions were collected from corresponding engineering documents and field investigation. A list of all ponds included in the model is contained in Appendix B. In *HEC-HMS*, pond routing was simulated using rating curves (elevation-storage and storage-discharge curves). Ponds were assumed to be dry at the start of each simulation. The model also contains one location with a flow split (see Figure 2.1): at the southern boundary of subbasin BA_C_102 a set of culverts (3 x 5.5 ft diameter reinforced concrete pipe) allows a portion of the runoff from basins BA_C_101 & 102 to flow south into the adjacent Montoyas watershed, while the majority of the runoff continues east along the north side of Paseo del Volcan and into the Barranca Arroyo. The flow split was modeled as a diversion in *HEC-HMS*. The inflow-diversion function was estimated based on the topography and a rating curve for the culvert. Depending on flow depth, it is estimated that 10-20% of the total discharge flows to the neighboring watershed at this point. According to City Center Drainage Facility Plan (CoRR, 2018), flow will be diverted to the Barranca Arroyo in the future; this is reflected in the ultimate conditions model.

2.10. Design Storm

In accordance with SSCAFCA policy, the 100-year 24-hour design storm was used to evaluate deficiencies in the Barranca watershed. It is a hypothetical storm event based on point precipitation frequency estimates from the NOAA Atlas 14 (NOAA, 2021). Precipitation estimates representative of the centroid of the Barranca watershed and are displayed in Table 2.5.

Table 2.5: Point precipitation frequency estimates for different recurrence interval and durations in the Barranca watershed.

	Point precipitation estimate (in)				
Duration	2-yr	10-yr	50-yr	100-year	500-year
5-min	0.227	0.364	0.511	0.579	0.747
15-min	0.428	0.687	0.964	1.090	1.410
1-h	0.713	1.150	1.610	1.820	2.350
2-h	0.819	1.300	1.830	2.080	2.720
3-h	0.874	1.360	1.900	2.150	2.810
6-h	1.000	1.520	2.080	2.340	2.980
12-h	1.120	1.660	2.220	2.480	3.100
24-h	1.290	1.880	2.500	2.790	3.460

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 DEVEX Conditions Results

Figure 2.6 shows design storm hydrographs at selected locations for existing land use conditions (black) and developed conditions with existing drainage infrastructure (DEVEX, red). 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.

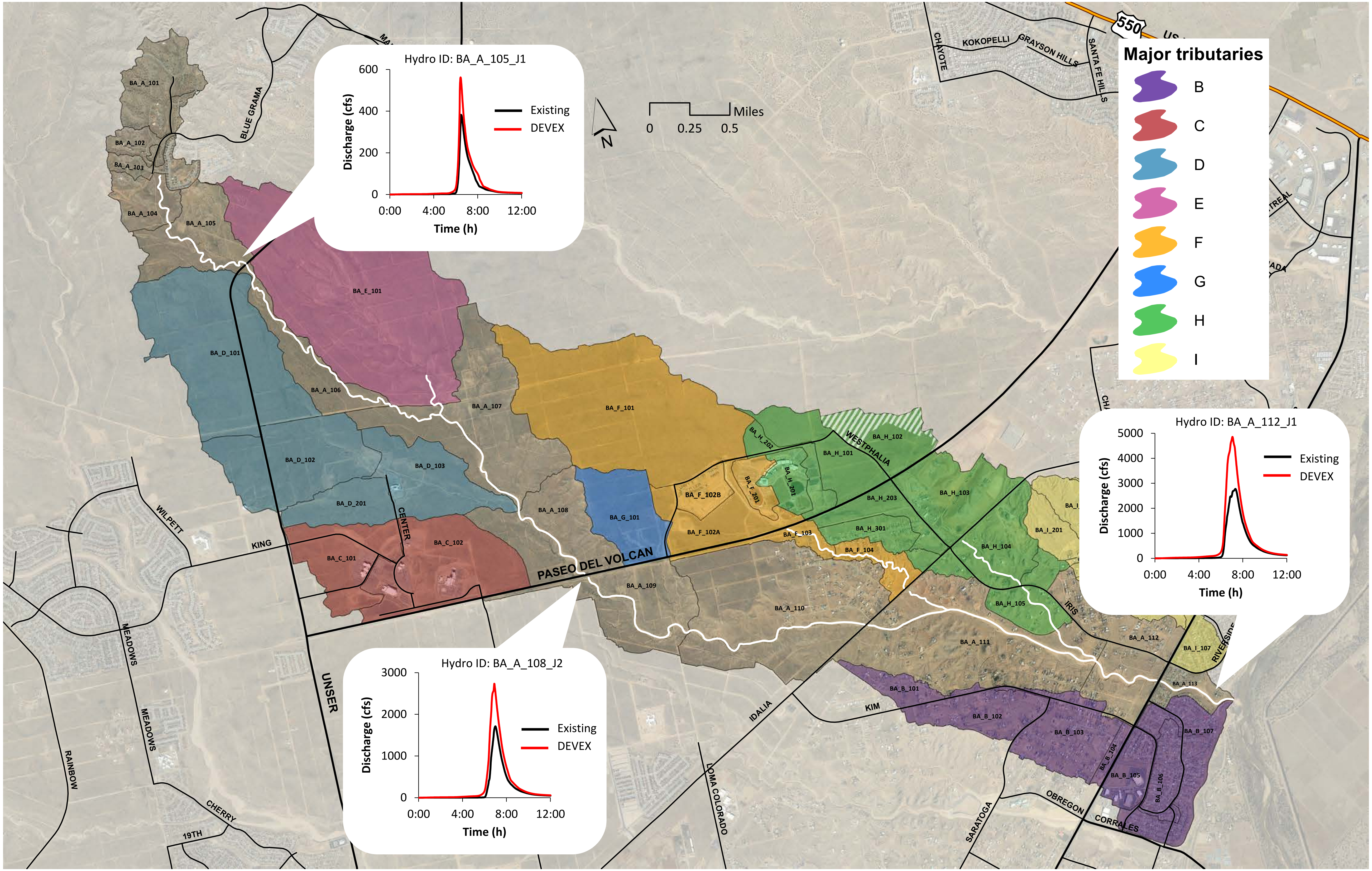

Figure 2.6: Runoff hydrographs resulting from the 100-yr design storm at selected analysis points for existing (black) and DEVEX (red) conditions.

2.12. Structure Capacities and Major Deficiencies

Structure capacities for major road crossings were analyzed based on existing and DEVEX conditions model runs. Results are summarized in Table 2.6. Figure 2.7 shows crossing structure locations.

Table 2.6: Major crossing structures, capacities and peak discharges under existing and developed conditions with existing infrastructure (DEVEX).

Crossing	Location	HMS_ID	Drainage Area (mi^2)	Existing Q_p (cfs) [a]	DEVEX Q_p (cfs) [a]	Capacity (cfs)
BA_01	Barranca Arroyo & Unser Blvd	BA_A_105_J1	1	383	562	370
BA_02	Barranca Arroyo & Paseo del Volcan	BA_A_108_J2	5	1712	2736	3880
BA_03	Barranca Arroyo & Idalia Rd	BA_A_110_J1	6	1975	3209	1190
BA_04	Barranca Arroyo & NM 528	BA_A_112_J1	10	2776	4856	3570
BA_05	Tributary B & NM 528	BA_B_104_J1	1	304	328	180
BA_06	Tributary B & Grande Vista Rd	BA_B_105_J1	1	347	401	180
BA_07	Tributary B & Sandia Vista Rd	BA_B_106_J1	1	448	489	240
BA_08	Tributary F & Paseo del Volcan	BA_F_102_J1	1	519	851	1380
BA_09	Tributary F & Idalia Rd	BA_F_104_J1	1	549	891	1800
BA_10	Tributary H & Idalia Rd	BA_H_103_J1	1	652	1024	540
BA_11	Tributary H & Iris Rd	BA_H_105_J1	1	906	1321	170
BA_12	Tributary I & NM 528	BA_I_106_J1	1	587	796	400
BA_13	Tributary I & Riverside Dr	BA_I_107_J1	1	701	919	240

[a] Flow rates from model runs with depth-area reduction factors corresponding to the drainage area contributing to each analysis point

blue	adequate capacity
green	< 10% exceedance
yellow	10-25% exceedance
orange	25-50% exceedance
red	> 50% exceedance

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 E). Shading in Table 2.6 indicates if structure capacity is sufficient (blue), or the severity of capacity exceedances (green to red). For analysis points with a contributing drainage area exceeding one square mile, depth-area reduction was applied by setting the storm area in the meteorological model equal to the corresponding drainage area (see drainage area, Table 2.6).

