SOUTH BROADWAY DRAINAGE MASTER PLAN

PREPARED FOR

ONE ALBUQUERQUE

PREPARED BY
RESPEC, Inc.
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MARCH 2023
RESPEC Project Number 04270.0004

RESPEC

I, Edward C. Naidu, do hereby certify that this report was duly prepared by me or under my direction and that I am a duly registered Professional Engineer under the laws of the State of New Mexico.

Edward C. Naidu, P.E.
NMPE No. 22997

March 17, 2023
Date

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

DEFINITION OF ACRONYMS

» AMAFCA-	Albuquerque Metropolitan Arroyo Flood Control Authority
» CBC-	Concrete Box Culvert
» CFS-	Cubic Feet Per Second
» CN –	Curve Number
» COA –	City of Albuquerque
» DEM –	Digital Elevation Model
» DTM –	Digital Terrain Modeling
» HSG-	Hydrologic Soil Group
» FEMA-	Federal Emergency Management Agency
» FIS-	Flood Insurance Study
» GPM	Gallons Per Minute
» HGL-	Hydraulic Grade Line
» HSG-	Hydrologic Soil Group
» MRCOG –	Mid-Region Council of Governments
» MRGCD –	Middle Rio Grande Conservancy District
» MVDMP-	Mid-Valley Drainage Management Plan
» NAVD-	North American Vertical Datum
» NCAT-	NGS Coordinate Conversion and Transformation Tool
» NGS-	National Geodetic Survey
» NGVD-	National Geodetic Vertical Datum
» NMDOT-	New Mexico Department of Transportation
» NOAA-	National Oceanic and Atmospheric Administration
» NRCS-	Natural Resource Conservation Service
» SCS-	Soil Conservation Service
» SWMM-	Storm Water Management Model
» TC-	Time of Concentration
» RCP-	Reinforced Concrete Pipe
» USDA-	United States Department of Agriculture
» USGS-	United States Geological Survey

EXECUTIVE SUMMARY

RESPEC was tasked by the City of Albuquerque to update the hydrologic and hydraulic analysis for the South Broadway Drainage Master Plan and prepare conceptual options and recommendations to minimize historical flooding throughout the study area. The study limits start south of Lomas Boulevard, a shared boundary with the Mid-Valley Drainage Management Plan (2012), and continues south to Sunport Boulevard and Woodward Road. The study limit is shown in **Figure E1**. The overall drainage area is approximately 2.3 square miles. Existing infrastructure included detention and retention ponds, a pump station, and storm drains that terminate in the San Jose Drain at the southern boundary.

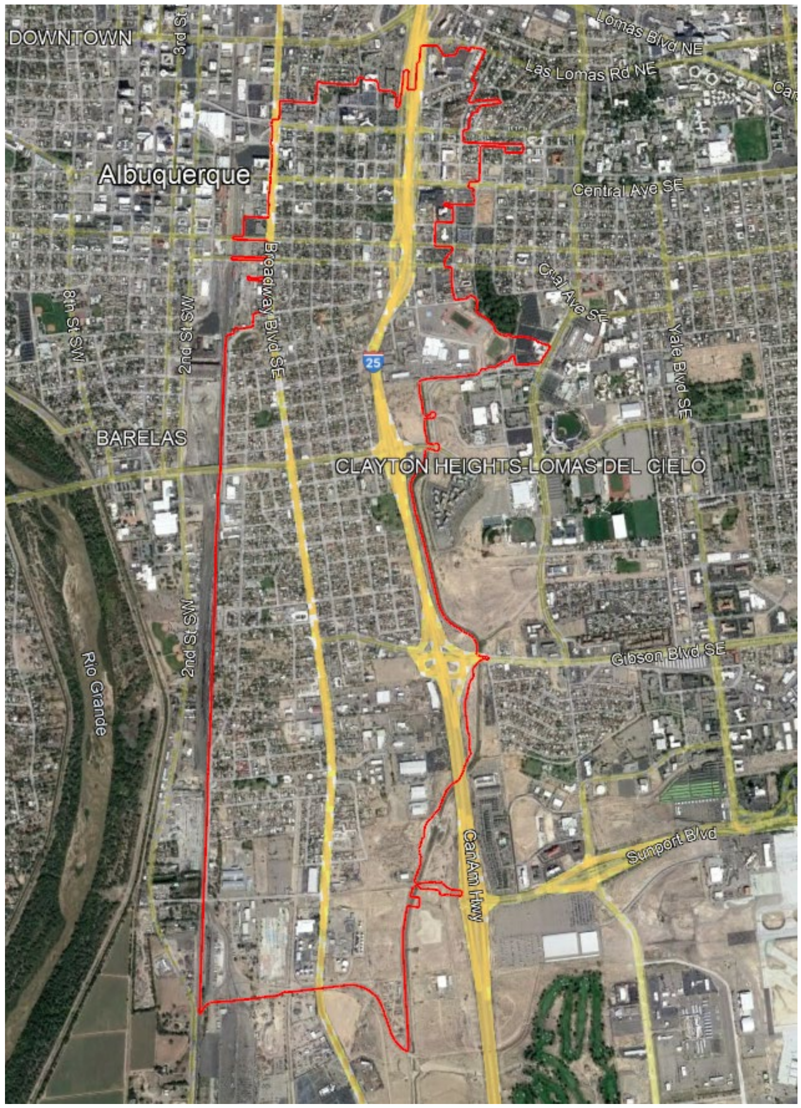


Figure E1: Vicinity Map

The analysis and modeling were developed with two factors in mind. Firstly, the historical flooding concerns throughout the South Broadway watershed. This was developed from the COA 311 database of registered complaints throughout the study area.

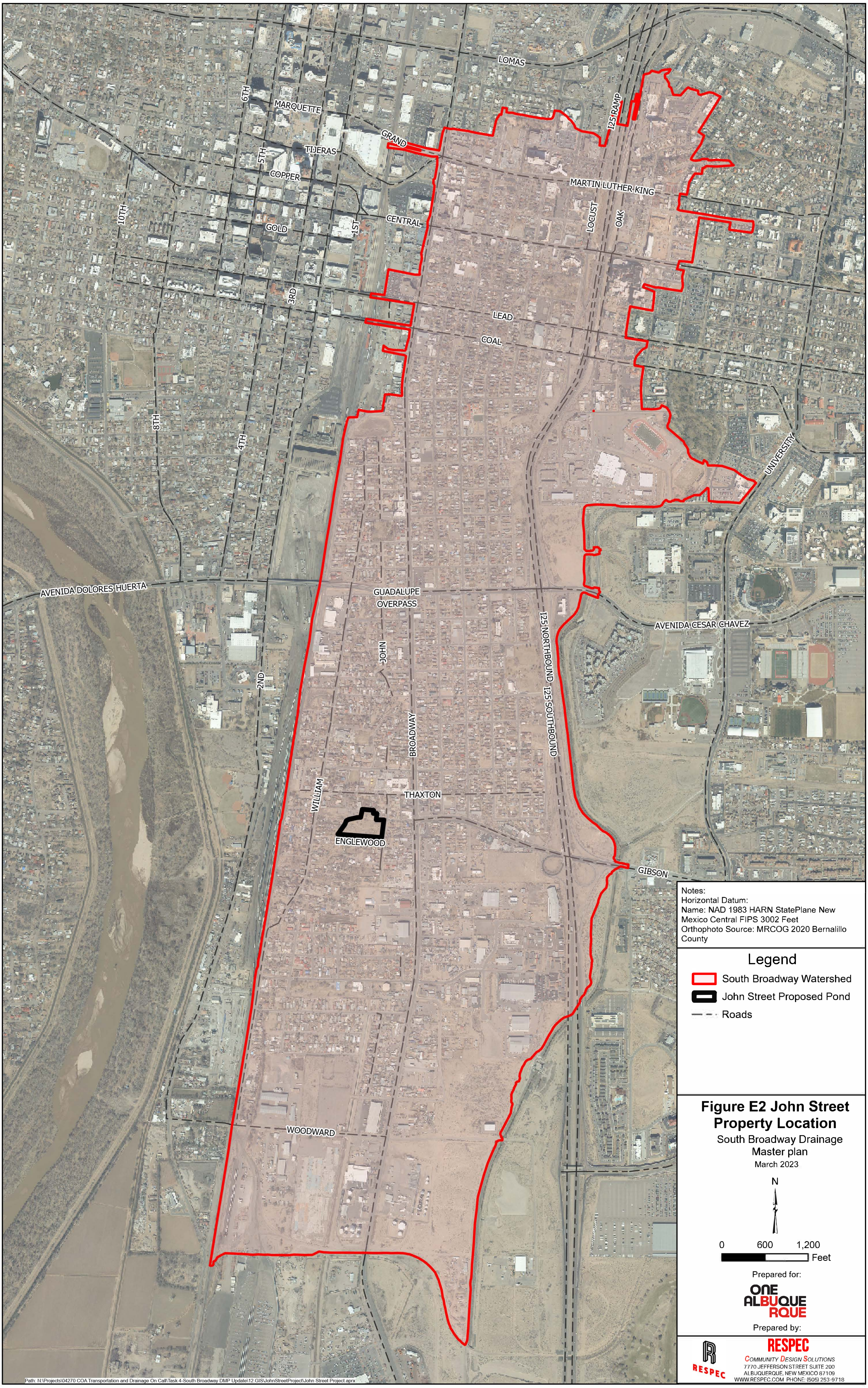
Second, using PCSWMM to simulate valley conditions similar to the approach for the Mid Valley DMP and the Alameda SWMM Drainage Study Report. All three watersheds have adjoining watershed boundaries. Thus, by having a consistent modeling approach, any future cross over projects will be fully compatible in terms of analysis assumptions and modeling software.

Having prior knowledge of the existing problem areas assisted in developing proposed improvements to help mitigate and reduce flooding where possible. During the development of the study, the City was able to successfully negotiate the transfer of a City owned property located at the intersections west of John Street, south of Thaxton Ave, east of Williams Street and north of Englewood Dr. The location of the proposed property is shown on **Figure E2**. This piece of property became fundamental to the development of proposed improvements as the watershed is in severe need of additional ponding facilities.

Four options were developed, and results were compared to evaluate overall system improvements. A certain configuration of a pond at John St was simulated in all four options. Three of the four options have 2 alternatives, Option 4 has one alternative. The primary differentiators between alternatives were the use of an embankment for the pond and experimenting with a pond-pump station combination. The goal of the embankment design was to help reduce export material and to provide an access road around the site. Using a pond-pump station allowed the facility to improve system capacity in both Broadway Blvd. and Williams Street, thus increasing the areas of impact from the pond.
The total construction costs of the 4 options are summarized on **Table E1**. An overview of the 4 options with design phasing is summarized on **Table E2**.

Table E1: Summary of Proposed Improvements Costs

Option No.	Alternative No.	Total Cost
1	Alternative 1	$9,372,063
	Alternative 2	$9,368,030
2	Alternative 1	$13,189,688
	Alternative 2	$13,049,245
3	Alternative 1	$12,238,606
	Alternative 2	$11,761,585
4*	Alternative 1	$12,352,423
*EOPC based on construction priority		



Notes:
Horizontal Datum:
Name: NAD 1983 HARN StatePlane New Mexico Central FIPS 3002 Feet
Orthophoto Source: MRCOG 2020 Bernalillo County

Legend
South Broadway Watershed
John Street Proposed Pond
Roads

Figure E2 John Street Property Location

South Broadway Drainage Master plan

March 2023

N

0 600 1,200 Feet

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Path: N:\Projects\04270 COA Transportation and Drainage On Call\Task 4-South Broadway DMP Update\12 GIS\JohnStreetProject\John Street Project.aprx

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Table E2: Summary of Proposed Improvements

Option No.	Design Phase with Description	Affected Area (System)
1	Phase1: • Construct John Street Pond (Gravity): BOP – 4941, TOP - 4951 **(Alternative 1)** – Height = 10 feet (no embankment BOP – 4941, TOP - 4955 **(Alternative 2))** – Height = 14 feet (with embankment) • Construct/modify Barelas Ditch storm drain for outfall from John Street Pond. • Add junction box to divert storm drain at Thaxton Ave & Broadway into a 66-inch storm drain that will discharge into John Street Pond. Phase 2: • Modify South Broadway and Kathryn Pond Slopes (1V:1.5H) and volume capacity. • Modify junction boxes at Kathryn Pond and Kathryn Avenue at Broadway Boulevard to divert more flow to San Jose Drain. • Connecting the 72-inch storm drain at Wheeler Avenue and Broadway Boulevard. Phase 3: • Modify junction box at Broadway Boulevard and Santa Fe Ave to divert more flows in to existing 72-inch storm drain towards John Street Pond • Upgrade outfall from South Broadway to a 54-inch diameter to the Bell-Commercial Pump Station.	South Broadway Bell-Commercial Kathryn San Jose
2	Phase 1: • Construct John Street Pond– Pump BOP – 4932, TOP - 4951 **(Alternative 1)** – Height = 19 feet (no embankment) BOP – 4933, TOP - 4956 **(Alternative 2)** – Height = 23 feet (with embankment) Wet Well Bottom (Alternative 1 & 2) – 4931 • Add junction box to divert storm drain at Thaxton Ave & Broadway into a 66-inch storm drain that will flow into John Street Pond. Phase 2: • Installing 72-inch storm drain with junction box at Williams and Thaxton to divert 72 inch and 36 inch storm drain into John Street Pond. Phase 3: • Modify South Broadway and Kathryn Pond Slopes (1V:1.5H) • Modify junction boxes at Kathryn Pond and Kathryn Avenue at Broadway Boulevard to divert more flow to San Jose Drain. • Connecting the 72-inch storm drain at Wheeler Avenue and Broadway Boulevard. Phase 4: • Modify junction box at Broadway Boulevard and Santa Fe Ave to divert more flows in to existing 72-inch storm drain towards John Street Pond. • Upgrade outfall from South Broadway to a 54-inch diameter to the Bell-Commercial Pump Station. Phase 5: • Upgrade Barelas Ditch storm drain.	South Broadway Bell-Commercial Kathryn San Jose
3	Phase 1: • Construct John Street Pond– Pump/Gravity) BOP – 4933, TOP - 4951 **(Alternative 1)** – Height = 18 feet (no embankment) BOP – 4932, TOP - 4955 **(Alternative 2)** – Height = 23 feet (with embankment) Wet Well Bottom Alternative 1 = 4932.25, Wet Well Bottom Alternative 2 = 4931 • Add junction box to divert storm drain at Thaxton Ave & Broadway into a 66-inch storm drain that will flow into John Street Pond. • Upgrade Barelas Ditch storm drain. Phase 2: • Installing 72-inch storm drain with junction box at Williams and Thaxton to divert 72 inch and 36 inch storm drain into John Street Pond. Phase 3: • Modify South Broadway and Kathryn Pond Slopes (1V:1.5H) • Modify junction boxes at Kathryn Pond and Kathryn Avenue at Broadway Boulevard to divert more flow to San Jose Drain. • Connecting the 72-inch storm drain at Wheeler Avenue and Broadway Boulevard. Phase 4:	South Broadway Bell-Commercial Kathryn San Jose

Option No.	Design Phase with Description	Affected Area (System)
	• Modify junction box at Broadway Boulevard and Santa Fe Ave to divert more flows in to existing 72-inch storm drain towards John Street Pond. • Upgrade outfall from South Broadway to a 54-inch diameter to the Bell-Commercial Pump Station.	
Option No.	**Design Phase with Description**	**Affected Area (System)**
4	Phase 1: • John Street Pond– Gravity & Pump Gravity - BOP – 4941, TOP - 4955 – Height = 14 feet (with embankment) Pump (Wet Well) – Bottom – 4931, Top= 4946 – Height = 15 feet. • Add junction box to divert storm drain at Thaxton Ave & Broadway into a 66-inch storm drain that will flow into John Street Pond. • Upgrade Barelas Ditch storm drain. John Street Pond– Pump • Installing 72-inch storm drain with junction box at Williams and Thaxton to divert 72 inch and 36 inch storm drain into John Street Pond. Phase 2: • Modify Kathryn Pond Slopes (1V:1.5H) • Modify junction boxes at Kathryn Pond and Kathryn Avenue at Broadway Boulevard to divert more flow to San Jose Drain. Phase 3: • Upgrade outfall from South Broadway to a 54-inch diameter to the Bell-Commercial Pump Station. Phase 4: • Modify junction box at Broadway Boulevard and Santa Fe Ave to divert more flows in to existing 72-inch storm drain towards John Street Pond. • Modify South Broadway Slopes (1V:1.5H)	South Broadway Bell-Commercial Kathryn San Jose

RESPEC established a selection matrix to select the best option based on certain criteria. Each option was rated with a score based on lifetime maintenance, total cost, flooding reduction, hydraulic restrictions, phasing opportunities and constructability. The results of the selection matrix are summarized on **Table E3**.

Table E3: Selection of Option Matrix

Option # Alt #	Lifetime Maintenance	Cost	Flooding Reduction	Hydraulic Restrictions	Phasing Opportunities	Constructability	Totals
Option 1 Alt 1	5	5	1	3	1	5	20
Option 1 Alt 2	4	5	2	3	1	5	20
Option 2 Alt 1	2	1	5	3	4	1	16
Option 2 Alt 2	1	1	4	2	4	1	13
Option 3 Alt 1	3	3	4	3	3	2	18
Option 3 Alt 2	2	4	1	3	3	2	15
Option 4 Alt 1	3	2	4	4	5	3	21

RESPEC recommends option 4 to be the most effective since it creates sufficient capacity in the South Broadway hydraulic network, moderate maintenance and creates beneficial future projects for the City. Furthermore, proposing two separate ponds allows the city to phase the improvements in Broadway Boulevard and Williams Street more strategically since the ponds are hydraulically isolated. General parameters for the pond and pumpstation are summarized below. A reservoir routing summary table is shown on **Figure E3**. This summarizes how the facilities function at the peak of the design storm.

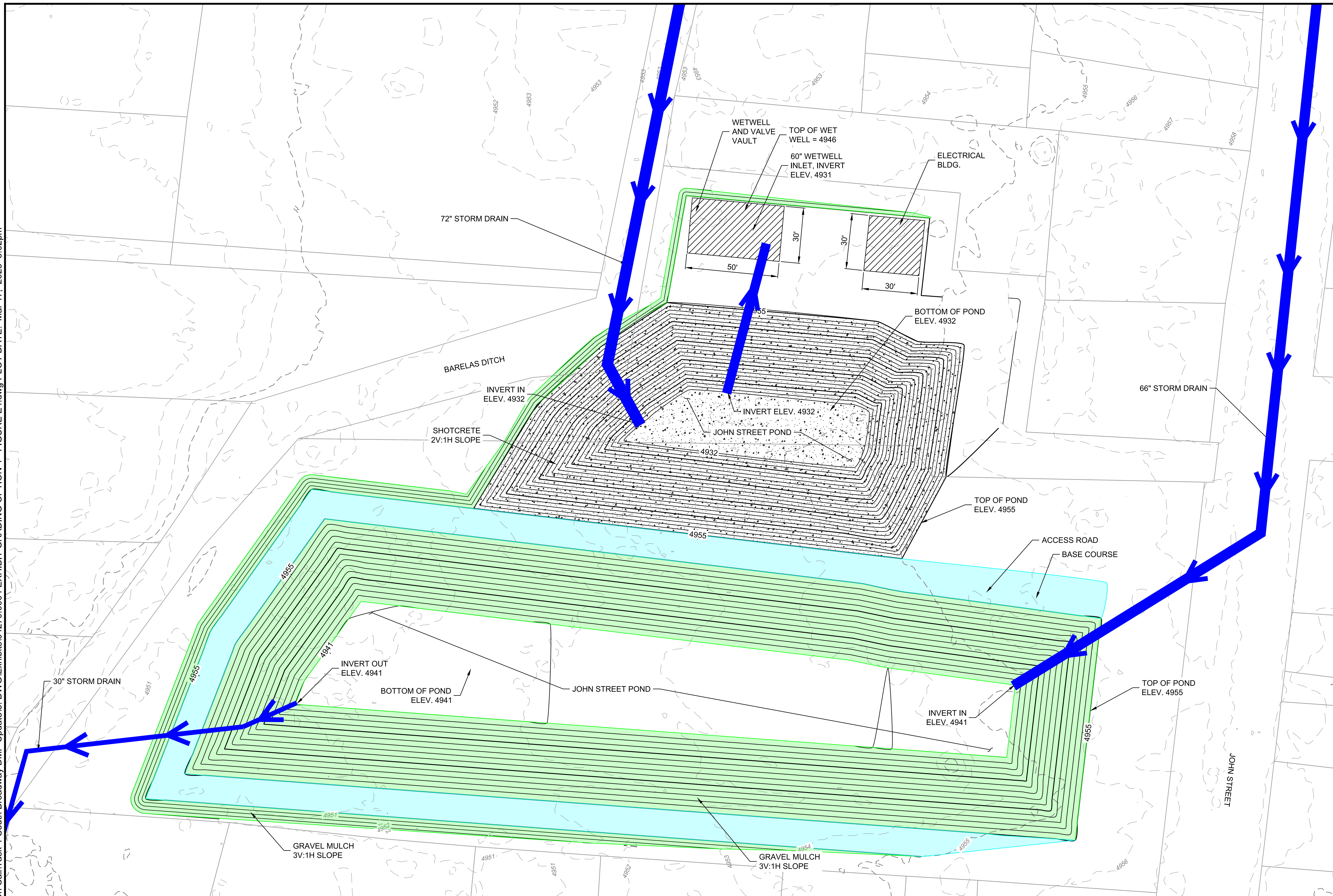
<u>John Street Wet Well Pond – Pump Station:</u>

- Wet well depth = 15 feet
- Design volume = 3.5 ac-ft.
- Pump discharge = 18 cfs or 8078 gpm

<u>John Street Main Pond – Gravity Pond:</u>

- Pond depth = 14 feet (4 foot embankment)
- Design volume = 12.5 ac-ft
- Outfall discharge = 21.2 cfs

Option 4, which is the recommended option, utilizes a two-stage pond which hydraulically separates the Broadway and Williams systems therefore eliminating the hydraulic constraints off site. The high stage pond will be a gravity pond which will control the Broadway system whereas the low stage pond/pumpstation will control the Williams system, optimizing the earthwork and the pump size. The Option 4 conceptual grading plan for John Street Pond is shown on **Figure E3.** An overview of option 4 project phasing is shown on **Figure E4.** These phases recommend which order the projects should be designed in.



