

# Final Stormwater Management Study

FOR

## The Grove at Lee's Summit

City of Lee's Summit  
Jackson County, Missouri

June 8, 2018

Prepared for:

The Grove at Lee's Summit, LLC.  
P.O. Box 57  
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Prepared by:

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# GBA



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## **Introduction:**

George Butler Associates, Inc. (GBA) has been hired to complete planning and construction submittals for The Grove development located in Lee's Summit, Missouri. The purpose of this report is to serve as a Final Master Stormwater Drainage Study for The Grove development and analyze how the development will fit into the surrounding watershed.

The Grove development encompasses 84 acres of development near the southwest corner of the intersection of Missouri Highway 291 and U.S. Highway 50 in Lee's Summit Missouri. The project area is bisected by SE Bailey Road and is currently undeveloped. The full build out of the development includes approximately 1.7 million square feet of mixed use development, in addition to required public improvements. The first phase of development includes an approximate 200,000 square foot light manufacturing facility, mass grading, regional stormwater retention, and construction of SE Summit Street and SE Decker Street.

## **Methodology:**

The Study methodology is based on allowable methods and procedures specified by the City of Lee's Summit codes and guidelines. A summary of each component of the report is provided below.

- The 2011 Version of APWA Section 5600
- HEC-HMS version 4.2 and TR-55 were used for basin modeling and routing

## **Existing Conditions:**

The Grove development encompasses 84 acres of development near the southwest corner of the intersection of Missouri Highway 291 and U.S. Highway 50 in Lee's Summit Missouri. The project area is bisected by SE Bailey Road and is currently undeveloped. The site consist of hydrologic type C soils per the NRCS soil report. See Appendix A for soil report. The site lies within Flood Zone X, areas determined to be outside the 0.2% annual chance flood, per FEMA FIRM 29095C0438G, dated January 20, 2017, and FIRM 29095C0419G, dated January 20, 2017.

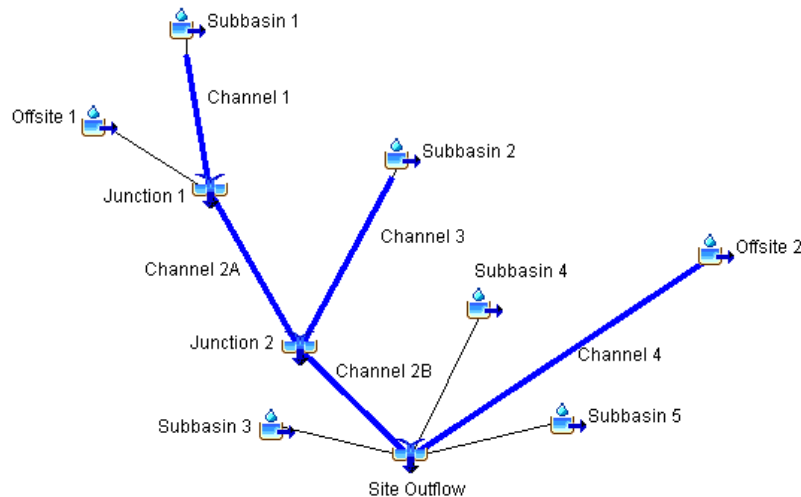
Approximately 52.73 acres north of SE Bailey Road drain south through the future Phase 1 Grove development, of which 36.89 acres is future Grove development, and 15.84 acres is offsite. Three RCP culverts convey water from north to south under SE Bailey Street to the southern part of The Grove development.

South of SE Bailey Road, which includes phase 1 of development, approximately 54.16 acres drain through The Grove development , of which 42.94 acres is future Gove development, and 11.22 is offsite area. The offsite area flows to a pond east of the railroad tracks adjacent to the property, where it is conveyed under the railroad tracks onto The Grove development. Natural drainage channels on The Grove property convey water to the southern property line, where a 36" CMP conveys water to the south. The 36" CMP is offsite and located between a series of commercial buildings along SE 16<sup>th</sup> Street. The 36" CMP daylights near the SE 16<sup>th</sup> Street right-of-way where a 30" RCP culvert conveys water south under SE 16<sup>th</sup> Street. See Table 1 below for Sub-Basin Summary. An composite curve number of 76.35 was calculated for all drainage areas (includes offsite). A composite curve number of 74.76 was calculated for the proposed site (does not include offsite).

	Sub-Basin	Area	Existing CN	Existing Tc (min.)
North of SE Bailey Rd	1	17.82	74	16.67
	2	19.07	74	24.55
South of SE Bailey Rd	3	19.38	74	37.08
	4	8.69	81	26.46
	5	14.87	74	28.41
Offsite	Off 1	15.84	86	12.78
	Off 2	11.22	74	11.28

**Table 1 – Existing Sub-Basin Summary**

HEC-HMS was used to model the existing site to acquire existing flows for the offsite drainage areas. See Figure 1 below for existing site HEC-HMS model. See Appendix A for existing HEC-HMS data and summary.



**Figure 1 – Existing Site HEC-HMS Model**

U.S. Army Corps of Engineers jurisdictional waters exist on site and a 404 permit has been secured and executed (permit no. 2017-00785). 12,247 stream credits and 0.11 acres of wetland credit have been purchased from an approved mitigation bank. See attached Exhibit 6 for permit.

### **Stormwater Detention:**

Stormwater detention is required per City of Lee’s Summit Design Standards and the 2011 version of APWA Section 5600. The comprehensive control strategy is to be used for site allowable release rates. The allowable peak release rates are as follows:

- 50% Storm (2 Year) – Less than or equal to 0.5 CFS per Acre
- 10% Storm (10 year) – Less than or equal to 2.0 CFS per Acre
- 1% Storm (100 year) – Less than or equal to 3.0 CFS per Acre

40 hour extended detention of the 90% mean annual rainfall event is also included under the comprehensive control strategy. The 90% mean annual rainfall event equates to a 1.37 inch, 24 hour rainfall event.

Two offsite drainage areas flow through the proposed development. These areas are not included within this development, and therefore stormwater detention will not be provided for the offsite drainage areas. The offsite drainage areas will be allowed to “pass through” at their existing flow rates. All proposed drainage areas within The Grove development will be detained to comprehensive control strategy release rates. Tables 2 through 4 below illustrate the allowable release rates for the 2, 10, and 100 year storms.

<b>2 Year Storm</b>				
	Watershed	Area (AC)	Allowable Release Rate (CFS/AC)	Allowable Release Rate (CFS)
Project Site	1	17.82	0.5	8.91
	2	19.07	0.5	9.535
	4	19.38	0.5	9.69
	5	8.69	0.5	4.345
	6	14.87	0.5	7.435
Offsite	Off 1	15.84	Same as Existing	39.97
	Off 2	11.22	Same as Existing	16.94
<b>Total</b>				<b>96.83</b>

**Table 2 – 2 Year Storm (50% annual chance) Allowable Release Rate**

<b>10 Year Storm</b>				
	Watershed	Area (AC)	Allowable Release Rate (CFS/AC)	Allowable Release Rate (CFS)
Project Site	1	17.82	2	35.64
	2	19.07	2	38.14
	4	19.38	2	38.76
	5	8.69	2	17.38
	6	14.87	2	29.74
Offsite	Off 1	15.84	Same as Existing	70.43
	Off 2	11.22	Same as Existing	36.69
<b>Total</b>				<b>266.78</b>

**Table 3 – 10 Year Storm (10% annual chance) Allowable Release Rate**

100 Year Storm				
	Watershed	Area (AC)	Allowable Release Rate (CFS/AC)	Allowable Release Rate (CFS)
Project Site	1	17.82	3	53.46
	2	19.07	3	57.21
	4	19.38	3	58.14
	5	8.69	3	26.07
	6	14.87	3	44.61
Offsite	Off 1	15.84	Same as Existing	111.2
	Off 2	11.22	Same as Existing	65.44
<b>Total</b>				<b>416.13</b>

**Table 4 – 100 Year Storm (1% annual chance) Allowable Release Rate**

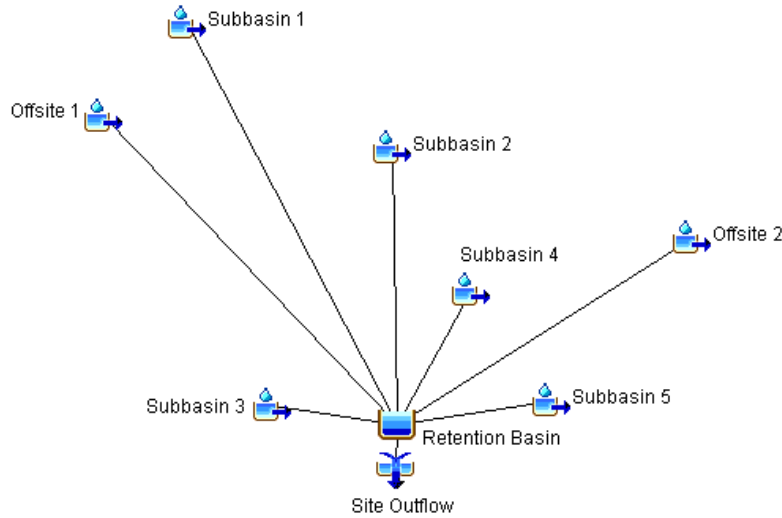
**Proposed Conditions:**

The proposed development will predominately drain via enclosed storm sewer. The existing drainage areas will remain the same under proposed conditions as they do under existing conditions. See Table 5 below for Existing vs. Proposed Sub-Basin Summary. A time of concentration of 5 minutes was selected as a conservative value as design values could change with future expansions. A composite curve number of 87.44 was calculated for all drainage areas (including offsite). A composite curve number of 89.61 was calculated for the proposed site (does not include offsite) The 7 sub-basins will drain to a proposed stormwater retention basin. See Appendix B for storm sewer plan and calculations.

	Sub-Basin	Area	Existing CN	Existing Tc (min.)	Proposed CN	Proposed Tc (min.)
North of SE Bailey Rd	1	17.82	74	16.67	94	5
	2	19.07	74	24.55	88	5
South of SE Bailey Rd	3	19.38	74	37.08	89	5
	4	8.69	81	26.46	90	5
	5	14.87	74	28.41	87	5
Offsite	Off 1	15.84	86	12.78	86	5
	Off 2	11.22	74	11.28	74	5

**Table 5 – Existing and Proposed Sub-Basin Summary**

The proposed site was modeled in HEC-HMS 4.2. See Figure 2 below for proposed model. See Appendix B for HEC-HMS model data and summaries.



**Figure 2 – Proposed HEC-HMS Model**

Offsite drainage area 1 currently discharges through multiple culverts under SE Bailey Road. Enclosed storm sewer will be constructed along SE Bailey Road to convey the Offsite 1 drainage to the south. The drainage from Offsite 2 will be rerouted in a proposed drainage swale to allow for construction of the first phase of development. The proposed drainage swale will be conveyed under SE Summit Street via 4'x5' RCB to the proposed retention basin.

A stormwater retention basin is to be constructed near the south end of the proposed site. The proposed retention basin will provide approximately 22.14 AC-FT of stormwater storage for the design storms. A 15'x10' concrete outflow structure is to be constructed to regulate outflows for the 2, 10, and 100 year storms, as well as the water quality storm. See plan sheet C7.8 for outflow structure construction details. See Table 6 below for stormwater retention basin summary. See Appendix B for basin elevation-storage-discharge values.

Storm	Allowable Peak Release Rate (CFS)	Proposed Peak Release Rate (CFS)	Peak Water Elevation (FT)
2	96.83	49.11	1003.65
10	266.78	137.18	1005.4
100	416.13	381.65	1007.07
100 Yr Low Flow Bypass	N/A	432.34	1007.38

**Table 6 – Proposed Retention Basin Summary**

As shown in Table 6, the proposed basin outflows are less than the calculated allowable release rates, ensuring the downstream storm system will function as designed.

The water quality volume for the proposed retention basin was calculated to be 3.74 AC-FT. The proposed retention basin is designed to store the water quality volume and release it over 40 hours, per APWA Section 5600. An 8 inch low flow orifice is to be constructed on the basin outflow structure to facilitate water quality volume drainage. See Appendix B for water quality

volume calculations. The water quality volume storage is achieved at elevation 1001.39 FT in the basin. See Table 7 below for basin elevation-storage summary.

Point of Interest	Elevation (FT)	Cumulative Storage (AC-FT)	Cumulative Storage Above Permanent Pool (AC-FT)
Bottom of Basin	992.00	0.00	N/A
5 Year Sediment Storage Depth (35,810 CF)	992.50	0.82	N/A
Permanent Pool Elevation	1000.00	16.40	0.00
Water Quality Volume Water Elevation	1001.39	20.14	3.74
2 Year Storm Peak Water Elevation	1003.65	26.72	10.32
10 Year Storm Peak Water Elevation	1005.40	32.72	16.32
100 Year Storm Peak Water Elevation	1007.07	39.55	23.15
Emergency Overflow Elevation	1007.75	42.71	26.31
100 Year Storm Bypass Peak Water Elev.	1010.04	53.77	37.37
Top of Basin	1011.04	58.6	42.20

**Table 7 – Proposed Retention Basin Elevation-Storage Summary**

In the event all openings in the outflow structure are blocked, the basin is able to pass the 100 year storm through the open top emergency bypass without over-topping of the basin. The peak water elevation during a 100-year storm bypass event was modeled to be 1010.04 FT. The downstream triple 48” culvert is sized to handle the 100 year storm bypass event. The top of the basin has been constructed to 1011.04 to allow for 1 foot of freeboard per APWA standards.

The downstream storm sewer currently consists of a 36 inch CMP which flows from north to south through the commercial development to the south. This 36” CMP is to be replaced with a triple 42” HDPE pipe culvert, extending from the retention basin outflow structure to the creek south of SE 16<sup>th</sup> Street. The triple 48 inch culvert will be approximately 434 feet in length. A rip rap basin is to be constructed to reduce the effects of downstream erosion. See attached plan sheets for details.

Sediment forebays have been excluded from design as they will not greatly contribute to ease of maintenance. Given the proposed basin configuration, two forebays would be required, one for each of the RCB’s entering the basin. This would negatively affect the design and operation of the basin in the following ways. The slopes to the potential forebay locations would not be any easier to traverse, therefore it would not be any easier to maintain two forebays than to simply drain the entire basin and remove all accumulated sediment. Given the depth of the basin, assuming the berm of the sediment basin was constructed at a 3:1 slope, adding two sediment basins would result in a loss of basin volume of approximately 32,000 CF, which is nearly the 5 year sediment volume for the watershed.

## **Summary and Recommendations:**

Construction of the proposed development per the recommendations of this report will meet or exceed the stormwater quality and quantity requirements of the City of Lee's Summit, Missouri. The designed stormwater management plan will reduce the risk of flooding for residents and businesses downstream of the project, and provide stormwater management and water quality benefits for the proposed development.

## **APPENDIX A – EXISTING CONDITIONS**

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Exhibit 1 – Location Map

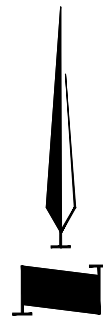
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Exhibit 3 – USDA/NRCS Soil Resource Report

Exhibit 4 – Existing Drainage Map

Exhibit 5 – Existing Conditions HEC-HMS Model Summary

Exhibit 6 – U.S. Army Corps of Engineers Permit



1000' 0' 1000' 2000'



SCALE : 1 INCH = 1000 FEET



PROJECT NUMBER  
13958

DATE  
4/3/18

THE GROVE  
LEE'S SUMMIT, MISSOURI  
PROJECT LOCATION

EXHIBIT

1

**NOTES TO USERS**

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Missouri State Plane West Zone (FIPS zone 2403). The horizontal datum was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services  
NOAA, NNGS12  
National Geodetic Survey  
SSMNC-3 #9202  
1315 East-West Highway  
Silver Spring, Maryland 20910-3282  
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov>.

**Base map** information shown on this FIRM was derived from the U.S. D.A. Farm Service National Agriculture Imagery Program (NAIP) dated 2014. Produced at scale of 1:24,000.

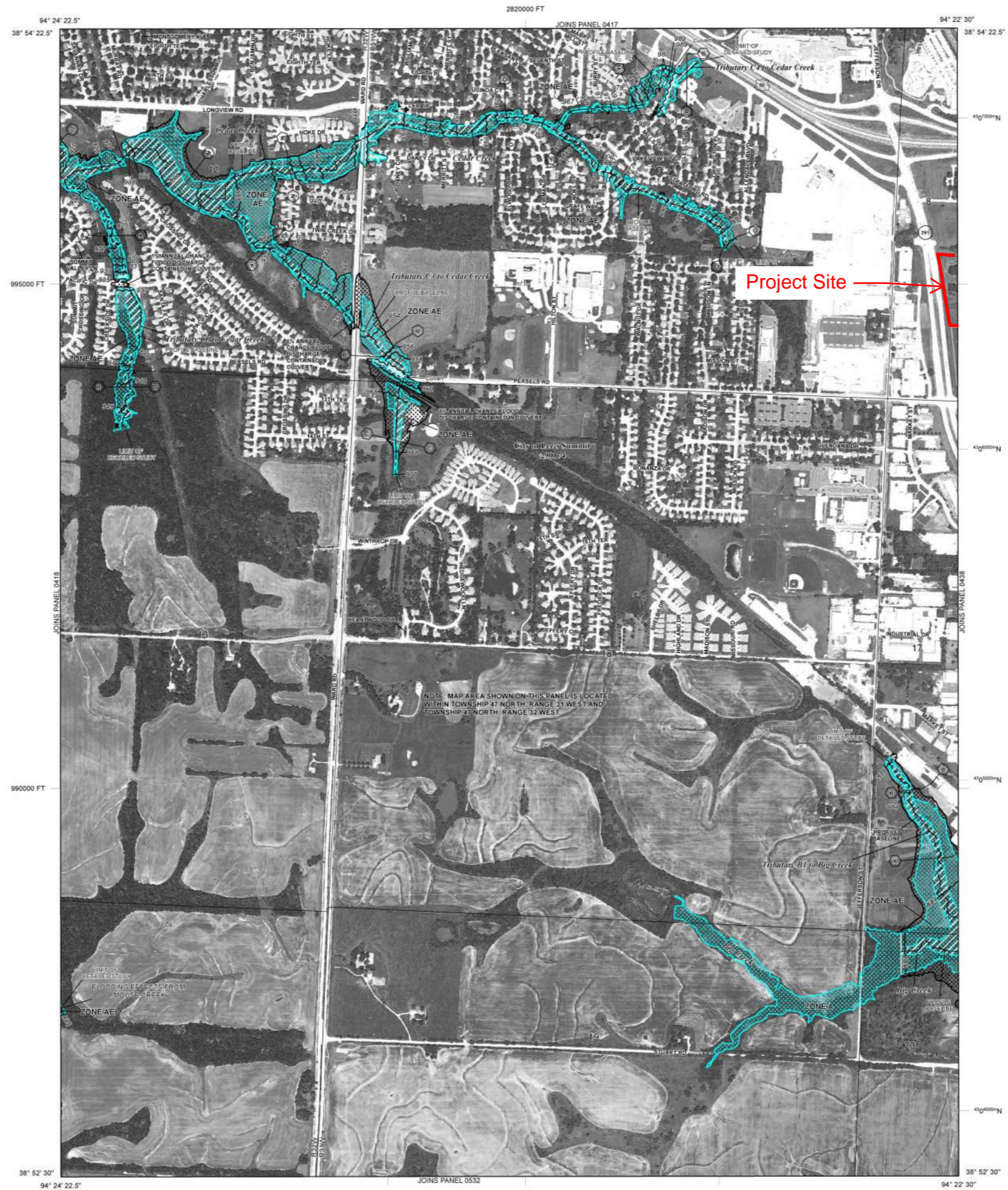
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

**Corporate limits** shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

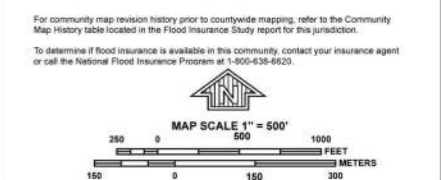
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels, community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.



**LEGEND**

- SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD**  
The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.
- ZONE A** No Base Flood Elevations determined.
  - ZONE AE** Base Flood Elevations determined.
  - ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
  - ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
  - ZONE AR** Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently dismantled. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
  - ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system and/or levee; no Base Flood Elevations determined.
  - ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
  - ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
- FLOODWAY AREAS IN ZONE AE**
- The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.
- OTHER FLOOD AREAS**
  - ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
  - OTHER AREAS**
  - ZONE D** Areas determined to be outside the 0.2% annual chance floodplain.
  - ZONE D** Areas in which flood hazards are undetermined, but possible.
  - COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**
  - OTHERWISE PROTECTED AREAS (OPAs)**
- CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.
- 1% Annual Chance Floodplain Boundary
  - 0.2% Annual Chance Floodplain Boundary
  - Floodway boundary
  - Zone D boundary
  - CBRS and OPA boundary
  - Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different base Flood Elevations, flood depths, or flood velocities.
  - Base Flood Elevation line and value; elevation in feet\*
  - Base Flood Elevation value where uniform within zone; elevation in feet\*
- \*Referenced to the North American Vertical Datum of 1988
- A ○ A Cross section line
  - 23 ○ 23 Transsect line
  - — — — — Culvert
  - — — — — Bridge
  - 45° 02' 08", 93° 02' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
  - 3100000 FT 5000-foot ticks: Missouri State Plane West Zone (FIPS Zone 2403), Transverse Mercator projection
  - DX5510 X Bench mark (see explanation in Notes to Users section of this FIRM panel)
  - M.S. River Mile
- MAP REPOSITORIES**  
Refer to Map Repositories list on Map Index
- EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP**  
September 29, 2006
- EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL**  
January 20, 2017 - to change Special Flood Hazard Areas.