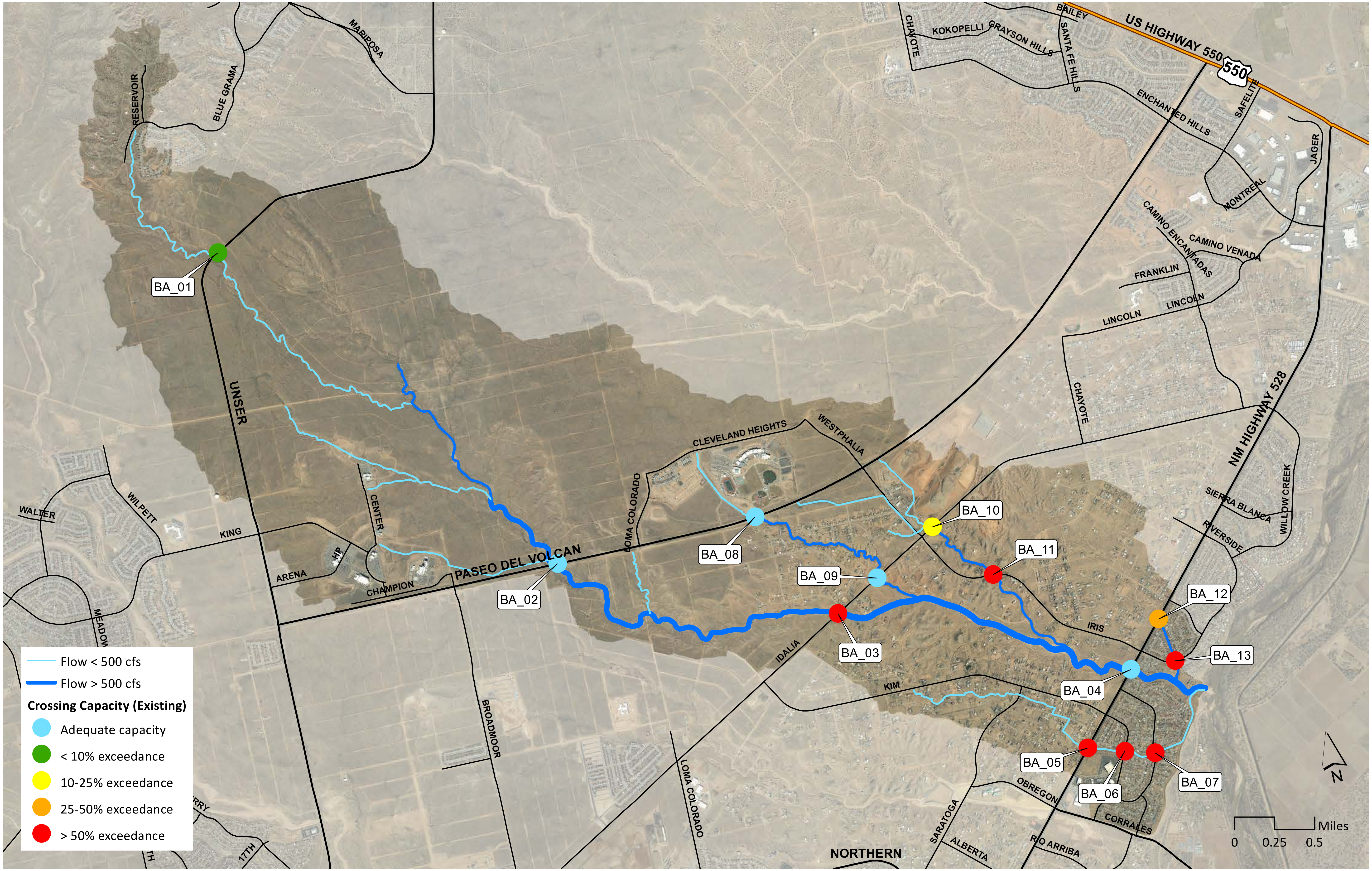

Figure 2.7: Major crossing structures and deficiencies in the Barranca watershed (Existing conditions).

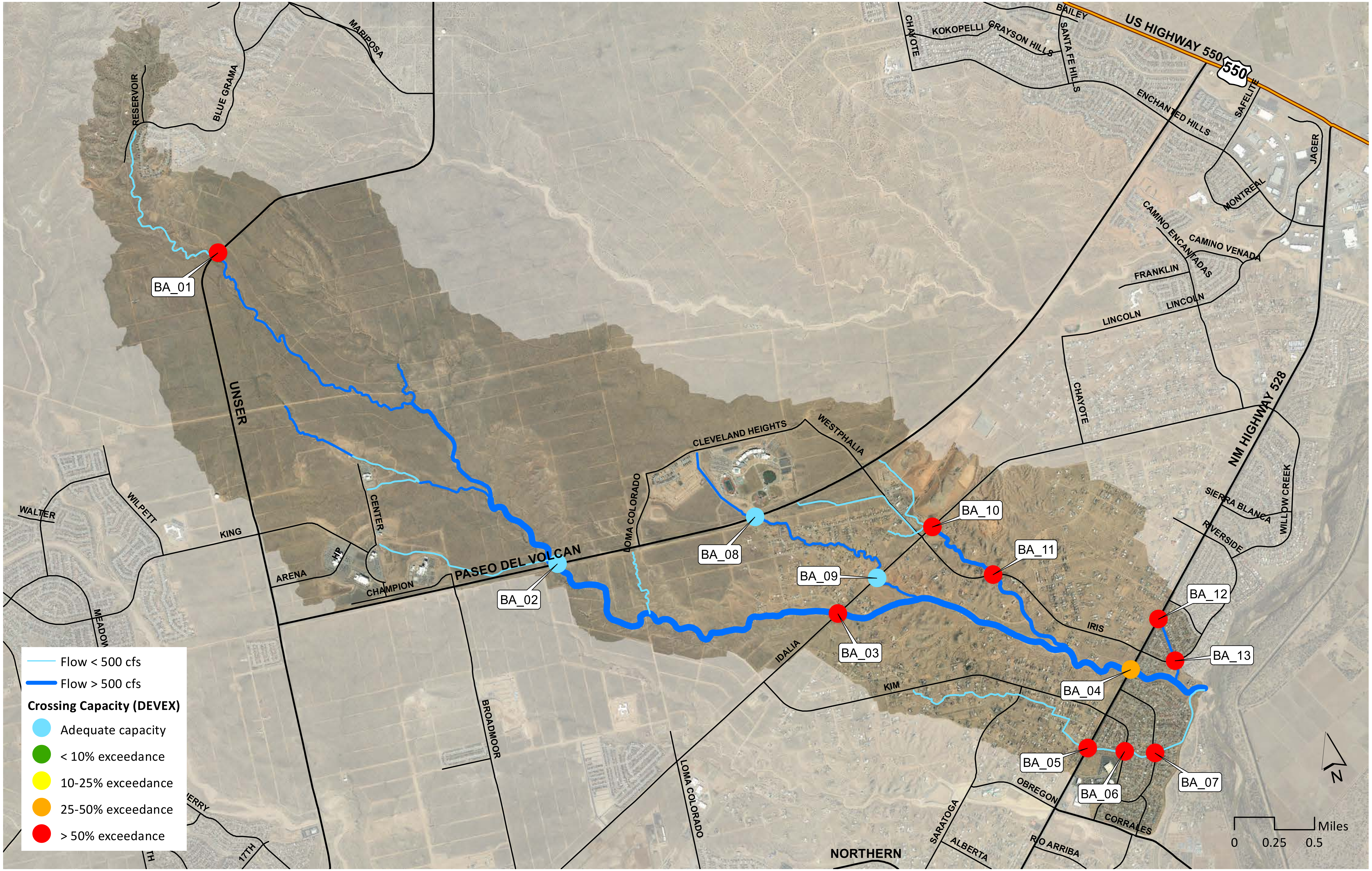

Figure 2.8: Major crossing structures and deficiencies in the Barranca watershed (DEVEX conditions).

In 2019, a Base Level Engineering (BLE) analysis was completed for SSCAFCA's jurisdictional area by ESP Associates, Inc. in coordination with the University of New Mexico's Earth Data Analysis Center under FEMA's Cooperating Technical Partners program. BLE studies are meant to help communities better predict their flooding risk using estimated base flood elevations.

Hydrologic and hydraulic computations and analyses of the BLE study consisted of determining excess precipitation amounts and calculating water surface elevations (WSELs) for the 10-year, 25-year, 50-year, 100-year, and 500-year storm events. Two-dimensional (2D) hydraulic models were developed for the project area using HEC-RAS version 5.0.7.

Although the 2D analysis can represent impacts from embankments and other features such as storage areas, no structures (i.e. dams, culverts, levees, etc.) were modeled in detail as part of the BLE analysis. SSCAFCA therefore contracted with ESP Associates to update the BLE model for the Barranca watershed by including culverts with 10% capacity exceedance or more for existing and/or DEVEX conditions.

Existing conditions inundation maps for ten culverts resulting from the 100-year storm are included below. The full report including inundation maps for DEVEX conditions at each structure is contained in Appendix F.