LEGEND

STORM DRAIN
GRAVEL MULCH
BASE COURSE
SHOTCRETE

Option 4-Alternative 1 - Pond Routing Summary
South Broadway Drainage Master Plan

Name	Invert Elev. (ft)	Rim Elev. (ft)	Max. Depth (ft)	Max. HGL (ft)	Max. Total Inflow (cfs)	Max. Outflow (cfs)	Total inflow (MG)	Total Inflow Volume (AF)	Pond Design Volume (AF)	Pond Design Depth (ft)	Freeboard to Top of Pond	Total Flood Volume (MG)	Total Flood Volume (AF)	Comments
John Street Main Pond	4941.00	4955	13.09	4954.09	214.3	21.22	6.41	19.68	12.5	14.00	0.91	0.00	0.00	Proposed Pond @ top of pond = 4955
John Street Wet Well Pond	4931.00	4946	14.89	4945.89	135.2	18.00	14.70	45.13	3.5	15.00	0.11	0.00	0.00	Proposed Wet Well @ top of pond = 4946

FIGURE E3 OVERVIEW OF JOHN STREET POND OPTION 4 SOUTH BROADWAY DRAINAGE MASTER PLAN

March 2023

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JOHN STREET OPTION 4		
	MAIN POND	WET WELL POND
TOP OF POND	4955.00	4946.00
BOTTOM OF POND	4941.00	4932.00
VOLUME CAPACITY	12.5 AC-FT	3.5 AC-FT

SOUTH BROADWAY POND		
	EXSITING	POND LAYOUT ALTERNATIVE
TOP OF POND	4952.00	4952.00
BOTTOM OF POND	4938.35	4938.35
VOLUME CAPACITY	25.2 AC-FT	31.8 AC-FT

KATHRYN POND		
	EXSITING	POND LAYOUT ALTERNATIVE
TOP OF POND	4946.00	4946.00
BOTTOM OF POND	4940.79	4940.79
VOLUME CAPACITY	4.9 AC-FT	7.5 AC-FT

LEGEND

PHASE 1

PHASE 2

PHASE 3

PHASE 4

FIGURE E4 OVER VIEW OF OPTION 4 SOUTH BROADWAY DRAINAGE MASTER PLAN

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RESPEC assigned a level of priority to the proposed improvements in helping the City prioritize funding to the crucial areas. Additionally, these were also recommendations of which order the projects should be constructed in. The recommended priorities of these phases are summarized in **Table E4**. An overview of priorities of the proposed improvements are shown on **Figure E5**.

Table E4: Recommended Priorities

Priority No.	Project Description
1	Construction of John Street Wet Well Pond and diversion of Williams St and Thaxton Ave 72 inch storm drain.
2	Kathryn Pond Improvements, diversions at Kathryn Ave and Williams St and Broadway Blvd.
3	Construction of John Street Gravity, diversion of Broadway Blvd 66 inch storm drain and upsizing storm drain in Barelas Ditch to a 30 inch.
4	Upsizing storm drain in Commercial to a 54 inch.
5	South Broadway Pond Improvements, diversion of Broadway Blvd and Santa Fe Ave and diversion of Broadway Blvd 72 inch storm drain and reconnect storm drain at Broadway and Wheeler Ave.

SOUTH BROADWAY DRAINAGE CONSTRUCTION PRIORITY		
PRIORITY NO.	PROJECT DESCRIPTION	COST
1	CONSTRUCTION OF JOHN STREET WET WELL POND AND DIVERSION OF WILLIAMS ST AND THAXTON AVE 72 INCH STORM DRAIN.	$3,277,517
2	KATHRYN POND IMPROVEMENTS, DIVERSIONS AT KATHRYN AVE AND WILLIAMS ST AND BROADWAY BLVD.	$862,543
3	CONSTRUCTION OF JOHN STREET GRAVITY, DIVERSION OF BROADWAY BLVD 66 INCH STORM DRAIN AND UPSIZING STORM DRAIN IN BARELAS DITCH TO A 30 INCH.	$2,821,072
4	UPSIZING STORM DRAIN IN COMMERCIAL TO A 54 INCH	$3,422,376
5	SOUTH BROADWAY POND IMPROVEMENTS, DIVERSION OF BROADWAY BLVD AND SANTA FE AVE AND DIVERSION OF BROADWAY BLVD 72 INCH DRAIN AND RECONNECT STORM DRAIN AT BROADWAY AND WHEELER AVE.	$1,968,915
	TOTAL	$12,352,423

LEGEND

- PRIORITY 1
- PRIORITY 2
- PRIORITY 3
- PRIORITY 4
- PRIORITY 5

FIGURE E5
RECOMMENDED PRIORITIES OF OPTION 4 SOUTH BROADWAY DRAINAGE MASTER PLAN

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1.0 GENERAL PROJECT INFORMATION

1.1 PROJECT OVERVIEW

RESPEC was tasked by the City of Albuquerque to update the hydrologic and hydraulic analysis for the South Broadway Drainage Master Plan and prepare conceptual options and recommendations to eliminate historical flooding areas throughout the study area. The study limits start south of Lomas Boulevard, a shared boundary with the Mid-Valley Drainage Management Plan (2012) and continues south until Sunport Boulevard and Woodward Road. The study area is outlined in red in **Figure 1**. The overall drainage area is approximately 2.3 square miles. The existing infrastructure in the study area includes detention and retention ponds, a pump station, and storm drains that terminate in the San Jose Drain at the southern boundary.

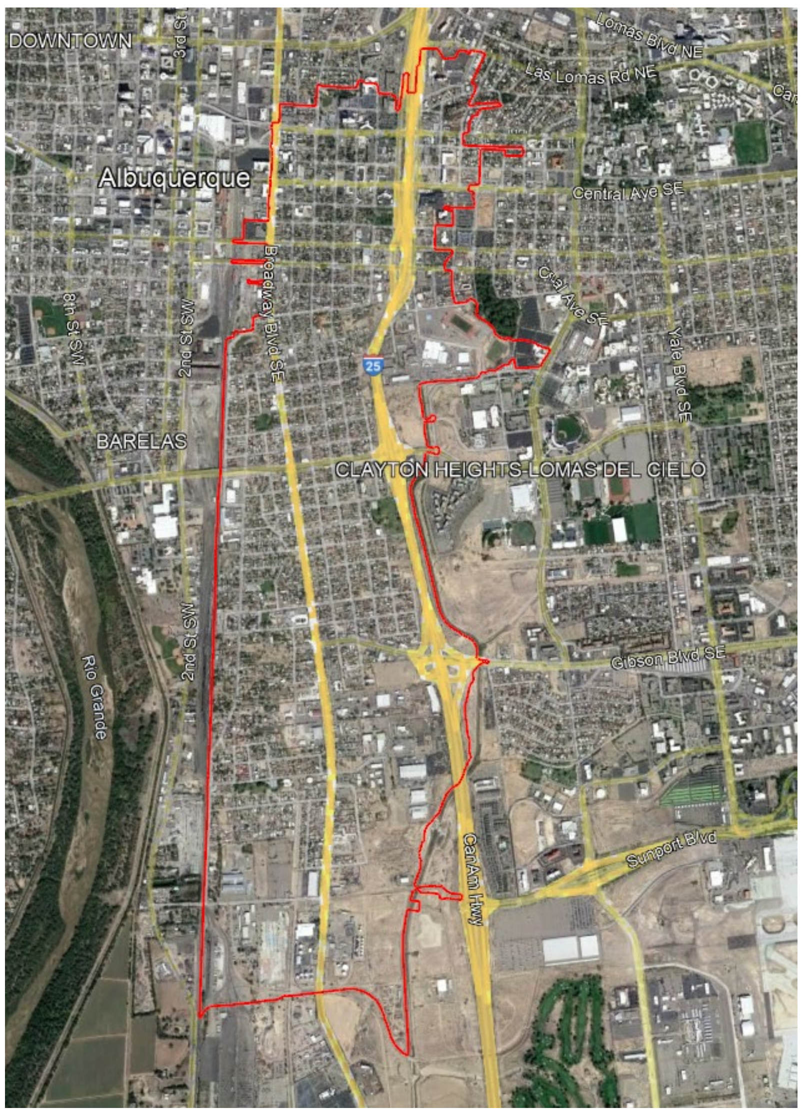

Figure 1: Location Map

1.2 BACKGROUND INFORMATION

The South Broadway watershed required an understanding of the complex hydrologic and hydraulic systems. This included knowledge of past studies, drainage infrastructure GIS data, FEMA floodplains and construction as-built documents.

1.2.1 PREVIOUS STUDIES

Listed below are previous studies of the area that provide critical information regarding the watershed. Various studies and reports for stormwater infrastructure throughout the study area that were reviewed to obtain pertinent information are included in Appendix 1. The Existing Study Area Map from South Broadway Studies completed by RESPEC in February 2022, is included in Appendix 1 as it provides reference for all the previous study locations below:

- *South Broadway Sector Drainage Management Plan (SBSDMP)*, written by Bohannan Huston Inc (BHI) in September 1990, summarizes the existing and developed conditions for the South Broadway Watershed for both hydrologic and hydraulic calculations.
- *Final South Broadway Detention Basin Analysis Phase Report*, written by Resource Technology Inc (RTI) in July 1990, analyzed a proposed detention pond (South Broadway Detention Pond) and refined the Bell Commercial Pump Station.
- *South Broadway Drainage and Stormwater Quality Management Plan*, completed by URS Corporation in 2013, updated hydrology from the report by Bohannan Huston Inc (1990), identified problem areas and proposed improvements.
- *Central Ave Drainage Improvements Volume 1 (2016) & Volume 2 (2018)*, written by WSP, analyzed drainage conditions and made recommendations along Central Avenue Improvements completed from Volume 1 include:
  - Modified inlets at both Central and Broadway and Union Square.
  - Modified inlets at Central near Walter Street.
  - Reconfiguration of the existing storm drain at the northeast corner of One Central Site and 1st and Central.
  - Plugging the 78-inch storage pipe at One Central Site.
  - Recommissioning the old Central Pump Station west of the railroad tracks to pump into an existing manhole at Central and 1st Street.
- *South Broadway Hydraulic Analysis Summary and Report*, written by Bohannan Huston Inc (BHI) in 2016 and 2017, respectively, summarized hydraulic modeling of the existing storm drains between the South Broadway Detention Basin and the Bell Commercial Pump Station as well as provide recommendations for improvements.
- *South Broadway Impact Analysis Report*, conducted by Smith Engineering Company in 2019, was a design document for the Marble Arno Storm Water Pump station. Simultaneously verifying predicted flows in the tributary watershed that could be directed elsewhere, and therefore, downsizing the pond.
- *Comparative Analysis of the South Broadway Sector Drainage Management Plan and the South Broadway Drainage and Water Quality Management Plan* was prepared by AMAFCA. This report provides a comparison between the two master plans written by Bohannan Huston Inc (BHI) in 1990 and by URS Corporation in 2013 which summarized the deficiencies in the South Broadway system.

- *Pump Station No. 37 Bell and Commercial Operations Manual*, written by Molzen Corbin in 2015, is a manual to document the existing infrastructure and how the different components for the system work.
- *ABQ Storm Water Pumping Stations Rehabilitation Study Phase 1*, completed by Bovay Engineers in 1981, was completed to identify problems in the existing pump station equipment.
- *Bell Commercial Pump Station Modifications*, written by Smith Engineering Company in 2010, determined how feasible the modifications and associated force main to the Bell Commercial Pump Station would handle the anticipated flows and identify improvements to the force main and pump capacity and divert flows from the existing Broadway storm drain system.
- *Bell Commercial Storm Water Pump Station No. 37 Force Main*, written by Molzen Corbin in 2011, was written to discuss the decision to upgrade the size and placement of the force main from the Storm Water Pump Station No. 37 to a new discharge point at Williams Street and Trumbull Avenue.
- *Mid-Valley Drainage Management Plan,* completed by Smith Engineering Company in 2012, is the master plan study with hydrologic and hydraulic analysis of the watershed, and included proposed improvements to help reduce flooding in the watershed.

1.2.2 EXISTING DRAINAGE INFRASTRUCTURE

The existing infrastructure was verified using background information provided from the City of Albuquerque which included as-built construction plans, GIS data and the Albuquerque Stormwater Utility Map (2000). These documents were used to verify essential information such as storm drain inverts, pipe sizes, pipe slopes, pipe materials, flow directions, pond volumes, elevation-storage-discharge curves, and pumps. The South Broadway study area consists of approximately 2.3 square miles of drainage area, approximately 14.7 miles of storm drain, 1 pump station, 7 detention ponds and 1 retention pond. Storage volume and ownership for ponds in the study area are summarized in **Table 1**. **Figure 2** is overview map of the existing infrastructure included in the watershed.

Table 1: Pond Subsystem Summary

Pond Name	Subsystem	Total Storage Volume (Acre-Feet)	Owner
Bell Commercial Wet Well	Bell-Commercial Pump Station	-	City of Albuquerque
BusinessIndstRetPondSouth	San Jose	4.9	Private
BusinessIndstUnit3Pond	Mechem Pond	0.7	Private
KarstenPond	San Jose	7.0	Private
KathrynPond	Kathryn Pond	4.9	City of Albuquerque
MechemPond	Mechem Pond	6.5	City of Albuquerque
S.BroadwayPond	South Broadway Pond	25.2	City of Albuquerque
SunportPond	Sunport Pond	7.3	Bernalillo County

Storage Number	Storage Name
1	BellCommercialPumpStation
2	BusinessIndstRetPondSouth
3	BusinessIndstUnit3Pond
4	KarstenPond
5	KathrynPond
6	MechemPond
7	S.BroadwayPond
8	SunportPond

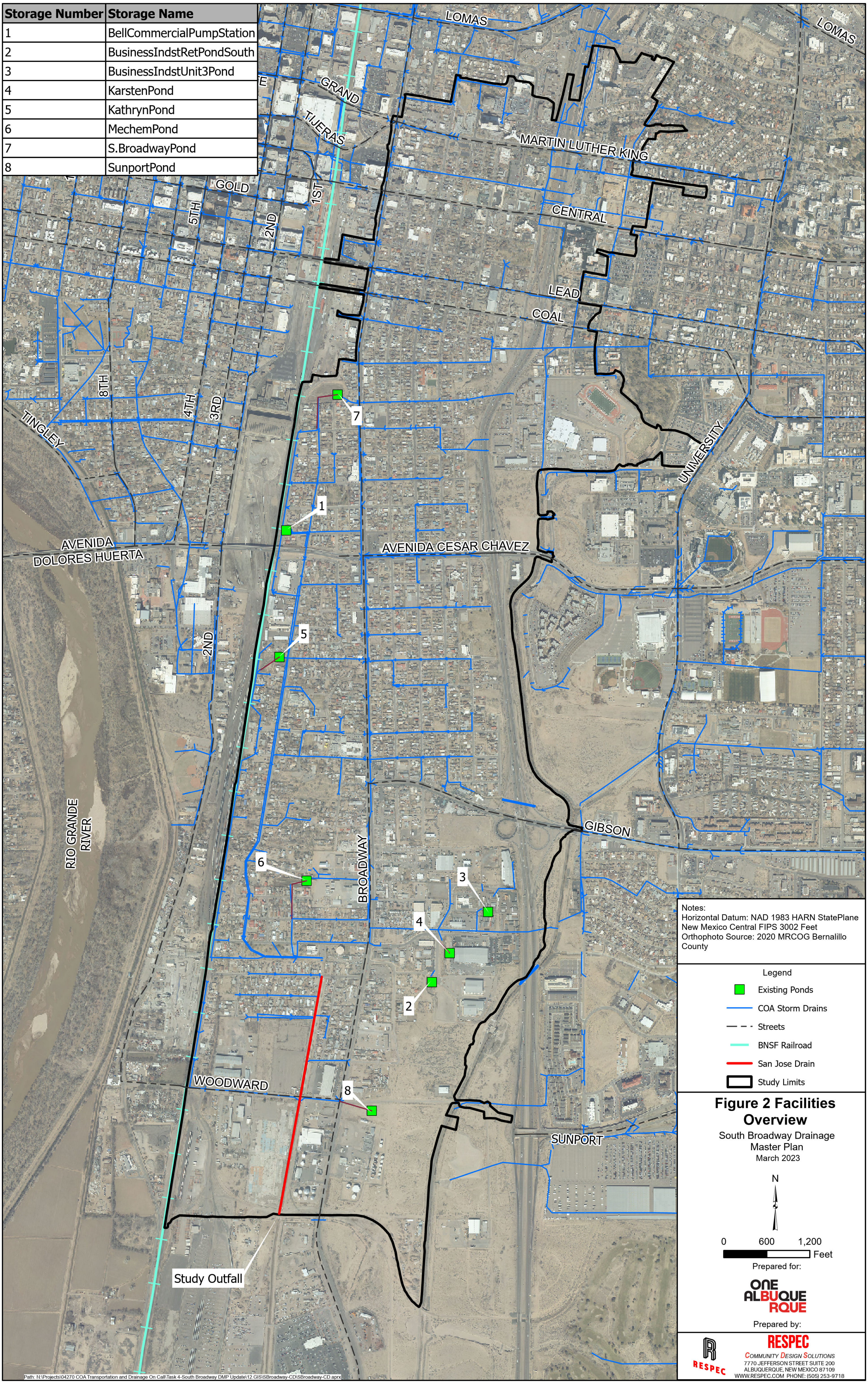

Figure 2 Facilities Overview

South Broadway Drainage Master Plan

March 2023

1.2.3 FEMA FLOOD PLAINS

According to the flood insurance study (FIS) from Federal Emergency Management Agency (FEMA), there is 2 flood zone within the South Broadway Study Area. These zones range are AH, and X. The flood zones come from the FIS numbers:

- 35001C0334G
- 35001C0342G

See effective Flood Insurance Rate Map (FIRM), in Appendix 1. An overview of the existing floodplains is provided in **Figure 3.**

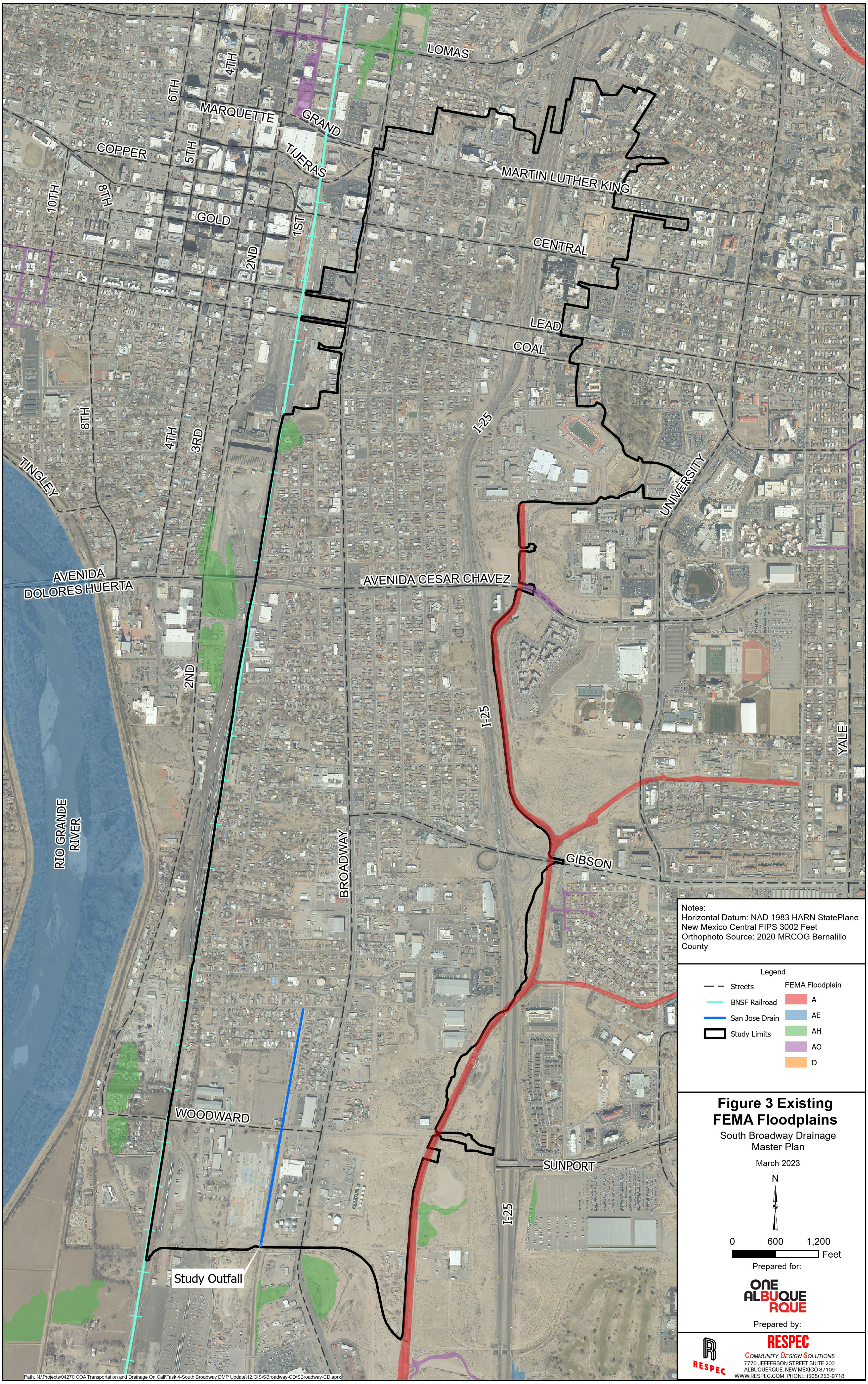

Figure 3 Existing FEMA Floodplains

South Broadway Drainage Master Plan

March 2023

1.3 DATUM CONVERSIONS

The National Oceanic and Atmospheric Administration (NOAA) NGS Coordinate Conversion and Transformation Tool (NCAT) was used to convert elevations in the old vertical datum of North Geodetic Vertical Datum (NGVD) 29 to the new datum of NAVD 88. After comparing the differences, an average conversion factor of 2.67 feet was applied to all NGVD 29 data points. See Appendix 1 for the datum conversion output.