**NATIONAL FLOOD INSURANCE PROGRAM**

**PANEL 0419G**

**FIRM FLOOD INSURANCE RATE MAP JACKSON COUNTY, MISSOURI AND INCORPORATED AREAS**

**PANEL 419 OF 625**  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

**CONTAINS:**

COMMUNITY	NUMBER	PANEL	SUFFIX
LEE'S SUMMIT, CITY OF	290174	0419	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

**MAP NUMBER 29095C0419G**  
**MAP REVISED JANUARY 20, 2017**  
Federal Emergency Management Agency

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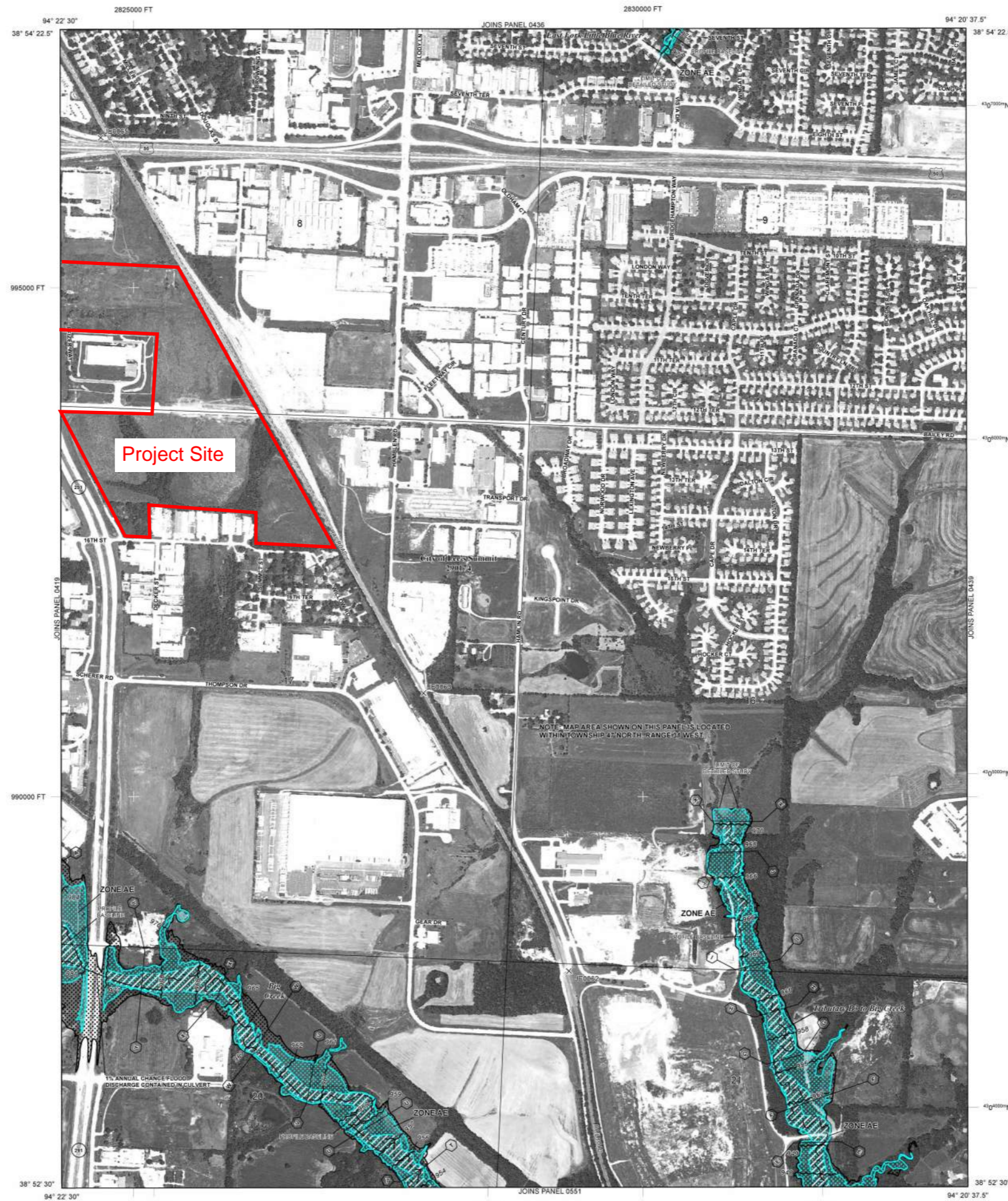
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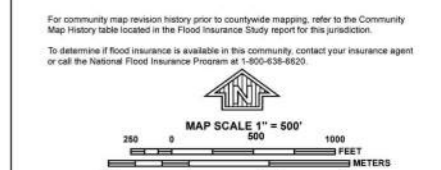
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**LEGEND**

- SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD**  
The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.
- ZONE A** No Base Flood Elevations determined.
  - ZONE AE** Base Flood Elevations determined.
  - ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
  - ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
  - ZONE AR** Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently discarded. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
  - ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
  - ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
  - ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
- FLOODWAY AREAS IN ZONE AE**  
The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.
- OTHER FLOOD AREAS**
  - ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
  - OTHER AREAS**
  - ZONE D** Areas determined to be outside the 0.2% annual chance floodplain. Areas in which flood hazards are undetermined, but possible.
  - COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**
  - OTHERWISE PROTECTED AREAS (OPAs)**
- CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.
- 1% Annual Chance Floodplain Boundary
  - 0.2% Annual Chance Floodplain Boundary
  - Floodway boundary
  - Zone D boundary
  - CBRS and OPA boundary
  - Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
  - Base Flood Elevation line and value; elevation in feet\*
  - Base Flood Elevation value where uniform within zone; elevation in feet\*
- \*Referenced to the North American Vertical Datum of 1988
- ⊖ ⊕ Cross section line
  - ⊖ ⊕ Transect line
  - ⊖ ⊕ Culvert
  - ⊖ ⊕ Bridge
  - 45° 02' 08", 93° 02' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
  - 3100000 FT 5000-foot ticks: Missouri State Plane West Zone (FIPS Zone 2403), Transverse Mercator projection
  - DX5510 X Bench mark (see explanation in Notes to Users section of this FIRM panel)
  - M.S. River Mile
- MAP REPOSITORIES**  
Refer to Map Repositories list on Map Index
- EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP**  
September 29, 2006
- EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL**  
January 20, 2017 - to change Special Flood Hazard Areas.



**NATIONAL FLOOD INSURANCE PROGRAM**

**PANEL 0438G**

**FIRM FLOOD INSURANCE RATE MAP JACKSON COUNTY, MISSOURI AND INCORPORATED AREAS**

**PANEL 438 OF 625**  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

**CONTAINS:**

COMMUNITY	NUMBER	PANEL	SUFFIX
LEE'S SUMMIT, CITY OF	290174	0438	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

**MAP NUMBER 29095C0438G**  
**MAP REVISED JANUARY 20, 2017**  
Federal Emergency Management Agency



United States  
Department of  
Agriculture

NRCS

Natural  
Resources  
Conservation  
Service

A product of the National  
Cooperative Soil Survey,  
a joint effort of the United  
States Department of  
Agriculture and other  
Federal agencies, State  
agencies including the  
Agricultural Experiment  
Stations, and local  
participants

# Custom Soil Resource Report for Jackson County, Missouri

## The Grove- Lee's Summit



# Preface

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Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist ([http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2\\_053951](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951)).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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# How Soil Surveys Are Made

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Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

## Custom Soil Resource Report

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

## Custom Soil Resource Report

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

# Soil Map

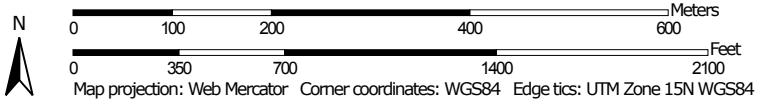
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The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.





































# Custom Soil Resource Report Soil Map



Map Scale: 1:7,620 if printed on A landscape (11" x 8.5") sheet.



### MAP LEGEND

- Area of Interest (AOI)**
  -  Area of Interest (AOI)
- Soils**
  -  Soil Map Unit Polygons
  -  Soil Map Unit Lines
  -  Soil Map Unit Points
- Special Point Features**
  -  Blowout
  -  Borrow Pit
  -  Clay Spot
  -  Closed Depression
  -  Gravel Pit
  -  Gravelly Spot
  -  Landfill
  -  Lava Flow
  -  Marsh or swamp
  -  Mine or Quarry
  -  Miscellaneous Water
  -  Perennial Water
  -  Rock Outcrop
  -  Saline Spot
  -  Sandy Spot
  -  Severely Eroded Spot
  -  Sinkhole
  -  Slide or Slip
  -  Sodic Spot
- Water Features**
  -  Streams and Canals
- Transportation**
  -  Rails
  -  Interstate Highways
  -  US Routes
  -  Major Roads
  -  Local Roads
- Background**
  -  Aerial Photography
- Other Features**
  -  Spoil Area
  -  Stony Spot
  -  Very Stony Spot
  -  Wet Spot
  -  Other
  -  Special Line Features

### MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL:  
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Jackson County, Missouri  
 Survey Area Data: Version 18, Sep 16, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 14, 2014—Oct 10, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	68.6	66.0%
10181	Udarents-Urban land-Sampsel complex, 5 to 9 percent slopes	35.4	34.0%
<b>Totals for Area of Interest</b>		<b>104.0</b>	<b>100.0%</b>

## Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the

## Custom Soil Resource Report

development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

## Jackson County, Missouri

### 10082—Arisburg-Urban land complex, 1 to 5 percent slopes

#### Map Unit Setting

*National map unit symbol:* 2w7ld  
*Elevation:* 750 to 1,130 feet  
*Mean annual precipitation:* 39 to 45 inches  
*Mean annual air temperature:* 50 to 55 degrees F  
*Frost-free period:* 177 to 220 days  
*Farmland classification:* All areas are prime farmland

#### Map Unit Composition

*Arisburg and similar soils:* 61 percent  
*Urban land:* 30 percent  
*Minor components:* 9 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Arisburg

##### Setting

*Landform:* Interfluves  
*Landform position (two-dimensional):* Summit  
*Landform position (three-dimensional):* Interfluve  
*Down-slope shape:* Convex  
*Across-slope shape:* Convex  
*Parent material:* Loess

##### Typical profile

*Ap - 0 to 6 inches:* silt loam  
*A - 6 to 13 inches:* silt loam  
*Bt - 13 to 19 inches:* silty clay loam  
*Btg - 19 to 56 inches:* silty clay loam  
*BCg - 56 to 79 inches:* silty clay loam

##### Properties and qualities

*Slope:* 1 to 5 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Somewhat poorly drained  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)  
*Depth to water table:* About 18 to 30 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Salinity, maximum in profile:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)  
*Available water storage in profile:* High (about 11.5 inches)

##### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 2e  
*Hydrologic Soil Group:* C  
*Ecological site:* Loess Upland Prairie (R107BY007MO)  
*Hydric soil rating:* No

**Description of Urban Land**

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 8  
*Hydric soil rating:* No

**Minor Components**

**Sharpsburg**

*Percent of map unit:* 3 percent  
*Landform:* Ridges  
*Landform position (two-dimensional):* Summit  
*Landform position (three-dimensional):* Interfluve  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Ecological site:* Loess Upland Prairie (R109XY002MO)  
*Hydric soil rating:* No

**Sampsel**

*Percent of map unit:* 3 percent  
*Landform:* Hills  
*Landform position (two-dimensional):* Backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Convex  
*Across-slope shape:* Concave  
*Ecological site:* Interbedded Sedimentary Upland Savanna (R109XY010MO)  
*Hydric soil rating:* Yes

**Greenton**

*Percent of map unit:* 3 percent  
*Landform:* Hillslopes  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Convex  
*Across-slope shape:* Convex  
*Ecological site:* Loess Upland Prairie (R109XY002MO)  
*Hydric soil rating:* No

**10181—Udarents-Urban land-Sampsel complex, 5 to 9 percent slopes**

**Map Unit Setting**

*National map unit symbol:* 1n85g  
*Elevation:* 600 to 900 feet  
*Mean annual precipitation:* 33 to 43 inches  
*Mean annual air temperature:* 50 to 57 degrees F  
*Frost-free period:* 175 to 220 days  
*Farmland classification:* Farmland of statewide importance

## Custom Soil Resource Report

### Map Unit Composition

*Udarents and similar soils:* 41 percent

*Urban land:* 39 percent

*Sampsel and similar soils:* 15 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Udarents

#### Setting

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Convex

*Across-slope shape:* Convex

*Parent material:* Mine spoil or earthy fill

#### Typical profile

*C1 - 0 to 5 inches:* silt loam

*C2 - 5 to 80 inches:* silty clay loam

#### Properties and qualities

*Slope:* 5 to 9 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Somewhat poorly drained

*Runoff class:* Very high

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.14 to 0.57 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Salinity, maximum in profile:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

*Available water storage in profile:* Moderate (about 9.0 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 6e

*Hydrologic Soil Group:* C

*Ecological site:* Deep Loess Upland Prairie (R107BY002MO)

*Other vegetative classification:* Mixed/Transitional (Mixed Native Vegetation)

*Hydric soil rating:* No

### Description of Urban Land

#### Setting

*Landform:* Hillslopes

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Side slope

*Across-slope shape:* Convex

#### Interpretive groups

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 8

*Hydric soil rating:* No

## Description of Sampsel

### Setting

*Landform:* Hillslopes  
*Landform position (two-dimensional):* Foothlope  
*Landform position (three-dimensional):* Base slope  
*Down-slope shape:* Concave  
*Across-slope shape:* Convex  
*Parent material:* Residuum weathered from shale

### Typical profile

*Ap - 0 to 13 inches:* silty clay loam  
*Bt - 13 to 80 inches:* silty clay

### Properties and qualities

*Slope:* 5 to 9 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Somewhat poorly drained  
*Runoff class:* Very high  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)  
*Depth to water table:* About 0 to 18 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Salinity, maximum in profile:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)  
*Available water storage in profile:* Moderate (about 8.6 inches)

### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 3e  
*Hydrologic Soil Group:* C/D  
*Ecological site:* Interbedded Sedimentary Upland Savanna (R109XY010MO)  
*Other vegetative classification:* Grass/Prairie (Herbaceous Vegetation)  
*Hydric soil rating:* No

# References

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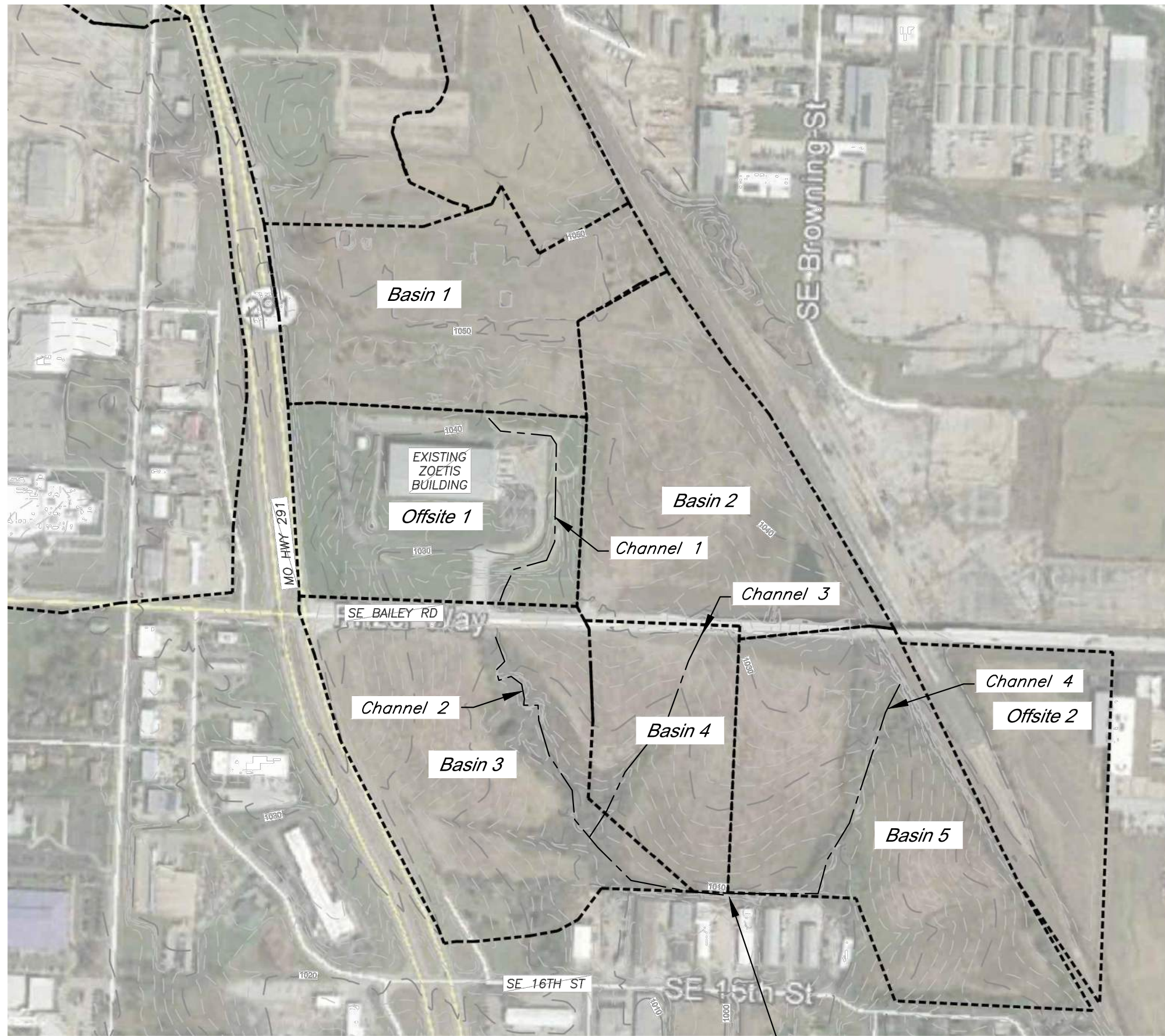
- American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.
- American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.
- Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.
- Federal Register. July 13, 1994. Changes in hydric soils of the United States.
- Federal Register. September 18, 2002. Hydric soils of the United States.
- Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.
- National Research Council. 1995. Wetlands: Characteristics and boundaries.
- Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2\\_054262](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262)
- Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2\\_053577](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577)
- Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2\\_053580](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580)
- Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.
- United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.
- United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2\\_053374](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374)
- United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084>

## Custom Soil Resource Report

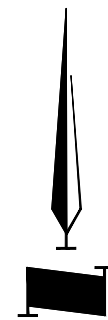
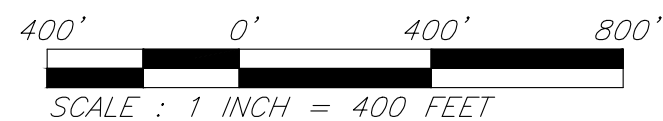
United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2\\_054242](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242)

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2\\_053624](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624)

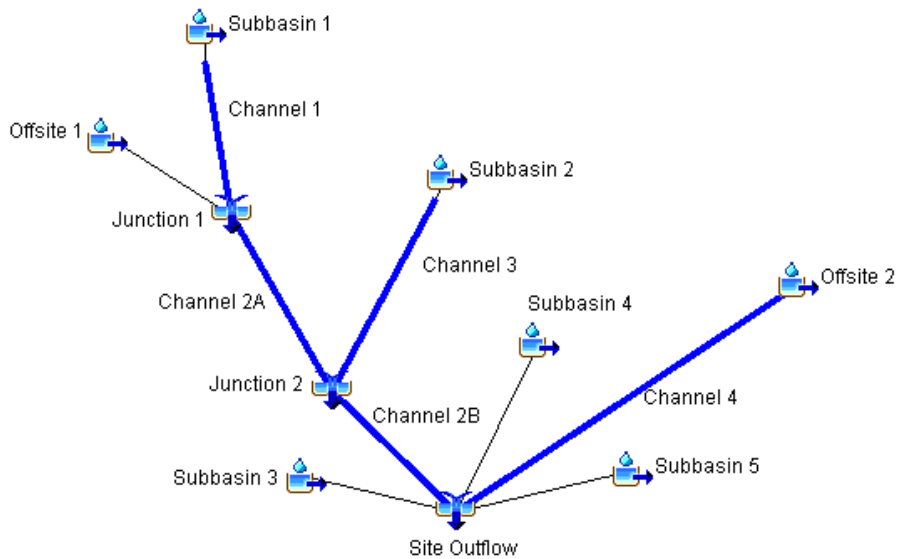
United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. [http://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs142p2\\_052290.pdf](http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf)



36" CMP



**Exhibit 5 – Existing Conditions HEC-HMS Model Summary**



	Sub-Basin	Area	Existing CN	Existing Tc (min.)
North of SE Bailey Rd	1	17.82	74	16.67
	2	19.07	74	24.55
South of SE Bailey Rd	3	19.38	74	37.08
	4	8.69	81	26.46
	5	14.87	74	28.41
Offsite	Off 1	15.84	86	12.78
	Off 2	11.22	74	11.28

Channel 1 Travel Time = 8.83 minutes  
 Channel 2A Travel Time = 10.69 minutes  
 Channel 2B Travel Time = 6.77 minutes  
 Channel 3 Travel Time = 5.4 minutes  
 Channel 4 Travel Time = 12.08 minutes

Project: The Grove 13958 Simulation Run: Existing 2 Yr

Start of Run: 03Mar2018, 10:00

Basin Model: Existing

End of Run: 04Mar2018, 10:06

Meteorologic Model: 2 Year

Compute Time: 03May2018, 08:51:38

Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI <sup>2</sup> )	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Subbasin 1	0.0278440	23.08	03Mar2018, 22:06	1.84
Channel 1	0.0278440	22.02	03Mar2018, 22:12	1.83
Offsite 1	0.0247500	39.97	03Mar2018, 22:00	2.77
Junction 1	0.0525940	54.50	03Mar2018, 22:06	4.60
Channel 2A	0.0525940	54.50	03Mar2018, 22:12	4.59
Subbasin 2	0.0297969	20.50	03Mar2018, 22:06	1.96
Channel 3	0.0297969	20.27	03Mar2018, 22:12	1.96
Junction 2	0.0823909	74.76	03Mar2018, 22:12	6.55
Channel 2B	0.0823909	72.41	03Mar2018, 22:12	6.54
Subbasin 3	0.0302812	16.70	03Mar2018, 22:18	1.99
Subbasin 5	0.0232344	15.01	03Mar2018, 22:12	1.53
Offsite 2	0.0175313	16.94	03Mar2018, 22:00	1.16
Channel 4	0.0175313	16.02	03Mar2018, 22:06	1.15
Subbasin 4	0.0135781	12.79	03Mar2018, 22:06	1.23
Site Outflow	0.1670159	130.40	03Mar2018, 22:12	12.44

Project: The Grove 13958 Simulation Run: Existing 10 Yr

Start of Run: 03Mar2018, 10:00

Basin Model: Existing

End of Run: 04Mar2018, 10:06

Meteorologic Model: 10 Year

Compute Time: 03May2018, 08:51:24

Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI <sup>2</sup> )	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Subbasin 1	0.0278440	49.44	03Mar2018, 22:06	3.86
Channel 1	0.0278440	47.75	03Mar2018, 22:06	3.85
Offsite 1	0.0247500	70.43	03Mar2018, 22:00	4.94
Junction 1	0.0525940	104.99	03Mar2018, 22:06	8.79
Channel 2A	0.0525940	104.99	03Mar2018, 22:12	8.78
Subbasin 2	0.0297969	45.48	03Mar2018, 22:06	4.12
Channel 3	0.0297969	44.27	03Mar2018, 22:12	4.12
Junction 2	0.0823909	149.26	03Mar2018, 22:12	12.90
Channel 2B	0.0823909	145.16	03Mar2018, 22:12	12.89
Subbasin 3	0.0302812	36.54	03Mar2018, 22:18	4.18
Subbasin 5	0.0232344	32.75	03Mar2018, 22:12	3.21
Offsite 2	0.0175313	36.69	03Mar2018, 22:00	2.43
Channel 4	0.0175313	35.04	03Mar2018, 22:06	2.43
Subbasin 4	0.0135781	24.75	03Mar2018, 22:06	2.35
Site Outflow	0.1670159	267.96	03Mar2018, 22:12	25.05

Project: The Grove 13958 Simulation Run: Existing 100 Yr

Start of Run: 03Mar2018, 10:00 Basin Model: Existing  
 End of Run: 04Mar2018, 10:06 Meteorologic Model: 100 Year  
 Compute Time: 03May2018, 08:51:30 Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI <sup>2</sup> )	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Subbasin 1	0.0278440	87.63	03Mar2018, 22:06	6.90
Channel 1	0.0278440	86.48	03Mar2018, 22:06	6.89
Offsite 1	0.0247500	111.20	03Mar2018, 22:00	7.96
Junction 1	0.0525940	175.89	03Mar2018, 22:06	14.86
Channel 2A	0.0525940	175.89	03Mar2018, 22:12	14.84
Subbasin 2	0.0297969	82.21	03Mar2018, 22:06	7.37
Channel 3	0.0297969	79.37	03Mar2018, 22:12	7.37
Junction 2	0.0823909	255.26	03Mar2018, 22:12	22.21
Channel 2B	0.0823909	249.01	03Mar2018, 22:12	22.18
Subbasin 3	0.0302812	66.02	03Mar2018, 22:12	7.47
Subbasin 5	0.0232344	58.66	03Mar2018, 22:12	5.75
Offsite 2	0.0175313	65.44	03Mar2018, 22:00	4.35
Channel 4	0.0175313	62.82	03Mar2018, 22:06	4.34
Subbasin 4	0.0135781	41.38	03Mar2018, 22:06	3.94
Site Outflow	0.1670159	465.52	03Mar2018, 22:12	43.68



DEPARTMENT OF THE ARMY  
CORPS OF ENGINEERS, KANSAS CITY DISTRICT  
636 FEDERAL BUILDING  
601 E. 12<sup>TH</sup> STREET  
KANSAS CITY, MISSOURI 64106-2824

February 12, 2018

Regulatory Branch  
(NWK-2017-00785)

Mr. Daren Fristoe  
The Grove at Lee's Summit, LLC  
P.O. Box 57  
Lee's Summit, Missouri 64063

Dear Mr. Fristoe:

As requested by your application, received on May 18, 2017, enclosed is a proposed Department of the Army (DA) permit, in duplicate, with drawings attached. When executed, the permit will authorize your plan to grade and fill two tributaries and two wetlands of Big Creek, for construction of a mixed-use development called The Grove. Additionally, the permit will authorize the temporary impacts to a tributary for installation of a sanitary sewer. The project is located in Sections 8 and 17, Township 47 north, Range 31 west, in Lee's Summit, Jackson County, Missouri.