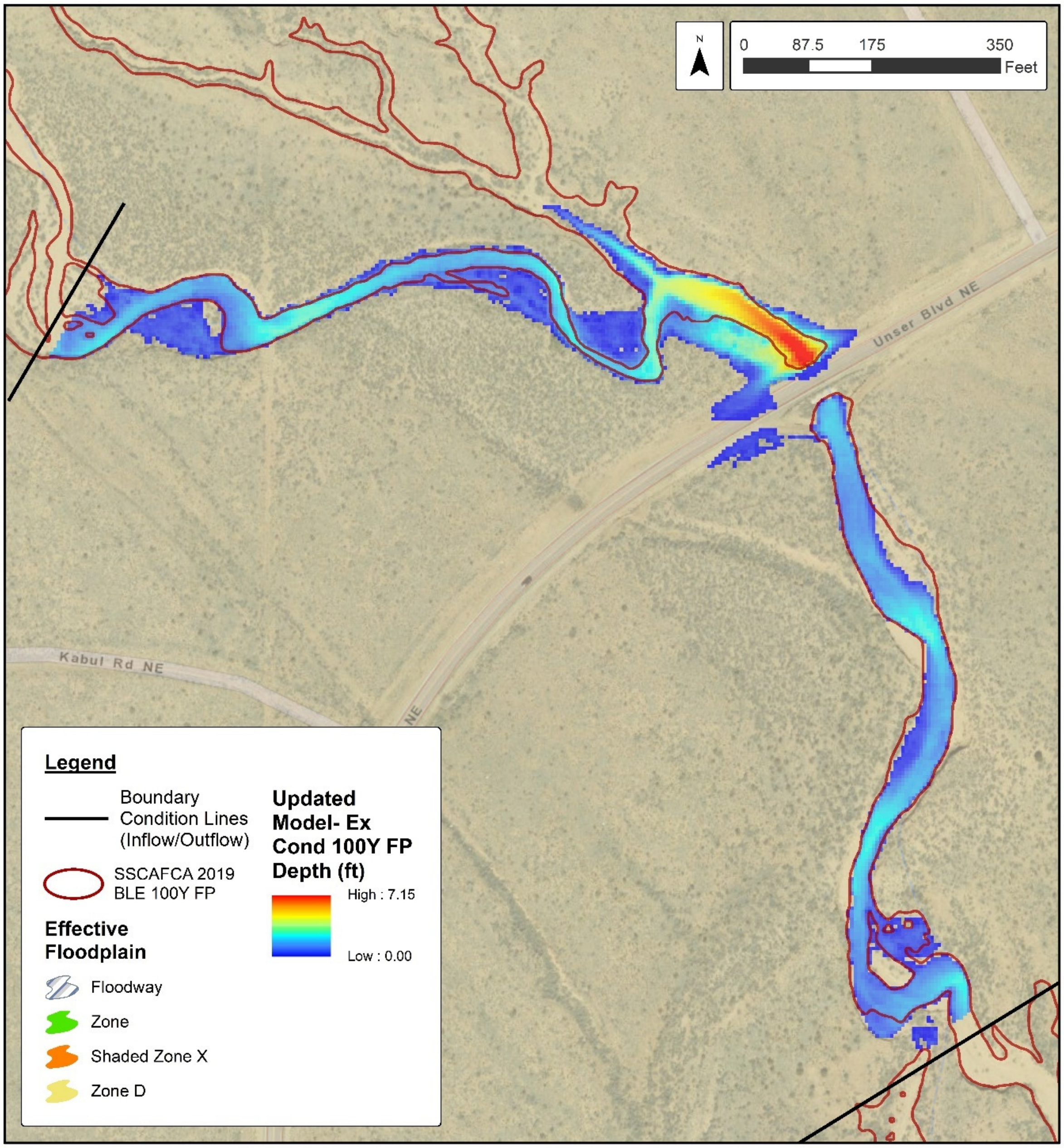

Figure 2.9: Flooding as a result of the 100-year storm in the vicinity of structure BA_01 (Barranca Arroyo and Unser Blvd.) under existing conditions (Barranca main stem).

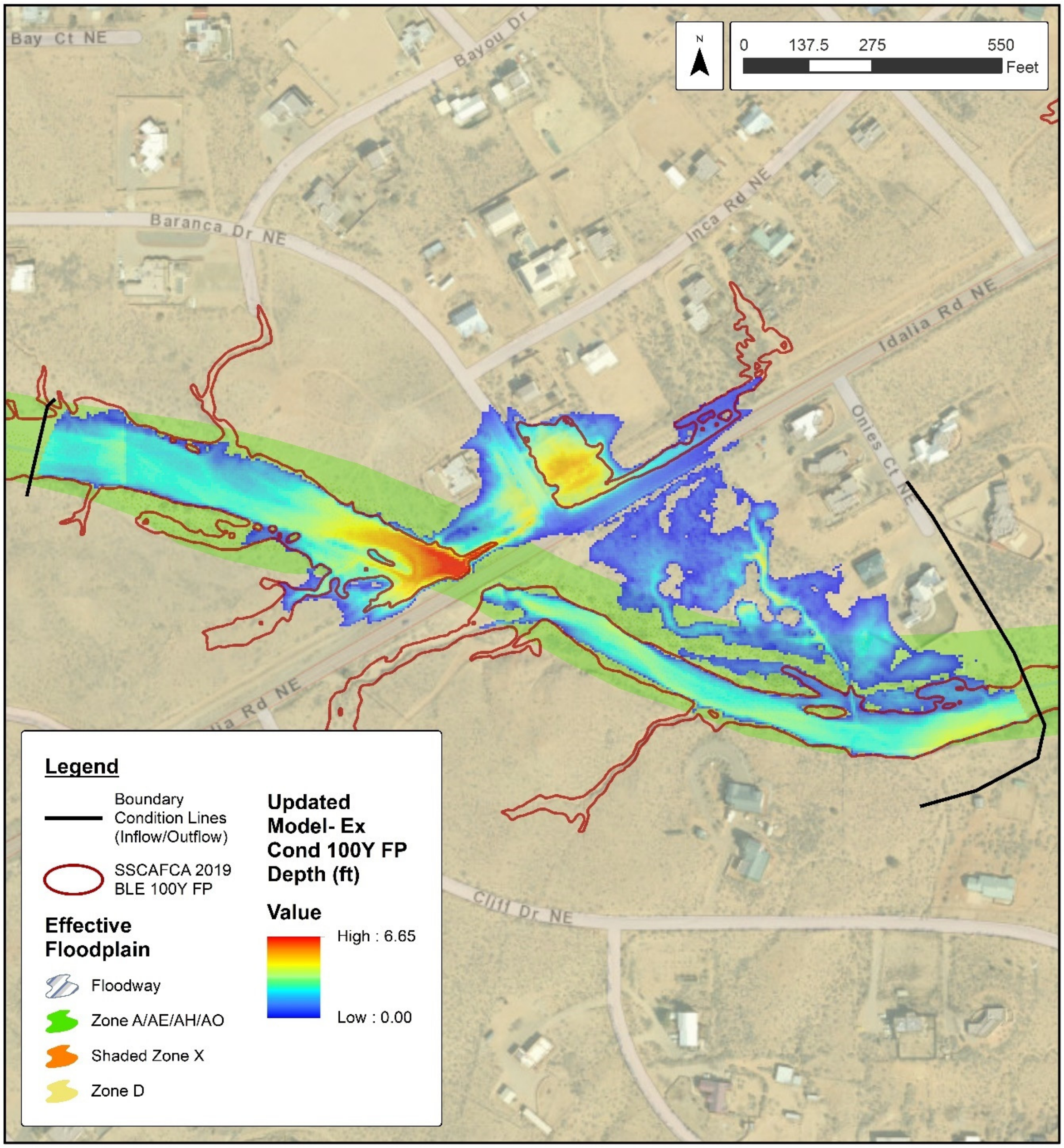

Figure 2.10: Flooding as a result of the 100-year storm in the vicinity of structure BA_03 (Barranca Arroyo and Idalia Blvd.) under existing conditions (Barranca main stem).

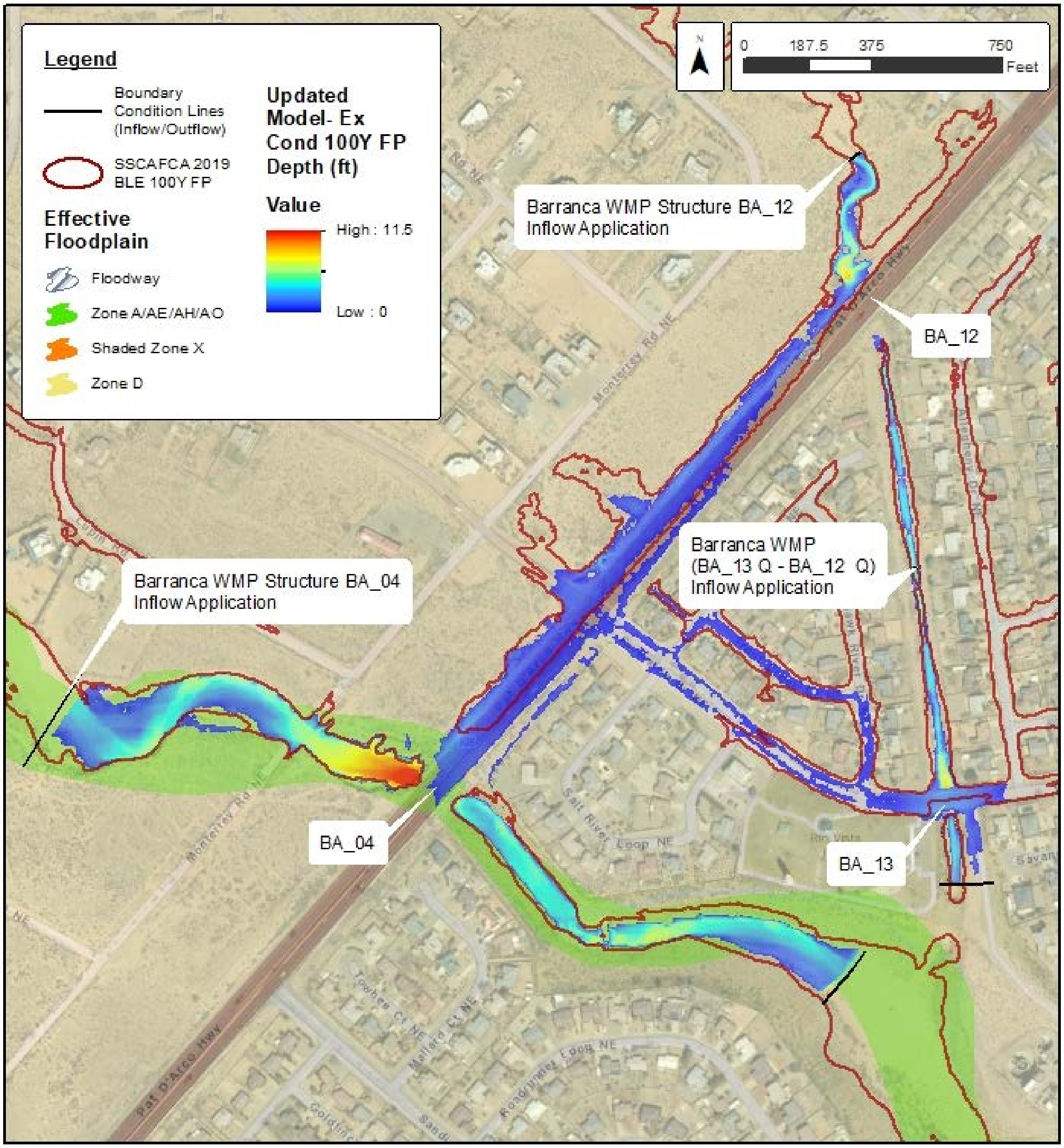

Figure 2.11: Flooding as a result of the 100-year storm in the vicinity of structures BA_04, BA_12 & BA_13 under existing conditions. Note that ponding in the roadway at structure BA_04 stems from structure BA_12 to the northeast (Barranca main stem and tributary I).