1.4 FIELD OBSERVATIONS

RESPEC conducted several field observations throughout the watershed. Field verification was necessary to validate the eastern boundary of the watershed. In addition to basin verification, existing pond infrastructure needed to be validated since many as-builts were missing. During field work, it was discovered that the Sunport-Woodward extension was beginning construction. This was not evident on the 2020 Mid Region Council of Governments (MRCOG) orthophotography. The current construction will affect the outer basin boundary in that area since most of the runoff will be directed into two ponds. The first pond, a water quality pond, will discharge into the South Diversion Channel, the second detention pond will discharge into the San Jose Drain using the existing storm drain in Woodward Rd. Appendix 1 includes annotated photos and field notes from field visits.

1.5 TOPOGRAPHIC DATA AND BACKGROUND IMAGERY

The subbasin delineation for the watershed was based on 2018 MRCOG Lidar. 2020 MRCOG aerial imagery was utilized for visual assessment of the watershed to ensure the latest development was captured.

1.6 MODELING APPROACH

The scope of this project required an update of the hydrologic and hydraulic parameters in the SWMM model from The South Broadway Drainage and Storm Water Quality Management Plan by URS (2013) to reflect the most current watershed conditions. There were three key factors for using PCSWMM for the South Broadway watershed.

PCSWMM is an ideal candidate for hydrologic modeling for valley areas as the software performs a volume based sub-catchment analysis to derive hydrographs. The model has additional options to increase the initial abstraction to account for the onsite ponding caused by depressed (valley) subbasins. The South Broadway watershed has distinct relief throughout the study area, particularly east of Williams Street. This area has well defined slopes and subbasins that will drain out into stormwater conveyance facilities. West of Williams Street, the watershed is mostly flat with small areas unable to drain into stormwater facilities. This is expected because the properties are lower than the adjoining roadways and will provide more retention ponding. This allowed the watershed to be split into basins with either valley or sloped characteristics. This is discussed in more detail in Section 2.1.2.

Second, was the inclusion of a very complex and highly time dependent hydraulic network. PCSWMM, with its dynamic wave routing option, provided the best means of simulating the routing and attenuation the pump station, ponds and storm drains would create.

Third, much of the storm drains lack slope, and as a result, the conveyance is heavily dependent on the timing of hydrograph entry into the system, and the maximum system hydraulic grade lines. The dynamic wave routing computational method in PCSWMM is ideal for this rather flat system because in many cases, flow can backwater and flow in a reverse direction in the hydraulic network if the system is surcharged downstream. PCSWMM can also simulate flooding at manholes, by allocating ponding areas that would represent the storage capacity of a flat roadway. The storm drains, when under capacity, can surcharge, however, the surcharge volume is stored at the manholes with storage volumes assigned. Once there is capacity in the storm drain, the storage volume is reintroduced into the conveyance system.

2.0 HYDROLOGIC ANALYSIS

A detailed hydrologic analysis was completed for both neighboring watersheds; the Mid-Valley Drainage Management Plan (2012) and the Alameda Drain Study (2022). RESPEC used the same hydrologic analysis as the basis for the South Broadway Drainage Master Plan.

2.1 EXISTING CONDITIONS

Utilizing the neighboring drainage reports of both the Mid-Valley Drainage Management Plan (2012) and the Alameda Drain Study (2022), the modeling approach for the existing conditions matched these accepted hydrology procedures for aid in consistency between watersheds. Appendix 1 shows an overview map of the Mid-Valley and Alameda Drain basin boundary as a reference. The sections below discuss the process of subbasin delineation and input parameter computation such as the initial abstraction, depression storage and the curve number.

2.1.1 DRAINAGE BASIN DELINEATION

Subbasins for this watershed were delineated using MRCOG 2018 DEM topographic data. Once RESPEC digitized basin boundaries using ArcGIS Pro, extensive field verification of subbasin boundaries were conducted due to the effect of residential and commercial improvements. The overall watershed was broken into 8 subsystems. The subsystems were determined by major storm drain outfalls, topographic divides, and ponds or pump station throughout the study area. The subsystems provided a systematic way to analyze elements with effective analysis points throughout the watershed. Classification for the subbasin names and PCSWMM subcatchments were developed to match the subsystems. Figure 4 provides an overview of the subsystems delineated while Figure 5 shows an overview of the subbasins that were delineated in the study area within each subsystem.

Systems	Sum of Areas (Acres)
Central Ave	25.2
Commerical-Bell Pump Station	49.2
Kathryn Pond	215.7
Mechem Pond	192.5
San Jose	449.6
South Broadway Pond	465.4
Sunport Pond	56.9

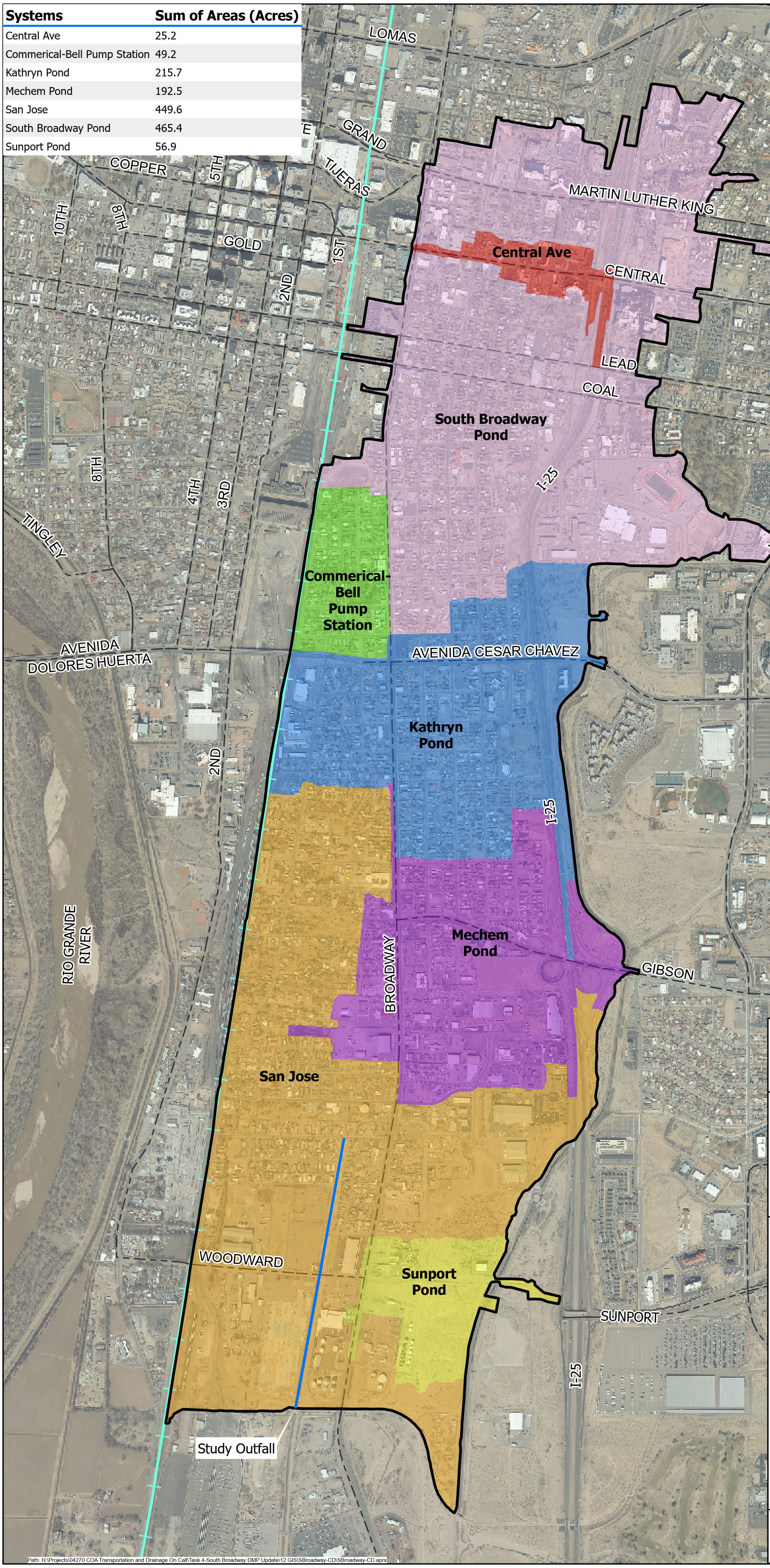

Figure 4 Systems Overview Map

South Broadway Drainage Master Plan

March 2023

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ONE ALBUQUERQUE

Prepared by:

RESPEC
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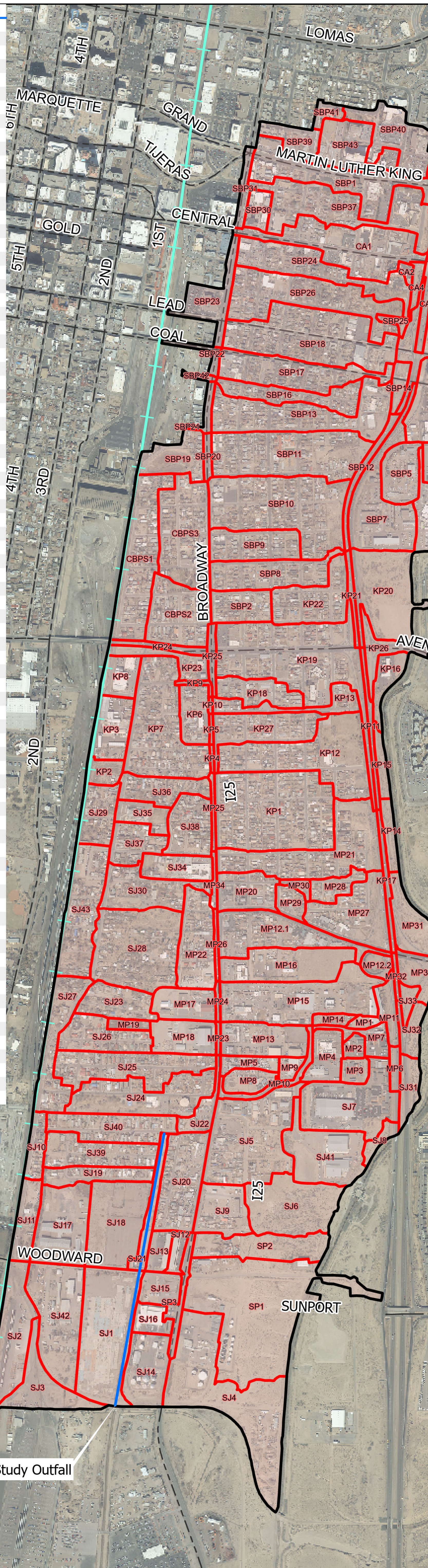
Name	Area (Acres)	Impervious (%)	Name	Area (Acres)	Impervious (%)
CA1	19.4	90	SBP19	7.6	35
CA2	0.8	90	SBP2	6.6	65
CA3	3.3	98	SBP20	1.3	98
CA4	1.7	75	SBP21	1.6	98
CBPS1	18.8	65	SBP22	1.6	98
CBPS2	12.8	65	SBP23	7.6	95
CBPS3	17.7	65	SBP24	14.3	65
KP1	31	65	SBP25	1	60
KP10	0.2	98	SBP26	20.2	65
KP11	2.5	98	SBP27	9.3	80
KP12	23	60	SBP28	14.1	85
KP13	5.9	65	SBP29	2.1	65
KP14	2.8	0	SBP3	11.4	50
KP15	2.4	0	SBP30	3	80
KP16	4.3	50	SBP31	2.5	98
KP17	2.5	98	SBP32	1.2	98
KP18	6.8	70	SBP33	23.5	70
KP19	33.8	70	SBP34	3.5	98
KP2	3	20	SBP35	5.7	60
KP20	17.1	15	SBP36	30.5	80
KP21	1.7	98	SBP37	20.3	75
KP22	11.3	65	SBP38	3	75
KP23	4.7	50	SBP39	5	80
KP24	2	98	SBP4	17.6	80
KP25	1.8	98	SBP40	11.6	85
KP26	4.7	75	SBP41	1.8	75
KP27	11	65	SBP42	0.6	98
KP3	7.8	85	SBP43	10	75
KP4	0.4	98	SBP5	7.3	85
KP5	0.4	98	SBP6	19.4	85
KP6	5.8	80	SBP7	16.5	85
KP7	22.9	60	SBP8	11.8	65
KP8	5	85	SBP9	9.5	65
KP9	0.7	98	SJ1	23.6	90
MP1	1.2	50	SJ10	3.8	60
MP10	2.9	98	SJ11	5.8	45
MP11	3.7	55	SJ12	2.1	85
MP12.1	14.8	70	SJ13	3	85
MP12.2	2.3	40	SJ14	10.1	80
MP13	9.8	85	SJ15	4.3	75
MP14	1.6	25	SJ16	3.5	85
MP15	22.2	85	SJ17	14	72
MP16	13.6	55	SJ18	16.1	60
MP17	6.7	85	SJ19	6	55
MP18	7.4	85	SJ2	14.1	80
MP19	1.5	20	SJ20	13.7	70
MP2	1.6	85	SJ21	4.4	75
MP20	7.6	72	SJ22	3.7	75
MP21	21.5	60	SJ23	7.6	45
MP22	11.4	65	SJ24	16.1	50
MP23	0.5	98	SJ25	15	65
MP24	0.7	98	SJ26	8.9	65
MP25	1.1	98	SJ27	11.3	70
MP26	1	98	SJ28	22.7	45
MP27	13.9	70	SJ29	7.1	60
MP28	3.7	65	SJ3	9.6	75
MP29	3	70	SJ30	10.9	50
MP3	2.3	70	SJ31	4	50
MP30	1.1	65	SJ32	3.6	45
MP31	8.6	25	SJ33	1.7	5
MP32	0.7	98	SJ34	6	60
MP33	6	35	SJ35	4.4	70
MP34	1	98	SJ36	7.3	50
MP4	5.7	72	SJ37	6.3	60
MP5	2.9	72	SJ38	8.6	60
MP6	1.6	50	SJ39	10.5	55
MP7	3.6	98	SJ4	32.5	45
MP8	3.8	50	SJ40	11	65
MP9	1.7	72	SJ41	14.2	85
SBP1	17.6	75	SJ42	18.3	85
SBP10	28.3	65	SJ43	15.3	60
SBP11	23.5	60	SJ5	24.2	55
SBP12	3.1	98	SJ6	16	0
SBP13	20.3	65	SJ7	17.6	85
SBP14	2.3	40	SJ8	2	15
SBP15	18.3	75	SJ9	8.6	75
SBP16	8.6	65	SP1	42.2	60
SBP17	14.3	70	SP2	11.2	25
SBP18	26.1	70	SP3	3.5	98



Notes:
Horizontal Datum: NAD 1983 HARN StatePlane New Mexico Central FIPS 3002 Feet
Orthophoto Source: 2020 MRCOG Bernalillo County

Legend
- Basin Boundaries
- Streets
- BNSF Railroad
- San Jose Drain
- Study Limits

Figure 5 Hydrology Overview

South Broadway Drainage Master Plan

March 2023

N

0 600 1,200 Feet

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Path: N:\Projects\04270 COA Transportation and Drainage On Call\Task 4-South Broadway DMP Update\12 GIS\SBroadway-CD\SBroadway-CD.aprx

2.1.2 SLOPED VERSUS VALLEY BASINS

One of the primary selectors for using PCSWMM for the hydrologic analysis was the fact that PCSWMM allows the user to account for valley watershed conditions where a lot more initial abstraction occurs. Many areas in the valley do not drain out topographically, and thus, there is a lot more on-site retention ponding that occurs. This greatly reduces the direct runoff volume from these areas. The model can be adjusted to capture this reduction in volume by adding a depression storage to those basins. Many properties will not drain out to the street as the street grade is higher than adjacent lots. This is especially true for areas where the dominant land treatment type is pervious with some directly connected impervious areas such as large farmstead type properties or agricultural fields. A detailed discussion on hydrologic input parameters will be provided in Section 2.1.4-2.1.7.

In contrast, sloped basins do have the ability to drain out to adjoining roads that connect to conveyance facilities. An example of this may be curb and gutter that connects to storm drains and eventually channel systems. RESPEC used topography and field work as primary factors to distinguish between sloped and valley basins. If the average subbasin slope was less than 1 percent, then the subbasin was a valley basin. **Figure 6** shows the distribution of sloped versus valley basins as they occur in the South Broadway watershed.

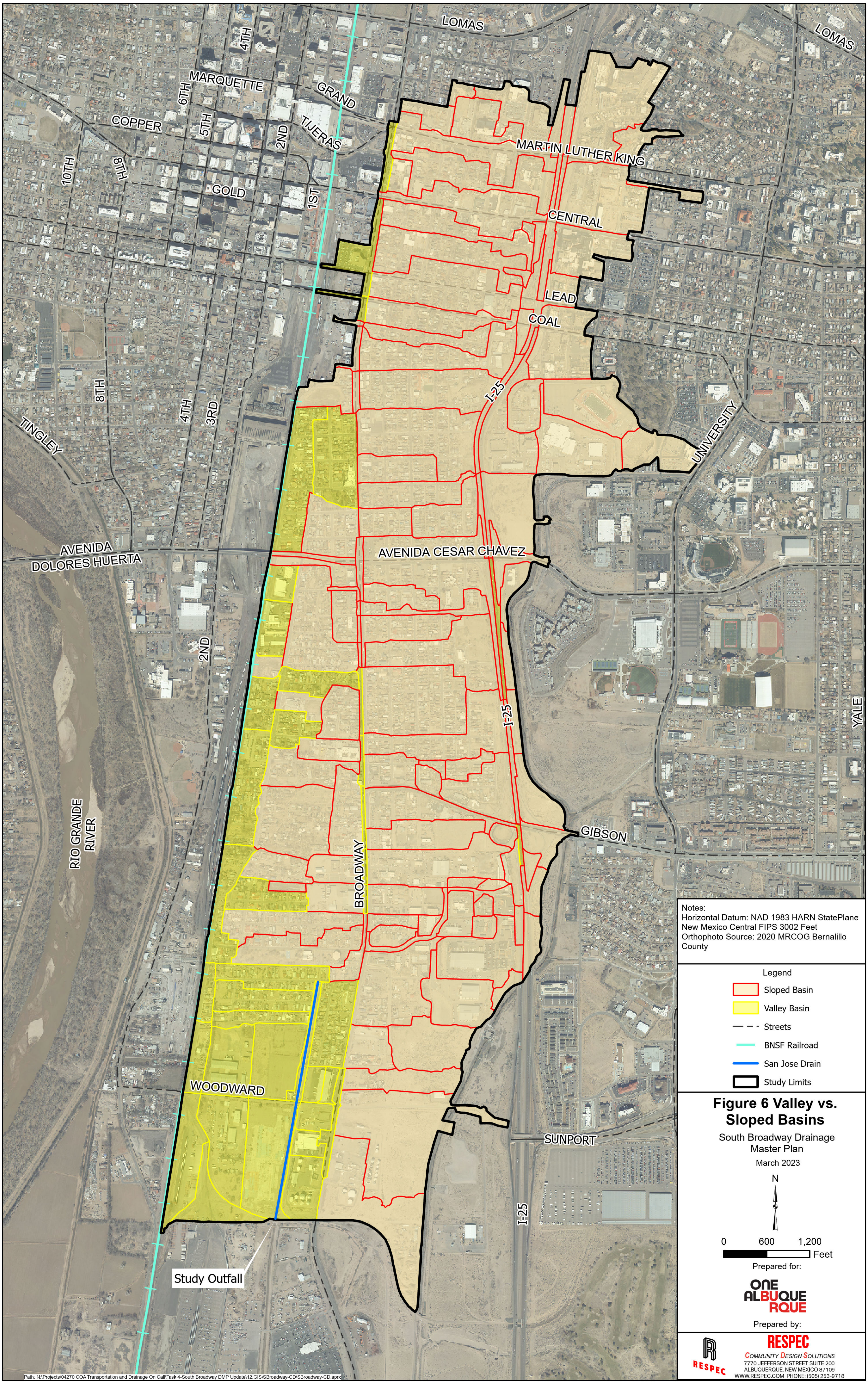

Figure 6 Valley vs. Sloped Basins

South Broadway Drainage Master Plan

March 2023

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2.1.3 DISCONNECTED SUBBASINS

Throughout the watershed, RESPEC determined that some subbasins will act as disconnected basins. These are subbasins that are hydrologically within the limits of the study area but cannot physically drain out. In some cases, these are depressed industrial areas, ponded areas, and developed or undeveloped lots that are depressed and therefore disconnected due to topography. Peak discharges and volumes were computed for these subbasins, but they were not hydrologically added to the hydraulic network. To run the model, PCSWWM requires each subbasin to either have an outfall or be connected to an outlet downstream. Given that these subbasins cannot drain, they were assigned their own outfall. **Figure 7** shows an example street view of a disconnected basin at the northwest corner of Stock Drive the Railroad tracks and Broadway Boulevard. The eastern side, being Broadway Boulevard, and the railroad tracks to the south, are significantly higher than the fence that is shown. Therefore, any runoff will pond, as there are no conveyance facilities in this area to route the runoff to the north.

Figure 7: Street View of Disconnected Basins

2.1.4 OVERVIEW OF SWMM HYDROLOGY

The hydrologic methods available in PCSWMM provides an effective tool for the analysis of subbasins that occur in valley conditions that are typically depressed and unable to drain out. This is because PCSWMM treats each subbasin or sub-catchment as a polygon for which a volume analysis is performed to generate a runoff hydrograph. The sub-catchment polygon is divided into an impervious portion, representing the directly connected impervious areas and a pervious portion which represents all pervious areas. The two types of areas are then internally routed using a subarea routing method. There are three principal methods for subarea routing which are discussed in detail below. Initial abstractions for areas that are depressed can then be manipulated to capture effect of depression storage and excess ponding that will occur. There are several key parameters that are required to generate hydrographs.