A copy of the water quality certification issued for your work, by the Missouri Department of Natural Resources has been attached to the enclosed DA permit. As stated in general condition "5" of the enclosed permit document, the conditions presented in the state's water quality certification are incorporated into the special conditions of the permit by reference.

This letter contains an initial proffered permit for your proposed project. If you object to the permit because of certain terms and conditions therein, you may request that the permit be modified accordingly. Enclosed you will find a Notification of Administrative Appeal Options and Process and Request for Appeal (NAO-RFA) form. If you request reconsideration of this decision you must submit a completed NAO-RFA form to the Kansas City District at the following address:

District Commander  
ATTN: Mark D. Frazier  
Chief, Regulatory Branch  
U.S. Army Engineer District, Kansas City  
601 East 12<sup>th</sup> Street, Suite 402  
Kansas City, MO 64106-2824  
Voice: 816-389-3990 FAX: 816-389-2032

In order for an NAO-RFA to be accepted by the U.S. Army Corps of Engineers (Corps), the Corps must determine that it is complete, that it meets the criteria for reconsideration under 33 CFR Part 331.6.b., and that it has been received by the District Office within 60 days of the date of the NAO-RFA. Should you decide to submit an NAO-RFA form, it must be received at the above address by April 13, 2018. It is not necessary to submit an NAO-RFA form to the District Office if you do not object to the provisions of your initial proffered permit.

If you wish to accept the permit in its present form, please sign the original and duplicate copy of the enclosed permit document. Each copy of the permit document should be signed on page 3 above the word "Permittee," dated, and returned within 30 days from the date of this letter. Also, the application fee of \$100 should be paid by check made payable to USAED-KC and remitted with the permit document. A

preaddressed envelope is enclosed for your convenience. Upon receipt of the properly signed documents and the application fee, the permit will be executed and returned to you for your files. Your signature on the standard permit means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.

Special condition "a" of the permit document requires you to complete and return a "Compliance Certification" upon completion of the authorized work and any required mitigation. The "Compliance Certification" form will be provided to you when your DA permit is executed.

In addition to the general and special conditions of this IP, special conditions have been added in order to replace the lost aquatic resources and to protect Threatened and Endangered Species that result from the authorized project.

1. The permittee must purchase 12,247 stream credits and 0.11 acres of wetland credit from an approved mitigation bank in the service area of the project. The current approved mitigation bank within the service area of the project is the Camp Branch Wetland and Stream Mitigation Bank. The compensatory mitigation credit purchase must be completed prior to the commencement of work within our regulatory jurisdiction. You must submit a receipt of payment from the mitigation provider that includes the amount of credits purchased and the date of credit purchase. Receipts submitted by authorized agents will not be accepted.

2. Please be aware that the endangered Indiana bat (*Myotis sodalis*) and the threatened northern long-eared bat (*Myotis septentrionalis*), may be present within your project area. To "not adversely affect" the listed species, the permittee must avoid cutting and clearing trees within the project area during the bats' active season March 31 – November 1. If you anticipate timber clearing within these dates, please contact the Corps of Engineers, Regulatory Branch, for further consultation with the United States Fish and Wildlife Service.

We are interested in your thoughts and opinions concerning your experience with the Kansas City District, Corps of Engineers Regulatory Program. Please feel free to complete our Customer Service Survey form on our website at: [http://corpsmapu.usace.army.mil/cm\\_apex/f?p=regulatory\\_survey](http://corpsmapu.usace.army.mil/cm_apex/f?p=regulatory_survey). You may also call and request a paper copy of the survey which you may complete and return to us by mail or fax.

If you have any questions concerning this matter, please feel free to write me or to contact Ms. Kailey Jones at (816) 389-2123 or by email at [kailey.j.jones@usace.army.mil](mailto:kailey.j.jones@usace.army.mil).

Sincerely,

A handwritten signature in black ink, appearing to read "David R. Hibbs", with a stylized flourish at the end.

David R. Hibbs  
Regulatory Program Manager  
Regulatory Branch

Enclosures

## DEPARTMENT OF THE ARMY PERMIT

**Permittee** The Grove at Lee's Summit, LLC

**Permit No.** NWK-2017-00785

**Issuing Office** U.S. Army Engineer District, Kansas City

NOTE: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the Corps of Engineers having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below, and with the plans and drawings attached hereto which are incorporated in and made a part of this permit.

**Project Description:** This permit authorizes the general grading and fill of 1,948 linear feet (LF) of intermittent tributary, 840 LF of ephemeral tributary, and 0.11 acres of two adjacent wetlands; and the temporary impact to 72 LF of intermittent tributary for excavation and installation of a sanitary sewer, as shown on the attached drawings.

**Permit Drawings:** Location map, aerial map, proposed impact maps: 4 sheets total, dated 25 January 2018.

**Project Location:** In two unnamed tributaries and two adjacent wetlands of Big Creek, in Sections 8 and 17, Township 47 north, Range 31 west, in Lee's Summit, Jackson County, Missouri.

(38.89492°, -94.37007°)

**Permit Conditions:**

### General Conditions:

1. The time limit for completing the work authorized ends on 31 December 2020. If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before the above date is reached.
2. You must maintain the activity authorized by this permit in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.
3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and state coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

4. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.

5. If a conditioned water quality certification has been issued for your project, you must comply with the conditions specified in the certification as special conditions to this permit. For your convenience, a copy of the certification is attached if it contains such conditions.

6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

Special Conditions:

See continuation sheets, pages 4 and 5, of this document.

Further Information:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:

Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403).

Section 404 of the Clean Water Act (33 U.S.C. 1344).

Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413).

2. Limits of this authorization.

a. This permit does not obviate the need to obtain other Federal, state, or local authorization required by law.

b. This permit does not grant any property rights or exclusive privileges.

c. This permit does not authorize any injury to the property or rights of others.

d. This permit does not authorize interference with any existing or proposed Federal project.

3. Limits of Federal Liability. In issuing this permit, the Federal Government does not assume any liability for the following:

a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.

c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

d. Design or construction deficiencies associated with the permitted work.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision. This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

- a. You fail to comply with the terms and conditions of this permit.
- b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (See 4 above).
- c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions. General condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit.

Your signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

\_\_\_\_\_  
(PERMITTEE)

\_\_\_\_\_  
(DATE)

\_\_\_\_\_  
(PRINTED NAME AND TITLE)

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

\_\_\_\_\_  
(DISTRICT ENGINEER)  
DOUGLAS B. GUTTORMSEN, COLONEL  
BY: David R. Hibbs, Regulatory Program Manager

\_\_\_\_\_  
(DATE)

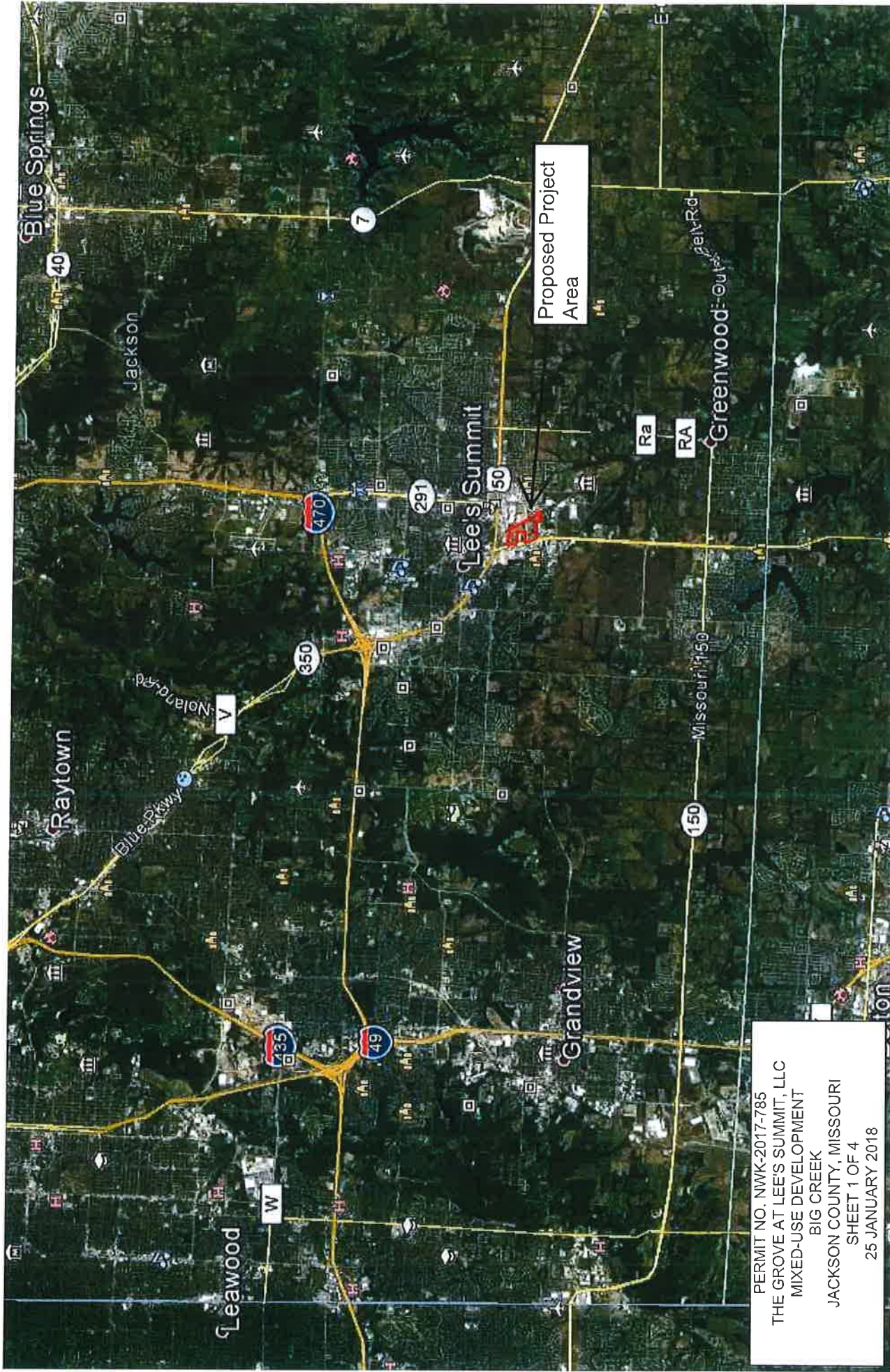
When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

\_\_\_\_\_  
(TRANSFEREE)

\_\_\_\_\_  
(DATE)

### **Special Conditions:**

- a. You must sign and return a "Compliance Certification" after you complete the authorized work and any required mitigation. Your signature will certify that you completed the work in accordance with this permit, including general and specific conditions, and that any required mitigation was completed in accordance with the permit conditions.
- b. The permittee must purchase 12,247 stream credits and 0.11 acres of wetland credit from an approved mitigation bank in the service area of the project. The current approved mitigation bank within the service area of the project is the Camp Branch Wetland and Stream Mitigation Bank. The compensatory mitigation credit purchase must be completed prior to the commencement of work within our regulatory jurisdiction. You must notify the project proponent that they must submit a receipt of payment from the mitigation provider that includes the amount of credits purchased and the date of credit purchase. Receipts submitted by authorized agents will not be accepted.
- c. Please be aware that the endangered Indiana bat (*Myotis sodalis*) and the threatened northern long-eared bat (*Myotis septentrionalis*), may be present within your project area. To "not adversely affect" the listed species, the permittee must avoid cutting and clearing trees within the project area during the bats' active season March 31 – November 1. If you anticipate timber clearing within these dates, please contact the Corps of Engineers, Regulatory Branch, for further consultation with the United States Fish and Wildlife Service.
- d. If any part of the authorized work is performed by a contractor, before starting work you must discuss the terms and conditions of this permit with the contractor; and, you must give a copy of this entire permit to the contractor.
- e. You must use clean, uncontaminated materials for fill in order to minimize excessive turbidity by leaching of fines, as well as to preclude the entrance of deleterious and/or toxic materials into the waters of the United States by natural runoff or by leaching.
- f. You must dispose of excess concrete and wash water from concrete trucks and other concrete mixing equipment in a nonwetland area above the ordinary high water mark and at a location where the concrete and wash water cannot enter the water body or an adjacent wetland area.
- g. You must excavate, dredge and/or fill in the watercourse in a manner that will minimize increases in suspended solids and turbidity which may degrade water quality and damage aquatic life outside the immediate area of operation.
- h. You must immediately remove and properly dispose of all debris during every phase of the project in order to prevent the accumulation of unsightly, deleterious and/or toxic materials in or near the water body.
- i. You must not dispose of any construction debris or waste materials below the ordinary high water mark of any water body, in a wetland area, or at any location where the materials could be introduced into the water body or an adjacent wetland as a result of runoff, flooding, wind, or other natural forces.
- j. You must store all construction materials, equipment, and/or petroleum products, when not in use, above anticipated high water levels.



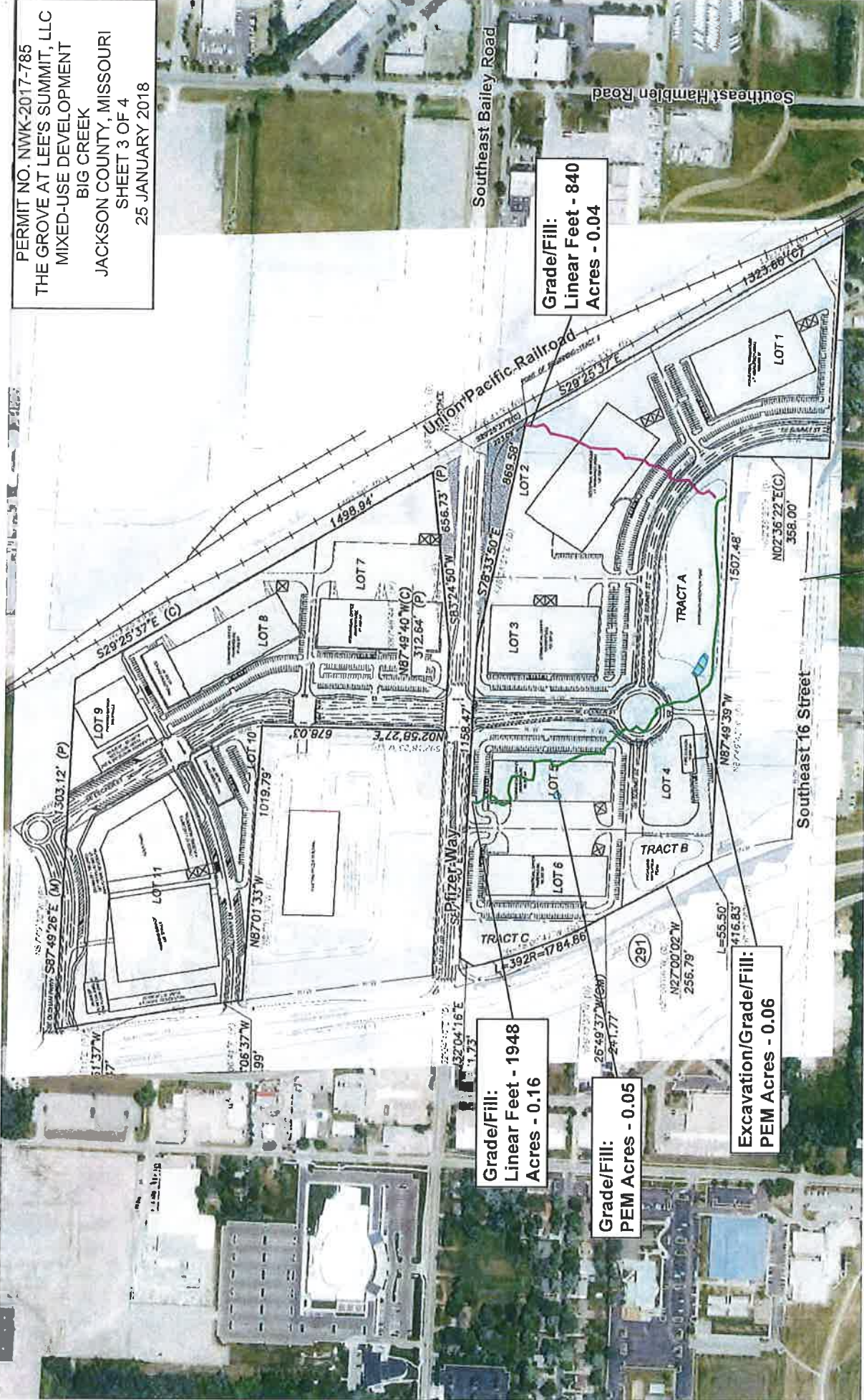
Proposed Project Area

PERMIT NO. NWK-2017-785  
THE GROVE AT LEE'S SUMMIT, LLC  
MIXED-USE DEVELOPMENT  
BIG CREEK  
JACKSON COUNTY, MISSOURI  
SHEET 1 OF 4  
25 JANUARY 2018



PERMIT NO. NWK-2017-785  
THE GROVE AT LEE'S SUMMIT, LLC  
MIXED-USE DEVELOPMENT  
BIG CREEK  
JACKSON COUNTY, MISSOURI  
SHEET 2 OF 4  
25 JANUARY 2018

PERMIT NO. NWK-2017-785  
THE GROVE AT LEE'S SUMMIT, LLC  
MIXED-USE DEVELOPMENT  
BIG CREEK  
JACKSON COUNTY, MISSOURI  
SHEET 3 OF 4  
25 JANUARY 2018

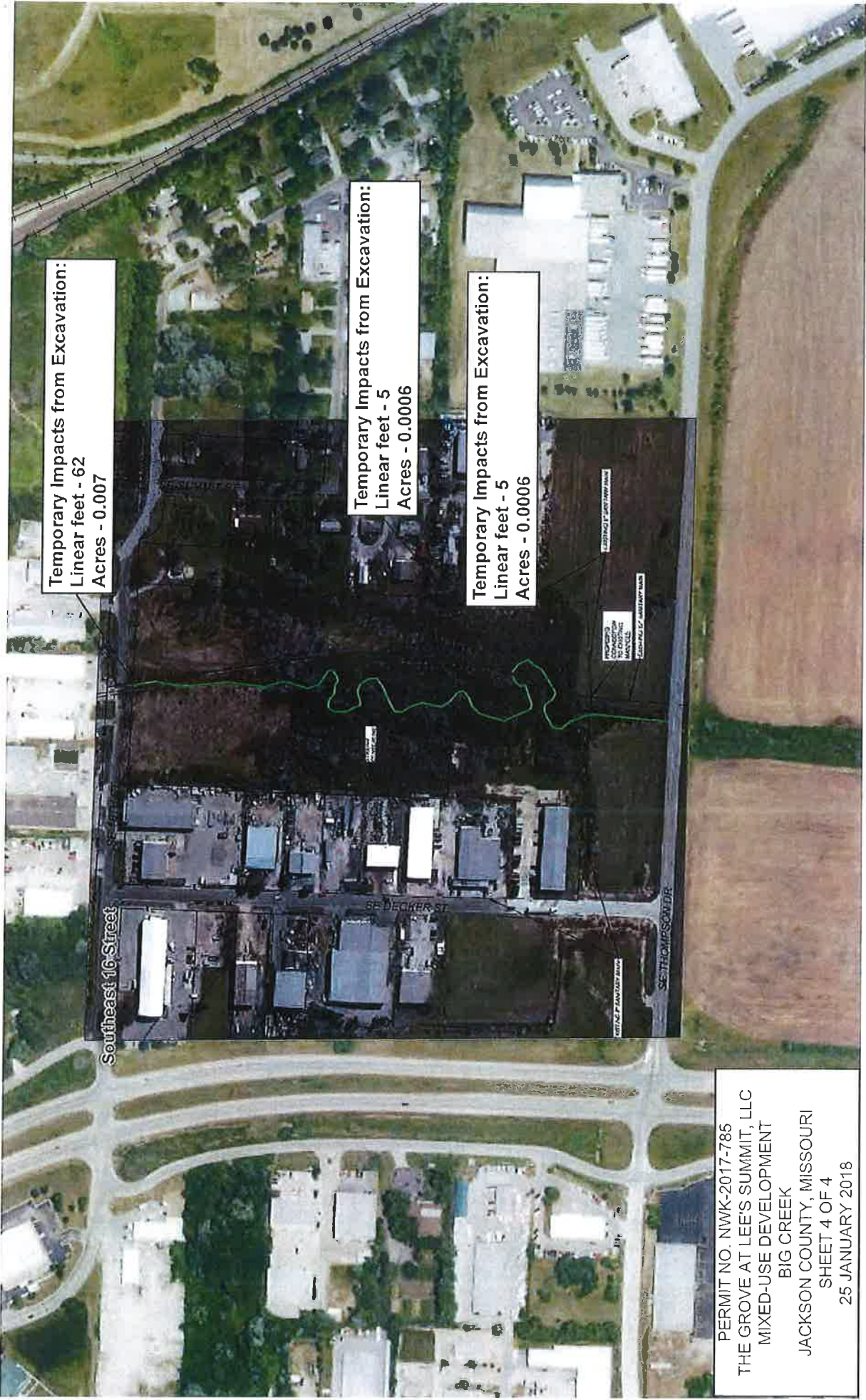


Grade/Fill:  
Linear Feet - 840  
Acres - 0.04

Grade/Fill:  
Linear Feet - 1948  
Acres - 0.16

Grade/Fill:  
PEM Acres - 0.05

Excavation/Grade/Fill:  
PEM Acres - 0.06



Temporary Impacts from Excavation:  
Linear feet - 62  
Acres - 0.007

Temporary Impacts from Excavation:  
Linear feet - 5  
Acres - 0.0006

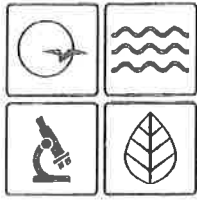
Temporary Impacts from Excavation:  
Linear feet - 5  
Acres - 0.0006

Southeast 16 Street

SE DECKER ST

SE HICKMAN ST

PERMIT NO. NWK-2017-785  
THE GROVE AT LEE'S SUMMIT, LLC  
MIXED-USE DEVELOPMENT  
BIG CREEK  
JACKSON COUNTY, MISSOURI  
SHEET 4 OF 4  
25 JANUARY 2018



Missouri Department of [dnr.mo.gov](http://dnr.mo.gov)

# NATURAL RESOURCES

Eric R. Greitens, Governor

Carol S. Comer, Director

NOV 22 2017

Mr. Robert Dunn  
The Grove at Lee's Summit, LLC  
P.O. Box 57  
Lee's Summit, MO 64063

RE: 2017-00785/CEK007233 in Jackson County

Dear Mr. Dunn:

The Missouri Department of Natural Resources' Water Protection Program has reviewed your request for Clean Water Act Section 401 Water Quality Certification (WQC) to accompany the U.S. Army Corps of Engineers' (USACE) Permit for 2017-00785 in which you are proposing to develop two parcels, one approximately 35 acres and one approximately 48 acres for the construction of The Grove at Lee's Summit, LLC mixed-use development. The proposal includes the construction of multi-family residential, commercial offices, and industrial warehouse space with associated amenities and stormwater detention.