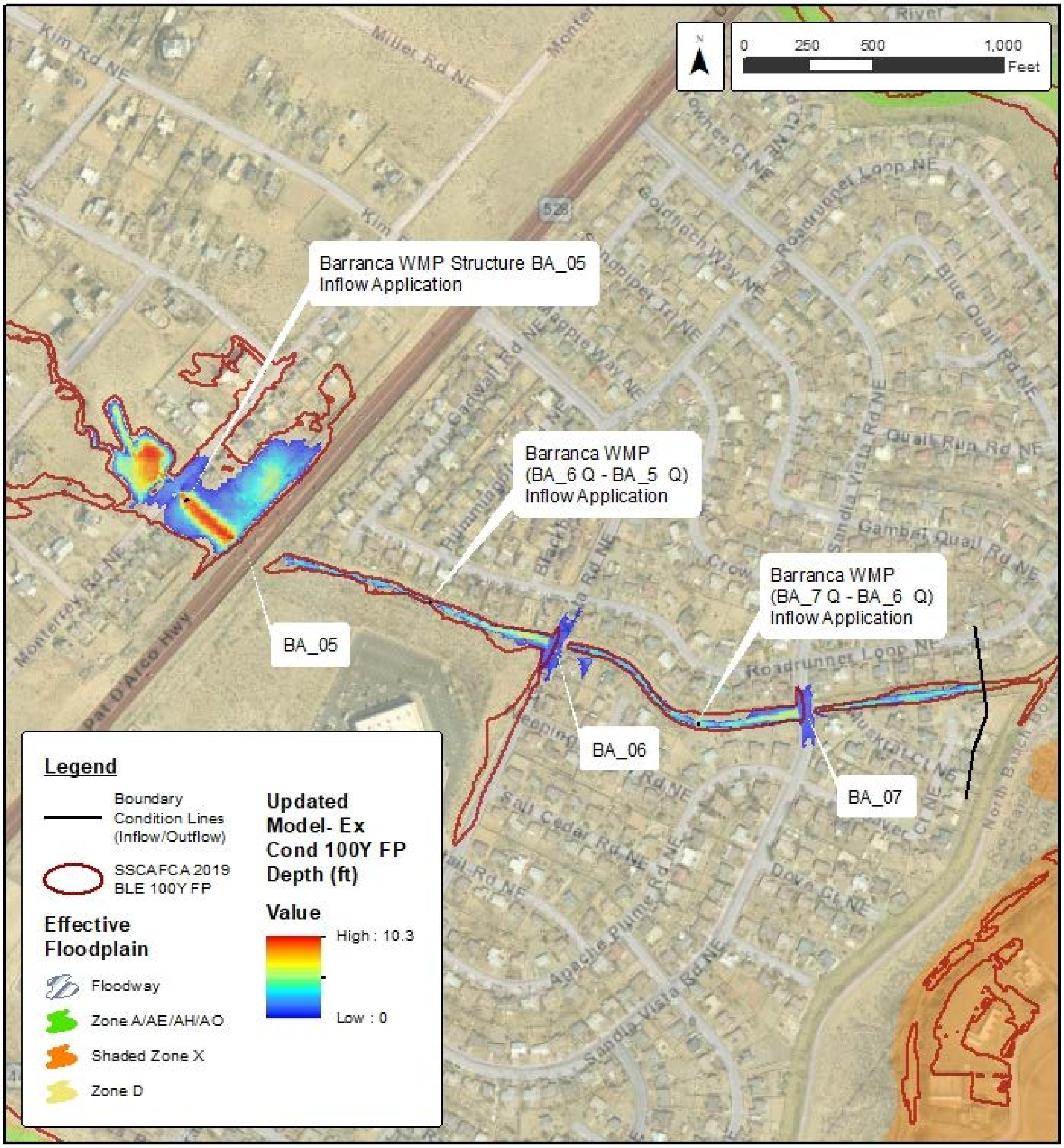

Figure 2.12: Flooding as a result of the 100-year storm in the vicinity of structures BA_05, BA_06 & BA_07 under existing conditions (tributary B).

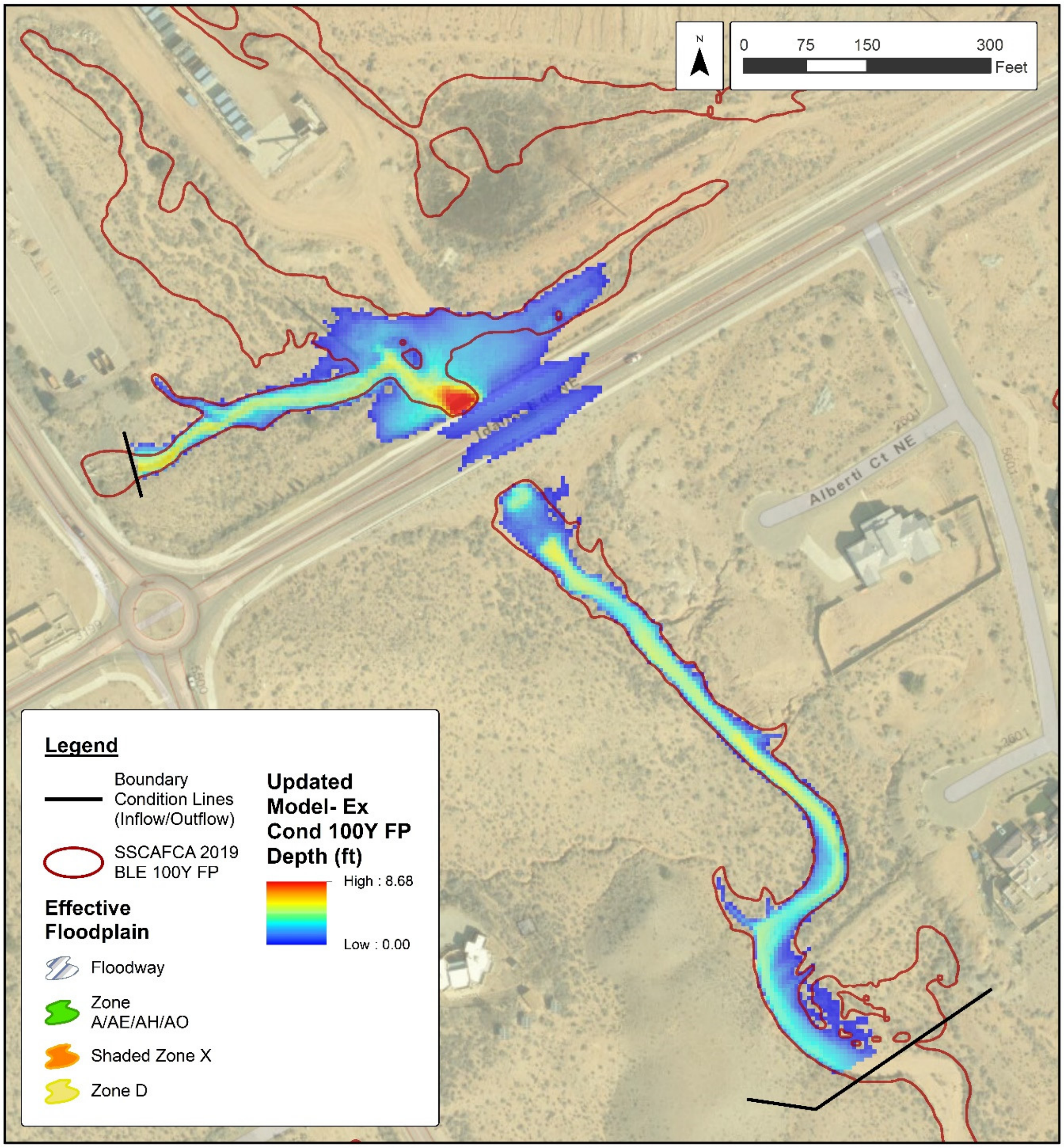

Figure 2.13: Flooding as a result of the 100-year storm in the vicinity of structure BA_10 under existing conditions (tributary H).