A general definition of terms is provided below:

- **Sub-catchment**: The equivalent term for a subbasin.
- **Area**: Subbasin area based measured from ArcGIS Pro.
- **Hydrologic Area Width**: The estimated width for sheet flow. This is a difficult parameter to estimate as the width for sheet flow in any subbasin is subjective. Alternatively, PCSWMM recommends computing the longest flow path, as this is a parameter easily measured based on topographic data. The overland flow width can then be estimated by taking the ratio of the basin area to the longest flow path. PCSWMM recommends that this parameter is one that should be calibrated as the width and area for the sub-catchment significantly affects the peak. For this analysis, RESPEC measured the longest flow path for each sub-catchment. PCSWMM has a built-in function that lets the user determine if the flow path or the width will be used as the direct input. The South Broadway model was set to select the longest flow path as the direct input which allowed the model to compute the width internally. Flow path lengths were adjusted for some sub-catchments to calibrate the unit peak discharges (cfs/acre) and runoff results.
- **Subarea Routing Method**: Determines how the computed runoff for a sub-catchment polygon gets routed internally. There are three primary routing methods: pervious, impervious or outlet.
  - The Pervious method assumes that some percentage of the runoff from the impervious area is directed over the pervious area in the sub-catchment. This method requires a composite curve number to be defined for the entire sub-catchment.
  - The Impervious method assumes that some portion of the pervious area is routed over the directly connected impervious area. This method requires the directly connected impervious area be defined as a percentage whereas the curve number is assigned to the pervious area.
  - The outlet method does not do internal routings. In this method, runoff from both the impervious area and pervious area are routed directly to the outlet of the sub-catchment.

For the South Broadway model, the impervious subarea routing method remained the same from the URS model. This is because for much of the area runoff from the pervious areas will flow over the directly connected impervious areas before entering the drainage infrastructure. Furthermore, the model can capture a faster direct runoff response from the directly connected impervious areas by using the Impervious Routing Method, especially when land uses get mixed such as residential and agricultural land.

Typically, when using curve numbers as the basis for simulating losses, subbasins must be defined as homogeneously as possible to prevent lumping of different land uses. However, in many instances this is not possible. As such, for subbasins that have multiple land uses combined in a single subbasin, an aerially weighted curve number was computed.

The peak discharge will get dampened if the differences in the curve numbers that are being weighted are too great, especially if the difference is greater than 5. Using the impervious subarea routing eliminates this situation as the directly connected impervious areas and pervious areas are distinctly separated and infiltration losses for each area is computed separately.

- **Percent Impervious**: Represents the percentage of the subbasin that is directly connected impervious areas. Any area is considered directly connected impervious if it can drain out to conveyance facilities. The percent imperviousness was approximated from both the 2020 MRCOG orthoimage for the county and Table 2-2a from the TR-55. The impervious area can also be assigned depression storage to account for minor losses that will occur in little ponding areas in the parking lot where poor grading could have occurred.
- **Curve Number**: TR-55's Urban Hydrology for Small Watersheds was used to select curve numbers for portion of the subbasin that was considered pervious. The model than uses the TR-55 method to compute infiltration losses for the pervious areas. The model must be toggled to use the curve number method as there are several loss methods available in the model.

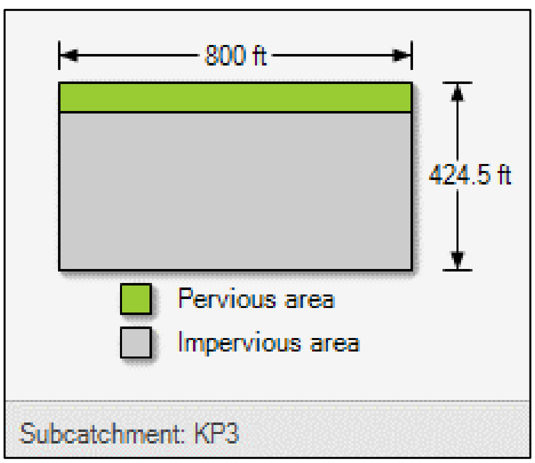

Figure 8: Sub-Catchment Polygon

An example of an idealized sub-catchment polygon for a subbasin in the Kathryn subsystem is shown in **Figure 8**. The model uses the longest flow path as the user defined input and internally computes the width of the sub-catchment. The impervious area is defined by the user and the model than computes the remainder of the area to be pervious. A curve number is assigned to the pervious part of the sub-catchment. Infiltration losses are computed separately for each distinct area.

2.1.5 RAINFALL DATA

The centroid of the watershed was used to obtain point rainfall depths from the NOAA Atlas 14 website to determine the 100-year 24-hour rainfall depths. This design storm was chosen as this system has a combination of storm drains and detention ponds to be modeled and the 100-year 24-hour storm is the design criteria for ponds. The differences in rainfall depths were minor across the study area and therefore a depth of 2.6 inches was used. For the South Broadway PCSWMM model, the AHYMO South Valley Rainfall Distribution was selected since it's the same rainfall distribution in the models for the adjacent watersheds. This distribution creates hydrographs that will peak at approximately 1.5 hours.

Figure 9 shows the differences between various rainfall distributions that have been used in various modeling approaches within Albuquerque and the County areas.

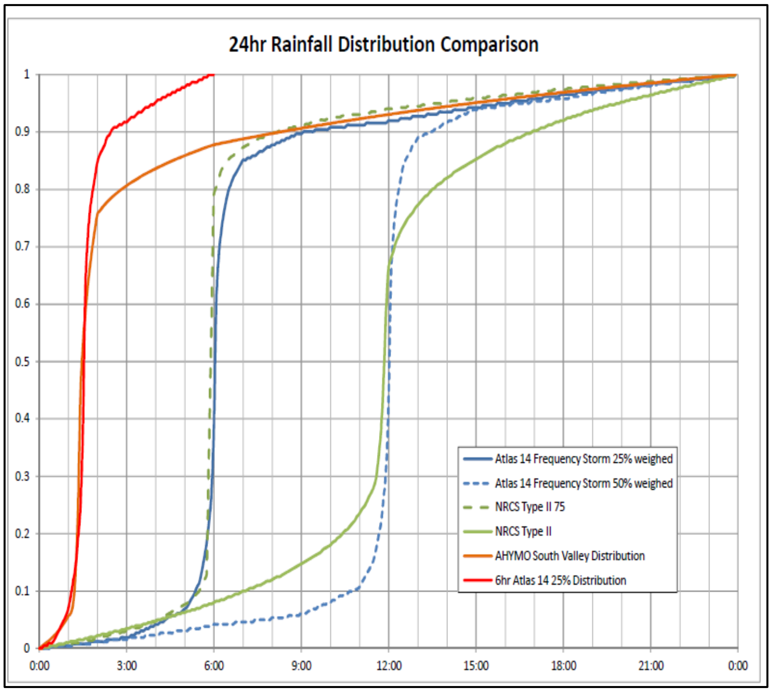

Figure 9: Rainfall Distribution

Hydrograph timing was an important consideration when considering rainfall distributions. Typical hydrologic models for NM use the Atlas 14-25% Frequency Distribution Storm, which is also shown on **Figure 9**. Hydrographs from this distribution will have hydrograph peak times at 6 hours. The South Broadway watershed shares its boundary with the Mid Valley drainage area and with the Alameda Drain Study. By using the same distribution, all three models will have hydrograph peak times occurring at the same time. In the future, should any cross-basin projects occur, the three models will all have consistent rainfall distributions which will allow seamless model integration.

2.1.6 INITIAL ABSTRACTION AND DEPRESSION STORAGE

SWMM has three parameters called D-Store Pervious, D-Store Impervious, and Zero-Impervious which can be used to further calibrate initial abstractions for any sub-catchment. They are defined as:

- **D-Store Pervious**: additional initial abstraction to be applied to pervious part of the sub-catchment beyond the initial abstraction associated with the curve number that has been selected for the pervious part of the sub-catchment. Primarily assigned to basins with less than 1% slope or valley basins.
- **D-Store Impervious**: Additional depression storage to be applied to impervious part of the sub-catchment.
- **Zero-Impervious**: Fraction of the impervious part of the sub-catchment that has 100% direct runoff.

To simulate additional initial abstractions in sub-catchments that were depressed, the procedure from the MVDMP was followed. The premise for this procedure was based on the "Analysis of the AHYMO Program for Flat Valley Areas" by Bohannan Huston, February 1995. The study concluded that to account for depressed watersheds in the valley, the default initial abstractions in the AHYMO model be increased to the values shown in **Table 2**.

Table 2: AHYMO Land Treatment Values

Land Treatment Type	Default Initial Abstraction	Recommended Initial Abstraction	Infiltration Rate
	(inches)	(inches)	(inches/hour)
A	0.65	1.20	1.67
B	0.50	1.05	1.25
C	0.35	0.90	0.83
D	0.1	0.85	0.04

The average of the recommended initial abstractions was 1 inch. The MVDMP approach was to determine initial abstractions associated with each curve number assigned to the valley sub-catchments. These initial abstractions are values derived from Table 10-1 in the National Engineering Handbook. The goal was to ensure that all valley subbasins would have a total initial abstraction of 1 inch. If the value was less than 1 inch, the difference was added to the D-Storage Pervious option in the model as the curve number is only applied for loss computations in the previous part of the sub-catchment. An example for sub-catchments in the San Jose system is shown in **Table 3.**

Table 3: Example of Sub-Catchments for the San Jose System

Basin Name	Curve Number	Default Initial Abstraction (inches) Column A	Additional Initial Abstraction Added Via Pervious Depression Storage (inches) Column B	Total Initial Abstraction (inches) Applied = Column A+B
SJ1	96	0.08	0.92	1
SJ2	94	0.13	0.87	1
SJ3	94	0.13	0.87	1

Detailed initial abstraction calculations for all valley sub-catchments are provided in Appendix 2. For all sub-catchments, a standard initial abstraction of 0.1 inches is applied to the impervious areas. For all sloped basins, no additional adjustments were made.

2.1.7 CURVE NUMBER SELECTION

The SCS Runoff CN Method was used to estimate the initial abstraction loss to determine excess precipitation (direct runoff). The Hydrologic Soil Group (HSG) of the watershed is important since this controls the amount of infiltration. HSG ranges from soil Type A to Type D, where Type A and Type B have high infiltration rates and low runoff potential, however, Type C and Type D have low infiltration rates and therefore high runoff potential. All soil data was gathered from the NRCS Web Soil Survey website. **Figure 10** shows the distribution of soil groups in the study area.

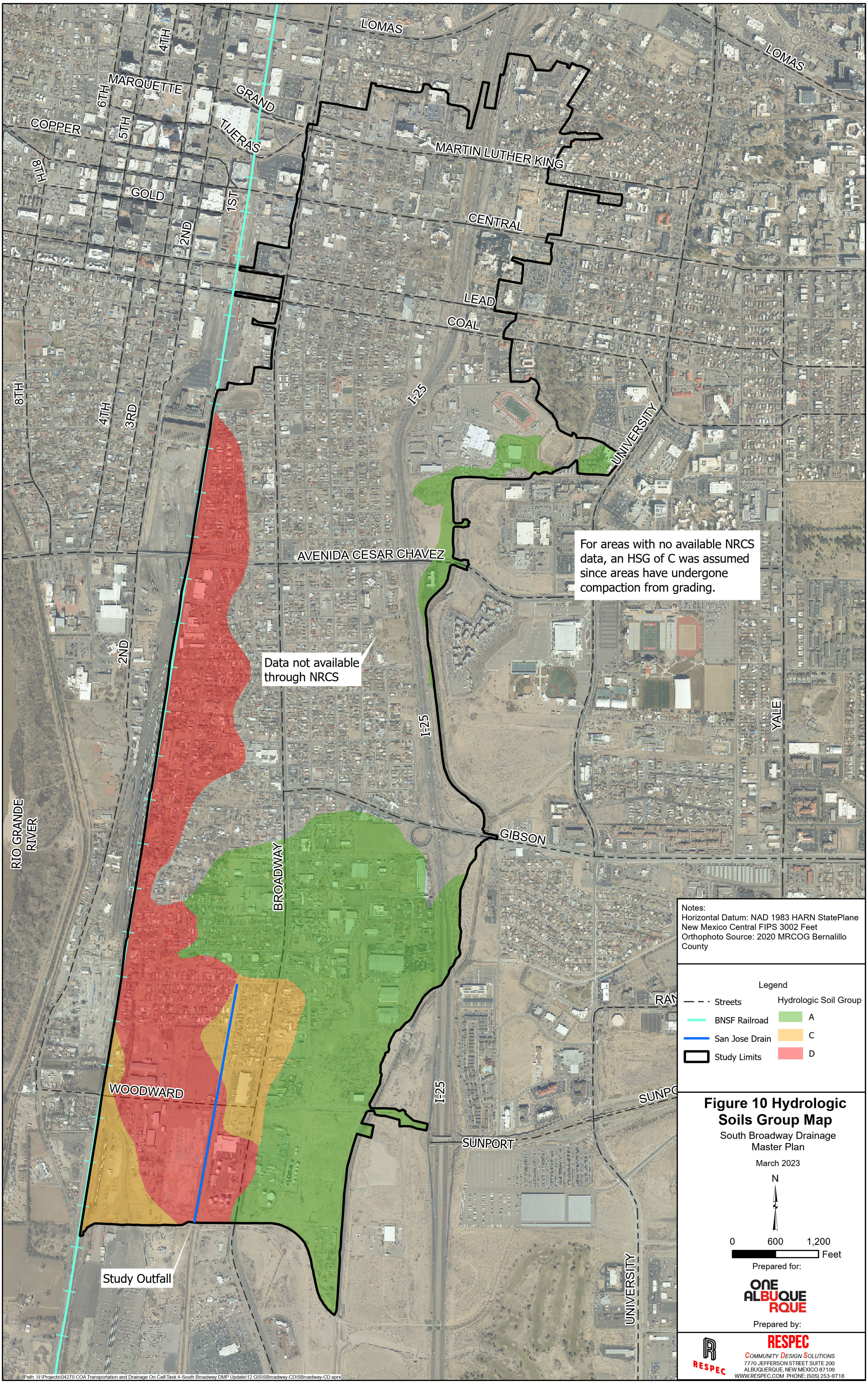

Figure 10 Hydrologic Soils Group Map

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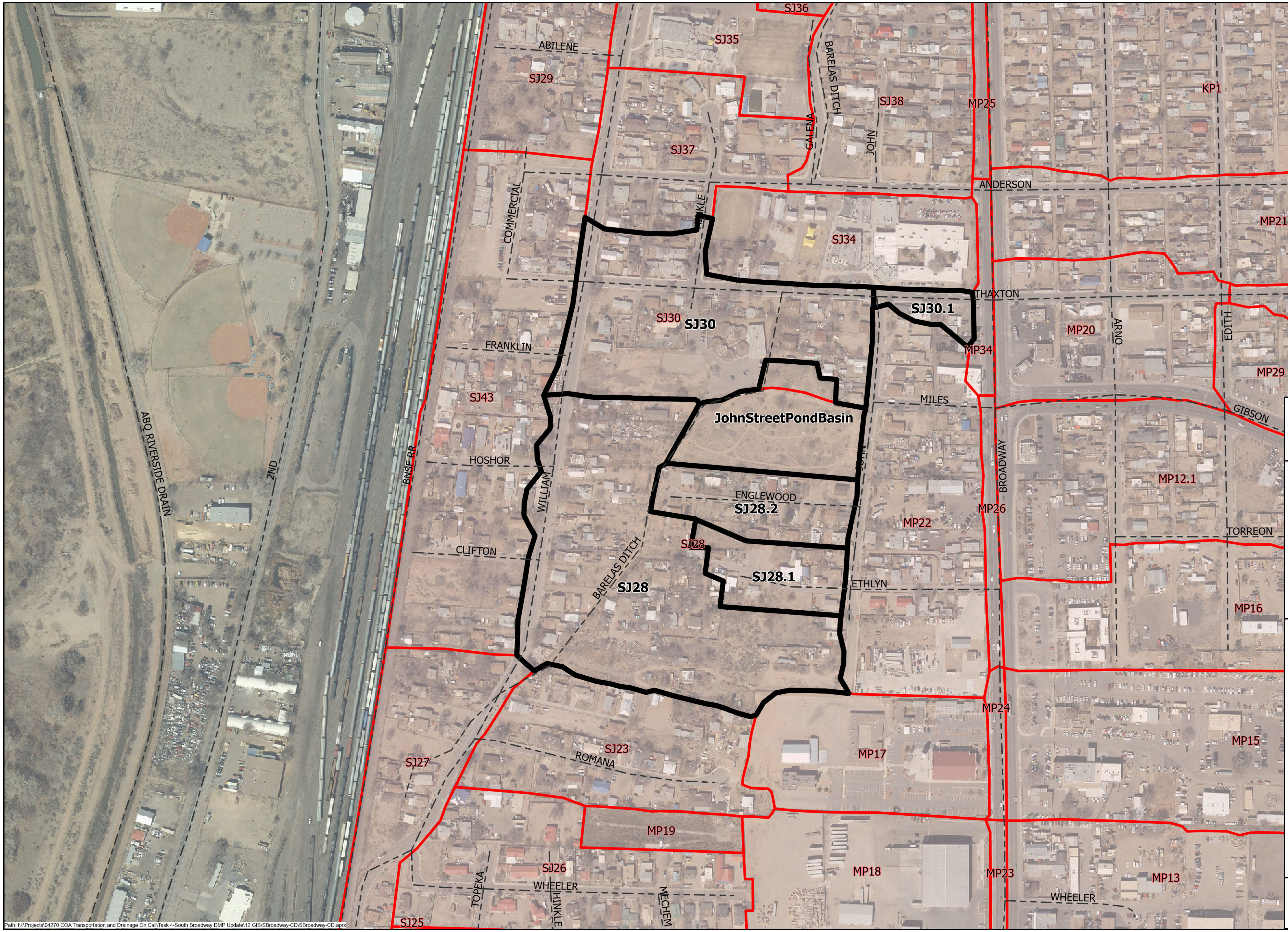
The standard approach to calculating a CN is to measure each area of contributing subbasin to an appropriate land use and corresponding hydrologic soil group. Sub-catchments that are not homogenous require aerially weighted composite curve numbers.

A large portion of the watershed had no available NRCS soils data. Since this area has undergone development that would have required grading and compaction of native soils, HSG C was assumed for curve number computations. Refer to Appendix 2 for CN calculations.

2.2 PROPOSED CONDITIONS

Hydrology methodologies remained the same from existing conditions, however, some basins boundaries were split strategically to better analyze runoff volumes and peak discharges going to proposed John Street Pond. Refer to **Figure 11** for an overview of the proposed conditions basin boundaries around John Street Pond.



Notes:
Horizontal Datum: NAD 1983 HARN StatePlane New Mexico Central FIPS 3002 Feet
Orthophoto Source: 2020 MRCOG Bernalillo County

Legend

- Streets
- Proposed Basins
- Existing Basins

Figure 11 Proposed Conditions Basin Map - John St.

South Broadway Drainage Master Plan

March 2023

N

0 150 300 Feet

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3.0 HYDRAULIC ANALYSIS

The URS (2013) model was the basis for this analysis. RESPEC verified and updated the hydraulic network as necessary from any development that had occurred in the last 9 years. The existing system has deficiencies that ranges from insufficient pond storage volume and storm drain capacity. The conceptual improvements discussed in section 3.2 will help increase capacity in the system and reduce flooding throughout the system.

GIS INTEGRATION WITH PCSWMM

PCSWMM is an excellent modeling tool due to its ability to interface with ArcGIS Pro when it comes to developing an extensive hydrologic and hydraulic model. ArcGIS Pro's graphical user interface (GUI) allows all pertinent data to be created and calculated within the software and displayed in attribute fields and geodatabases. The data is then directly imported into PCSWMM to begin the model building process. The data required for the construction of the PCSWMM was stored in a geodatabase which included shapefiles which have both associated metadata and attribute tables. These shapefiles can host a variety of different things from subbasins to storm drain infrastructure. All representative data in the model was integrated using ArcGIS Pro and appropriate geodatabases were submitted to the City of Albuquerque digitally. Model generation and input parameters for all components are discussed in the following sections.

3.1 EXISTING CONDITIONS

3.1.1 MODEL GENERATION FOR HYDRAULIC NETWORK

RESPEC verified the existing conditions data in the SWMM model from URS (2013), starting from south of Lomas Boulevard to its outfall in the San Jose Drain, south of Woodward Road. This data, along with all the pertinent information such inverts, pipe size, pipe length and pipe material, were incorporated into a geodatabase to be imported into PCSWMM.

The hydraulic network, which represented the storm drains, channels and ponds in the watershed were developed based on review of as-built construction drawings, City GIS shapefiles, and the 2000 City of Albuquerque Utility Map.

The input data required for modeling in PCSWMM was entered into the shapefile's attributes. Critical parameters required for modeling storm drains include:

- Length
- Slope
- Manning's "n" Value
- Diameter
- Shape
- Inlet and Outlet Offset
- Entrance and Exist Loss Coefficients

Inlet and outlet offsets are parameters that were used if the storm drains do not connect to manholes at the inverts such as at a drop manhole. An example of a storm drain with an outlet offset is shown in **Figure 12**.

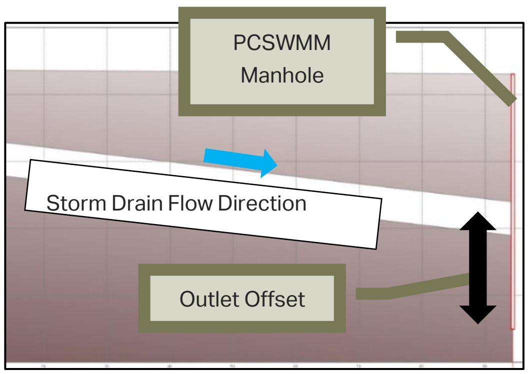

Figure 12: Storm Drain with Outlet Offset Example

SWMM applies manhole loss coefficients to the downstream pipe segments. As such, conduits require entrance and exit loss coefficients. Since this is a master plan level study, a standard value of 0.9 for entrance losses and 1 for exit losses were used which would model energy losses at manholes conservatively. The cross-section geometry for the San Jose Drain open channel in the model were based on a combination of 2018 MRCOG Lidar and as-built construction drawings. From field work in September 2022, the channel starts as being concrete lined from Bethel Ave to Woodward Rd shown in **Figure 13**. Downstream of Woodward Rd, to the outfall of the model, it's heavily vegetated as shown in **Figure 14**.