The proposed development would permanently fill 1,948 linear feet (LF) of intermittent stream, 840 LF of an ephemeral tributary, and 0.11 acre of emergent wetland. Additionally, the applicant has proposed to temporarily impact 72 LF of intermittent Tributary 1 for the placement of a sanitary sewer line in three locations.

The proposed project is located in Sections 8 and 17, Township 47 North, Range 31 West in Lees Summit, Jackson County, Missouri. Approximate geographic coordinates for the center of the project are 38.89492°N and 94.37007°W. Approximate geographic coordinates for aquatic impacts and impact sizes are as follows:

Streams	Impact Size (LF)	Latitude (°N)	Longitude (°W)
Intermittent	1,948	38.895822	94.372770
Ephemeral tributary	840	38.895311	94.367827
Wetland	Impact Size (Acres)	Latitude (°N)	Longitude (°W)
Emergent wetland	0.06	38.893489	94.370988
Emergent wetland	0.05	38.894936	94.372635



Recycled paper

This WQC is being issued under Section 401 of Public Law 95-217, The Clean Water Act of 1977 and subsequent revisions. This office certifies the proposed project will not cause the general or numeric criteria to be exceeded nor impair beneficial uses established in the Water Quality Standards, 10 CSR 20-7.031, provided the following conditions are met:

1. The 2,788 LF of stream impacts were assessed using the 2013 State of Missouri Stream Mitigation Method and determined to require 12,247 stream mitigation credits. Compensatory mitigation shall be satisfied by the purchase of 12,247 credits from the Camp Branch Wetland and Stream Mitigation Bank or other approved in-lieu fee provider or mitigation bank. A copy of the purchase document shall be provided to the Department at the address below prior to the start of work within jurisdictional waters at the site.
2. The Grove at Lee's Summit, LLC shall purchase 0.11 wetland acres as mitigation credit from the Camp Branch Wetland and Stream Mitigation Bank or other approved in-lieu fee provider or mitigation bank. A copy of the purchase document shall be provided to the Department at the address below prior to the start of work within jurisdictional waters at the site.
3. Antidegradation requirements dictate all appropriate and reasonable Best Management Practices (BMPs) related to erosion and sediment control, project stabilization and prevention of water quality degradation are applied and maintained; for example, preserving vegetation, streambank stability, and basic drainage. BMPs shall be properly installed prior to conducting authorized activities and maintained, repaired and/or replaced as needed during all phases of the project to limit the amount of discharge of water contaminants to waters of the state. The project shall not involve more than normal stormwater or incidental loading of sediment caused by project activities so as to comply with Missouri's general water quality criteria [10 CSR 20-7.031(4); Page 16 at <http://www.sos.mo.gov/cmsimages/adrules/csr/current/10csr/10c20-7a.pdf>].
4. Streambed gradient downstream of the project shall not be adversely altered during project construction. No project shall accelerate bed or bank erosion outside of the project area.
5. The project shall not allow the filling of jurisdictional springs such as those associated with a water body's point of origin or located in a streambed.
6. Conduct project activity at low flows and water levels to limit the amount of sediment disturbance caused by the heavy equipment.
7. All precautions shall be taken to avoid the release of wastes or fuel to streams and other adjacent waters as a result of this operation. Petroleum products spilled into any water or on the banks where the material may enter waters of the state shall be immediately cleaned up and disposed of properly. Any such spills of petroleum shall be reported as soon as possible, but no later than 24 hours after discovery to the Department's Environmental Emergency Response phone line at 573-634-2436 or website at <http://dnr.mo.gov/env/esp/esp-eer.htm>.

8. Only clean, nonpolluting fill shall be used.
9. Any waste concrete or concrete rinsate shall be disposed of in a manner that does not result in any discharge to the jurisdictional water ways.
10. Clearing of vegetation and trees shall be the minimum necessary to accomplish the activity, except for the removal of invasive or noxious species and placement of ecologically beneficial practices.
11. Disturbed areas shall be restored to a stable condition to protect water quality as soon as possible. Seeding, mulching and needed fertilization should be within three days of final contouring. To ensure erosion and deposition of soil in waters of the state are not occurring from this project, onsite inspections of these areas should be conducted as necessary to ensure successful revegetation and stabilization.
12. Acquisition of a WQC shall not be construed or interpreted to imply the requirements for other permits are replaced or superseded, including Clean Water Act Section 402 National Pollutant Discharge Elimination System Permits. Permits or any other requirements shall remain in effect. Questions regarding permit requirements may be directed to the Department's Kansas City Regional Office by phone at 816-251-0700.
13. Land disturbance activities disturbing one or more acres of total area for the entire project may require a stormwater permit. Instructions on how to apply for and receive the online land disturbance permit are located at [www.dnr.mo.gov/env/wpp/epermit/help.htm](http://www.dnr.mo.gov/env/wpp/epermit/help.htm). Questions regarding permit requirements may be directed to the Department's Land Disturbance phone line at 573-526-2082 or toll free at 855-789-3889.
14. The city of Lee's Summit is covered under Municipal Separate Storm Sewer System Permit MO-R040016 with measures to control and possibly treat stormwater. You shall comply with all stormwater requirements of the city's Stormwater Management Plan and any related ordinances.
15. Representatives from the Department shall be allowed upon request on the project property, which includes the site(s) where the authorized activity takes place and any associated compensatory mitigation site(s), to inspect the authorized activity and mitigation efforts as deemed necessary by the Department to ensure compliance with WQC conditions and water quality standards. The applicant or their consultant shall submit any requested information deemed necessary by the Department to ensure compliance with WQC conditions.
16. The WQC is based on the plans as submitted. Should any plan modifications occur, please contact the Department to determine whether the WQC remains valid or needs to be amended or revoked.

Mr. Robert Dunn

Page 4


Pursuant to Chapter 644, RSMo, commonly referred to as the Missouri Clean Water Law, and fee regulations under 10 CSR 20-6.011(2)(I), this WQC shall be valid only upon payment of a fee of \$150. The enclosed invoice contains the necessary information on how to submit your fee. Payment must be received within ten business days of receipt of this WQC. Upon receipt of the fee, the applicable office of the USACE will be informed the WQC is now in effect and final.

If you were adversely affected by this decision, you may be entitled to an appeal before the Administrative Hearing Commission (AHC) pursuant to 10 CSR 20-1.020 and Section 621.250, RSMo. To appeal, you must file a petition with the AHC within 30 days after the date this decision was mailed or the date it was delivered, whichever date was earlier. If any such petition is sent by registered mail or certified mail, it will be deemed filed on the date it is mailed; if it is sent by any method other than registered mail or certified mail, it will be deemed filed on the date it is received by the AHC. Contact information for the AHC is by mail at Administrative Hearing Commission, United States Post Office Building, Third Floor, 131 West High Street, P.O. Box 1557, Jefferson City, MO 65102 by phone at 573-751-2422, by fax at 573-751-5018, and by website at [www.oa.mo.gov/ahc](http://www.oa.mo.gov/ahc).

This WQC is part of the USACE's permit. Water Quality Standards must be met during any operations authorized. If you have any questions, please contact Mr. Mike Irwin by phone at 573-522-1131, by email at [mike.irwin@dnr.mo.gov](mailto:mike.irwin@dnr.mo.gov), or by mail at Department of Natural Resources, Water Protection Program, P.O. Box 176, Jefferson City, MO 65102-0176. Thank you for working with the Department to protect our environment.

Sincerely,

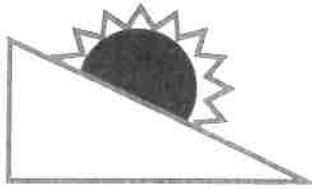
WATER PROTECTION PROGRAM

  
Chris Wieberg  
Director

CW:mip

Enclosure

- c: Ms. Sherry Bell, Fiscal Management Section, Budget and Fees Unit
- Mr. Jesse Cochran, Kansas City Regional Office
- Ms. Kailey Jones, U.S. Army Corps of Engineers, Kansas City District
- Mr. Kelsey Kropp, TranSystems
- Ms. Corinne Rosania, Kansas City Regional Office
- Mr. Steve Sturgess, Kansas City Regional Office
- Ms. Terrie Williams, Kansas City Regional Office



# SWALLOW TAIL LLC

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Tuesday, March 13, 2018

Mrs. Kailey Jones  
US Army Corps of Engineers  
Regulatory Division Kansas City District  
635 Federal Building 601 East 12<sup>th</sup> Street  
Kansas City Missouri 64106

RE: Mitigation Credit Purchase NWK-2017-00785 The Grove at Lee's Summit LLC  
CONFIRMATION OF CREDIT PURCHASE

Dear Mrs. Jones,

By means of this correspondence, we have assigned mitigation credit for the aforementioned permit as follows:

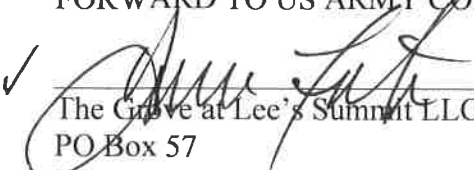
SITE NAME: CAMP BRANCH WETLAND AND STREAM MITIGATION BANK  
CREDITS: 0.11 WETLAND CREDITS  
12,247 STREAM CREDITS

The applicant has been instructed to submit separate correspondence signifying their purchase of said credits. A hardcopy of this correspondence has been mailed to the project representative.

Sincerely,  
SWALLOW TAIL LLC  
*David L. Flick*  
David L. Flick  
Managing Member

Copy: Mr. Doug Berka, US Army Corps of Engineers

APPLICANT CONFIRMATION  
FORWARD TO US ARMY CORPS OF ENGINEERS AFTER SIGNING BELOW:

✓   
\_\_\_\_\_  
The Grove at Lee's Summit LLC  
PO Box 57  
Lee's Summit MO 64063  
Attn: Daren Fristoe

---

24820 Miller Road • Harrisonville, MO 64701  
(816) 810-8377  
[dflick@terratechnologies.com](mailto:dflick@terratechnologies.com)

## MITIGATION CREDIT AGREEMENT

This MITIGATION CREDIT AGREEMENT (Agreement) is made and entered into as of February 12, 2018, (the “Effective Date”), by and between Swallow Tail LLC (“Seller”) and The Grove at Lee’s Summit, LLC (“Purchaser”).

### WITNESSETH:

WHEREAS Purchaser has applied for a U. S. Army Corps of Engineers (“USACOE”) permit under Section 404 of the Clean Water Act to allow impacts to Jurisdictional Waters (“Project”). Project Number assigned by the USACOE is NWK-2017-00785. The project manager with the Corps of Engineers is Kailey Jones.

WHEREAS, as a condition to the issuance of a permit from the USACOE, the Purchaser is required to compensate for said impacts, and elects to satisfy part of the requirement through the purchase of mitigation credits in the Sellers’ Camp Branch Creek Stream and Wetland Mitigation Bank (“Mitigation Bank”).

WHEREAS, the USACOE has determined that Purchaser is allowed to purchase credits due to permanent impacts resulting from the activities at the subject site.

NOW, THEREFORE, for and in consideration of the mutual covenants herein contained and other good and valuable consideration, the receipt and sufficiency of which are hereby mutually acknowledged, it is agreed as follows:

- 1) RECITALS: The recitals are hereby incorporated by this reference.

2) COMPENSATION: Purchaser shall, subject to the terms and conditions hereinafter provided, pay to the Seller the sum of **Four hundred ninety-five thousand nine hundred and thirty DOLLARS (\$495,930)** (“Purchase Price”) for 0.11 wetland credits and 12,247 stream credits at the Mitigation Bank. The Purchase Price is derived from the unit cost of \$55,000 per wetland credit and \$40 per stream credit. Purchase Price is to be paid in the manner following:

a.) PURCHASE PRICE: Upon signing this Agreement, Purchaser will pay the total balance due, or \$495,930.

3) SELLERS WARRANTY: In consideration of the Purchase Price, Seller affirms that it has sufficient credits in the Mitigation Bank to satisfy the credits required by Purchaser and agrees to sell such credits to Purchaser. It is understood and agreed that Purchaser shall have no obligation to perform any responsibility or incur any liability associated with the creation, development, maintenance and/or management of the Mitigation Bank.

4) NOTICES: Any notices required or permitted hereunder shall be sufficiently given if delivered by overnight courier, by United States mail, return receipt requested to the parties hereto as follows:

If to Seller: Swallow Tail LLC c/o Terra Technologies Inc.  
6240 West 135th Street, Suite 100  
Overland Park, KS 66223  
Attn: Mr. David Flick

If to Purchaser: The Grove at Lee’s Summit LLC  
PO Box 57  
Lee’s Summit MO 64063  
Attn: Daren Fristoe

Any notice given pursuant hereto by overnight courier shall be effective after recipient signs for notice; any notice given pursuant hereto by United States mail, return receipt requested, shall be effective as of receipt of confirmation by the sending party.

5) PRIOR AGREEMENTS: This Agreement shall supersede any and all prior understandings and agreements between the parties hereto, whether written or oral, with respect to the subject matter hereof and may be amended only by a written instrument executed by or on behalf of both Seller and Purchaser.

6) APPLICABLE LAW: Purchaser and Seller shall be contractually bound to this Agreement, which shall be governed by the laws of the state of Missouri and subject to the requirements of any applicable federal law or regulation. Changes in federal, state or local laws, however, which might have otherwise impacted this Agreement shall not be enforced retroactively after execution of this Agreement.

7) CONTRACT ACCEPTANCE: This Agreement is null and void if not executed by both parties within 180 days after the Effective Date of the Agreement.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be executed as of the Effective Date.

Purchaser

The Grove at Lee's Summit, LLC

By:

  
Daren Fristoe

Seller

Swallow Tail LLC

By:

David L. Flick  
David L. Flick

**THE GROVE AT LEES SUMMIT LLC**

2300 MAIN ST STE 900  
KANSAS CITY, MO 64108-2408

6873

90/7162

DATE 03-09-18

PAY TO THE  
ORDER OF Swallow Tail LLC

\$ 495,930

Four Hundred Ninety Five Thousand Nine hundred Thirty <sup>00</sup>/<sub>100</sub> 00/100  
DOLLARS



JPMorgan Chase Bank, N.A.  
www.Chase.com

The Gravel Water & Stream Credits  
MEMO

⑆322271627⑆

20071968716873

## **APPENDIX B – PROPOSED CONDITIONS**

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Exhibit 7 – Proposed Drainage Map

Mass Grading Plan Sheet C4.0 – Grading Plan

Mass Grading Plan Sheet C5.1 – C5.5 – Storm Plan and Profile

Summit and Decker Sheets C9.1 – C9.5 – Storm Plan and Profiles

Summit and Decker Sheet C10.1 – Drainage Map

Phase 1A FDP Plan Sheet C4.0 – Drainage Map

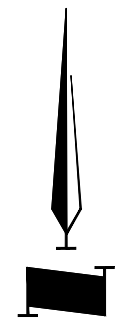
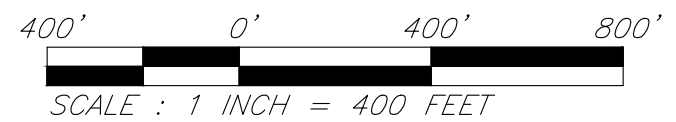
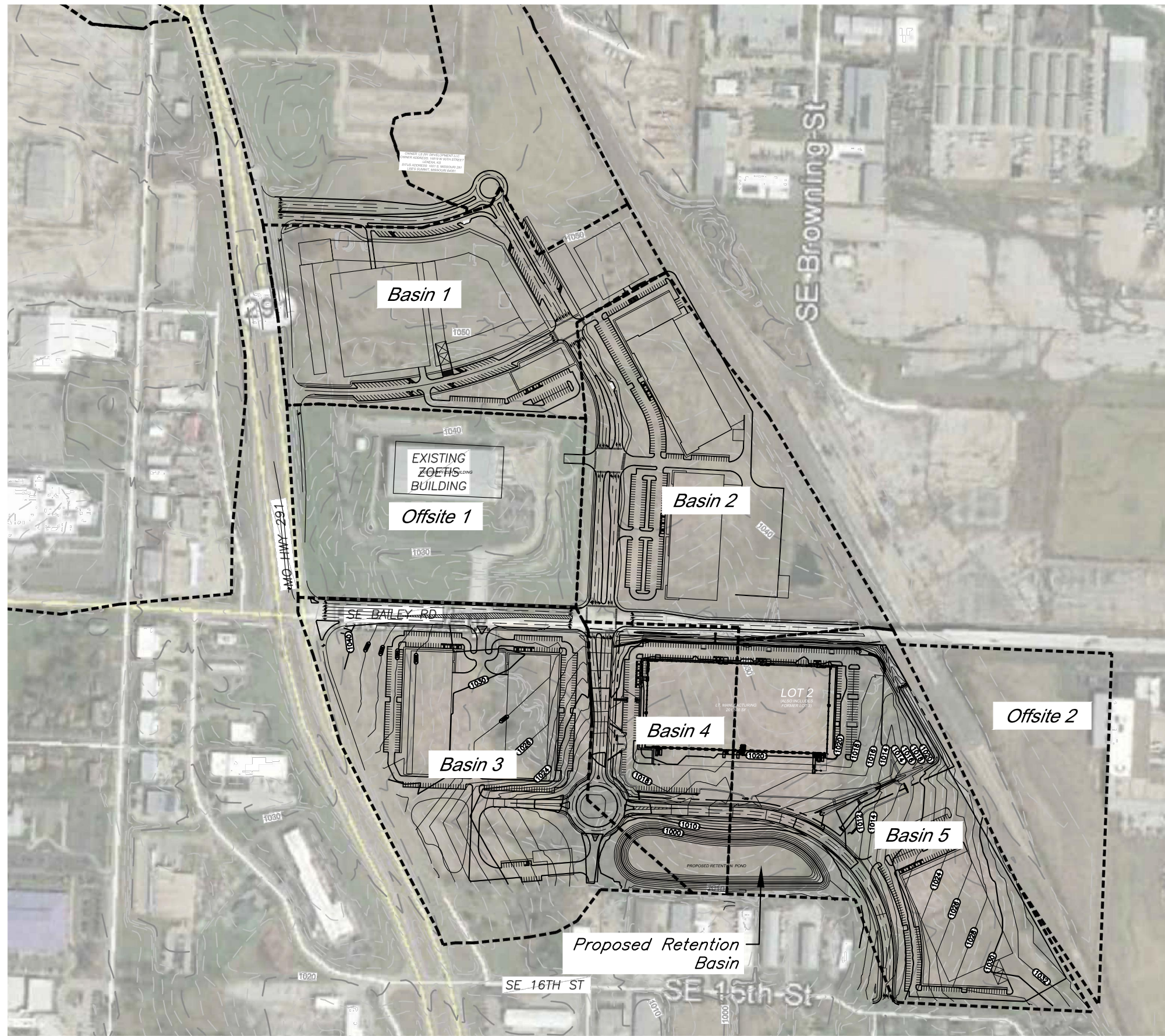
Phase 1A FDP Plan Sheet C5.0 – Storm Plan

Phase 1A FDP – Plan Sheet C5.1 – C5.2 Storm Plan and Profile

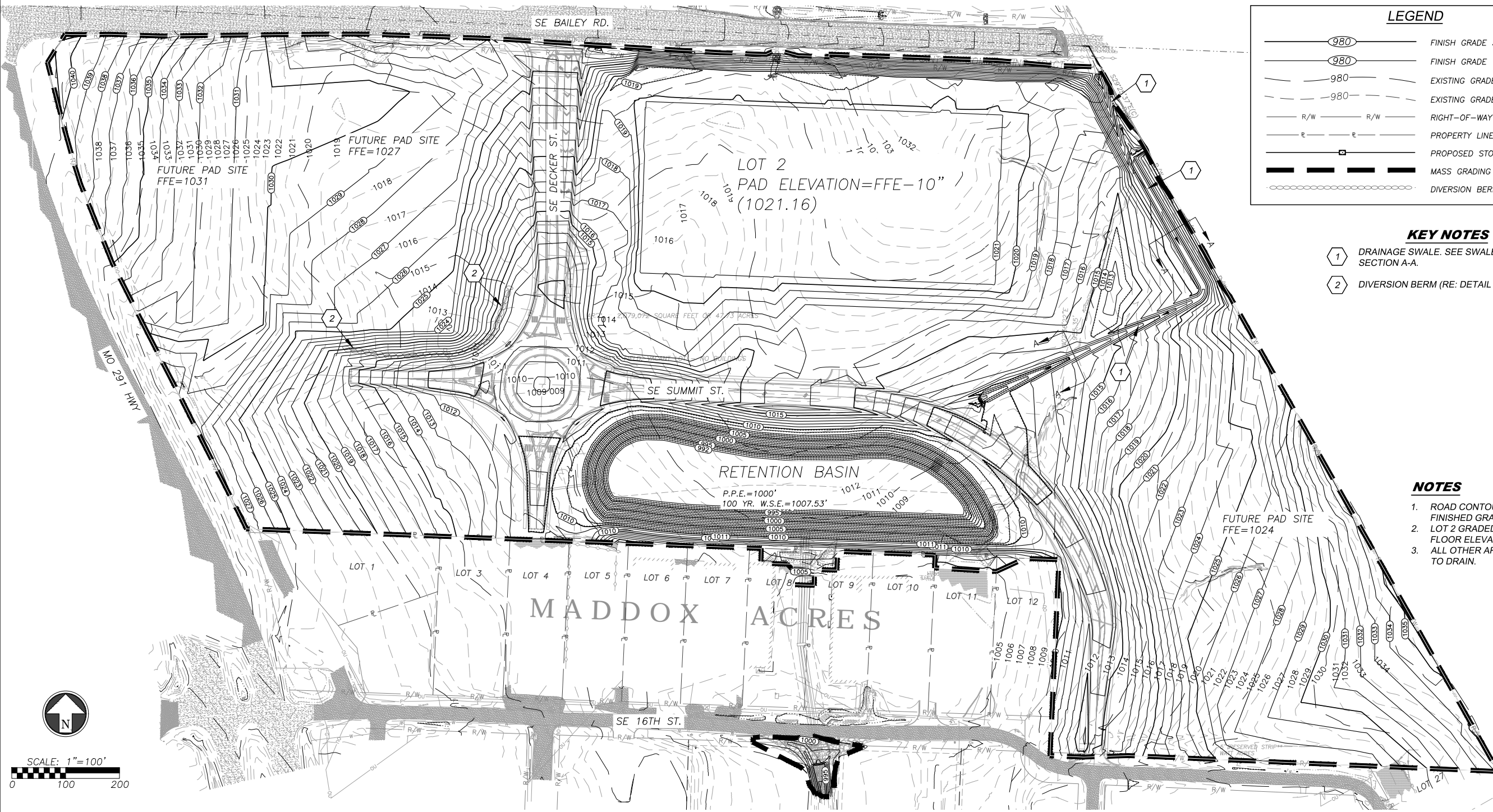
Exhibit 8 – Storm Sewer Calculations

Exhibit 9 – Proposed Conditions HEC-HMS Model Summary

Exhibit 10 – Water Quality Volume Calculations



G:\13958\Civil 3D\Production Drawings\Mass Grading and Stormwater Plans\021730-FDP1A-MSSGRAD-SHIFTS-GRAD.dwg Layout: MASS GRADING PLAN -- Friday June 08, 2018, 2:56pm -- Copyright 2018, George Butler Associates, Inc.