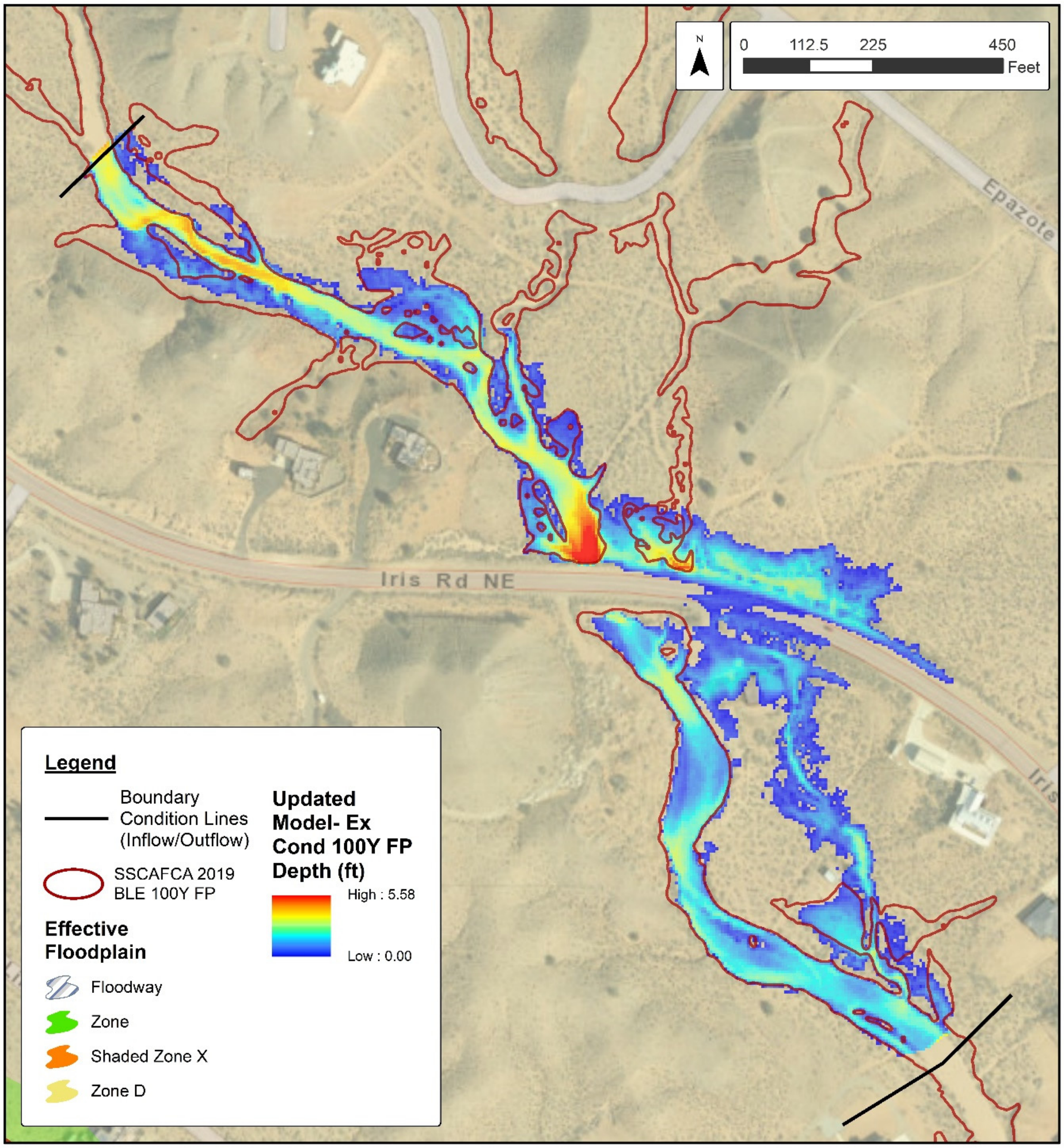

Figure 2.14: Flooding as a result of the 100-year storm in the vicinity of structure BA_11 under existing conditions (tributary H).

Existing ponds were evaluated for deficiencies based on existing and DEVEX conditions model runs. Figure 2.15 shows pond locations in the watershed. The following color scheme was adopted to highlight pond deficiencies based on this analysis:

Green (no concern) – ponds have sufficient capacity under existing and DEVEX conditions.

Yellow (low concern) – activation of the emergency spillway during the 100-year storm under existing and/or DEVEX conditions, but no expected impact to downstream infrastructure because ponds discharge directly into a publicly owned right-of-way and no flood related impacts are expected.

Red (high concern) – ponds have insufficient capacity under existing and/or DEVEX conditions and spill onto roadways or private property.

A detailed table with results for all ponds included in the hydrologic models is contained in Appendix B; the table includes notes for each deficient pond.

2.13. Lateral Erosion Envelope

Lateral migration is a natural arroyo process and occurs in both urbanized and natural watersheds. In 2008, SSCAFCA published the *Sediment and Erosion Design Guide* (Mussetter, 2008) to provide guidance for evaluating the lateral and vertical stability of arroyos, and for establishing the lateral erosion envelope (LEE). The LEE represents the maximum lateral migration distance of an arroyo that can be expected over the next 30-50 years and identifies a corridor where properties and infrastructure are potentially at risk from erosion. Figure 2.16 shows mapped lateral erosion envelopes in the Barranca watershed (see Appendix D for calculations). For an interactive display please refer to SSCAFCA's web map https://www.sscafca.org/maps/. In this document, the LEE is delineated for any reach where peak discharge during the 100-year storm is expected to exceed 500 cfs under existing conditions, as well as for all SSCAFCA-owned arroyos, regardless of expected discharge. However, please note that erosion can cause problems and threaten structures and infrastructure in smaller arroyo systems where the LEE has not been calculated. SSCAFCA recommends performing LEE analysis prior to development of any land adjacent to a natural arroyo, regardless of size. Local municipalities may include LEE considerations in their development ordinances (see for example City of Rio Rancho Chapter 152.33 ordinance, flood-related erosion-prone areas).

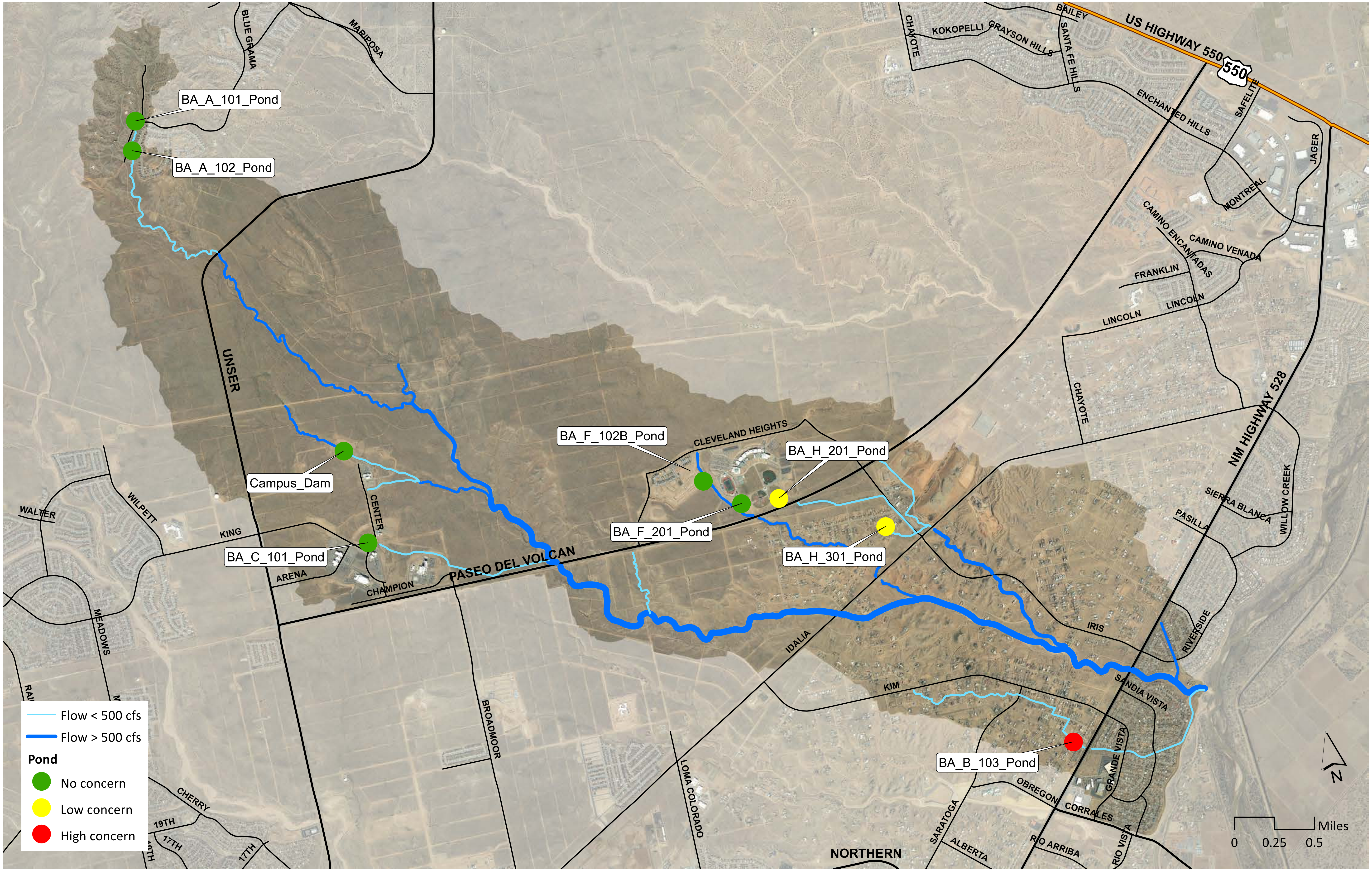

Figure 2.15: Existing stormwater detention ponds in the Barranca watershed and associated deficiencies.

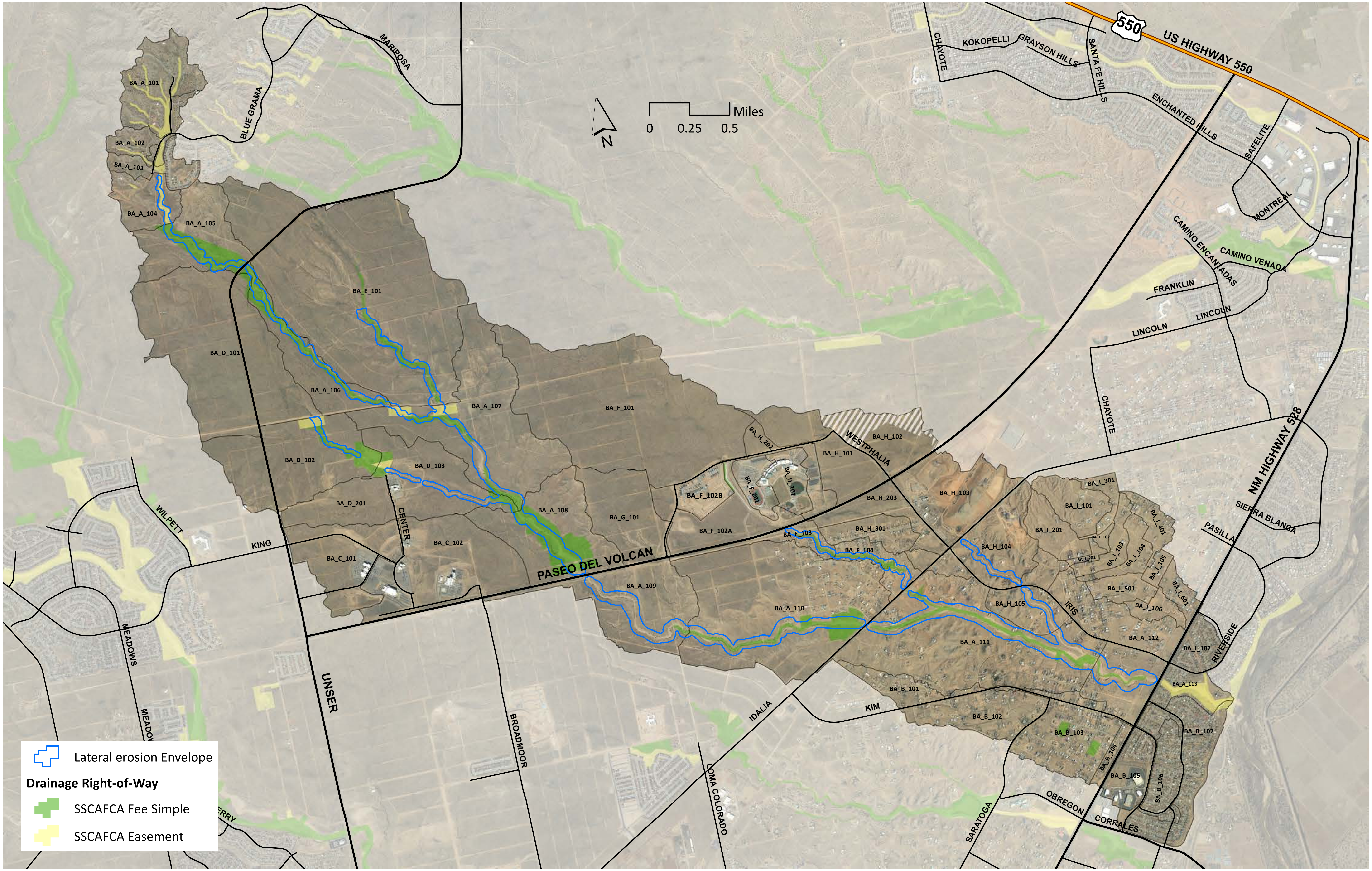

Figure 2.16: Lateral erosion envelopes (blue) in the Barranca watershed.