Figure 13: San Jose Drain at Bethel Avenue


Figure 14: San Jose Drain Downstream of Woodward

To simulate the channel hydraulics, a Manning's "n" value is required in SWMM. RESPEC selected an "n" value of 0.05 to simulate the channel conditions at maximum vegetative growth and a 0.015 where the channel is concrete lined. Since the model has a combination of open channel and culvert structures, culvert codes in PCSWMM representing entrance losses (Ke), were assigned to the structures that were consistent with the structure's inlet conditions in the field. The model, based on its internal computations, determines whether the culvert is inlet or outlet controlled. A schematic view of a trapezoidal channel is shown in **Figure 15**.

Manholes require input parameters that include a rim elevation, an invert elevation, and a depth. The model can use an invert elevation with a user specified rim elevation to compute the manhole depth. This was the approach taken for this model. A schematic view of a typical manhole is shown in **Figure 16**.

Some manholes, particularly in the valley areas, were allocated a ponded area based on available street storage. This will simulate stormwater surcharge out of the inlets and ponding in a street when a storm drain system capacity was exceeded. PCSWMM will use the storage area to contain the excess volume before reintroducing it back into the storm drain system once the storm drain has regained its capacity. Storage area was computed using MRCOG Lidar and aerial imagery to approximate street widths.

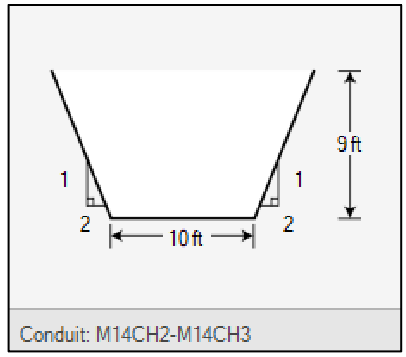

Figure 15: Channel Schematic Example

Manholes can also be simulated with a surcharge depth. A surcharge depth is typically applied to simulate a bolted manhole to maintain volume continuity. In some cases, if the downstream pipe does not have the conveyance capacity and the system surcharges, a surcharge depth can be applied to ensure that the volume is not lost from the system. The profile might show a surcharged hydraulic grade line, but the model preserves the systems volume. Typically, in a stormwater system, runoff from a subbasin will enter the storm drain system via several inlets that are in the subbasin. In this model, hydrographs from the subbasins were added directly into a manhole and in some instances, due to downstream capacity issues, the system would surcharge. A summary table included in Appendix 3 provides detailed ponding area calculations for the various subsystems whereas.

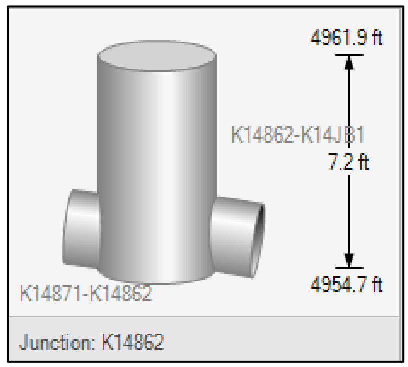

Figure 16: Manhole Schematic Example

3.1.2 PONDS AND PUMP STATION

The South Broadway has 7 ponding facilities and 1 pump station. The detention ponds and pump station provide significant attenuation in the system which causes peak flows from the various subsystems to arrive at different times. This difference in timing will significantly affect the hydraulic capacity of the system. There are four configurations for modeling pump stations. For this model, the pump was modeled as a Type 2 pump, which operates as an inline pump station whose discharge increases as the depth increases at the inlet node. SWMM represents a pump station visually as a conduit and the pump curve data is associated to the pump. The pump curve data allows the model to determine starting depths and discharges. The pump station modeled in PCSWMM has a ponding facility attached to it that will act as the wet well.

Ponds in SWMM are simulated as storage nodes. SWMM requires a depth and area rating curve which it will then use to compute volume internally. The pond outfall, depending on the nature of the outlet works, can be simulated either with a simple single outlet pipe connection (conduit) or an outlet works consisting of reverse inclined ported risers, a special feature called an outlet. For an outlet, a user defined head and discharge rating curve is assigned.

This discharge rating curve is based on the height of the outlet tower, the size, port spacing and number of the reverse inclined ports and the diameter of the principal outlet pipe. The elevation storage discharge rating curves were all obtained from record drawings and verified from field work. MRCOG Lidar was used to verify contour areas. Detailed elevation storage discharge rating curves for the ponds simulated in the model are provided in Appendix 2.

The Sunport Pond is part of the Sunport Boulevard Woodward Road extension. The project was still in construction during the development of this master plan update and will need to be updated once as-built construction drawings are produced. Meanwhile, RESPEC used the stamped design analysis report for pertinent data from Bernalillo County to put into the model. A full modeling schematic is shown in **Figure 17**.

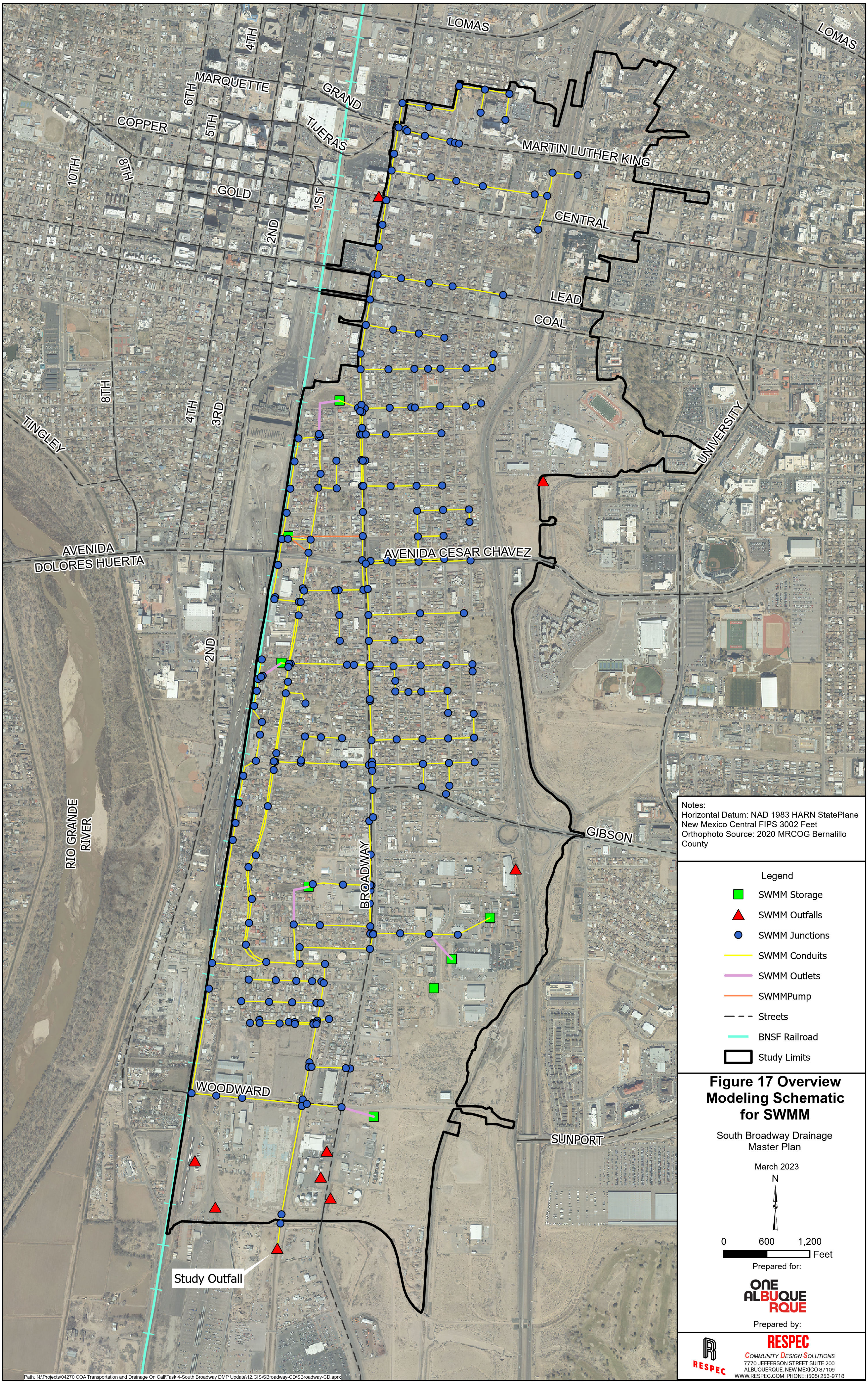

Figure 17 Overview Modeling Schematic for SWMM

South Broadway Drainage Master Plan

March 2023

3.1.3 MODELING SENSITIVITY & CALIBRATION

RESPEC validated and updated the PCSWMM model that was completed by URS in 2013. Once the model was updated, RESPEC completed quality control of the model for any errors and verifying the output, such as unit peak discharges and runoff volume. Major quality control items were:

- **Unit peak discharge**: Validate the peak flows were representative of development type. Past studies such as the MVDMP were used as a reference. As a rule of thumb:
    - Heavily developed impervious areas were expected to produce approximately 3.2-4.5 cfs/acres.
    - Medium-High density residential areas were expected to produce approximately 2.5-3.0 cfs/acre.
    - Low density residential areas were expected to produce approximately 1.5-2.0 cfs/acre.
    - Valley subbasins were expected to produce approximately 0.8-1.5 cfs/acre depending on the directly connected impervious areas present.
- **Profiles**: All storm drain systems were checked for adverse slopes or incorrect connections.
- **Node flooding**: Assessed to see if manholes were flooding due to incorrect data or simply due to system deficiencies.
- **Volume losses**: Assessed to ensure that the model wasn't losing volume due to incorrect data.
- **Continuity**: Ensure that the dynamic wave equation was being solved correctly. This is a partial differential equation that is resolved for the hydraulic component of the model. When the model is not able to find a solution for a segment of storm drain or open channel, the continuity errors start increasing. Very short lengths of storm drain, open channels, or complex hydraulic connections such as diversions, weirs and orifices can be the leading causes for this continuity error. The quickest way to reduce continuity error is to adjust the time step interval. By giving the model adequate time steps to find solutions for all hydraulic systems, the continuity errors can be minimized. The existing conditions South Broadway model is at a 1 second routing time step interval with an option of a varied time step of 0.01 seconds. The varied time step allows SWMM to compute below the set routing time step and still satisfy the Courant condition through each conduit as necessary. In the SWMM manual, the acceptable percentage (%) range for routing continuity is between 0 to 1%. The South Broadway model with these parameters is running with a 0.3% routing continuity, which is acceptable, and a final runtime of approximate 1 minute.

3.1.4 NODE FLOODING AND VOLUME LOSS

The system does lose volume; however, this occurs at manholes and ponds. The flooding occurs due to the system deficiencies as opposed to modeling errors. To conserve volume in the system, the model can be artificially manipulated by adding fictitious storage volumes to manhole nodes and artificially extending the elevation and area rating curves for ponds that flood. However, no artificial manipulation of existing data was done in order the preserve the reality of the existing system and to demonstrate the effectiveness of the proposed improvements. Junctions where inflow hydrographs are introduced into the system were assigned a surcharge depth where acceptable to allow the runoff volumes to be effectively accounted for. The node flooding is documented in the node flooding summary table in Appendix 3.

3.1.5 EXISTING CONDITIONS RESULTS

The South Broadway hydraulic network is an old system and has become undersized from the additional development over the years. South Broadway is a hydraulically driven system which means it's time dependent and head driven since slopes are very flat. There have been some drainage mitigation to help resolve flooding and increase capacity, however, being in an area that is so flat makes improvements challenging.

The Department of Municipal Development (DMD) provided RESPEC a GIS shapefile of all locations within the study area with documented complaints through the 311 system. **Figure 18** shows locations provided from the City for identified floodings and flooding junctions from the model. The major problem is the existing ponds and storm drains are under capacity. These deficiencies are caused from undersized pipe sizes, and not having enough storage volume in the existing ponds. These system deficiencies have been identified and correlated similarly to the historical flooding which are shown in **Table 4.**

Table 4: Model Flooding Location Summary

System Name	Flooding Concerns
South Broadway Pond	• Marquette storm drain (311 data) • Broadway Boulevard from Marquette to Central • Locust St between MLK Ave s & Central • East of 1-25 on Oak Avenue and Tijeras Avenue. • Lead Ave flooding Broadway to Elm St. • Iron Avenue at input hydrograph. • Santa Fe Ave at input hydrograph. • Pacific Ave at input hydrograph. 311 shows flooding in alley at Arno. • Cromwell Ave • Garfield Avenue flooding at input hydrograph. • South Broadway Pond flooding. Top of Pond is higher than downstream MH.
Central Ave	• Flooding at Central & Walter (311)
Bell-Commercial Pump Station	• South Broadway outlet node is flooding • Cromwell Ave/Williams and John St flooding • Capacity of pump station (constraint)
Kathryn Pond	• Storm drain in Lewis & Edith/High St (311)

	• Avenida Cesar Chavez east of Broadway Boulevard • Trumbull Ave and Williams St - ponding about 9" in street • Southern Ave storm drain under capacity (12") • Kathryn Ave west of Broadway • Kathryn pond under capacity - storage
Mechem Pond	• Storm drain between San Jose st and Alamo Ave on Broadway • Kathryn ave storm drain east of Broadway under capacity & along Arno st. • Anderson Ave East of Broadway SD under capacity • Thaxton Ave on Broadway and going east- Orifice plate • Gibson Boulevard and Walter st. • Mechem Pond under capacity - storage
San Jose Drain	• Storm drain in commercial along railroad tracks surcharging - ~ 4-6" depth • Storm drain in Williams is flooding • Descanso street • Bethel flooding • Abajo street flooding • Anderson Ave on Hinkle, to Thaxton ave towards Williams • Wesmeco rd and Arno (311 flooding)

Table 5 provides a summary of how the existing ponds operate at the peak of the design storm.

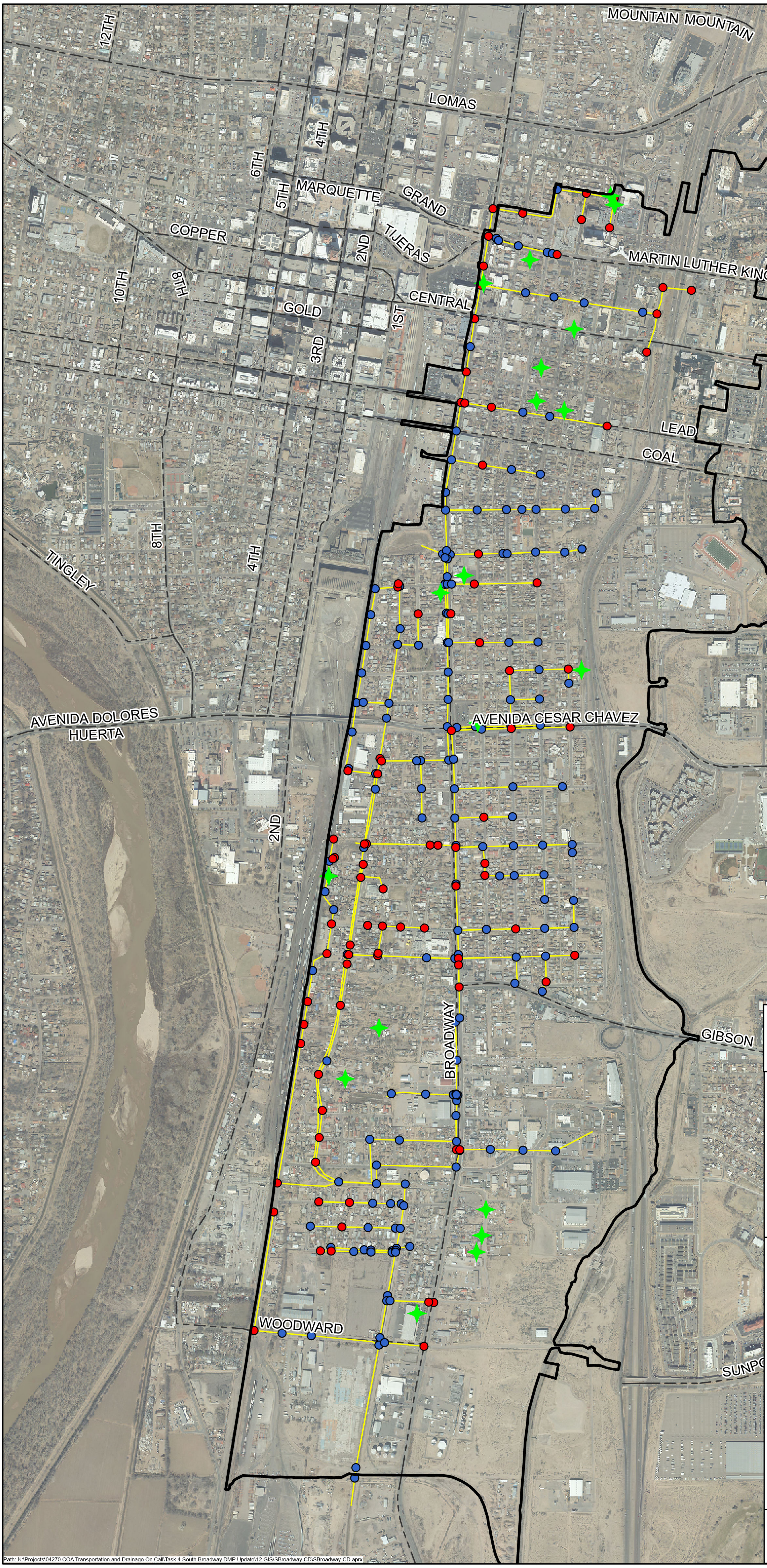

Figure 18 Identified Flooding Locations

South Broadway Drainage Master Plan

March 2023

Prepared for:

ONE ALBUQUERQUE

Prepared by:

RESPEC

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Table 5: Existing Pond Characteristics

Pond Name	Invert Elevation (ft)	Rim Elevation (ft)	Max Depth (ft)	Max HGL (ft)	Max Total Inflow (cfs)	Max Total Outflow (cfs)	Total Inflow (MG)	Total Inflow Volume (AF)	Pond Design Volume (AF)	Pond Design Depth (ft)	Freeboard to Top of Pond
Bell Commercial Pump Station	4924.67	4949.67	3.51	4928.18	93.3	91.8	16.7	51.3	-	25.0	21.5
Business Indst. Ret Pond South	4973.00	4985.00	9.03	4982.03	65.1	0.0	1.0	3.2	4.9	12.0	3.0
BusinessIndstUnit3Pond	4998.00	5007.00	1.37	4999.37	21.5	20.5	0.3	1.0	0.7	9.0	7.6
Karsten Pond	4985.00	4996.00	5.3	4990.30	73.2	13.6	1.2	3.6	7.0	11.0	5.7
Kathryn Pond	4940.79	4946.00	5.21	4946.00	189.7	17.9	8.0	24.5	4.9	5.2	0.0
Mechem Pond	4937.17	4946.37	9.2	4946.37	328.9	45.1	10.1	31.0	6.5	9.2	0.0
S.Broadway Pond	4938.35	4952.00	13.08	4951.43	434.7	84.1	17.1	52.5	25.2	13.6	0.6
Sunport Pond	4934.28	4941.50	6.17	4940.45	183.3	20.8	3.4	10.3	7.3	7.2	1.1

3.2 PROPOSED CONDITIONS

The existing hydraulic system for South Broadway indicates significant deficiencies throughout the watershed. Improvement alternatives were developed to help mitigate flooding throughout the system. This was accomplished by upgrading existing infrastructure and proposing another pond or pump station. These options were driven by using the property that is currently owned by the COA for a detention pond, called the John Street Pond. John Street Pond is located west of John Street, south of Thaxton Avenue, east of Williams Street and north of Englewood Drive. Option 1-3 have two alternatives that were considered.

The four options have similar improvements that are included in each to help improve the system throughout which include:

- Modifying pond grading to steeper side slopes for South Broadway Pond and Kathryn Pond for more volume capacity.
- Modifying junction boxes at Kathryn Pond and South Broadway Pond.
- Upgrading storm drains downstream of South Broadway Pond in Commercial.
- Connecting storm drain at Wheeler Ave and Broadway Boulevard.
- Upsizing the storm drain in Barelas Ditch to a 30" diameter storm drain.

3.2.1 OPTION 1 - JOHN STREET POND – GRAVITY

The existing 60 inch storm drain in Broadway Boulevard and Thaxton Avenue will be diverted into a 66 inch storm drain in Thaxton Avenue towards John Street, routed through the detention pond and discharge into the proposed 30 inch storm drain in the Barelas Ditch easement. The junction box at Williams and Kathryn will modified to divert more flow to San Jose Drain. An orifice plate will be added in the manhole at Kathryn and Broadway Boulevard to divert flows towards the San Jose Drain as it bypasses Kathryn Pond. See **Figure 19** for an overview plan with phasing of this option 1. This option will be split into 3 phases:

- Phase 1: Constructing John Street Pond, installing the 30 inch storm drain in Barelas Ditch and constructing the 66 inch storm drain in Thaxton with junction box diversion.
- Phase 2: Improvements to the volume capacity of South Broadway Pond and Kathryn Pond shown in **Figure 22** & **Figure 23**. Modifying junction boxes at Kathryn and Williams St., Kathryn Avenue and Broadway Boulevard and Broadway Boulevard and Kathryn Ave. Connecting the 72 inch storm drain at Wheeler Ave and Broadway Boulevard.
- Phase 3: Upgrading storm drain in Commercial Street at the outlet of South Broadway Pond to a 54 inch diameter and modifying the junction box at Broadway Boulevard and Santa Fe Ave upstream of South Broadway Pond to divert flow into the existing 72 inch storm drain.

John Street Pond will have 2 alternatives to maximize storage volume and earthwork quantities. Alternative 1 will have the top of pond at elevation 4,951 with no embankment as shown in **Figure 20**. Alternative 2 will have the top of pond at elevation 4,955 feet with an embankment on the west of the pond as shown in **Figure 21**. Both alternatives will be gravity discharge out to the Barelas Ditch storm drain.