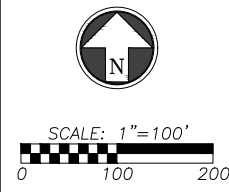


**LEGEND**

- FINISH GRADE 5' CONTOURS
- FINISH GRADE 1' CONTOURS
- EXISTING GRADE 5' CONTOURS
- EXISTING GRADE 1' CONTOURS
- RIGHT-OF-WAY LINE
- PROPERTY LINE
- PROPOSED STORM SEWER MAIN
- MASS GRADING LIMITS
- DIVERSION BERM

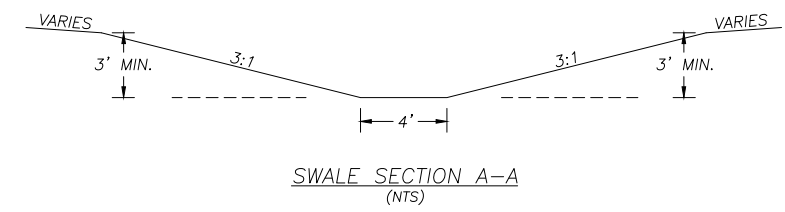
- KEY NOTES**
- DRAINAGE SWALE. SEE SWALE TYPICAL SECTION A-A.
  - DIVERSION BERM (RE: DETAIL ON SHEET C7.3)

- NOTES**
1. ROAD CONTOURS SHOWN AT FINISHED GRADE MINUS 15.5'.
  2. LOT 2 GRADED TO FINISH FLOOR ELEVATION MINUS 10".
  3. ALL OTHER AREAS GRADED TO DRAIN.



**GRADING NOTES**

1. CONTRACTOR SHALL OBTAIN A COPY OF THE PRELIMINARY SUBSURFACE EXPLORATION - PROPOSED INDUSTRIAL DEVELOPMENT - THE GROVE - LEE'S SUMMIT, MISSOURI, DATED MARCH 10, 2017 PREPARED BY GEOTECHNOLOGY INC. AND SATISFY HIMSELF AS TO THE EXISTING CONDITIONS AND RECOMMENDATIONS CONTAINED IN THE REPORT.
2. AS DISCUSSED IN THE GEOTECHNICAL REPORT, OVER EXCAVATION OF EXISTING UNSUITABLE SOILS WILL BE REQUIRED UNDER BUILDING AND PAVEMENT AREAS. CONTRACTOR SHALL PERFORM OVER EXCAVATION OF UNSUITABLE SOILS AS A PART OF THIS WORK.
3. ALL MATERIAL UNDER PAVEMENT SURFACES AND BUILDING SLABS SHALL BE REMEDIATED IN ACCORDANCE WITH THE GEOTECHNICAL REPORT.
4. ALL TOPSOIL, VEGETATION, ROOT STRUCTURES, AND DELETERIOUS MATERIALS SHALL BE STRIPPED FROM THE GROUND SURFACE PRIOR TO THE PLACEMENT OF EMBANKMENTS.
5. ALL DISTURBED AREAS THAT ARE NOT TO BE PAVED (GREEN SPACES) SHALL BE FINISH GRADED WITH A MINIMUM OF SIX INCHES OF TOPSOIL.
6. ALL EXCAVATION AND EMBANKMENTS SHALL COMPLY WITH THE RECOMMENDATIONS PROVIDED BY THE GEOTECHNICAL ENGINEER.
7. PRIOR TO PLACING ANY CONCRETE OR ASPHALT PAVEMENT THE CONTRACTOR SHALL PERFORM A PROOF ROLL OF THE PAVEMENT SUB-GRADE WITH A FULLY LOADED TANDEM AXLE DUMP TRUCK. THE PROOF ROLL SHALL BE CONDUCTED IN THE PRESENCE OF THE ENGINEER AND THE ON-SITE GEOTECHNICAL REPRESENTATIVE. AREAS THAT DISPLAY RUTTING OR PUMPING THAT ARE UNSATISFACTORY TO THE ENGINEER SHALL BE RE-WORKED AND A FOLLOW-UP PROOF ROLL SHALL BE CONDUCTED PRIOR TO ACCEPTANCE OF THE SUB-GRADE FOR PAVING. THE CONTRACTOR MAY, AT ITS OWN EXPENSE, STABILIZE THE SUB-GRADE USING CLASS C FLY ASH OR QUICKLIME.
8. FINISHED GRADES SHALL NOT BE STEEPER THAN 3:1.
9. ALL GRADING WORK SHALL BE CONSIDERED UNCLASSIFIED. NO ADDITIONAL PAYMENTS SHALL BE MADE FOR ROCK EXCAVATION. CONTRACTOR SHALL SATISFY HIMSELF AS TO ANY ROCK EXCAVATION REQUIRED TO ACCOMPLISH THE IMPROVEMENTS SHOWN HEREON.



9801 Renner Boulevard  
Lenexa, Kansas 66219  
913.492.0400  
www.gbateam.com

PROPOSED FACILITY FOR:  
**THE GROVE AT LEE'S SUMMIT**  
MASS GRADING AND STORMWATER  
MISSOURI HWY 291 & 16TH STREET  
LEE'S SUMMIT, MISSOURI



Clint Loumaster  
Professional Engineer  
License No. PE-2011009651

REVISION

PROJECT NUMBER  
13958.00

DATE  
6/8/18

DESIGNED

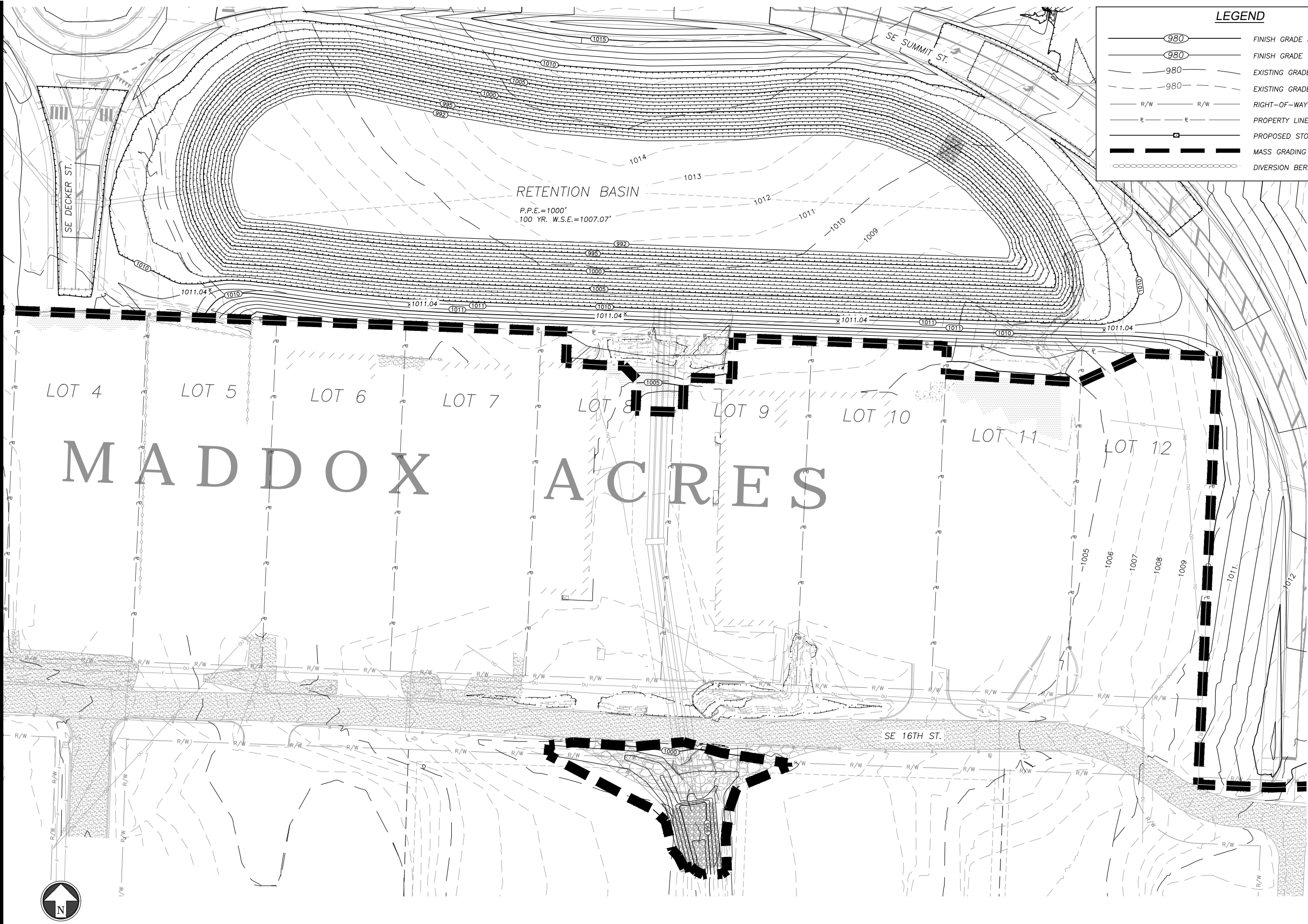
DRAWN

REVIEWED

SHEET TITLE  
**MASS GRADING PLAN**

SHEET NUMBER  
**C4.0**

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**LEGEND**

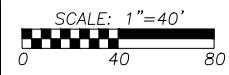
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	FINISH GRADE 1' CONTOURS
	EXISTING GRADE 5' CONTOURS
	EXISTING GRADE 1' CONTOURS
	RIGHT-OF-WAY LINE
	PROPERTY LINE
	PROPOSED STORM SEWER MAIN
	MASS GRADING LIMITS
	DIVERSION BERM

RETENTION BASIN  
P.P.E.=1000'  
100 YR. W.S.E.=1007.07'

LOT 4    LOT 5    LOT 6    LOT 7    LOT 8    LOT 9    LOT 10    LOT 11    LOT 12

# MADDOX ACRES

SE 16TH ST.



PROPOSED FACILITY FOR:

**THE GROVE AT LEE'S SUMMIT**  
MASS GRADING AND STORMWATER  
MISSOURI HWY 291 & 16TH STREET  
LEE'S SUMMIT, MISSOURI



Clint Loumaster  
Professional Engineer  
License No. PE-2011009651

REVISION

PROJECT NUMBER  
13958.00

DATE  
6/8/18

DESIGNED

DRAWN

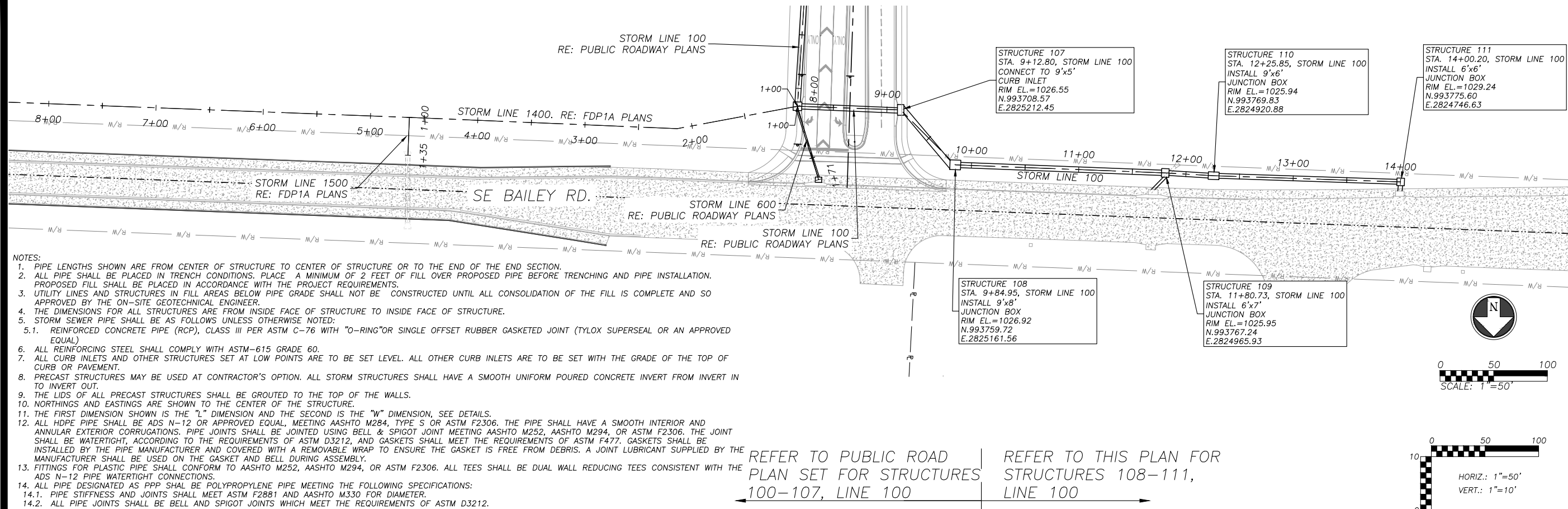
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SHEET TITLE

RETENTION BASIN GRADING PLAN

SHEET NUMBER

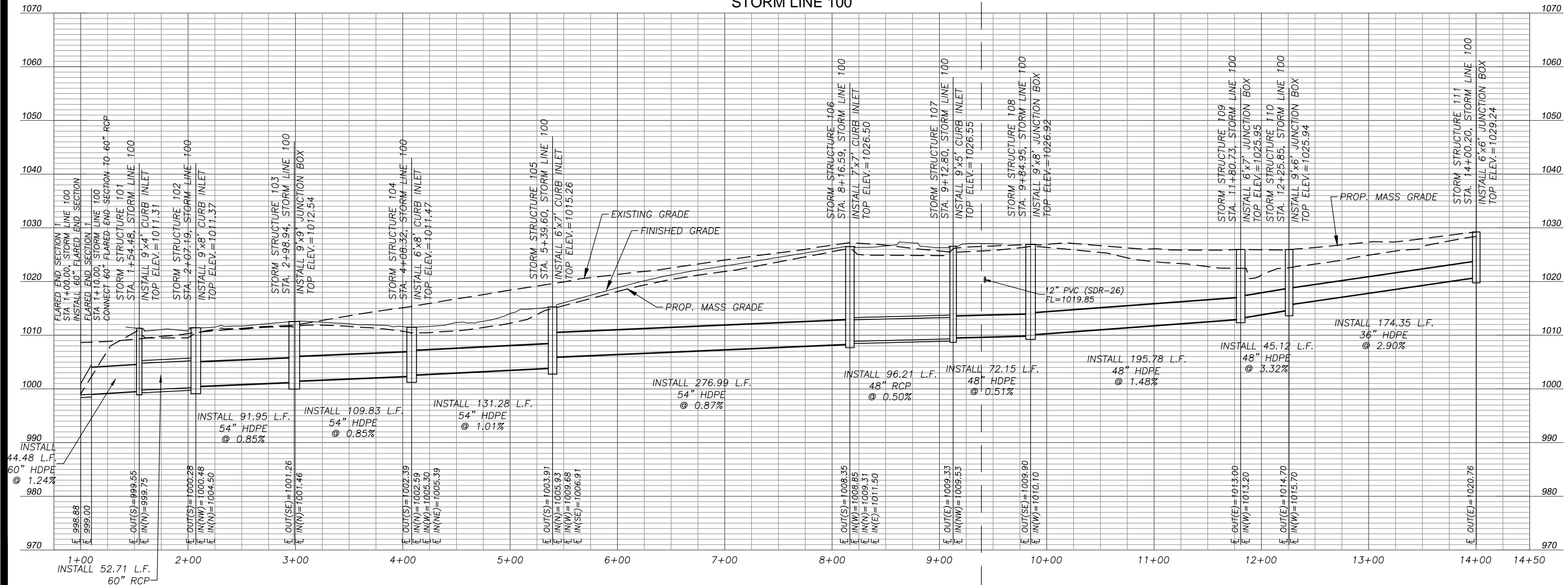
**C4.1**



REFER TO PUBLIC ROAD PLAN SET FOR STRUCTURES 100-107, LINE 100

REFER TO THIS PLAN FOR STRUCTURES 108-111, LINE 100

STORM LINE 100



REVISION
PROJECT NUMBER 13958.00
DATE 6/8/18
DESIGNED
DRAWN
REVIEWED
SHEET TITLE STORM PLAN AND PROFILE (1)
SHEET NUMBER <b>C5.1</b>





Clint Loumaster  
Professional Engineer  
License No. PE-2011009651

REVISION

PROJECT NUMBER  
13958.00

DATE  
6/8/18

DESIGNED

DRAWN

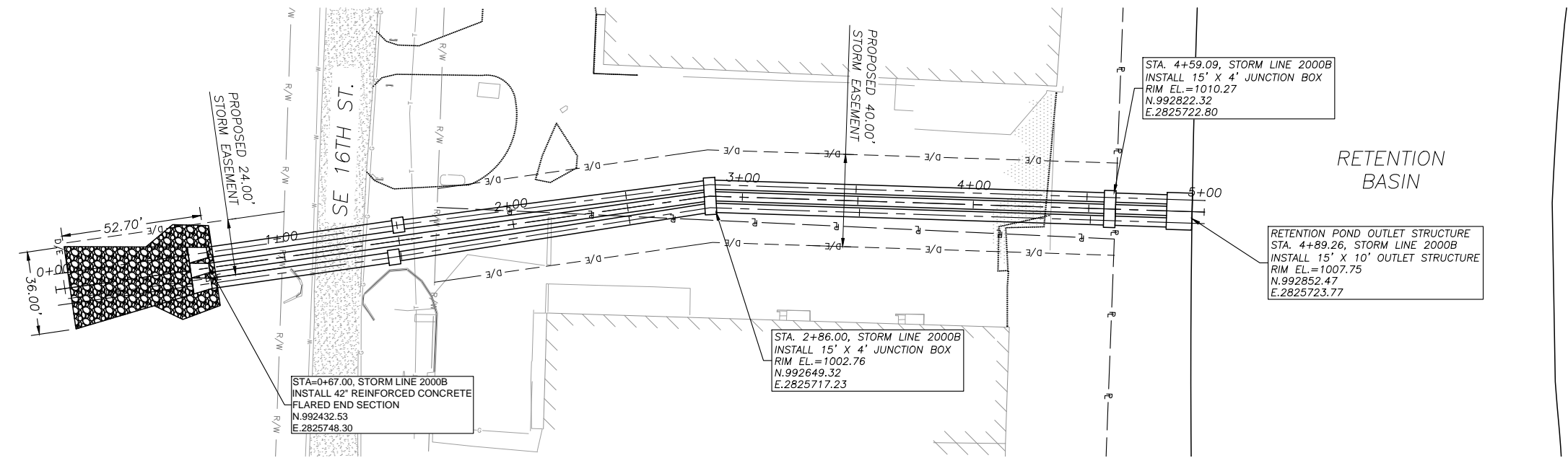
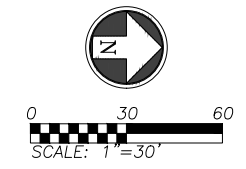
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SHEET TITLE

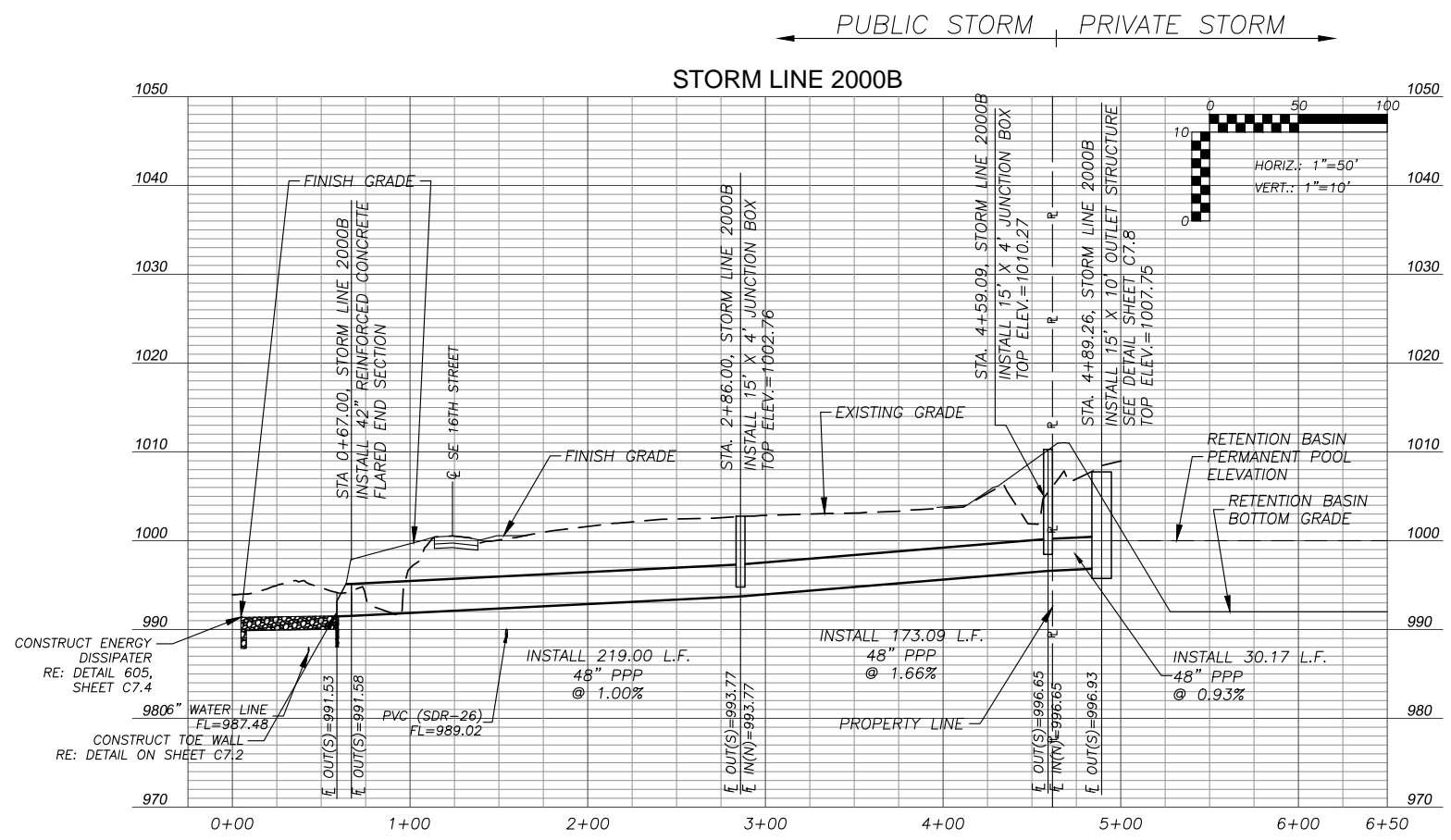
**STORM PLAN AND PROFILE (3)**

SHEET NUMBER

**C5.3**

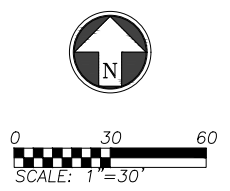
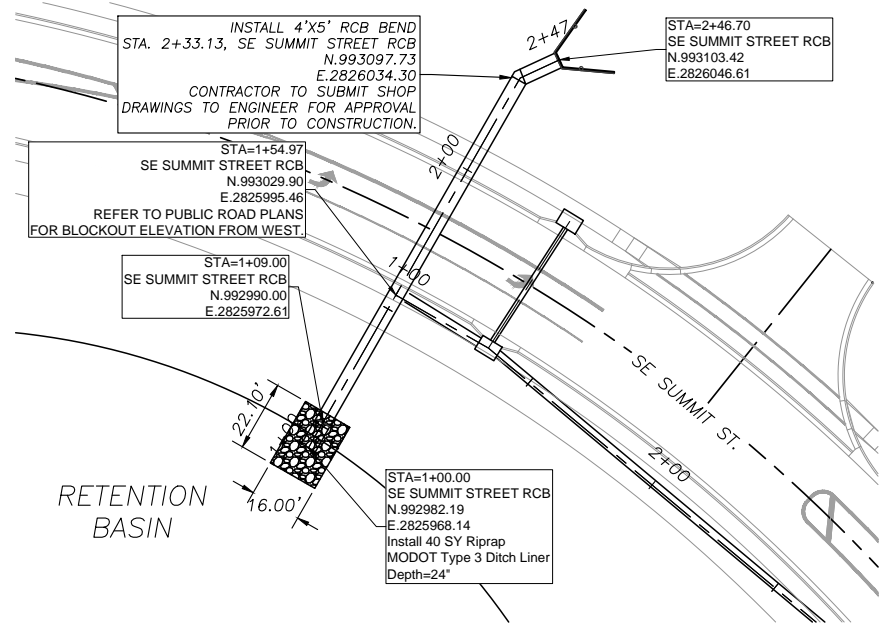