2.14. References

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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 drainage deficiencies identified as part of this study, along with proposed solutions and needs for additional analysis.

3.1. Future Regional Stormwater Detention Facilities

Table 2.6 and Figure 2.7 show that under existing conditions, only one crossing structure along the main stem of the Barranca Arroyo has a severe capacity exceedance (structure BA_03, Idalia Rd). Two structures, one upstream and one downstream of Idalia Rd., are projected to be impacted by flooding when the roadway overtops (see Appendix F).

3.1.1. Future PDV Dam

The City of Rio Rancho is in the process of designing a replacement for the undersized culvert, and it is expected that the new structure will solve the capacity constraint. Given the planned culvert improvement there is no need for a large regional flood control facility along the main stem of the arroyo at present. However, DEVEX conditions analysis indicates that under future urbanization, flow attenuation may become necessary (see Figure 2.8). One location for a future flood control dam upstream of Paseo del Volcan had been identified in the past (SSCAFCA, 2010), and necessary right-of-way has been purchased by SSCAFCA. A conceptual design for a flood control dam (PDV dam, see Figure 3.1) was completed in 2014 (Honea 2014) and included two design alternatives with maximum storage volumes of 293 ac-ft and 344 ac-ft, respectively. Timing and final configuration of the facility will depend entirely on future urbanization.

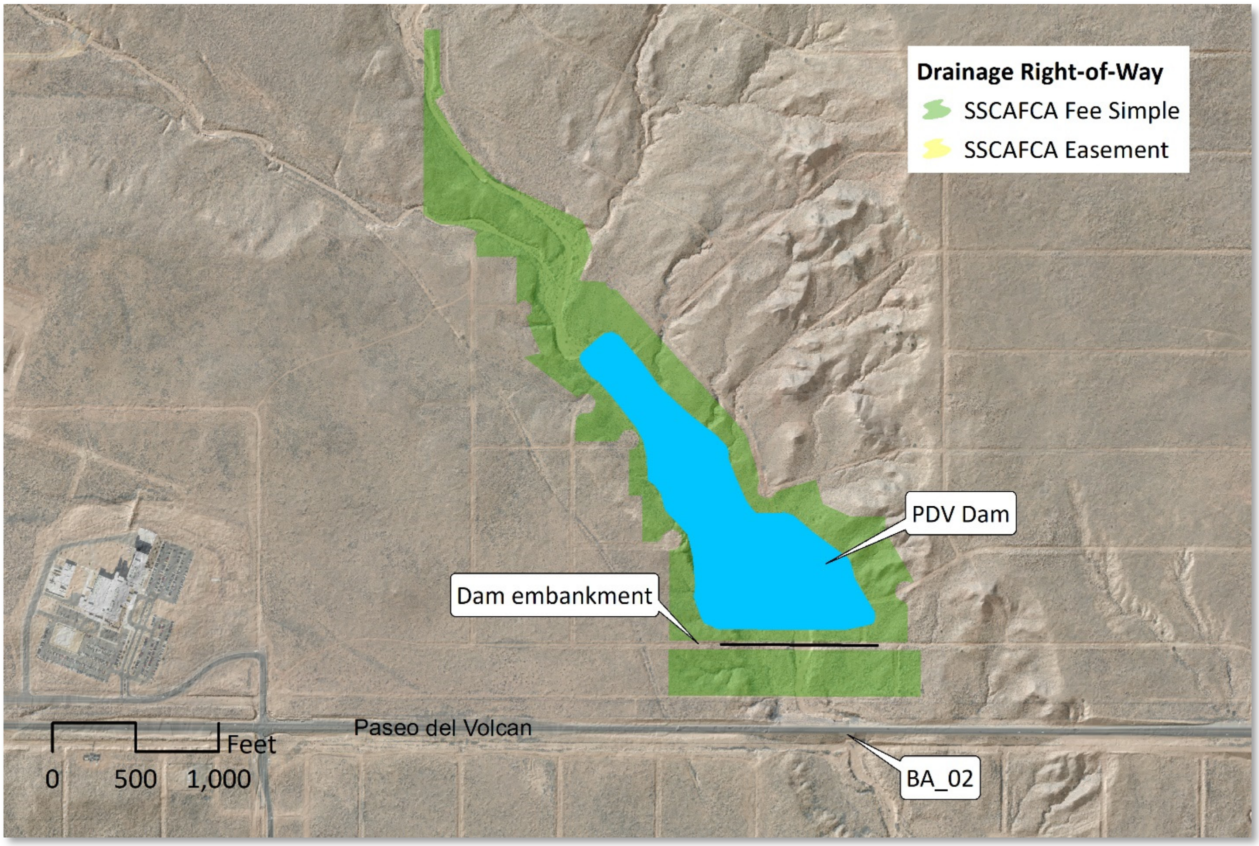

Figure 3.1: Overview map showing a conceptual layout of PDV dam.

3.1.2. Tributary I (Honduras) Improvements

The crossing structure at NM528 and Tributary I (BA_12) is undersized for existing and DEVEX conditions (see Figure 2.7 and Figure 2.11). This will cause runoff to flow southeast along NM528 on the upstream side; some flow will spill into the main stem of the Barranca Arroyo at crossing BA_04. An estimated 34 cfs and 152 cfs will cross NM528 under existing and DEVEX conditions, respectively, leading to flooding along roadways in the River's Edge subdivision downstream (Figure 2.11). SSCAFCA is currently working on a design analysis report for Tributary I upstream of NM528 to mitigate flooding and erosion issues in the basin, and attenuate peak discharge (SSCAFCA, 2022). Four ponds are proposed for the tributary, with peak storage values during the 100-year design storm ranging from 3.0-6.7 ac-ft. Planned ponds and storm drain will be designed to address internal drainage and erosion issues in tributary I upstream of NM528. Moreover, proposed infrastructure is expected to reduce peak discharge at the NM528 culvert crossing (BA_12) to 221 cfs for developed conditions, well below the estimated capacity of 381 cfs.

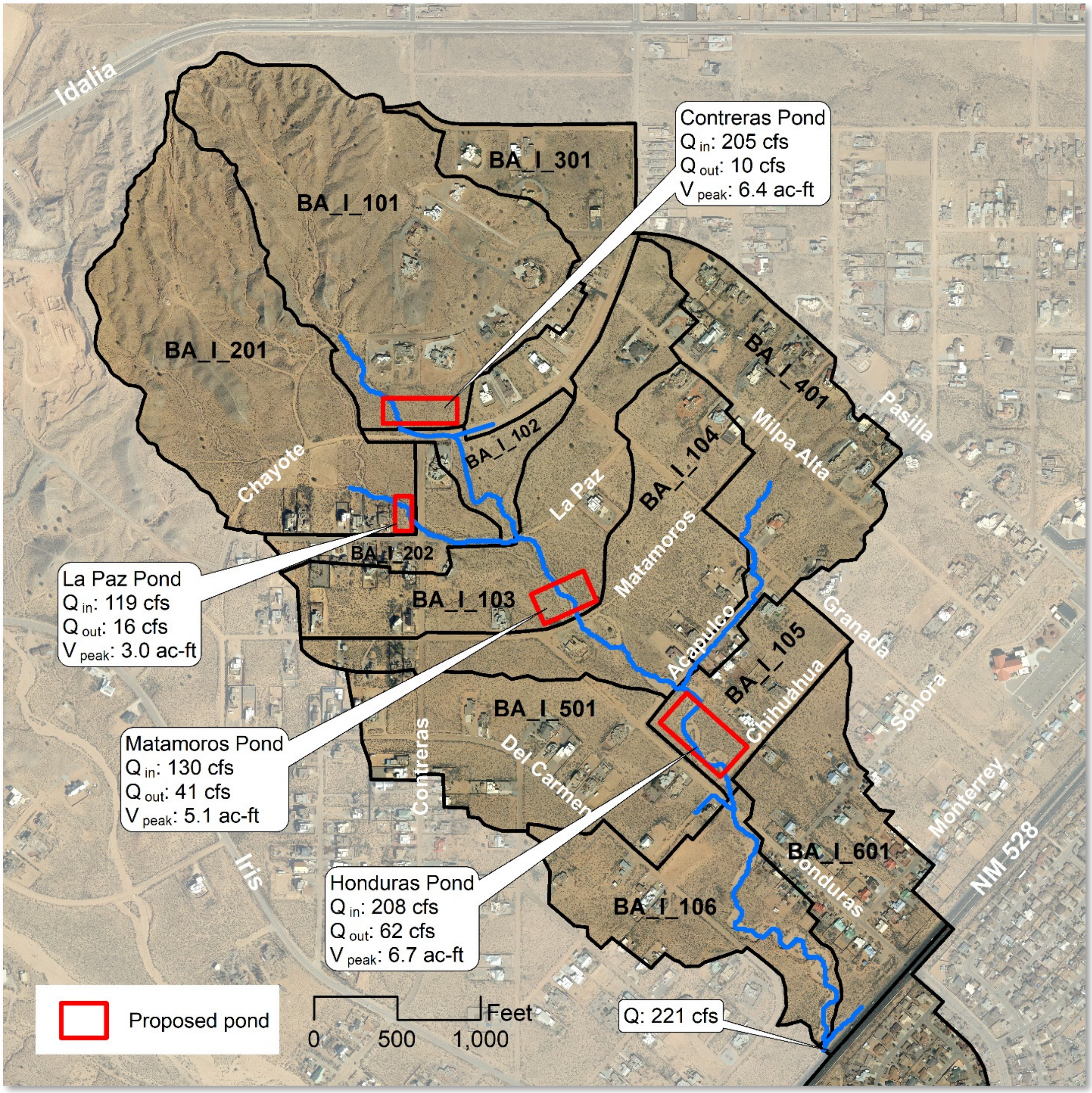

Figure 3.2: Proposed ponds in the tributary I; flow rates and volumes are for ultimate conditions (developed watershed with proposed ponds in place).