Cost of Alternative 1: $9,372,063
Cost of Alternative 2: $9,368,030

JOHN STREET OPTION 1		
	POND LAYOUT ALTERATIVE 1	POND LAYOUT ALTERNATIVE 2
TOP OF POND	4951.00	4955.00
BOTTOM OF POND	4941.00	4941.00
VOLUME CAPACITY	18.7 AC-FT	27.6 AC-FT

SOUTH BROADWAY POND		
	EXSITING	POND LAYOUT ALTERNATIVE
TOP OF POND	4952.00	4952.00
BOTTOM OF POND	4938.35	4938.35
VOLUME CAPACITY	25.2 AC-FT	31.8 AC-FT

KATHRYN POND		
	EXSITING	POND LAYOUT ALTERNATIVE
TOP OF POND	4946.00	4946.00
BOTTOM OF POND	4940.79	4940.79
VOLUME CAPACITY	4.9 AC-FT	7.5 AC-FT

LEGEND

PHASE 1

PHASE 2

PHASE 3

FIGURE 19 OVERVIEW OF OPTION 1 SOUTH BROADWAY DRAINAGE MASTER PLAN

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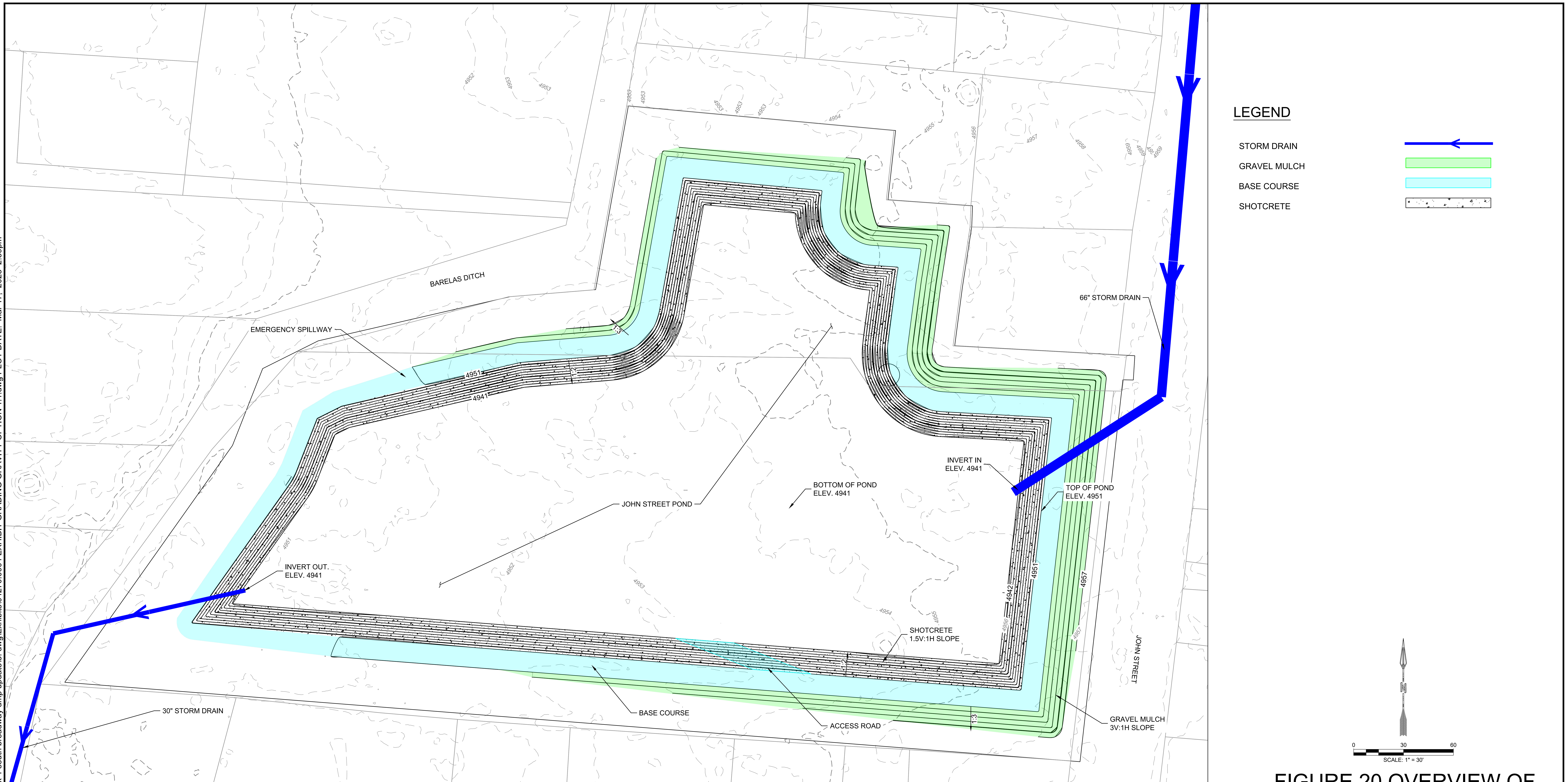
NAME: N:\Projects\04270 coa transportation and drainage on call\task 4-south broadway dmp update\3. dwg\Exhibits\04270.0004 DESIGN OPTIONS 1.dwg PLOT DATE: Mar 17, 2023 2:59pm



Option 1-Alternative 1 - Pond Routing Summary
South Broadway Drainage Master Plan

Name	Invert Elev. (ft)	Rim Elev. (ft)	Max. Depth (ft)	Max. HGL (ft)	Max. Total Inflow (cfs)	Max. Outflow (cfs)	Total inflow (MG)	Total Inflow Volume (AF)	Pond Design Volume (AF)	Pond Design Depth (ft)	Freeboard to Top of Pond	Total Flood Volume (MG)	Total Flood Volume (AF)	Comments
John Street Pond	4941.00	4951	7.3	4948.30	204.0	19.02	6.58	20.20	18.7	10.00	2.70	0.00	0.00	Proposed Pond @ top of pond = 4951

FIGURE 20 OVERVIEW OF JOHN STREET POND OPTION 1.1 BROADWAY DRAINAGE MASTER PLAN

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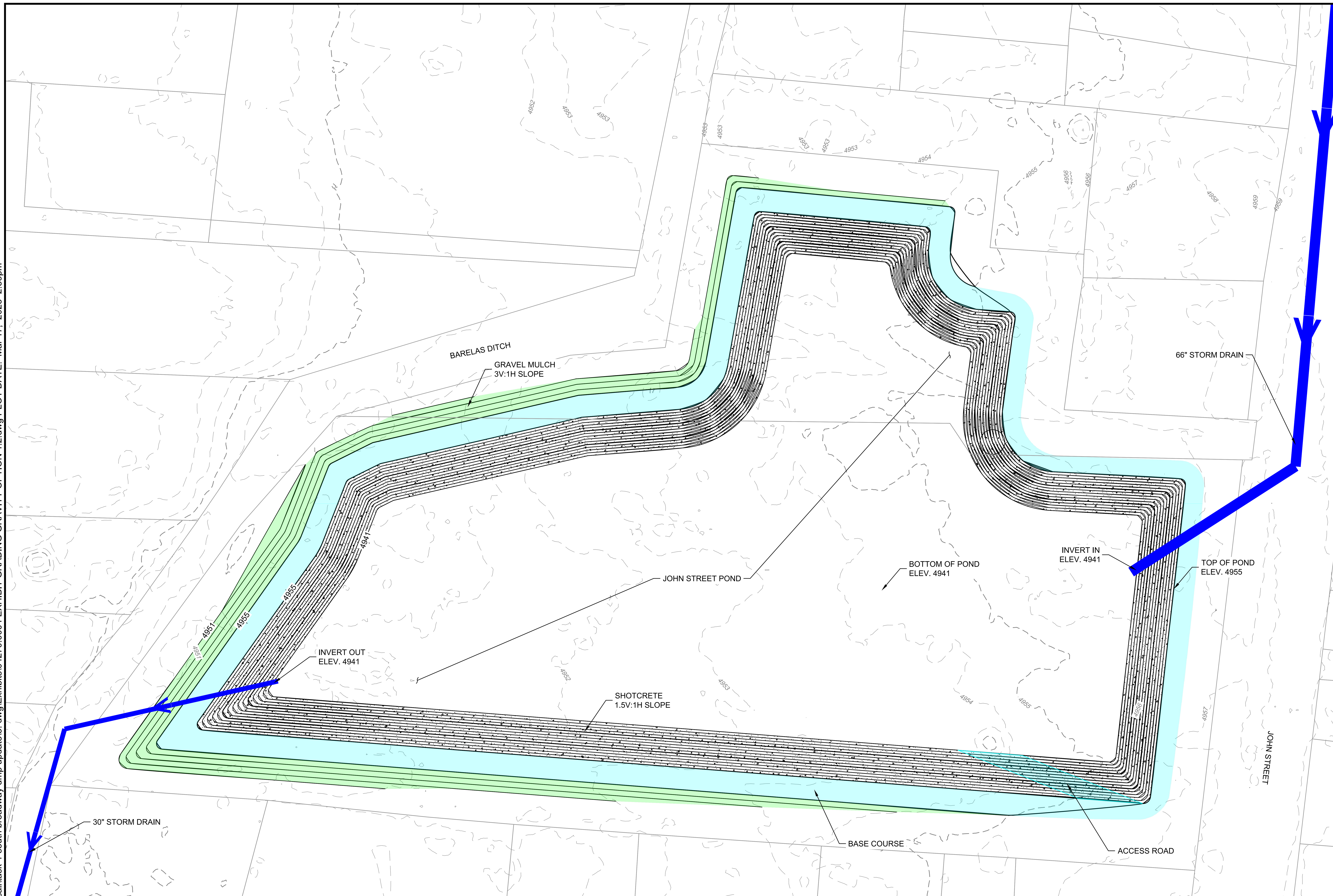

LEGEND

- STORM DRAIN
- GRAVEL MULCH
- BASE COURSE
- SHOTCRETE

SCALE: 1" = 30'

Option 1-Alternative 2 - Pond Routing Summary
South Broadway Drainage Master Plan

Name	Invert Elev. (ft)	Rim Elev. (ft)	Max. Depth (ft)	Max. HGL (ft)	Max. Total Inflow (cfs)	Max. Outflow (cfs)	Total inflow (MG)	Total Inflow Volume (AF)	Pond Design Volume (AF)	Pond Design Depth (ft)	Freeboard to Top of Pond	Total Flood Volume (MG)	Total Flood Volume (AF)	Comments
John Street Pond	4941.00	4955	7.37	4948.4	208.48	19.11	6.63	20.35	27.6	14.00	6.63	0.00	0.00	Proposed Pond @ top of pond = 4955

FIGURE 21 OVERVIEW OF JOHN STREET POND OPTION 1.2 SOUTH BROADWAY DRAINAGE MASTER PLAN

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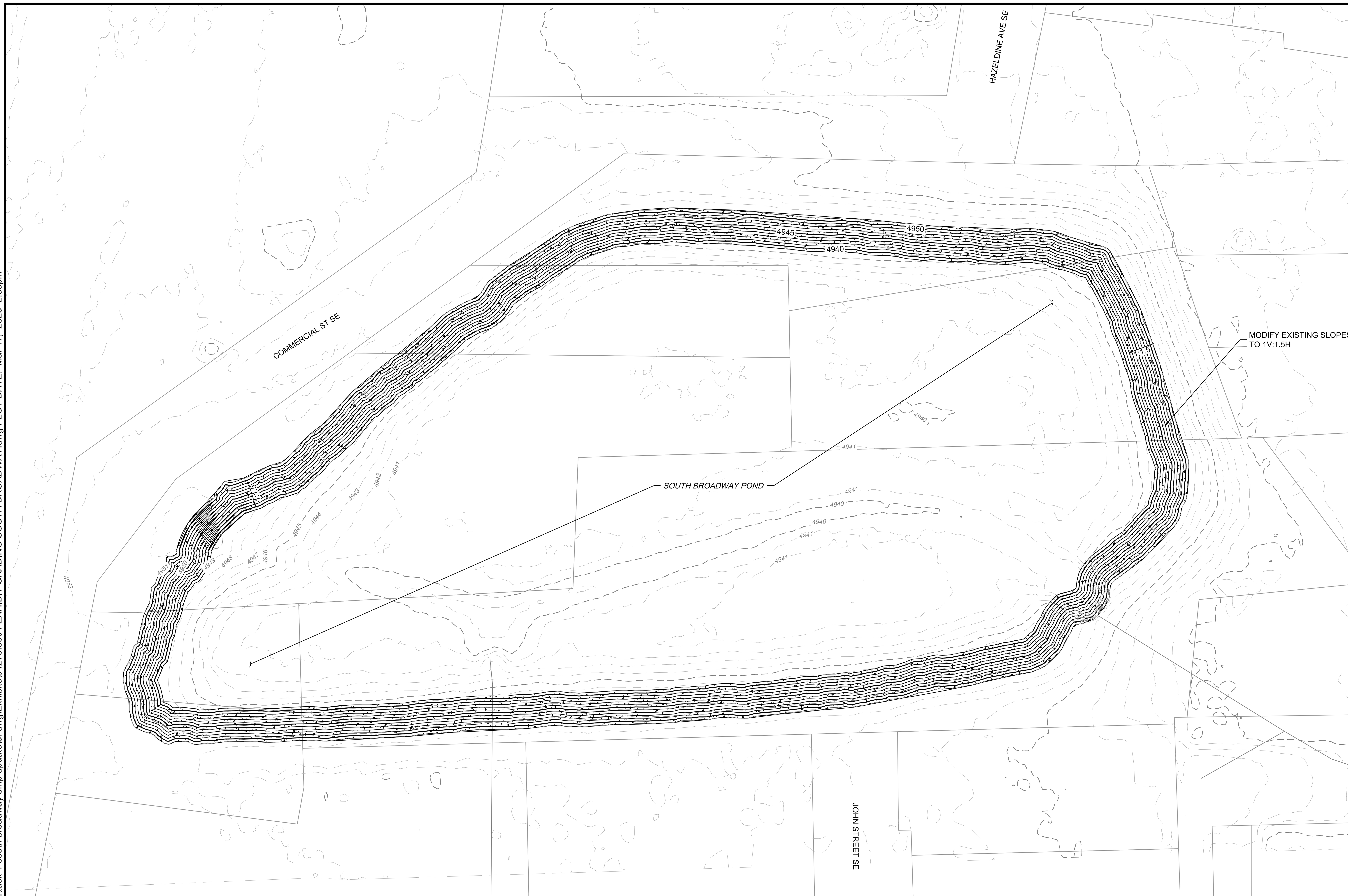

LEGEND

SHOTCRETE

0 30 60
SCALE: 1" = 30'

Existing Pond Routing Summary
South Broadway Drainage Master Plan

Name	Invert Elev. (ft)	Rim Elev. (ft)	Max. Depth (ft)	Max. HGL (ft)	Max. Total Inflow (cfs)	Max. Outflow (cfs)	Total inflow (MG)	Total Inflow Volume (AF)	Pond Design Volume (AF)	Pond Design Depth (ft)	Freeboard to Top of Pond	Total Flood Volume (MG)	Total Flood Volume (AF)	Comments
S.BroadwayPond	4938.35	4952.00	13.08	4951.43	434.7	84.1	17.10	52.50	25.20	13.65	0.57	0.00	0.00	

Option 1-Alternative 1 - Pond Routing Summary
South Broadway Drainage Master Plan

Name	Invert Elev. (ft)	Rim Elev. (ft)	Max. Depth (ft)	Max. HGL (ft)	Max. Total Inflow (cfs)	Max. Outflow (cfs)	Total inflow (MG)	Total Inflow Volume (AF)	Pond Design Volume (AF)	Pond Design Depth (ft)	Freeboard to Top of Pond	Total Flood Volume (MG)	Total Flood Volume (AF)	Comments
S.BroadwayPond*	4938.35	4952.00	12.28	4950.63	539.5	81.5	18.70	57.41	31.8	13.65	1.37	0.00	0.00	

FIGURE 22 OVERVIEW OF SOUTH BROADWAY POND IMPROVEMENTS SOUTH BROADWAY DRAINAGE MASTER PLAN

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NAME: N:\Projects\04270 coa transportation and drainage on call\task 4-south broadway dmp update\3. dwg\Exhibits\04270.0004 EXHIBIT GRADING KATHRYN.dwg PLOT DATE: Mar 17, 2023 3:00pm

Existing Pond Routing Summary
South Broadway Drainage Master Plan

Name	Invert Elev. (ft)	Rim Elev. (ft)	Max. Depth (ft)	Max. HGL (ft)	Max. Total Inflow (cfs)	Max. Outflow (cfs)	Total inflow (MG)	Total Inflow Volume (AF)	Pond Design Volume (AF)	Pond Design Depth (ft)	Freeboard to Top of Pond	Total Flood Volume (MG)	Total Flood Volume (AF)	Comments
KathrynPond	4940.79	4946.00	5.21	4946.00	189.7	17.9	7.97	24.47	4.90	5.21	0.00	4.61	14.15	

Option 1-Alternative 1 - Pond Routing Summary
South Broadway Drainage Master Plan

Name	Invert Elev. (ft)	Rim Elev. (ft)	Max. Depth (ft)	Max. HGL (ft)	Max. Total Inflow (cfs)	Max. Outflow (cfs)	Total inflow (MG)	Total Inflow Volume (AF)	Pond Design Volume (AF)	Pond Design Depth (ft)	Freeboard to Top of Pond	Total Flood Volume (MG)	Total Flood Volume (AF)	Comments
KathrynPond*	4940.79	4946.00	5.21	4946.00	125.5	31.9	2.41	7.40	7.5	5.21	0.00	0.03	0.10	

FIGURE 23 OVERVIEW OF KATHRYN POND IMPROVEMENTS SOUTH BROADWAY DRAINAGE MASTER PLAN

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3.2.2 OPTION 2 – JOHN STREET POND – PUMP STATION

Option 2 is doing a pump station. The existing 60 inch storm drain in Broadway Boulevard and Thaxton Avenue will be diverted into a 66 inch storm drain in Thaxton Avenue going west towards John Street into John Street Pond. The 72 inch and 36 inch storm drain in Williams Street will be directed east in Thaxton into a 72 inch storm drain, connect with the 66 inch storm drain in a junction box, and drain into the John Street Pond through the Barelas Ditch easement with a 72 inch storm. The alternative is to direct the 66inch storm drain down Thaxton Street to John Street similar to Option 1, however, still divert the 72 inch and 36 inch down Thaxton Avenue east through the Barelas Ditch easement on the north side of John Street Pond but makes it more difficult to phase out. This pond will have a pump station with 1 sump pump and 2 main pumps that will direct flows into Williams Street south of Thaxton. The pumps combined discharge will be approximately 67 cfs or 30,070 gallons per minute.

See **Figure 24** for an overview plan with phasing of this option 2. This option will be split into 5 phases:

- Phase 1: Constructing John Street Pond with pump station and constructing the 66-inch storm drain in Thaxton with junction box diversion.
- Phase 2: Installing the 72 inch storm drain with diversion at Williams St and Thaxton Ave into John Street Pond.
- Phase 3: Improvements to the volume capacity of South Broadway Pond and Kathryn Pond. Modifying junction boxes at Kathryn and Williams St., Kathryn Ave and Broadway Boulevard and Broadway Boulevard and Kathryn Ave. Connecting the 72-inch storm drain at Wheeler Ave and Broadway Boulevard.
- Phase 4: Upgrading storm drain in Commercial Street at the outlet of South Broadway Pond to a 54-inch diameter and modifying the junction box at Broadway Boulevard and Santa Fe Ave upstream of South Broadway Pond to divert flow into the existing 72 inch storm drain.
- Phase 5: Installing the 30 inch storm drain in Barelas Ditch.

The John Street Pond pump station will have 2 alternatives to maximize storage volume and earthwork quantities. Alternative 1 will have the top of pond at 4,951 feet with no embankment as shown in **Figure 25**. Alternative 2 will have the top of pond at 4,956 feet with an embankment on the west end of the pond as shown in **Figure 26**. The invert of the wet well will be at elevation 4,931 for both alternatives. Alternative 1 has a total pond depth of 19 feet deep. Alternative 2 will be 23 feet deep with a 5-foot embankment on the west of the pond.