- NOTES:
- PIPE LENGTHS SHOWN ARE FROM CENTER OF STRUCTURE TO CENTER OF STRUCTURE OR TO THE END OF THE END SECTION. ALL PIPES SHALL BE FIELD STAKED TO THE INSIDE WALL FACE OF THE STRUCTURE.
  - ALL PIPE SHALL BE PLACED IN TRENCH CONDITIONS. PLACE A MINIMUM OF 2 FEET OF FILL OVER PROPOSED PIPE BEFORE TRENCHING AND PIPE INSTALLATION. PROPOSED FILL SHALL BE PLACED IN ACCORDANCE WITH THE PROJECT REQUIREMENTS.
  - UTILITY LINES AND STRUCTURES IN FILL AREAS BELOW PIPE GRADE SHALL NOT BE CONSTRUCTED UNTIL ALL CONSOLIDATION OF THE FILL IS COMPLETE AND SO APPROVED BY THE ON-SITE GEOTECHNICAL ENGINEER.
  - THE DIMENSIONS FOR ALL STRUCTURES ARE FROM INSIDE FACE OF STRUCTURE TO INSIDE FACE OF STRUCTURE.
  - STORM SEWER PIPE SHALL BE AS FOLLOWS UNLESS OTHERWISE NOTED:
    1. REINFORCED CONCRETE PIPE (RCP), CLASS III PER ASTM C-76 WITH "O-RING" OR SINGLE OFFSET RUBBER GASKETED JOINT (TYLOX SUPERSEAL OR AN APPROVED EQUAL)
    2. ALL REINFORCING STEEL SHALL COMPLY WITH ASTM-615 GRADE 60.
    3. ALL CURB INLETS AND OTHER STRUCTURES SET AT LOW POINTS ARE TO BE SET LEVEL. ALL OTHER CURB INLETS ARE TO BE SET WITH THE GRADE OF THE TOP OF CURB OR PAVEMENT.
    4. PRECAST STRUCTURES MAY BE USED AT CONTRACTOR'S OPTION. ALL STORM STRUCTURES SHALL HAVE A SMOOTH UNIFORM POURED CONCRETE INVERT FROM INVERT TO INVERT OUT.
    5. THE LIDS OF ALL PRECAST STRUCTURES SHALL BE GROUTED TO THE TOP OF THE WALLS.
    6. NORTHINGS AND EASTINGS ARE SHOWN TO THE CENTER OF THE STRUCTURE.
    7. THE FIRST DIMENSION SHOWN IS THE "L" DIMENSION AND THE SECOND IS THE "W" DIMENSION, SEE DETAILS.
    8. ALL HDPE PIPE SHALL BE ADS N-12 OR APPROVED EQUAL, MEETING AASHTO M284, TYPE S OR ASTM F2306. THE PIPE SHALL HAVE A SMOOTH INTERIOR AND ANNULAR EXTERIOR CORRUGATIONS. PIPE JOINTS SHALL BE JOINTED USING BELL & SPIGOT JOINT MEETING AASHTO M252, AASHTO M294, OR ASTM F2306. THE JOINT SHALL BE WATERTIGHT, ACCORDING TO THE REQUIREMENTS OF ASTM D3212, AND GASKETS SHALL MEET THE REQUIREMENTS OF ASTM F477. GASKETS SHALL BE INSTALLED BY THE PIPE MANUFACTURER AND COVERED WITH A REMOVABLE WRAP TO ENSURE THE GASKET IS FREE FROM DEBRIS. A JOINT LUBRICANT SUPPLIED BY THE MANUFACTURER SHALL BE USED ON THE GASKET AND BELL DURING ASSEMBLY.
    9. FITTINGS FOR PLASTIC PIPE SHALL CONFORM TO AASHTO M252, AASHTO M294, OR ASTM F2306. ALL TEES SHALL BE DUAL WALL REDUCING TEES CONSISTENT WITH THE ADS N-12 PIPE WATERTIGHT CONNECTIONS.
    10. ALL PIPE DESIGNATED AS PPP SHALL BE POLYPROPYLENE PIPE MEETING THE FOLLOWING SPECIFICATIONS:
      1. PIPE STIFFNESS AND JOINTS SHALL MEET ASTM F2881 AND AASHTO M330 FOR DIAMETER.
      2. ALL PIPE JOINTS SHALL BE BELL AND SPIGOT JOINTS WHICH MEET THE REQUIREMENTS OF ASTM D3212.

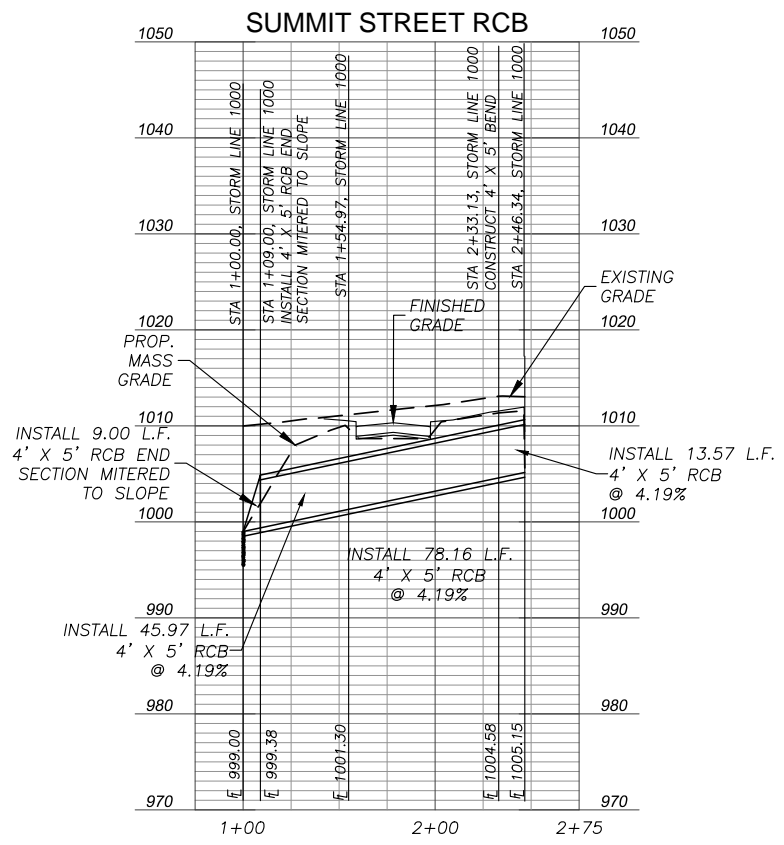


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- NOTES:
- PIPE LENGTHS SHOWN ARE FROM CENTER OF STRUCTURE TO CENTER OF STRUCTURE OR TO THE END OF THE END SECTION. ALL PIPES SHALL BE FIELD STAKED TO THE INSIDE WALL FACE OF THE STRUCTURE.
  - ALL PIPE SHALL BE PLACED IN TRENCH CONDITIONS. PLACE A MINIMUM OF 2 FEET OF FILL OVER PROPOSED PIPE BEFORE TRENCHING AND PIPE INSTALLATION. PROPOSED FILL SHALL BE PLACED IN ACCORDANCE WITH THE PROJECT REQUIREMENTS.
  - UTILITY LINES AND STRUCTURES IN FILL AREAS BELOW PIPE GRADE SHALL NOT BE CONSTRUCTED UNTIL ALL CONSOLIDATION OF THE FILL IS COMPLETE AND SO APPROVED BY THE ON-SITE GEOTECHNICAL ENGINEER.
  - THE DIMENSIONS FOR ALL STRUCTURES ARE FROM INSIDE FACE OF STRUCTURE TO INSIDE FACE OF STRUCTURE.
  - STORM SEWER PIPE SHALL BE AS FOLLOWS UNLESS OTHERWISE NOTED:
    - REINFORCED CONCRETE PIPE (RCP), CLASS III PER ASTM C-76 WITH "O-RING" OR SINGLE OFFSET RUBBER GASKETED JOINT (TYLOX SUPERSEAL OR AN APPROVED EQUAL)
  - ALL REINFORCING STEEL SHALL COMPLY WITH ASTM-615 GRADE 60.
  - ALL CURB INLETS AND OTHER STRUCTURES SET AT LOW POINTS ARE TO BE SET LEVEL. ALL OTHER CURB INLETS ARE TO BE SET WITH THE GRADE OF THE TOP OF CURB OR PAVEMENT.
  - PRECAST STRUCTURES MAY BE USED AT CONTRACTOR'S OPTION. ALL STORM STRUCTURES SHALL HAVE A SMOOTH UNIFORM POURED CONCRETE INVERT FROM INVERT IN TO INVERT OUT.
  - THE LIDS OF ALL PRECAST STRUCTURES SHALL BE GROUTED TO THE TOP OF THE WALLS.
  - NORTHINGS AND EASTINGS ARE SHOWN TO THE CENTER OF THE STRUCTURE.
  - THE FIRST DIMENSION SHOWN IS THE "L" DIMENSION AND THE SECOND IS THE "W" DIMENSION, SEE DETAILS.
  - ALL HDPE PIPE SHALL BE ADS N-12 OR APPROVED EQUAL, MEETING AASHTO M284, TYPE S OR ASTM F2306. THE PIPE SHALL HAVE A SMOOTH INTERIOR AND ANNULAR EXTERIOR CORRUGATIONS. PIPE JOINTS SHALL BE JOINTED USING BELL & SPIGOT JOINT MEETING AASHTO M252, AASHTO M294, OR ASTM F2306. THE JOINT SHALL BE WATERTIGHT, ACCORDING TO THE REQUIREMENTS OF ASTM D3212, AND GASKETS SHALL MEET THE REQUIREMENTS OF ASTM F477. GASKETS SHALL BE INSTALLED BY THE PIPE MANUFACTURER AND COVERED WITH A REMOVABLE WRAP TO ENSURE THE GASKET IS FREE FROM DEBRIS. A JOINT LUBRICANT SUPPLIED BY THE MANUFACTURER SHALL BE USED ON THE GASKET AND BELL DURING ASSEMBLY.
  - FITTINGS FOR PLASTIC PIPE SHALL CONFORM TO AASHTO M252, AASHTO M294, OR ASTM F2306. ALL TEES SHALL BE DUAL WALL REDUCING TEES CONSISTENT WITH THE ADS N-12 PIPE WATERTIGHT CONNECTIONS.
  - ALL PIPE DESIGNATED AS PPP SHALL BE POLYPROPYLENE PIPE MEETING THE FOLLOWING SPECIFICATIONS:
    - PIPE STIFFNESS AND JOINTS SHALL MEET ASTM F2881 AND AASHTO M330 FOR DIAMETER.
    - ALL PIPE JOINTS SHALL BE BELL AND SPIGOT JOINTS WHICH MEET THE REQUIREMENTS OF ASTM D3212.



Clint Loumaster  
Professional Engineer  
License No. PE-2011009651

REVISION

PROJECT NUMBER  
13958.00

DATE  
6/8/18

DESIGNED

DRAWN

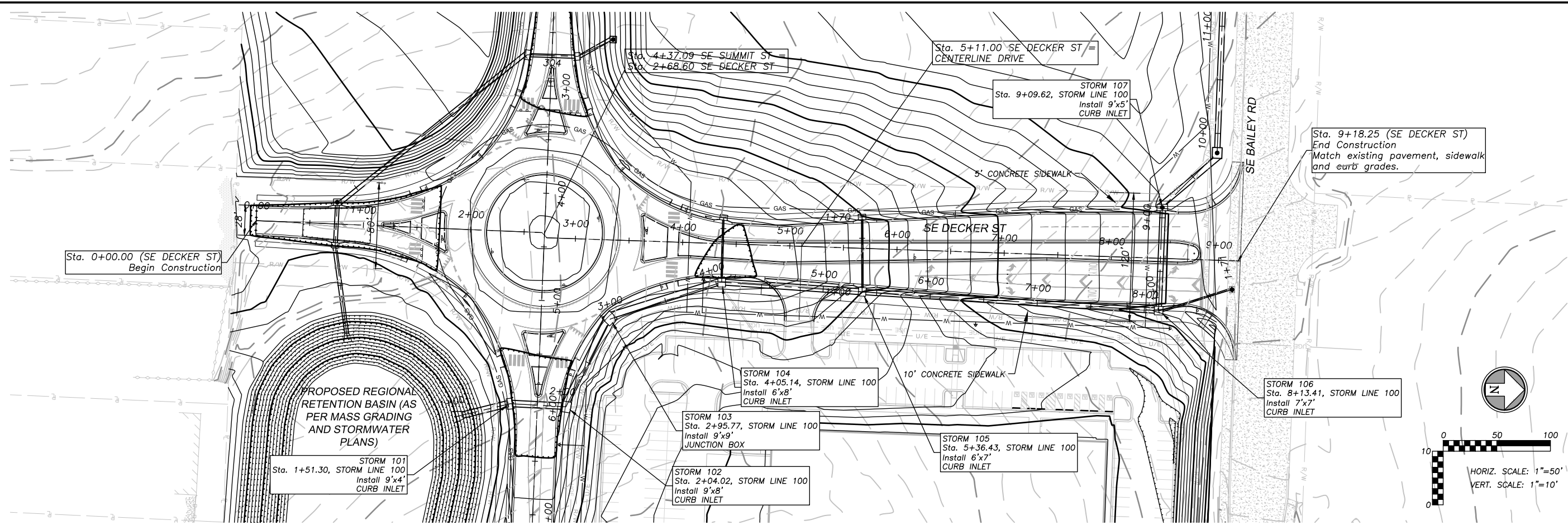
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SHEET TITLE

STORM PLAN AND PROFILE (5)

SHEET NUMBER

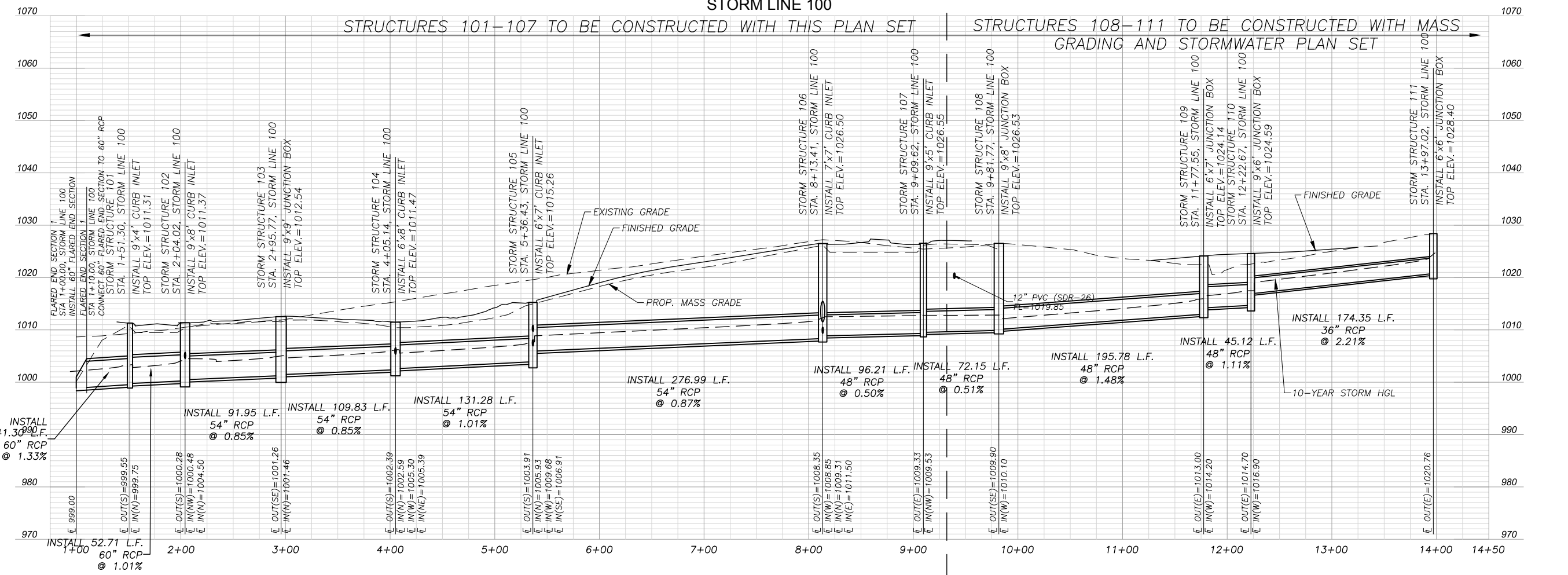
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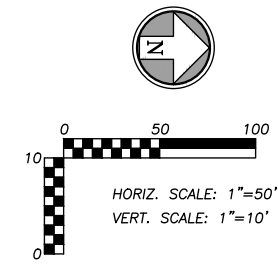
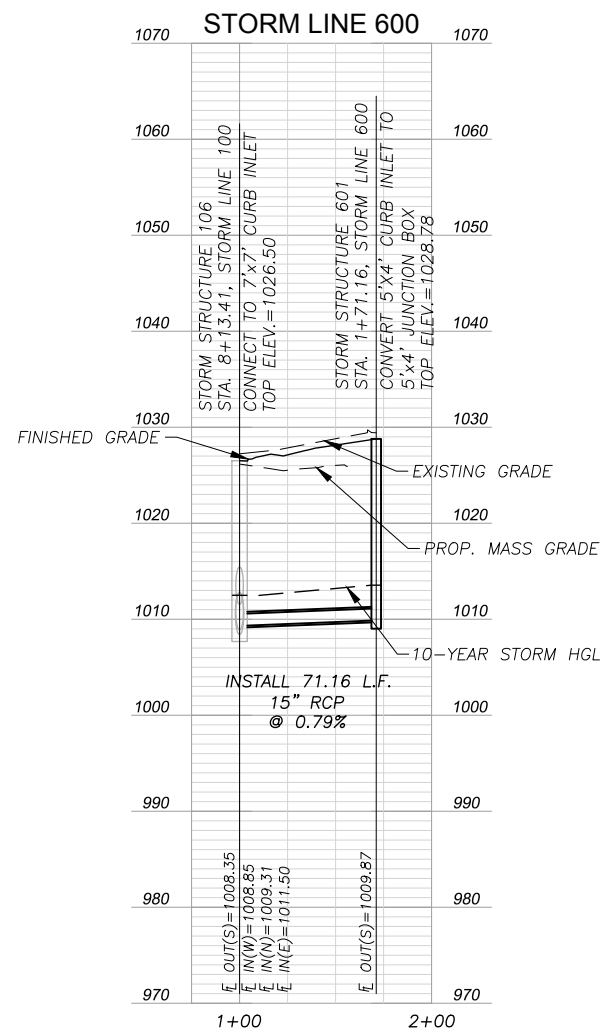
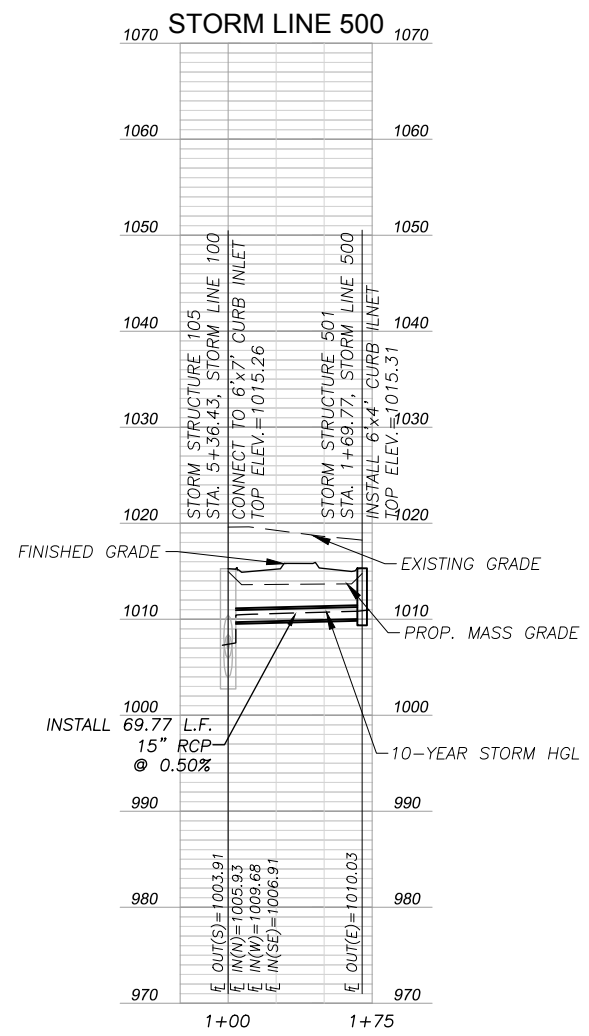
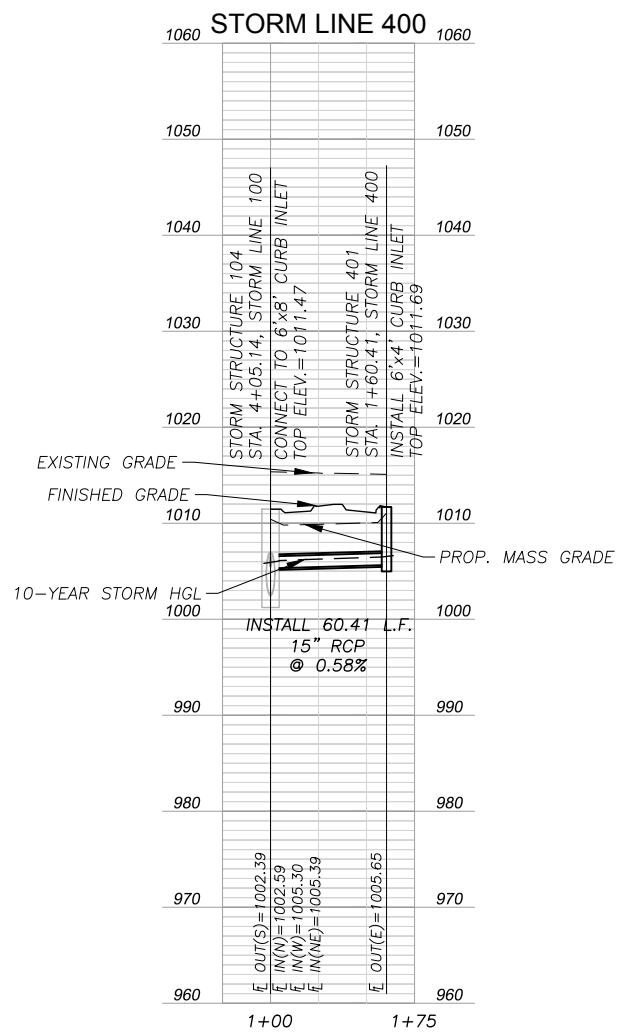
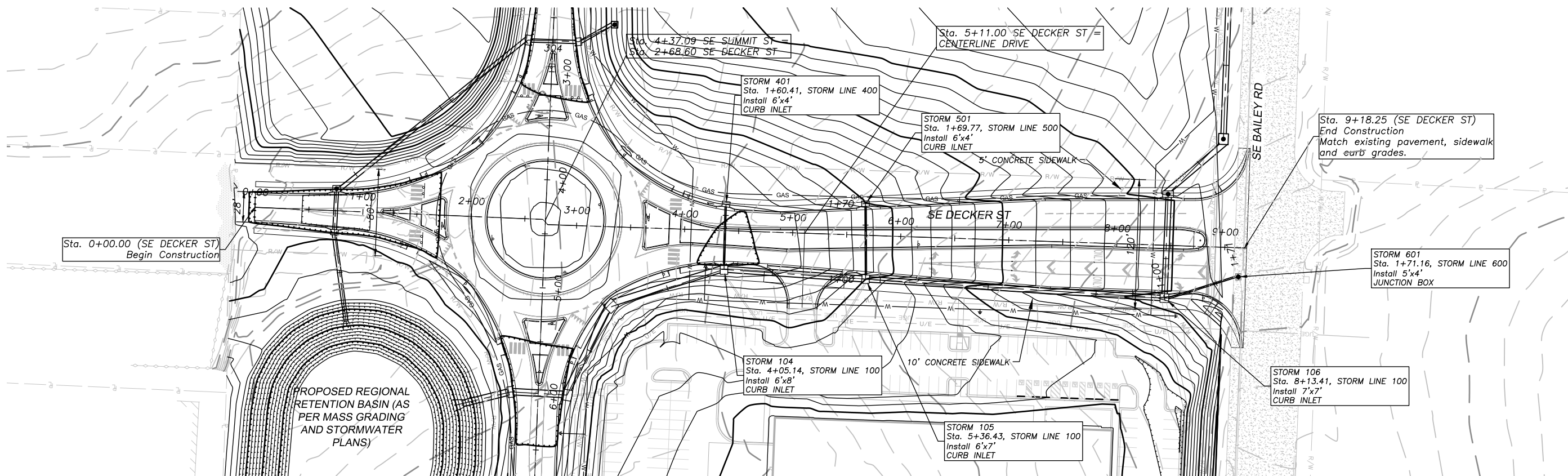
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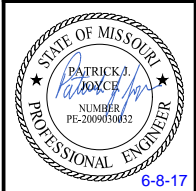
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**CITY OF LEE'S SUMMIT**  
**JACKSON COUNTY, MISSOURI**  
**PUBLIC ROAD IMPROVEMENTS FOR**  
**SE DECKER ST. & SE SUMMIT ST.**  
**STORM SEWER PLAN & PROFILE**