3.2. Local Drainage Problems

The majority of drainage deficiencies in the watershed occur along tributaries, specifically tributaries B, H and I. The following subsections identify proposed solutions and need for further analysis.

3.2.1. Tributary B (Guadalajara)

Figure 2.7 and Figure 2.12 illustrate that the crossings at NM528 (BA_05) as well as Grande Vista and Sandia Vista Rd (BA_06 & BA_07) are undersized even under existing conditions.

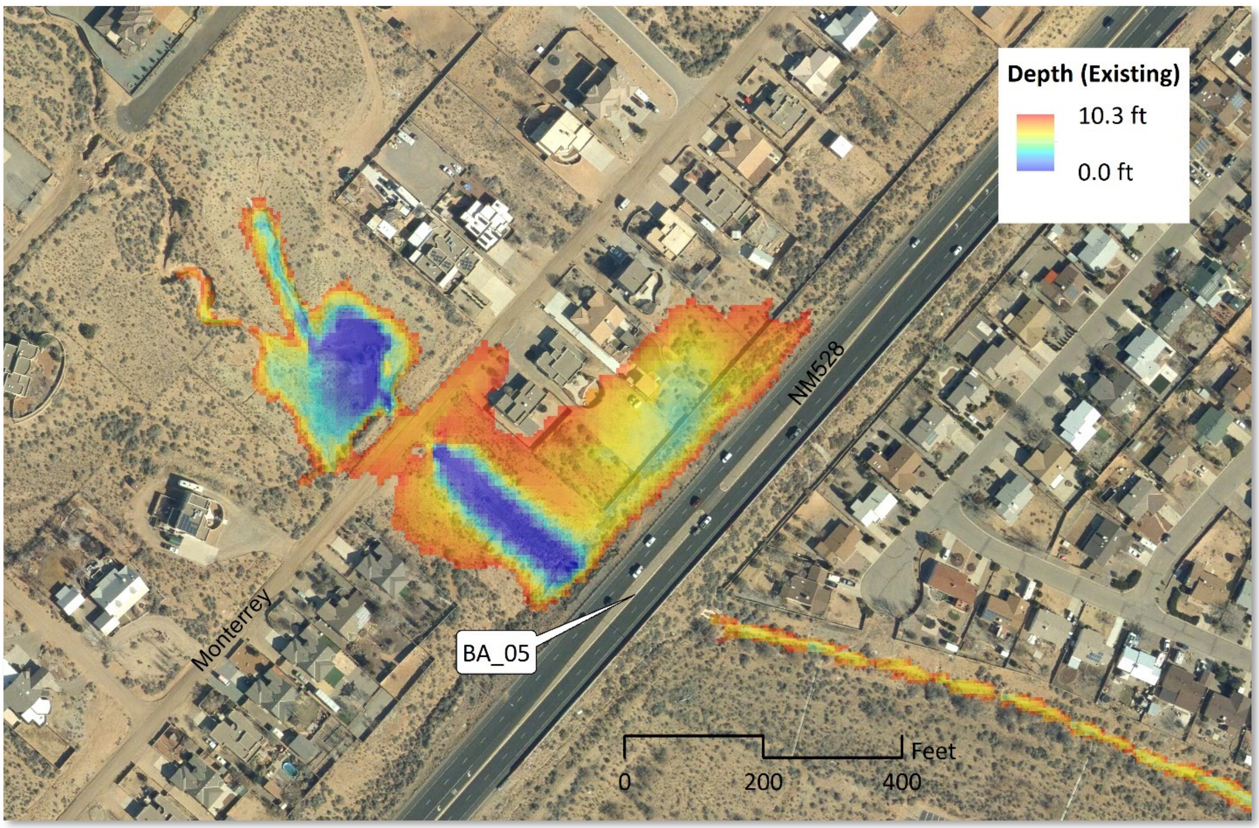

Figure 3.3: Crossing structure BA_11 in tributary B and extent of expected flooding during existing conditions.

While the roadway at NM528 is not overtopped during the 100-year storm, limited culvert capacity causes ponding on the upstream side that impacts adjacent properties. Additionally, a pond upstream of Monterrey Rd. (BA_B_103_Pond, see Figure 2.15) owned by the City of Rio Rancho is undersized for existing and DEVEX conditions and will spill over the roadway. Mitigation of this problem will require additional storage and peak flow attenuation upstream of NM528. A detailed study of tributary B is therefore recommended.

3.2.2. Tributary H

Two culverts in tributary H are undersized for existing and DEVEX conditions (see Figure 2.7, Figure 2.13, and Figure 2.14).

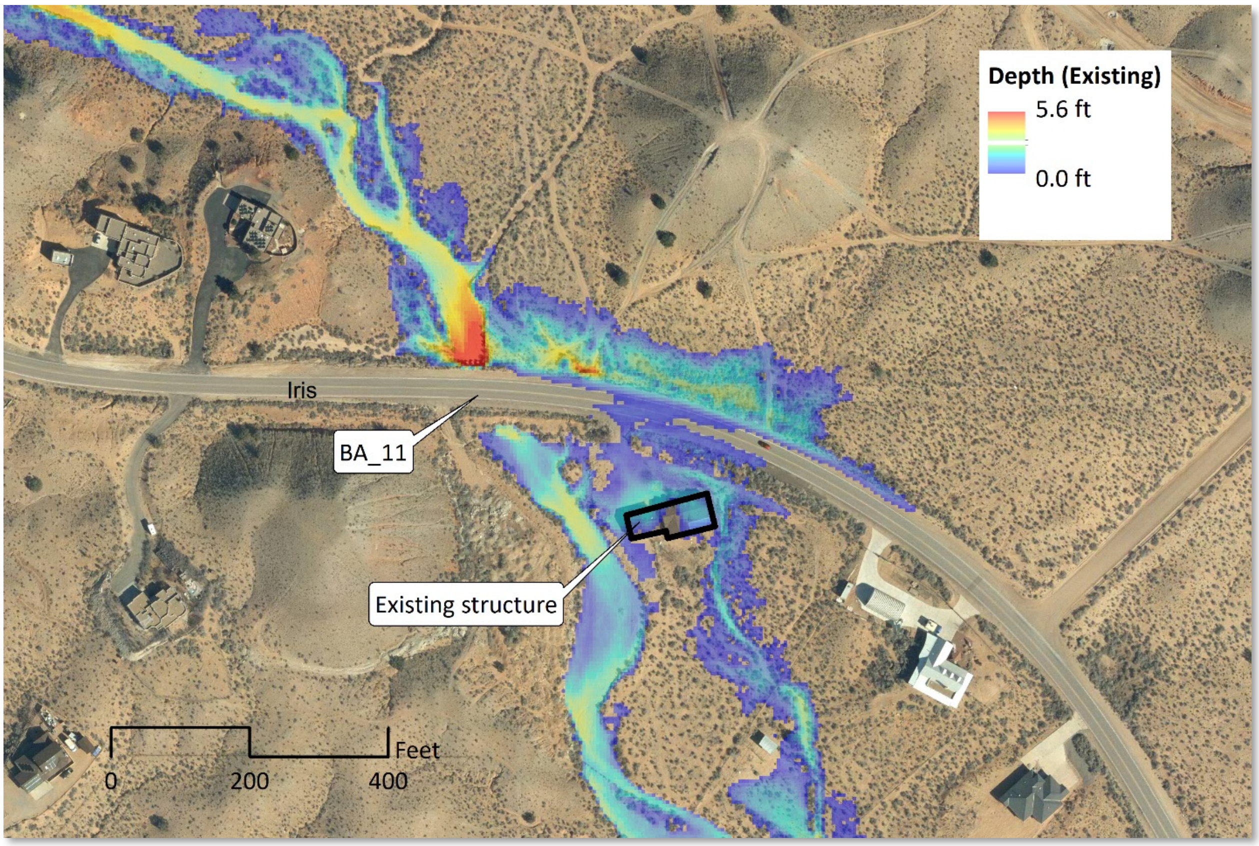

Figure 3.4: Crossing structure BA_11 in tributary H and extent of expected flooding during existing conditions; the black outline shows the location of an existing house impacted by floodwaters spilling over the roadway.

At structure BA_10, an estimated 42 cfs will spill over the roadway (depth 0.8 ft) under existing conditions, and 384 cfs (depth 1.5 ft) under DEVEX conditions. No residential properties are expected to be affected at present. Structure BA_11 is severely undersized, and flow over the roadway will affect at least one house on the downstream side of the crossing (see Figure 3.4).

There is currently no planned drainage infrastructure in tributary H upstream of structure BA_11; moreover, no publicly owned drainage right-of-way exists along tributary H. A detailed study to identify potential solutions is therefore recommended.