Cost of Alternative 1: $13,189,688
Cost of Alternative 2: $13,049,245

JOHN STREET OPTION 2		
	POND LAYOUT ALTERATIVE 1	POND LAYOUT ALTERNATIVE 2
TOP OF POND	4951.00	4956.00
BOTTOM OF POND	4932.00	4933.00
VOLUME CAPACITY	26.5 AC-FT	32.0 AC-FT

SOUTH BROADWAY POND		
	EXSITING	POND LAYOUT ALTERNATIVE
TOP OF POND	4952.00	4952.00
BOTTOM OF POND	4938.35	4938.35
VOLUME CAPACITY	25.2 AC-FT	31.8 AC-FT

KATHRYN POND		
	EXSITING	POND LAYOUT ALTERNATIVE
TOP OF POND	4946.00	4946.00
BOTTOM OF POND	4940.79	4940.79
VOLUME CAPACITY	4.9 AC-FT	7.5 AC-FT

LEGEND

- PHASE 1
- PHASE 2
- PHASE 3
- PHASE 4
- PHASE 5

FIGURE 24 OVERVIEW OF OPTION 2 SOUTH BROADWAY DRAINAGE MASTER PLAN

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LEGEND

- STORM DRAIN
- GRAVEL MULCH
- BASE COURSE

SCALE: 1" = 30'

Option 2-Alternative 1 - Pond Routing Summary

South Broadway Drainage Master Plan

Name	Invert Elev. (ft)	Rim Elev. (ft)	Max. Depth (ft)	Max. HGL (ft)	Max. Total Inflow (cfs)	Max. Outflow (cfs)	Total inflow (MG)	Total Inflow Volume (AF)	Pond Design Volume (AF)	Pond Design Depth (ft)	Freeboard to Top of Pond	Total Flood Volume (MG)	Total Flood Volume (AF)	Comments
John Street Pond	4931.00	4951	14.44	4945.4	340.2	62.00	44.80	58.87	26.5	20.00	5.56	0.00	0.00	Proposed Pond @ top of pond = 4951

FIGURE 25 OVERVIEW OF JOHN STREET POND OPTION 2.1 SOUTH BROADWAY DRAINAGE MASTER PLAN

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NAME: N:\Projects\04270 coa transportation and drainage on call\task 4-south broadway dmp update\3. dwg\Exhibits\04270.0004 EXHIBIT GRADING OPTION 2.1.dwg PLOT DATE: Mar 17, 2023 3:00pm

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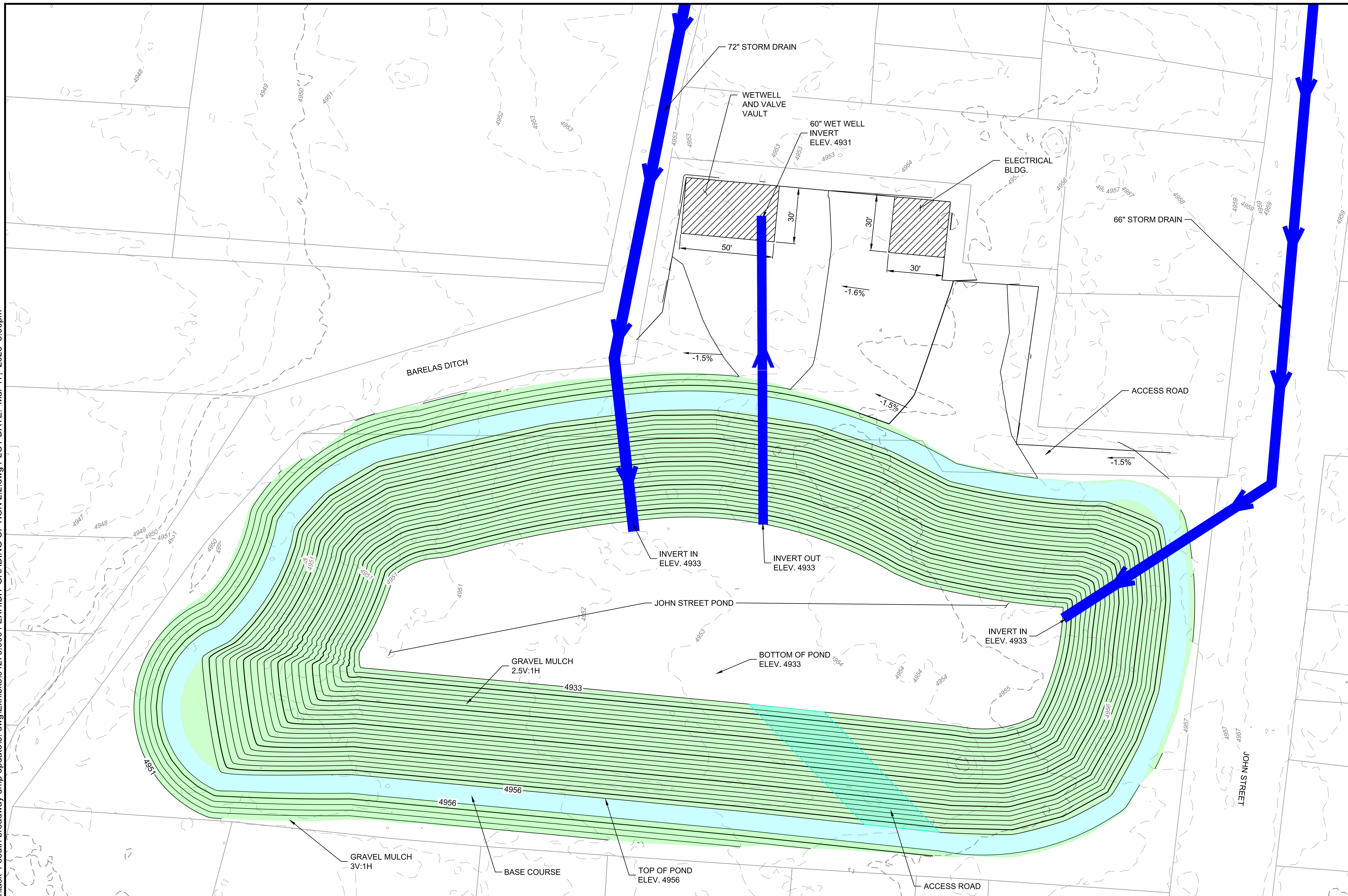

LEGEND

- STORM DRAIN
- GRAVEL MULCH
- BASE COURSE

N

0 30 60
SCALE: 1" = 30'

Option 2-Alternative 2 - Pond Routing Summary
South Broadway Drainage Master Plan

Name	Invert Elev. (ft)	Rim Elev. (ft)	Max. Depth (ft)	Max. HGL (ft)	Max. Total Inflow (cfs)	Max. Outflow (cfs)	Total inflow (MG)	Total Inflow Volume (AF)	Pond Design Volume (AF)	Pond Design Depth (ft)	Freeboard to Top of Pond	Total Flood Volume (MG)	Total Flood Volume (AF)	Comments
John Street Pond	4931.00	4956	15.15	4946.2	333.5	67.00	44.70	137.23	32.0	25.00	9.85	0.00	0.00	Proposed Pond @ top of pond = 4956

FIGURE 26 OVERVIEW OF JOHN STREET POND 2.2 SOUTH BROADWAY DRAINAGE MASTER PLAN

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3.2.3 OPTION 3 – JOHN STREET POND – GRAVITY & PUMP STATION

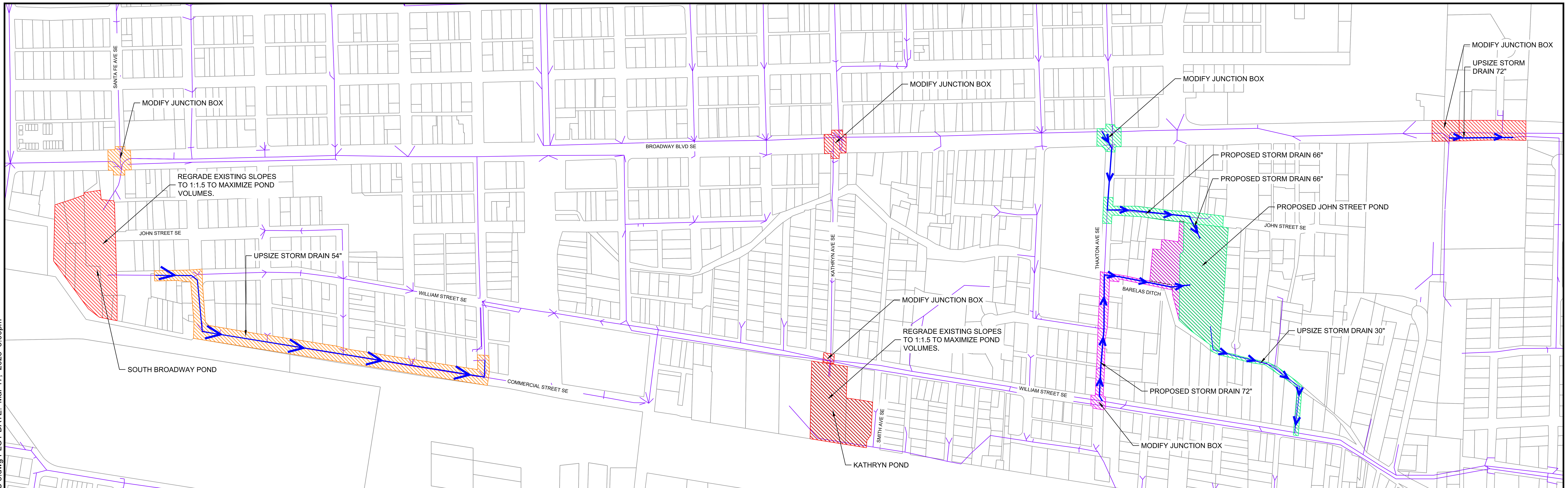
Option 3 will combine options 1 and 2 with using a pump and gravity approach. The existing 60 inch storm drain in Broadway Boulevard and Thaxton Avenue will be diverted into a 66-inch storm drain in Thaxton Avenue going west towards John Street into John Street Pond. The 72 inch and 36 inch storm drain in Williams Street will be directed east in Thaxton into a 72 inch storm drain, connect with the 66-inch storm drain in a junction box, and drain into the John Street Pond through the Barelas Ditch easement with a 72 inch storm. The alternative is to direct the 66 inch storm drain down Thaxton Street to John Street similar to Option 1, however, still divert the 72 inch and 36 inch down Thaxton Avenue east through the Barelas Ditch easement on the north side of John Street Pond but makes it more difficult to phase out. This pond will have a pump station with 1 sump pump and 2 main pumps that will direct flows into Williams Street south of Thaxton. The pumps combined discharge will be approximately 53 cfs or 23,786 gallons per minute.

The pump station will be pumped through a force main and discharge in Williams at Thaxton. The gravity outfall will be at the southwest end of the pond and will discharge into the proposed 30-inch Barelas Ditch storm drain. The existing 60-inch storm drain in Broadway Boulevard and Thaxton Avenue will be diverted into a 66 inch storm drain in Thaxton Avenue towards John Street into John Street Pond. See **Figure 27** for an overview plan with phasing of this option 3. This option will be split into 4 phases:

- Phase 1: Constructing John Street Pond Gravity, constructing the 66 inch storm drain in Thaxton with junction box diversion and installing the 30 inch storm drain in Barelas Ditch.
- Phase 2: Constructing John Street Pond Pump Station, installing the 72 inch storm drain with diversion at Williams St and Thaxton Ave into John Street Pond.
- Phase 3: Improvements to the volume capacity of South Broadway Pond and Kathryn Pond. Modifying junction boxes at Kathryn and Williams St., Kathryn Ave and Broadway Boulevard and Broadway Boulevard and Kathryn Ave. Connecting the 72 inch storm drain at Wheeler Ave and Broadway Boulevard.
- Phase 4: Upgrading storm drain in Commercial Street at the outlet of South Broadway Pond to a 54 inch diameter and modifying the junction box at Broadway Boulevard and Santa Fe Ave upstream of South Broadway Pond to divert flow into the existing 72 inch storm drain.

The John Street Pond pump station will have 2 alternatives to maximize storage volume and earthwork quantities. Alternative 1 will have the top of pond at 4,951 feet with no embankment as shown in **Figure 28**. Alternative 2 will have the top of pond at 4,956 feet with an embankment on the west end of the pond as shown in **Figure 29.** The invert of the wet well will be at elevation 4,932.25 and 4,931 for alternative 1 and alternative 2 respectively. Alternative 1 has a total pond depth of 19 feet deep. Alternative 2 will be 23 feet deep with a 5-foot embankment on the west of the pond.

Cost of Alternative 1: $12,238,606
Cost of Alternative 2: $11,761,585



JOHN STREET OPTION 3		
	POND LAYOUT ALTERATIVE 1	POND LAYOUT ALTERNATIVE 2
TOP OF POND	4951.00	4955.00
BOTTOM OF POND	4933.00	4932.00
VOLUME CAPACITY	21.9 AC-FT	23.9 AC-FT

SOUTH BROADWAY POND		
	EXSITING	POND LAYOUT ALTERNATIVE
TOP OF POND	4952.00	4952.00
BOTTOM OF POND	4938.35	4938.35
VOLUME CAPACITY	25.2 AC-FT	31.8 AC-FT

KATHRYN POND		
	EXSITING	POND LAYOUT ALTERNATIVE
TOP OF POND	4946.00	4946.00
BOTTOM OF POND	4940.79	4940.79
VOLUME CAPACITY	4.9 AC-FT	7.5 AC-FT

LEGEND

PHASE 1

PHASE 2

PHASE 3

PHASE 4

FIGURE 27 OVER VIEW OF OPTION 3 SOUTH BROADWAY DRAINAGE MASTER PLAN

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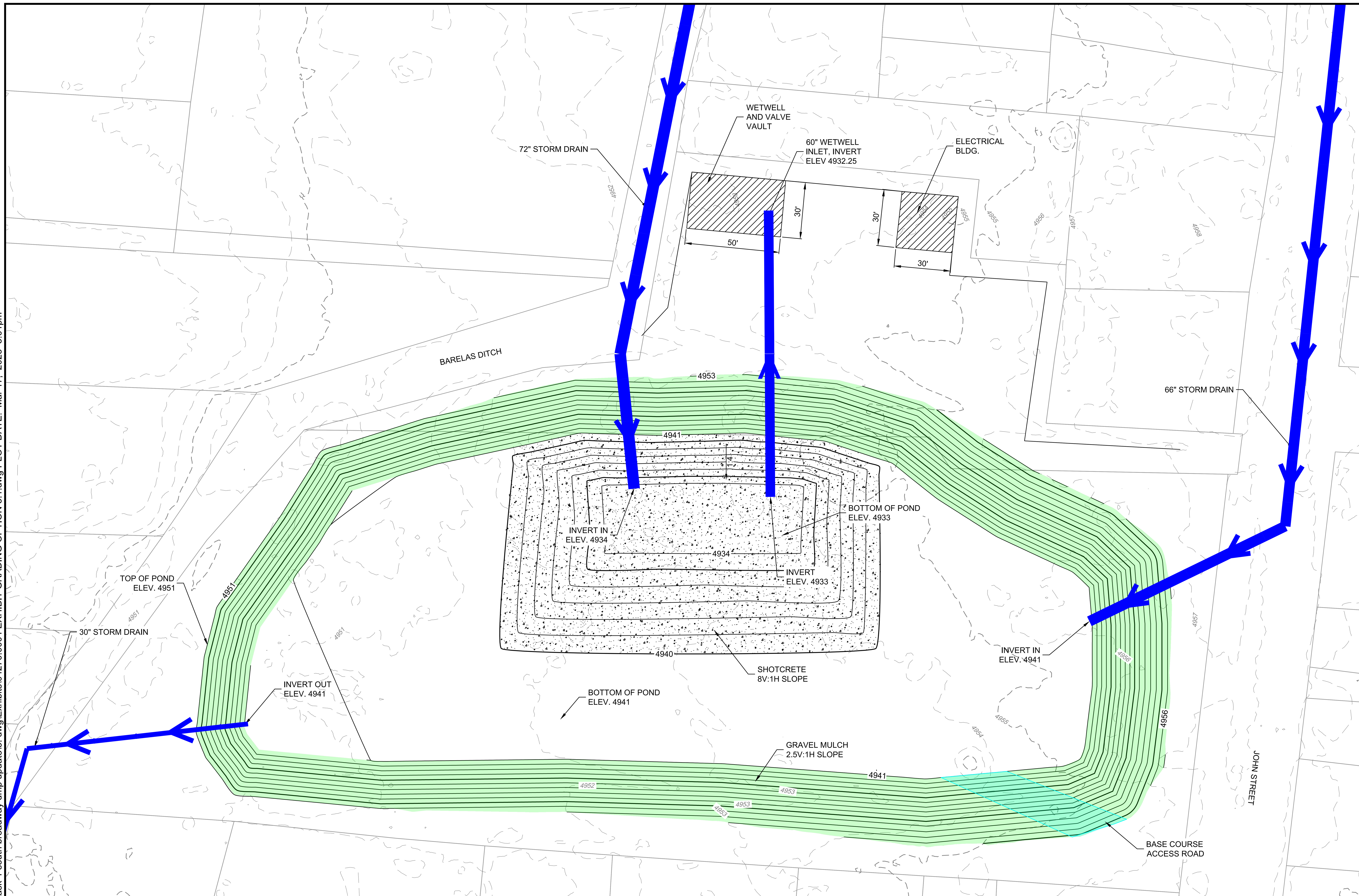

NAME: N:\Projects\04270 coa transportation and drainage on call\task 4-south broadway dmp update\3. dwg\Exhibits\04270.0004 EXHIBIT GRADING OPTION 3.1.dwg PLOT DATE: Mar 17, 2023 3:01pm

Option 3-Alternative 1 - Pond Routing Summary
South Broadway Drainage Master Plan

Name	Invert Elev. (ft)	Rim Elev. (ft)	Max. Depth (ft)	Max. HGL (ft)	Max. Total Inflow (cfs)	Max. Outflow (cfs)	Total inflow (MG)	Total Inflow Volume (AF)	Pond Design Volume (AF)	Pond Design Depth (ft)	Freeboard to Top of Pond	Total Flood Volume (MG)	Total Flood Volume (AF)	Comments
John Street Pond	4932.25	4951	14.18	4946.4	330.6	84.1	40.20	123.41	21.9	18.75	4.57	0.00	0.00	Proposed Pond @ top of pond = 4951

LEGEND

- STORM DRAIN
- GRAVEL MULCH
- BASE COURSE
- SHOTCRETE

0 30 60
SCALE: 1" = 30'

FIGURE 28 OVERVIEW OF JOHN STREET POND OPTION 3.1 SOUTH BROADWAY DRAINAGE MASTER PLAN

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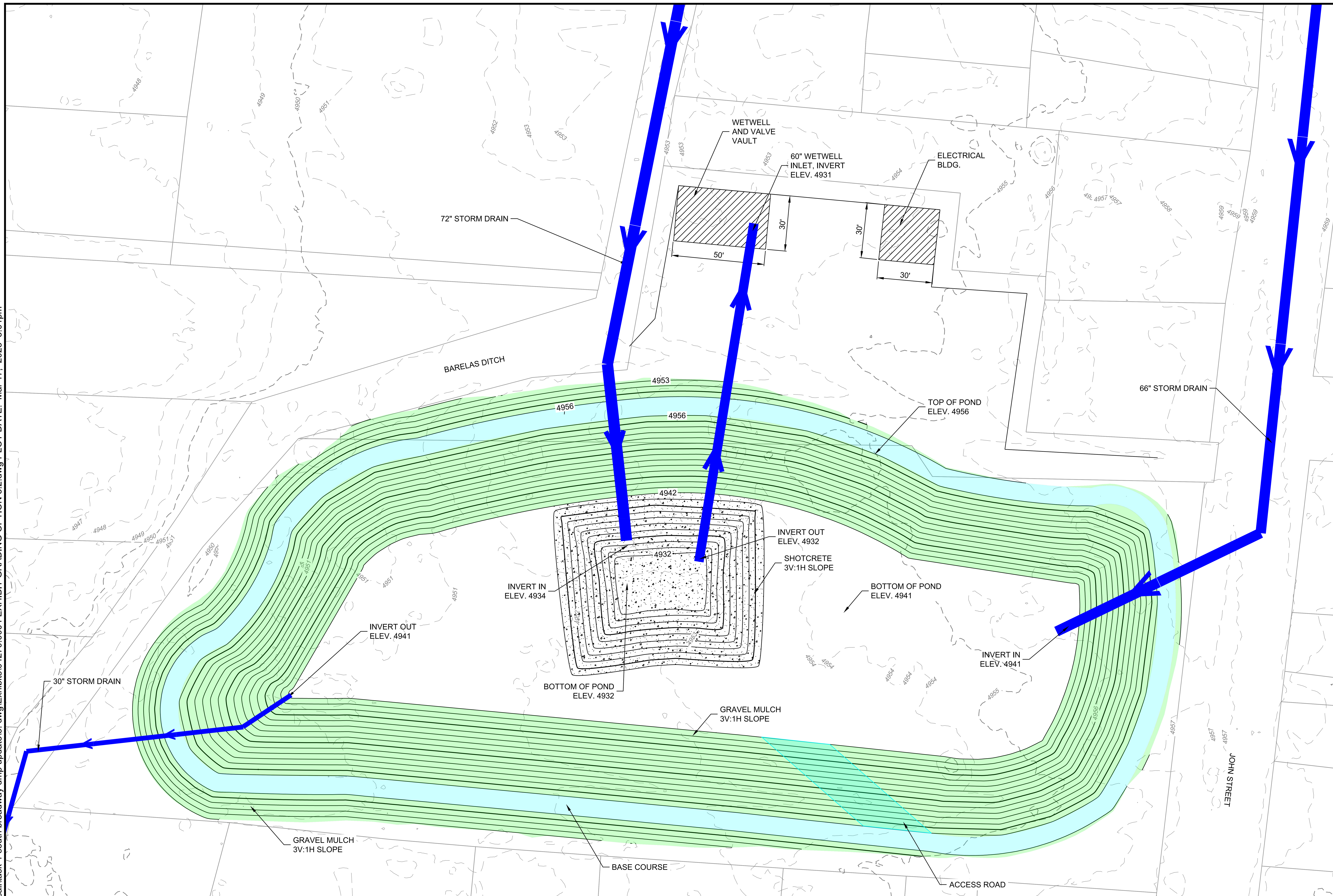

LEGEND

- STORM DRAIN
- GRAVEL MULCH
- BASE COURSE
- SHOTCRETE

0 30 60
SCALE: 1" = 30'

Option 3-Alternative 2 - Pond Routing Summary
South Broadway Drainage Master Plan

Name	Invert Elev. (ft)	Rim Elev. (ft)	Max. Depth (ft)	Max. HGL (ft)	Max. Total Inflow (cfs)	Max. Outflow (cfs)	Total inflow (MG)	Total Inflow Volume (AF)	Pond Design Volume (AF)	Pond Design Depth (ft)	Freeboard to Top of Pond	Total Flood Volume (MG)	Total Flood Volume (AF)	Comments
John Street Pond	4931.00	4956	16.71	4947.7	272.1	103.08	14.90	45.74	23.9	25.00	8.29	0.00	0.00	Proposed Pond @ top of pond = 4956