Design: DRS Drawn: SKE  
 Checked: PUJ  
 Issue Date: 04/21/17  
 Project Number: 021730



Rev.	Date	Description	By	App.

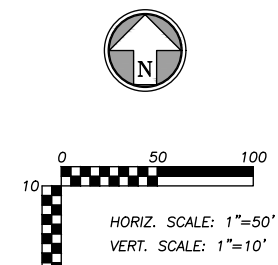
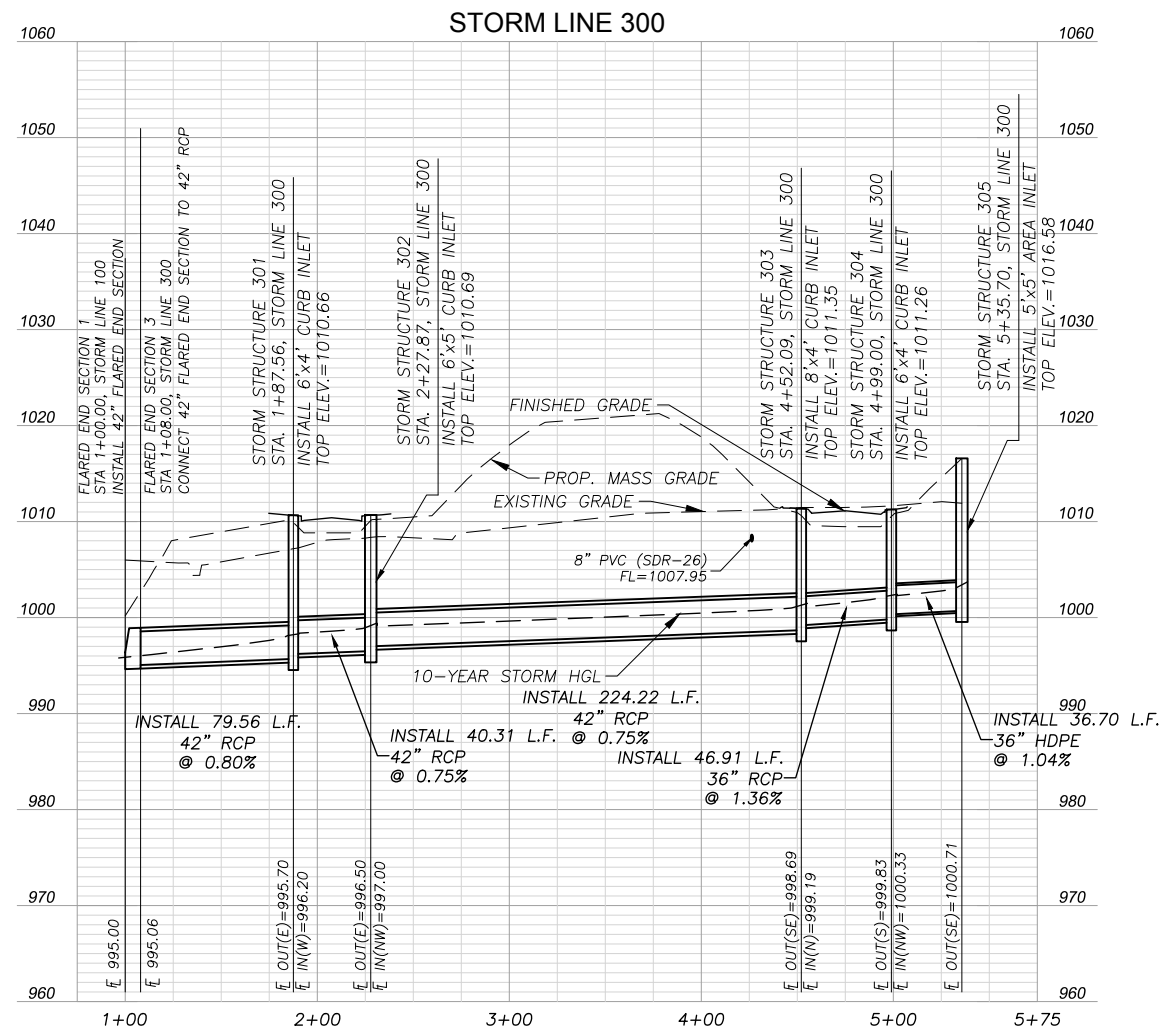
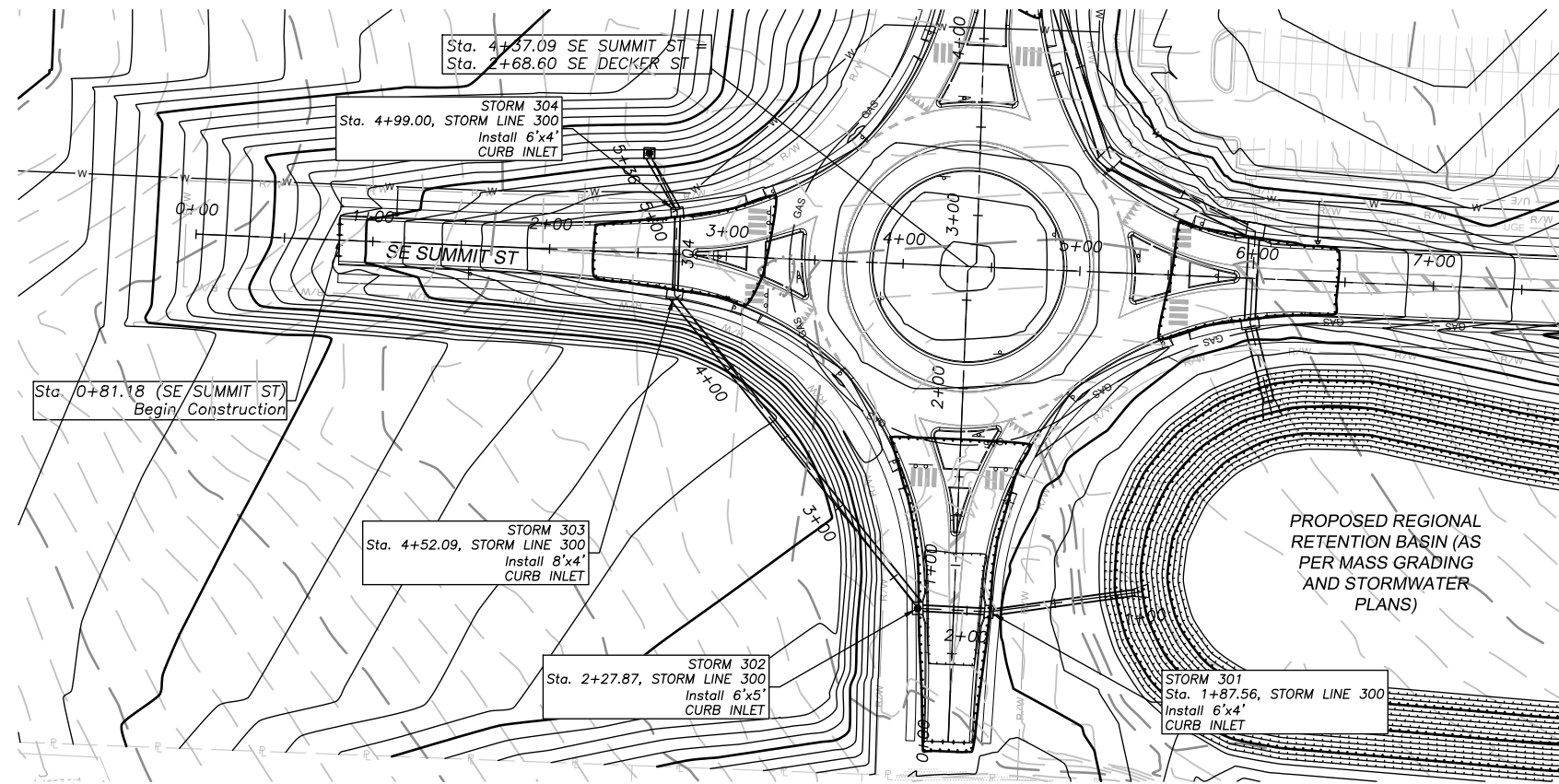


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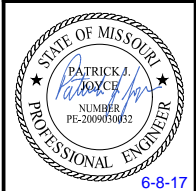
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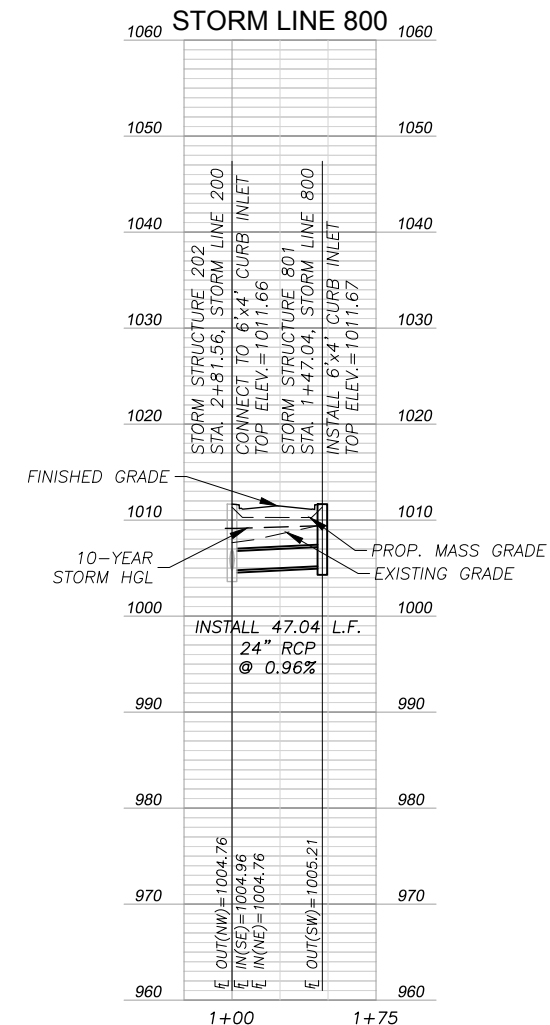
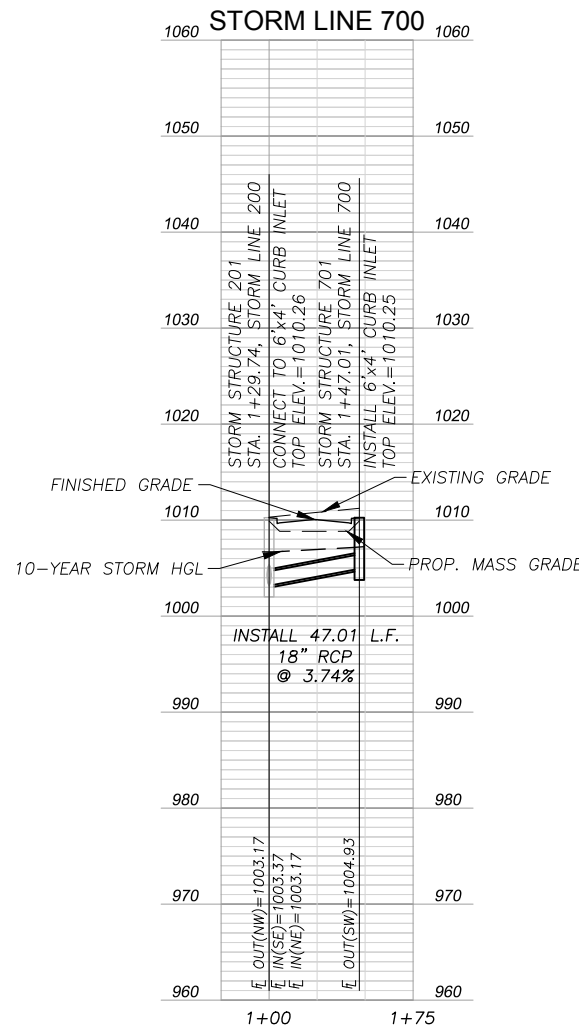
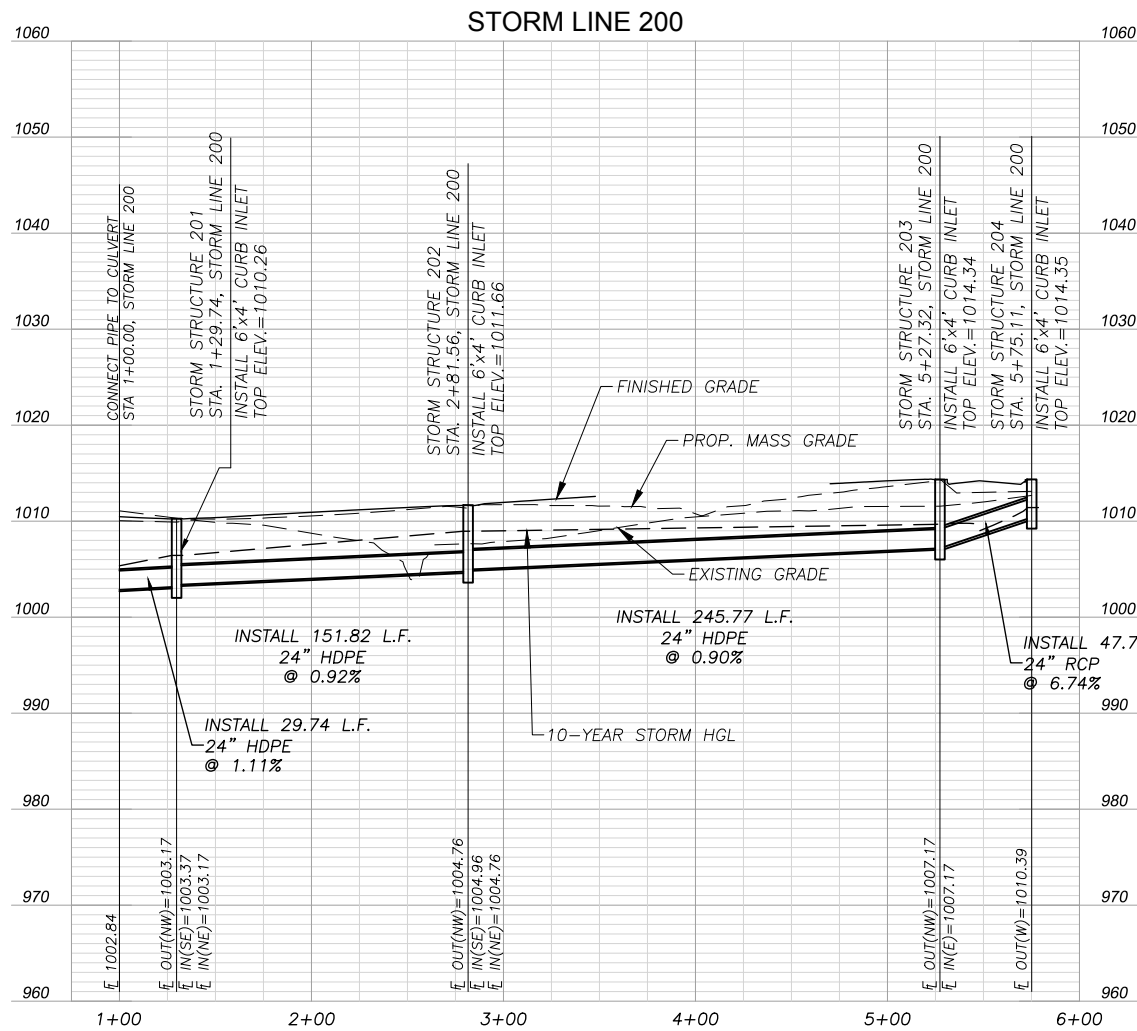
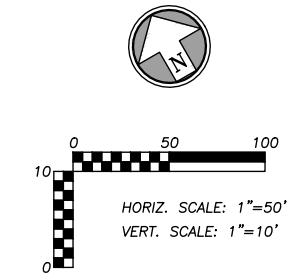
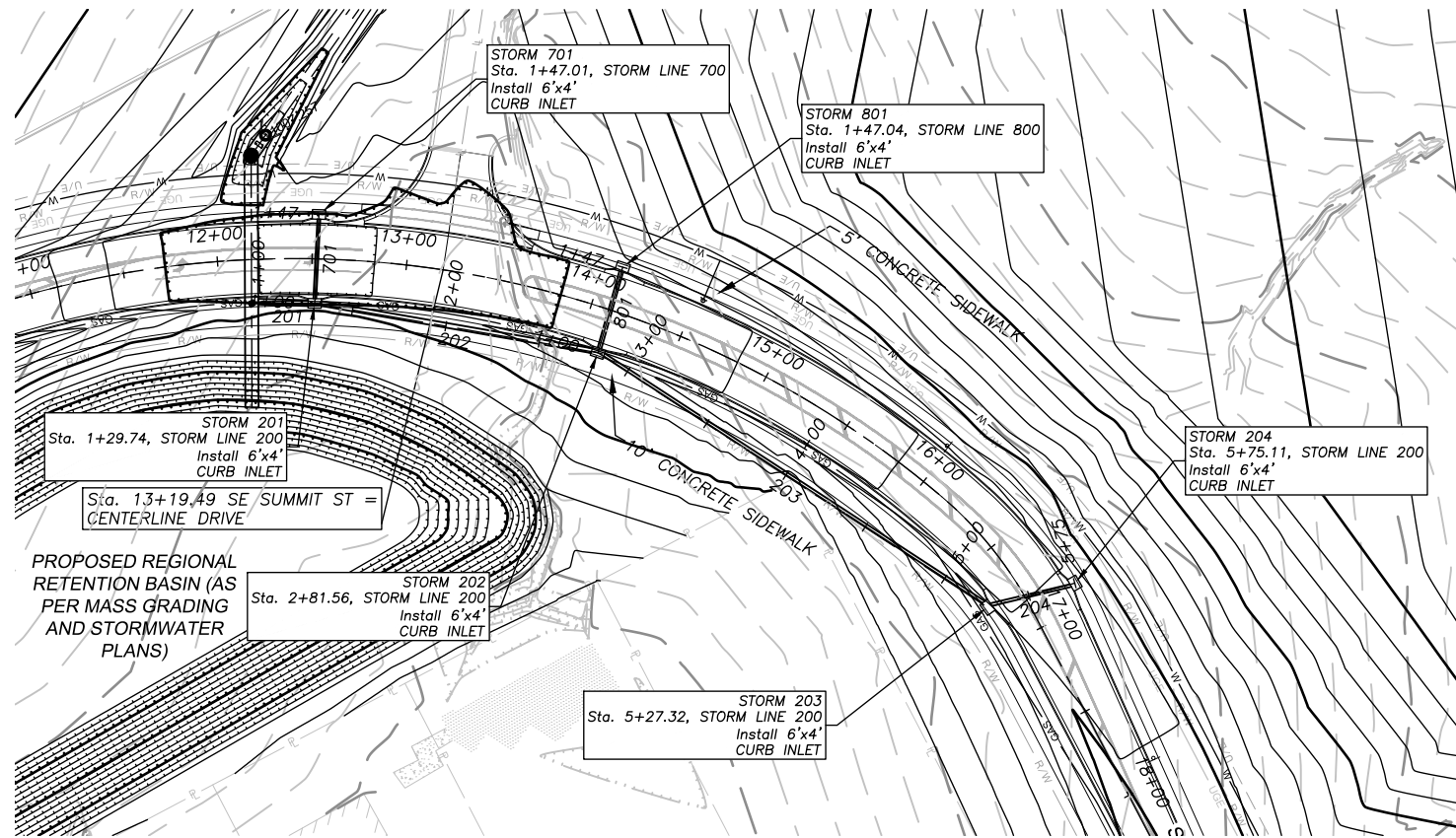