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 Barranca watershed, strategic purchase of drainage right-of-way will be critical to achieve the important goal preserving permeable channel beds from lining. Insufficient public drainage right-of-way exists along many major arroyo reaches, and some are entirely held in private ownership (see Figure 2.16). Lateral erosion envelopes may be used as a guide for identifying priorities for land acquisition.

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 the 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 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 eight 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
- Industrial and high-risk runoff control
- Control of floatables

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 Barranca watershed to help reduce potential sediment and pollutants in stormwater runoff include:

- SSCAFCA, in cooperation with the 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) will be utilized wherever feasible to slow down the velocity of stormwater runoff and promote infiltration into the soil.
- Water quality treatment mechanisms will be incorporated in the design of all regional stormwater detention facilities.

One regional water quality facility is currently planned in the watershed near the confluence with the Rio Grande (see Figure 3.5). According to a conceptual design completed for SSCAFCA (Berman, 2021), the structure would span the arroyo and contain thirty-four 30-inch diameter culverts with adverse slopes as well as three inverted ported risers. Both are designed to cause deposition of sediment, capture floatables, and sequester oils and greases on the upstream side. The combined capacity of all culverts is estimated at 1,900 cfs; during large storms, the structure is designed to safely convey excess flows over a reinforced spillway.

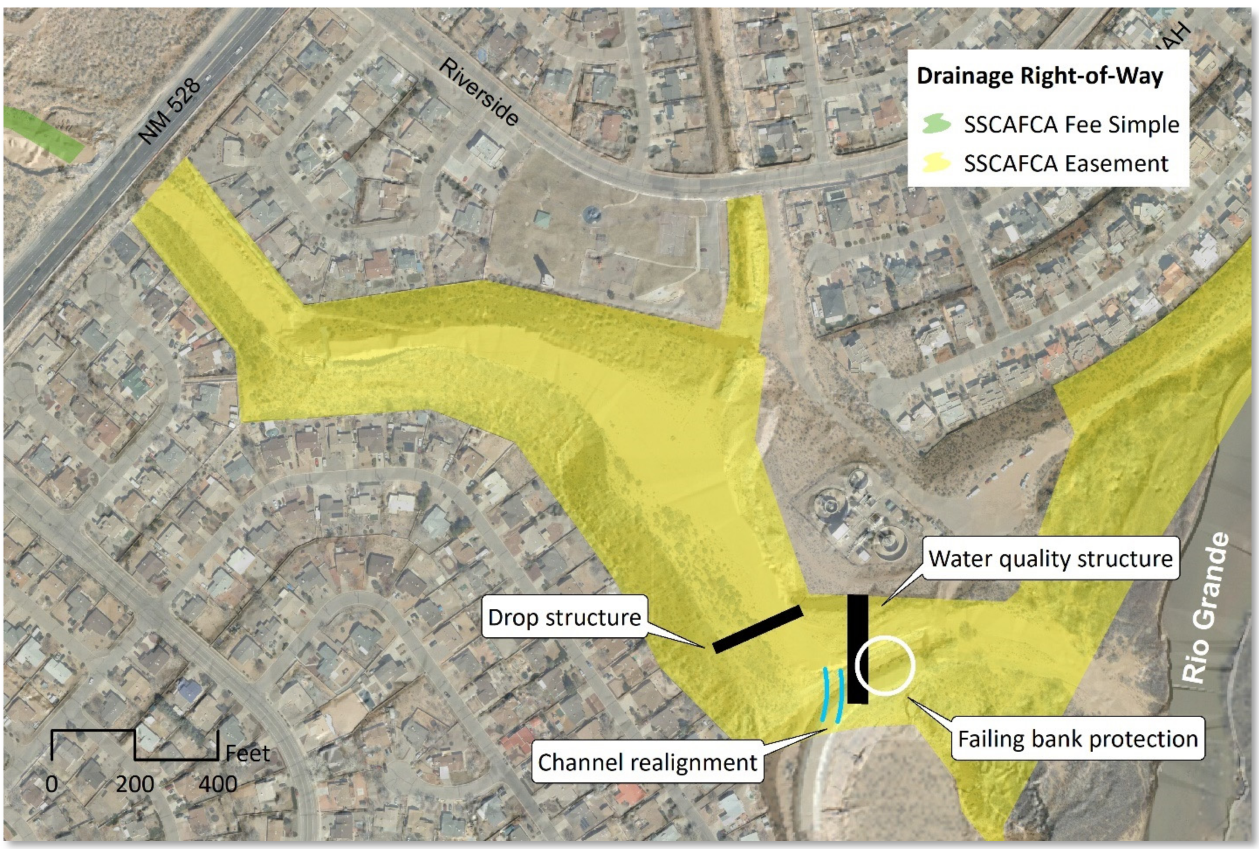

Figure 3.5: Proposed water quality structure in the lower Barranca Arroyo.

As part of the water quality structure design, realignment of the concrete channel conveying flows from Tributary B to the Barranca Arroyo is proposed (see Figure 3.5). Existing bank protection along the north side of the channel is failing due to undercutting of the concrete by flows in the main stem of the Barranca Arroyo (Figure 3.6). Realignment of the channel would divert flows into the proposed water quality pond and remedy the erosion issue, with the added benefit that flows from Tributary B would also be treated before reaching the Rio Grande.

Figure 3.6: Failing bank protection in the lower Barranca Arroyo.

3.5. Quality of Life

SSCAFCA has long recognized that land owned and operated by the authority has multi-use potential when not in use to actively convey stormwater. The original quality-of-life mater plan (SSCAFCA, 2006) laid the foundation for a comprehensive, connected system of multi-use areas along arroyos within SSCAFCA's jurisdiction. The plan was updated in 2022 and includes a series of focused actions in the short term, as well as long-range projects, organized by watershed (SSCAFCA, 2022b). Priority projects identified in the quality-of-life plan include a trail along the main stem of the Barranca Arroyo that would also serve as maintenance access for SSCAFCA, along with a wildlife corridor between NM528 and Idalia Road (Figure 3.7). Long-term projects include connector trails that would link the Barranca watershed with existing or proposed trail infrastructure in neighboring basins. For additional details, the reader is referred to the quality-of-life plan, which can be found on SSCAFCA's website (www.sscafca.org).

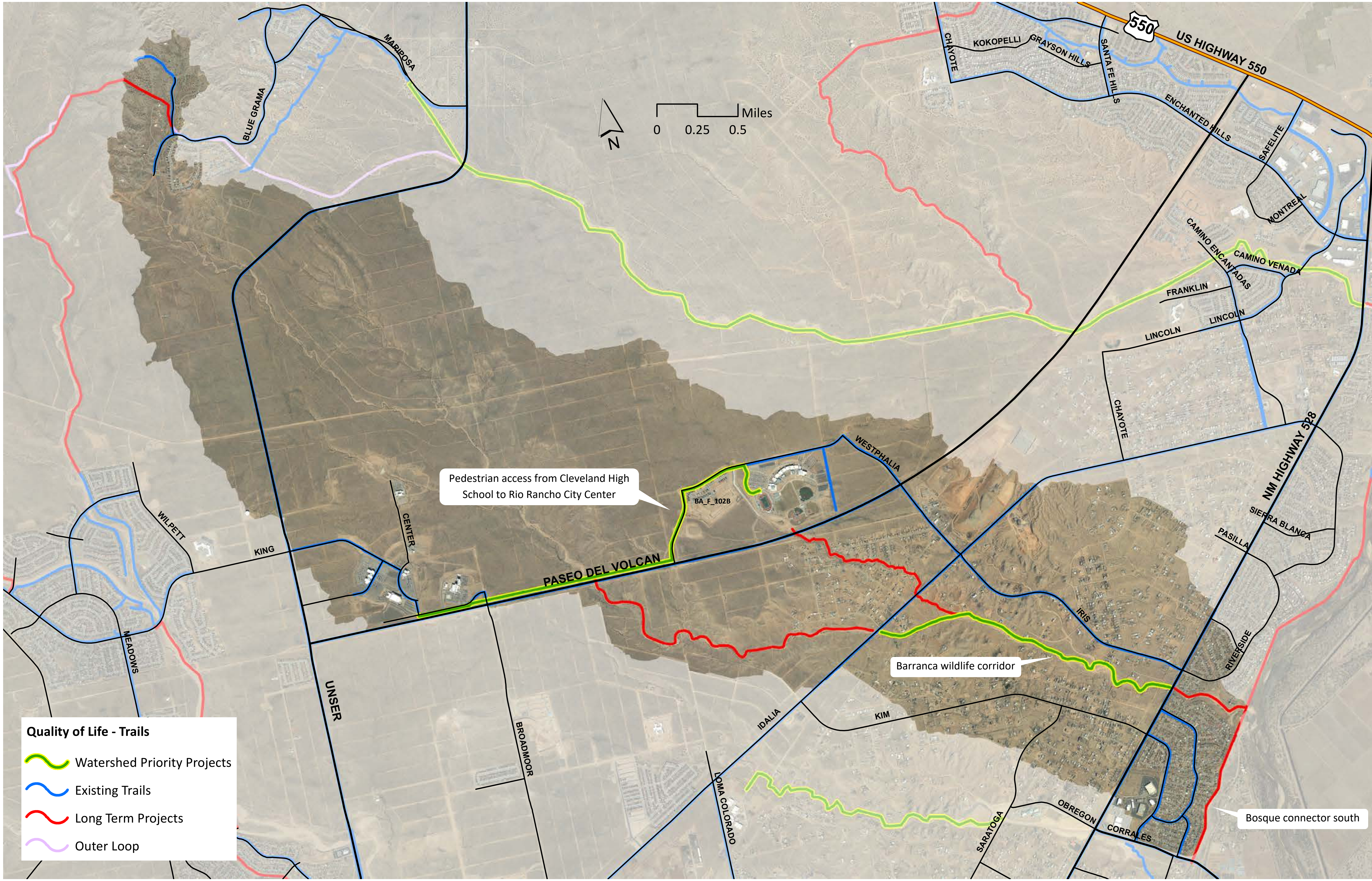

Figure 3.7: Existing and proposed trails in the Barranca watershed.

3.6. References

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