FIGURE 29 OVERVIEW OF JOHN STREET POND OPTION 3.2 SOUTH BROADWAY DRAINAGE MASTER PLAN

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3.2.4 OPTION 4 – JOHN STREET POND – DUAL GRAVITY & PUMP STATION

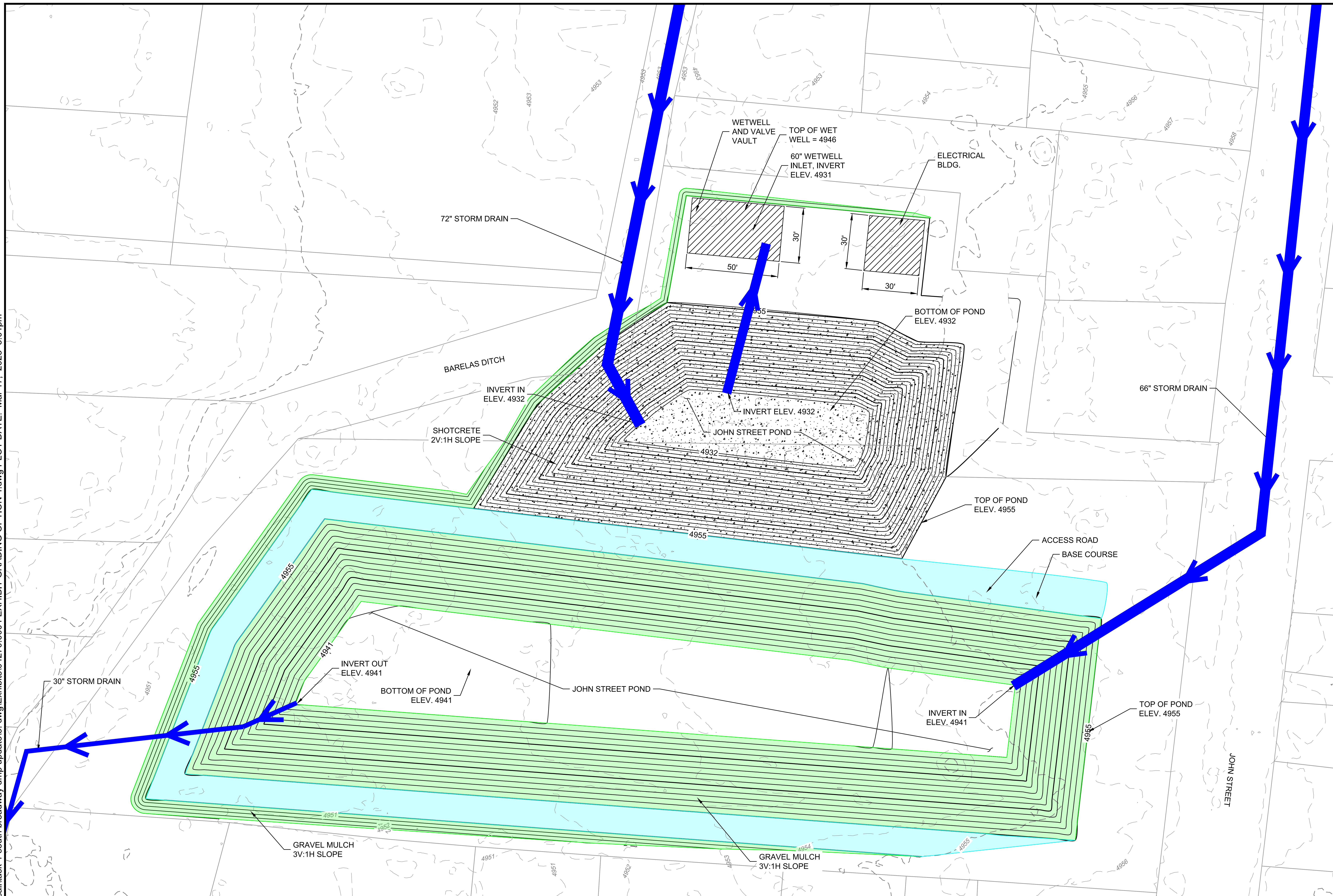
Option 4 is a pump and gravity approach utilizing two separate ponds. The existing 60 inch storm drain in Broadway Boulevard and Thaxton Avenue will be diverted into a 66-inch storm drain in Thaxton Avenue going west towards John Street into John Street Pond. The 72 inch and 36 inch storm drain in Williams Street will be directed east in Thaxton into a 72 inch storm drain, connect with the 66 inch storm drain in a junction box, and drain into the John Street Pond through the Barelas Ditch easement with a 72 inch storm.

Pond one is John Street Pond-Gravity and Pond two is John Street Pond-Pump. The dual ponds provide more flexibility in the system by diverting flows from Williams Street and Broadway Boulevard. This configuration maximizes the area of potential benefit in the study area. The top of the wet well in John Street Pond-Pump will be set at an elevation of 4946 to stay below the manhole rim at Williams Street and Thaxton Avenue. The wet well at this elevation helps relieve flooding at the manhole in Williams Street and Thaxton Avenue as it's the constraint in the system. This pond will have a pump station with 1 sump pump and 2 main pumps that will direct flows into Williams Street south of Thaxton. The pumps combined discharge will be approximately 18 cfs or 8078 gallons per minute. The John Street Pond-Gravity will divert flows from Broadway Boulevard and will discharge into the proposed Barelas Ditch 30 inch storm drain. The top of the pond will be at elevation 4955 with a 4 foot embankment.

See **Figure 30** for an overview plan of Option 4 for John Street Pond. This option will be split into 4 phases shown on **Figure E4**. The phases are as follows:

- Phase 1: John Street Pond Gravity & Pump Station, installing the 72 inch storm drain with diversion at Williams St and Thaxton Ave into John Street Pond, installing the 66 inch storm drain in Thaxton with junction box diversion and installing the 30 inch storm drain in Barelas Ditch.
- Phase 2: Improvements to the volume capacity of Kathryn Pond, modifying junction boxes at Kathryn and Williams St., and Kathryn Ave and Broadway Boulevard.
- Phase 3: Upgrading storm drain in Commercial Street at the outlet of South Broadway Pond to a 54 inch diameter
- Phase 4: Improvements to the volume capacity of South Broadway Pond, modifying junction boxes at Broadway Boulevard and Santa Fe Ave upstream of South Broadway Pond to divert flow into the existing 72 inch storm drain and connecting the 72 inch storm drain at Wheeler Ave and Broadway Boulevard.

Cost of Alternative: $12,352,423.



LEGEND

- STORM DRAIN
- GRAVEL MULCH
- BASE COURSE
- SHOTCRETE

SCALE: 1" = 30'

Option 4-Alternative 1 - Pond Routing Summary
South Broadway Drainage Master Plan

Name	Invert Elev. (ft)	Rim Elev. (ft)	Max. Depth (ft)	Max. HGL (ft)	Max. Total Inflow (cfs)	Max. Outflow (cfs)	Total inflow (MG)	Total Inflow Volume (AF)	Pond Design Volume (AF)	Pond Design Depth (ft)	Freeboard to Top of Pond	Total Flood Volume (MG)	Total Flood Volume (AF)	Comments
John Street Main Pond	4941.00	4955	13.09	4954.09	214.2	21.22	6.41	19.68	12.5	14.00	0.91	0.00	0.00	Proposed Pond @ top of pond = 4955
John Street Wet Well Pond	4931.00	4946	14.86	4945.86	126.0	18.00	14.60	44.82	3.5	15.00	0.14	0.00	0.00	Proposed Wet Well @ top of pond = 4946

FIGURE 30 OVERVIEW OF JOHN STREET POND OPTION 4 SOUTH BROADWAY DRAINAGE MASTER PLAN

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For all options and phasing, an engineer's opinion of probable cost (EOPC) summary is included in Appendix 4. Overall improvement costs are summarized in **Table 6,** but phasing plans are provided to guide implementation over a longer period of time as funding becomes available.

Table 6: Cost Summary of Options

Option No.	Alternative No.	Total Cost
1	Alternative 1	$9,372,063
	Alternative 2	$9,368,030
2	Alternative 1	$13,189,688
	Alternative 2	$13,049,245
3	Alternative 1	$12,238,606
	Alternative 2	$11,761,585
4	Alternative 1	$12,352.423

RESPEC created a selection matrix to rank the best option based on certain criteria. Each option was rated with a score based on lifetime maintenance, total cost, flooding reduction, hydraulic restrictions, phasing opportunities, constructability. The results of the section matrix and rankings are summarized on **Table 7**.

Table 7: Selection Matrix

Option # Alt #	Lifetime Maintenance	Cost	Flooding Reduction	Hydraulic Restrictions	Phasing Opportunities	Constructability	Tot als
Option 1 Alt 1	5	5	1	3	1	5	20
Option 1 Alt 2	4	5	2	3	1	5	20
Option 2 Alt 1	2	1	5	3	4	1	16
Option 2 Alt 2	1	1	4	2	4	1	13
Option 3 Alt 1	3	2	4	3	3	2	17
Option 3 Alt 2	2	3	1	3	3	2	14
Option 4 Alt 1	**3**	**2**	**4**	**4**	**5**	**3**	**21**
*Ranking: 1 being the lowest and 5 being the highest							

The options discussed in the previous sections were phased strategically to help minimize the burden of construction costs plus, create feasible options within the City's budget. A summary of proposed options is shown on **Table 8.**

Table 8: Summary of Options

Option No.	Alternative No.	Description	Total Cost	Pros	Cons	Ranking
1	Alternative 1	Detention pond with no embankment that will divert flows from Broadway Boulevard.	$9,372,063	• The least lifetime maintenance • Easier to construct • Construction costs are lower • Improves Barelas ditch storm drain as outfall to surrounding reduce flooding	• Diverts only Broadway Boulevard • Less options for phasing and construction • Higher earthwork export	3
	Alternative 2	Detention pond with an embankment that will divert flows from Broadway Boulevard.	$9,368,030	• The least lifetime maintenance • Easier to construct • Embankment to use export material • Construction costs are lower	• Diverts only Broadway Boulevard • Less options for phasing and construction	2
2	Alternative 1	Pond with a pump station with no embankment that will divert flows from Broadway Boulevard and Williams Street.	$ 13,189,688	• Diverts flows from both Broadway Boulevard and Williams Street • More phases and projects to reduce surrounding flooding	• More lifetime maintenance which includes operations and maintenance plan • More complex to construction • Unused storage volume in pond due to HGL restriction in Williams Street • Larger pump station	5
	Alternative 2	Pond with a pump station with an embankment that will divert flows from Broadway Boulevard and Williams Street.	$13,049,245	• Diverts flows from both Broadway Boulevard and Williams Street • More phases and projects to reduce surrounding flooding • Embankment to use export material	• More lifetime maintenance which includes operations and maintenance plan • More complex to construction • Unused storage volume in pond due to HGL restriction in Williams Street • Larger pump station	7
3	Alternative 1	Combined detention pond with a pump station with no embankment that will divert flows from Broadway Boulevard and Williams Street.	$12,238,606	• Diverts flows from both Broadway Boulevard and Williams Street • Utilizes partly gravity for detaining runoff volume • More phases and projects to reduce surrounding flooding • Improves Barelas ditch storm drain as outfall to reduce surrounding flooding	• More lifetime maintenance which includes operations and maintenance plan • More complex to construction • Unused storage volume in pond due to HGL restriction in Williams Street • Higher construction cost • Larger pump station	4
	Alternative 2	Combined detention pond with a pump station with an embankment that will divert flows from Broadway Boulevard and Williams Street.	$11,761,585	• Diverts flows from both Broadway Boulevard and Williams Street • Utilizes partly gravity for detaining runoff volume • More phases and projects to reduce surrounding flooding • Improves Barelas ditch storm drain as outfall to reduce surrounding flooding • Embankment to use export material	• More lifetime maintenance which includes operations and maintenance plan • More complex to construction • Unused storage volume in pond due to HGL restriction in Williams Street • Larger pump station	6
4	Alternative 1	Independent detention pond and pump station with an embankment that will divert flows from Broadway Boulevard and Williams Street.	$12,352,421	• Diverts flows from both Broadway Boulevard and Williams Street • Additional phasing possible for ponds since they're separate • Utilizes partly gravity for detaining runoff volume from second pond • Improves Barelas ditch storm drain as outfall to reduce surrounding flooding • Embankment to use export material • Less restriction on HGL in Williams Street	• Unused storage volume in the wet well pond • More lifetime maintenance which includes operations and maintenance plan	1

Proposing John Street Pond helped reduce flooding and has an improved impact on the surrounding areas from the proposed improvements. These improved areas are shown on **Figure 31**.

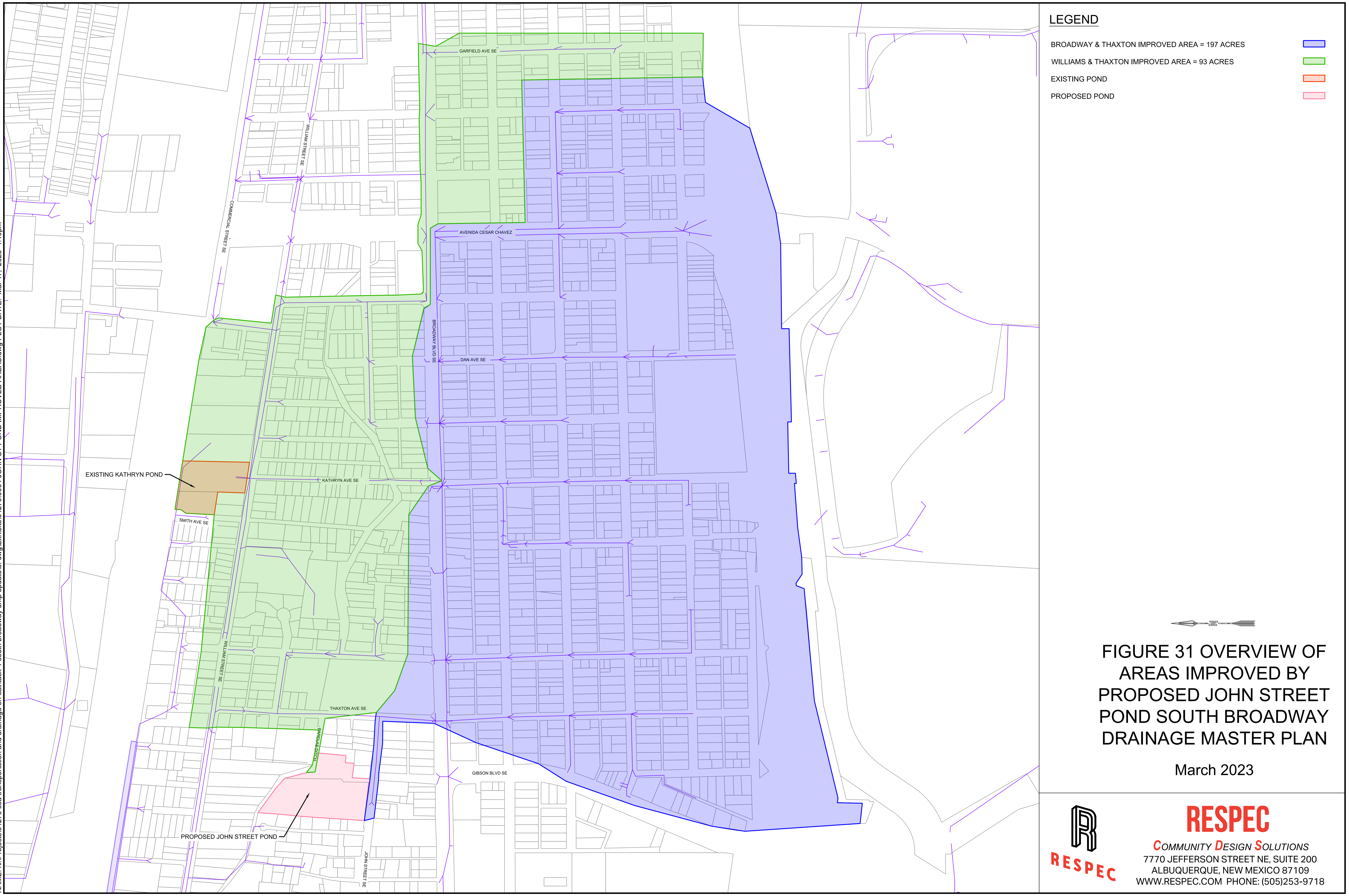

FIGURE 31 OVERVIEW OF AREAS IMPROVED BY PROPOSED JOHN STREET POND SOUTH BROADWAY DRAINAGE MASTER PLAN

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4.0 CONCLUSION AND RECOMMENDATIONS

This South Broadway Drainage Master Plan updates both the hydrologic and hydraulic analyses to current watershed conditions. This updated master plan was necessary since the previous master plans were completed in 1990 and 2013. The *South Broadway Sector Drainage Management Plan (SBSDMP)* completed in 1990 by Bohannon Huston analyzed the existing conditions and hydraulic network deficiencies, plus proposed improvements for reducing flooding and generating hydraulic network capacity. The *South Broadway Drainage and Stormwater Quality Management Plan*, completed by URS Corporation in 2013, updated the analysis completed by Bohannon Huston (1990), plus developed additional proposed improvements to the South Broadway watershed.

The existing flooding history in the South Broadway watershed has been a great concern for the City of Albuquerque. Understanding the existing hydraulic network in the South Broadway watershed was a crucial step in developing the proposed improvements in this master plan. Using the City of Albuquerque property for John Street Pond created opportunities for needed improvements to storage volume and reducing capacity deficiencies.

RESPEC recommends Option 4 to be the most effective since it reduces existing flooding and creates sufficient capacity in the South Broadway hydraulic network. Furthermore, proposing two separate ponds allows the City to phase the improvements in Broadway Boulevard and Williams Street more strategically since the ponds are hydraulically isolated. Out of all the options, Option 4 maximizes the area of benefit in the study area.

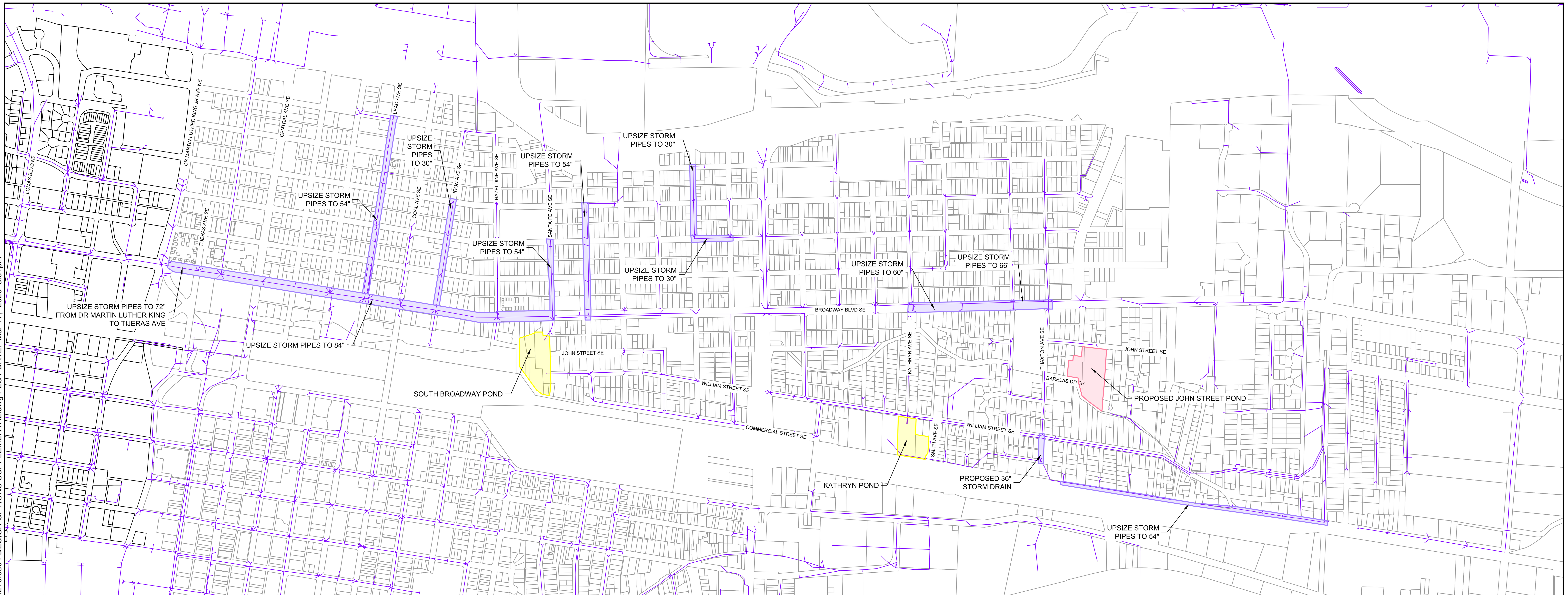
RESPEC explored other supplemental options to help improve the area. These projects are considered lower priority, however, can be implemented in the future, contingent on the City of Albuquerque's available funding.

These supplemental improvements include:

- Upgrading the storm drain in Broadway Boulevard from Dr Martin Luther King Jr Avenue to South Broadway Pond to an 84 inch diameter storm drain.
- Upgrading storm in Williams Steet at San Jose Avenue north to Franklin Avenue to a 54 inch diameter
- Continuing the 66 inch storm drain at Thaxton Avenue and Broadway Boulevard north to Kathryn Avenue.
- Upgrade Lead Avenue from Broadway Boulevard to Elm Street with a 48 inch diameter storm drain
- Upgrade Iron Avenue from Broadway Boulevard to Walter Street with a 30 inch diameter storm drain.
- Upgrade Santa Fe Street from Broadway Boulevard to Edith Boulevard with a 54 inch diameter storm drain and divert into existing 72 inch storm drain in Broadway Boulevard.
- Upgrade Pacific Avenue from Broadway Boulevard to Walter Street with a 54 inch diameter storm drain.
- Upgrade Edith Boulevard between Lewis Avenue to Bell Avenue to a 30 inch diameter storm drain. Also, upgrade Lewis Avenue to High Street with a 30 inch diameter storm drain.
- Lowering the pond in South Broadway Pond and adding a pump station that will discharge into the existing 72 inch pipe at Broadway Boulevard and Santa Fe Street.

- Adding a 36 inch storm drain connection on Thaxton Avenue between Williams Street and Commercial Street.

These supplemental improvements are shown on **Figure 32**.



LEGEND

SUPPLEMENTAL

EXISTING PONDS

PROPOSED PONDS

FIGURE 32 OVERVIEW OF SUPPLEMENTAL IMPROVEMENTS SOUTH BROADWAY DRAINAGE MASTER PLAN

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APPENDIX 1

BACKGROUND INFORMATION

APPENDIX 2

HYDROLOGIC ANALYSIS

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APPENDIX 3

HYDRAULIC ANALYSIS

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APPENDIX 4

ENGINEERS OPINION OF PROBABLE COST