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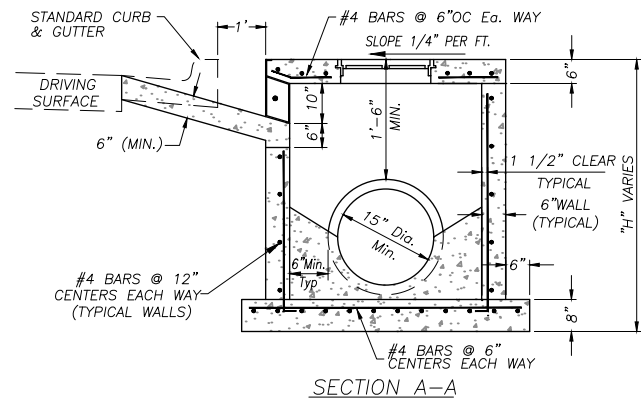
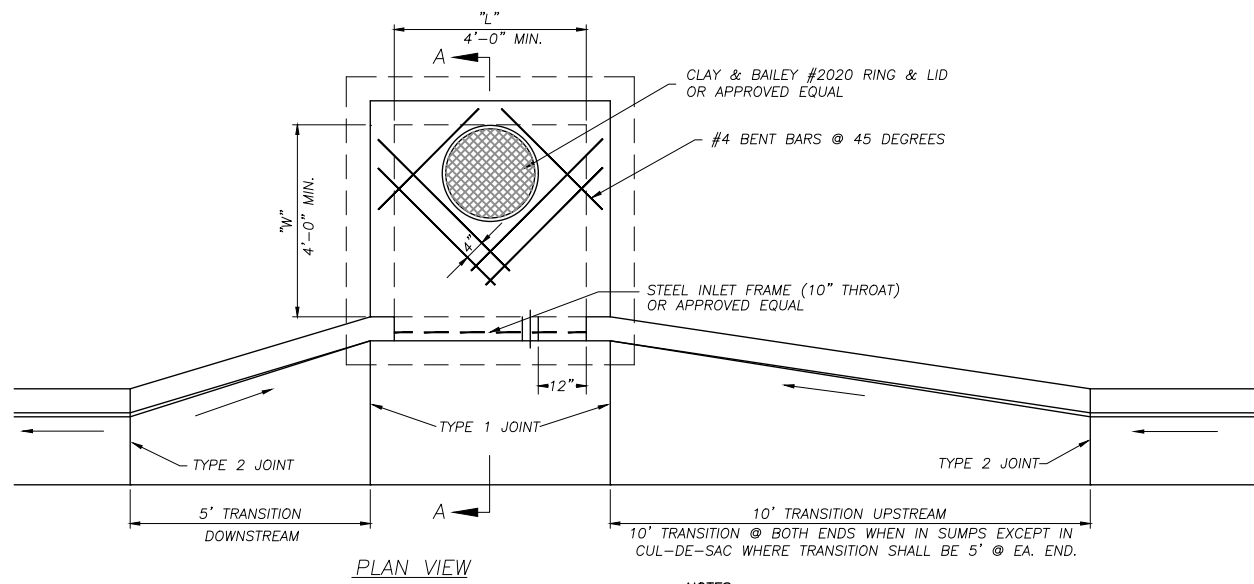
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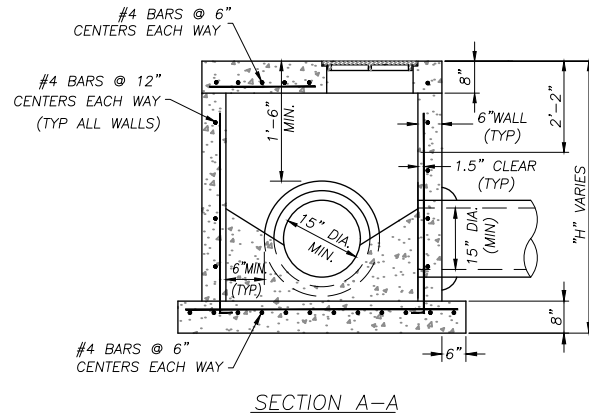
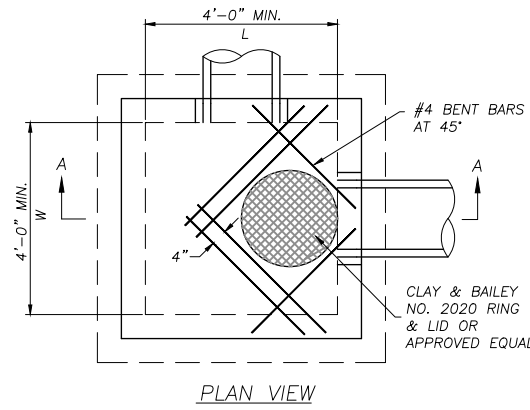
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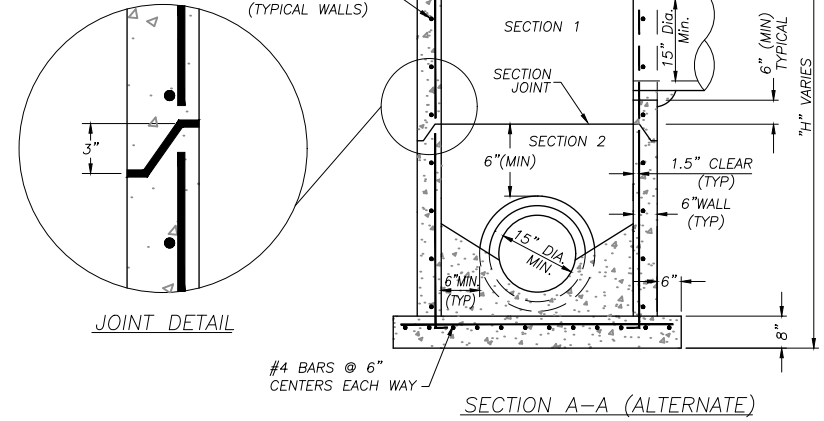
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- NOTES:**
1. ALL CONCRETE SHALL BE 4000 psi.
  2. INLET CONSTRUCTION NOTES SHALL LIST THE "L" DIMENSION FIRST, THE "W" DIMENSION SECOND, AND THE "H" DIMENSION THIRD.
  3. FLOOR OF INLET SHALL HAVE A SHAPED CONCRETE INVERT TO PROVIDE FOR SMOOTH FLOW.
  4. THE MINIMUM DIMENSION BETWEEN TOP OF PIPE AND TOP OF BOX SHALL BE 1'-6" (TYPICAL ALL WALLS)
  5. ALL INGRADE INLETS SHALL CONFORM TO STREET GRADE. ALL INLETS IN SUMP SHALL BE LEVEL. BEVEL ALL EXPOSED EDGES WITH 3/4" TRIANGULAR MOLDING.
  6. THE THROAT AND TRANSITION ARE SUBSIDIARY TO THE STRUCTURE.



- NOTES:**
1. ALL CONCRETE SHALL BE 4000 psi.
  2. JUNCTION BOX CONSTRUCTION NOTES SHALL LIST THE "L" DIMENSION FIRST, THE "W" DIMENSION SECOND, AND THE "H" DIMENSION THIRD.
  3. FLOOR OF JUNCTION BOX SHALL HAVE A SHAPED CONCRETE INVERT TO PROVIDE FOR SMOOTH FLOW.
  4. THE MINIMUM DIMENSION BETWEEN TOP OF PIPE AND TOP OF BOX SHALL BE 1'-6" (TYPICAL ALL WALLS)
  5. STEPS SHALL BE C&B 2102, MA INDUSTRIES PS2-PF OR APPROVED EQUAL. (IN THE EVENT "H" IS EQUAL TO OR GREATER THAN 12 FEET MA INDUSTRIES PS2-PF WILL NOT BE ALLOWED.)

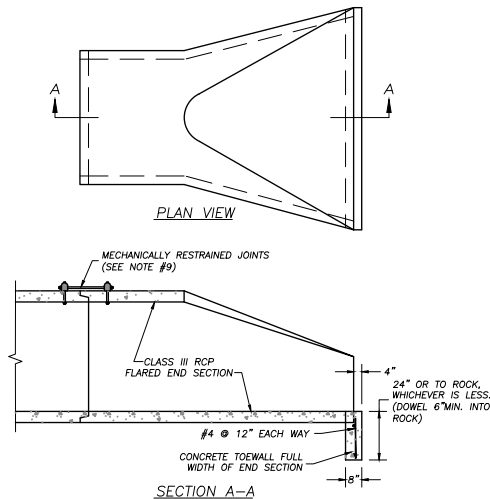


JOINT DETAIL

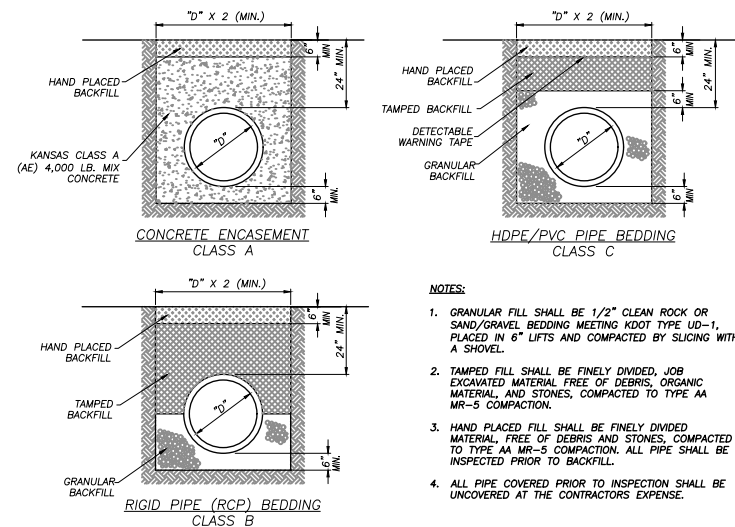
001 CURB INLET

002 JUNCTION BOX

- NOTES:**
1. ALL CONCRETE SHALL BE 4000 psi.
  2. REINFORCING STEEL SHALL BE NEW BILLET, MINIMUM GRADE 60 AS PER ASTM A615, AND SHALL BE BENT COLD.
  3. ALL DIMENSIONS RELATIVE TO REINFORCING STEEL ARE TO CENTERLINE OF BARS. 2" CLEARANCE SHALL BE PROVIDED THROUGHOUT UNLESS NOTED OTHERWISE. TOLERANCE OF +/- 1/8" SHALL BE PERMITTED.
  4. ALL LAP SPLICES NOT SHOWN SHALL BE A MINIMUM OF 40 BAR DIAMETERS IN LENGTH.
  5. ALL CONCRETE CONSTRUCTION SHALL MEET THE APPLICABLE REQUIREMENTS OF STANDARD SPECIFICATIONS FOR STATE ROAD AND BRIDGE CONSTRUCTION, KANSAS DEPARTMENT OF TRANSPORTATION, LATEST EDITION, AND SPECIAL PROVISIONS.
  6. ALL DOWELS SHALL BE ACCURATELY PLACED AND SECURELY TIED IN PLACE PRIOR TO PLACEMENT OF BOTTOM SLAB CONCRETE. STICKING OF DOWELS INTO FRESH OR PARTIALLY HARDENED CONCRETE WILL NOT BE ACCEPTABLE.
  7. ALL REINFORCING STEEL SHALL BE SUPPORTED ON FABRICATED STEEL BAR SUPPORTS @ 3'-0" MAXIMUM SPACING.
  8. DO NOT SCALE THESE DRAWINGS FOR DIMENSIONS OR CLEARANCES. ANY QUESTIONS REGARDING DIMENSIONS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND CONTRACTING OFFICER PRIOR TO CONSTRUCTION.
  9. THE LAST THREE JOINTS OF RCP, INCLUDING THE END SECTION, SHALL BE MECHANICALLY RESTRAINED WHERE DISCHARGING INTO UNIMPROVED SYSTEMS.

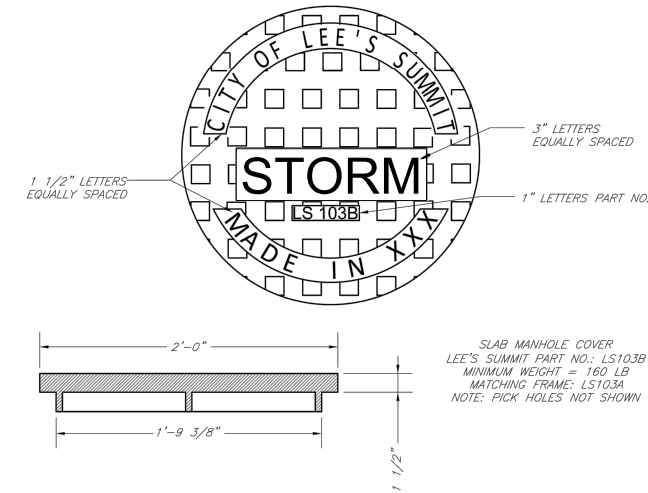


003 END SECTION WITH TOE WALL



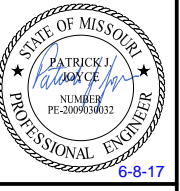
- NOTES:**
1. GRANULAR FILL SHALL BE 1/2" CLEAN ROCK OR SAND/GRAVEL BEDDING MEETING KDOT TYPE UD-1, PLACED IN 6" LIFTS AND COMPACTED BY SLICING WITH A SHOVEL.
  2. TAMPED FILL SHALL BE FINELY DIVIDED, JOB EXCAVATED MATERIAL FREE OF DEBRIS, ORGANIC MATERIAL, AND STONES, COMPACTED TO TYPE AA MR-5 COMPACTION.
  3. HAND PLACED FILL SHALL BE FINELY DIVIDED MATERIAL, FREE OF DEBRIS AND STONES, COMPACTED TO TYPE AA MR-5 COMPACTION. ALL PIPE SHALL BE INSPECTED PRIOR TO BACKFILL.
  4. ALL PIPE COVERED PRIOR TO INSPECTION SHALL BE UNCOVERED AT THE CONTRACTOR'S EXPENSE.

004 PIPE BEDDING



005 MANHOLE FRAME AND LID

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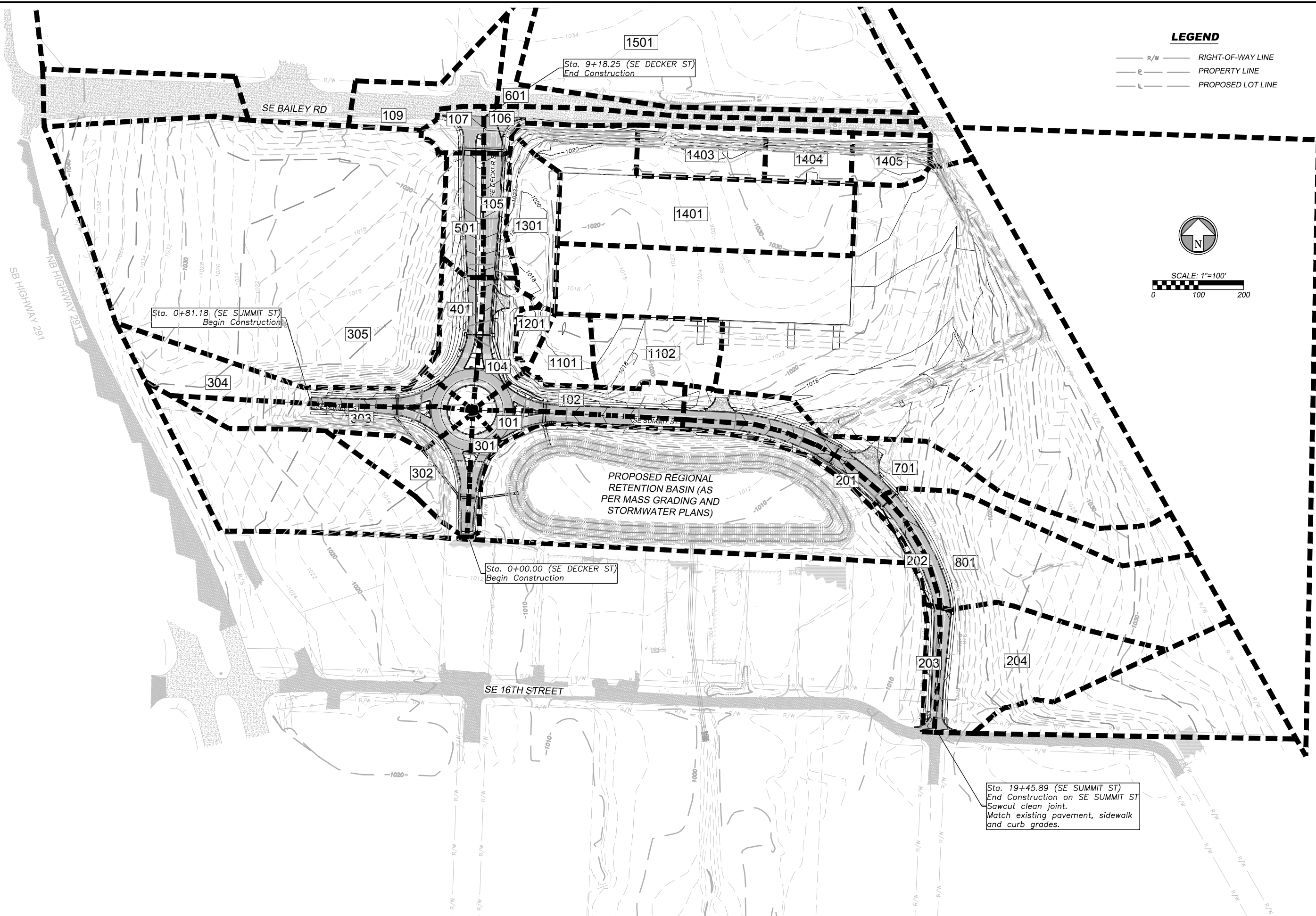


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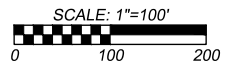
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**CITY OF LEE'S SUMMIT**  
**JACKSON COUNTY, MISSOURI**  
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**SE DECKER ST. & SE SUMMIT ST.**  
**STORM SEWER DETAILS**

Design: DRS Drawn: SKE  
 Checked: PJJ  
 Issue Date: 04/21/17  
 Project Number: 021730



**LEGEND**

- R/W RIGHT-OF-WAY LINE
- PROPERTY LINE
- PROPOSED LOT LINE



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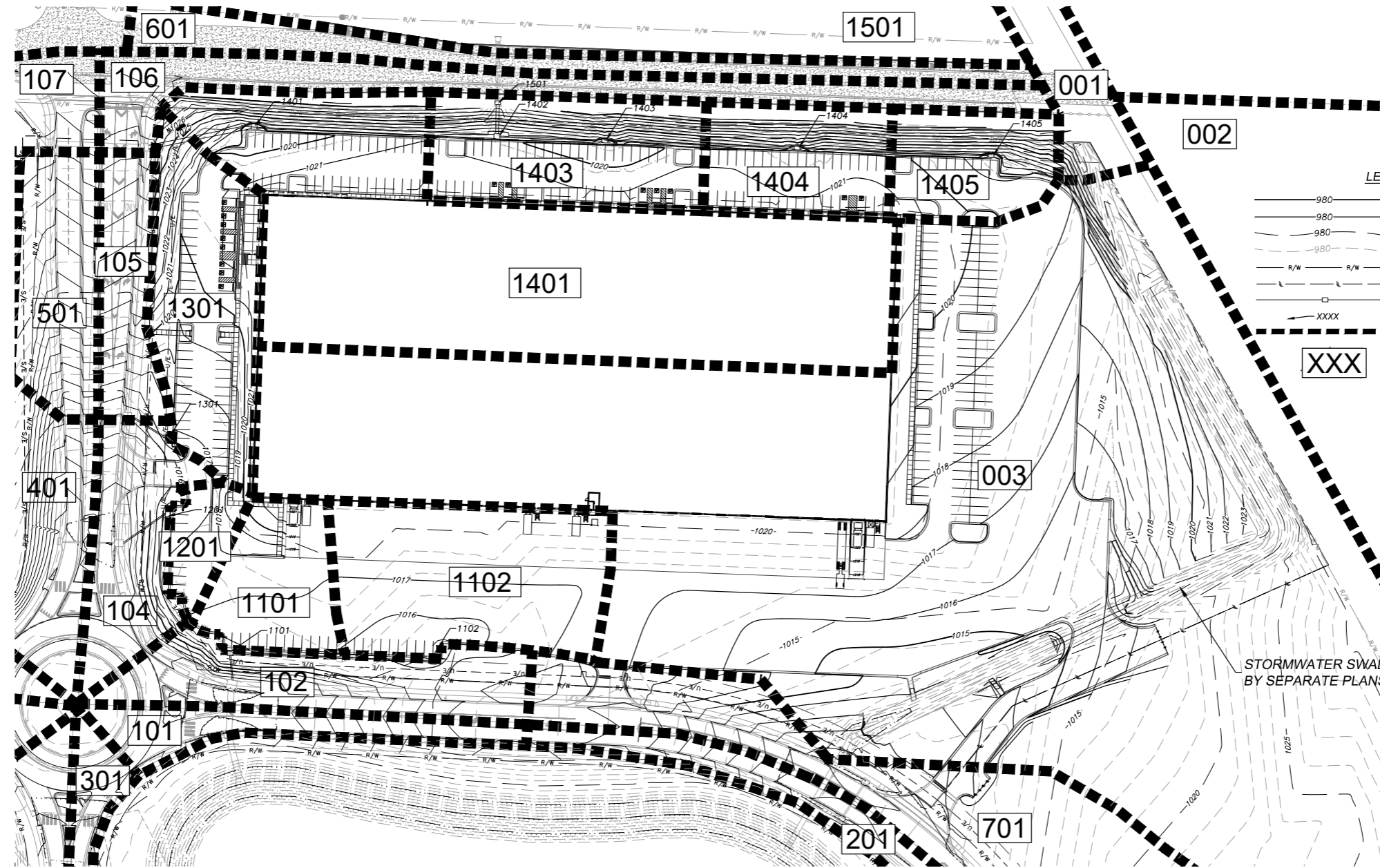


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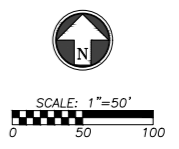
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 SE DECKER ST. & SE SUMMIT ST.  
 DRAINAGE MAP**

Design: DRS Drawn: SKE  
 Checked: PJJ  
 Issue Date: 04/21/17  
 Project Number: 021730



**LEGEND**

	980	FINISH GRADE 5' CONTOURS
	980	FINISH GRADE 1' CONTOURS
	980	EXISTING GRADE 5' CONTOURS
	980	EXISTING GRADE 1' CONTOURS
	R/W	RIGHT-OF-WAY LINE
	L	LOT LINE
	S	PROPOSED STORM SEWER MAIN
	XXXX	PROPOSED STORM STRUCTURE NUMBER
		PROPOSED DRAINAGE LIMITS
		PROPOSED DRAINAGE AREA



**STORM NOTES**

- PROJECT IS A PART OF A LARGER DEVELOPMENT WITH REGIONAL WATER QUALITY TREATMENT AND REGIONAL DETENTION, THUS ON-SITE CONTROLS ARE NOT REQUIRED.
- STORM LINES 1100, 1200, 1300, 1400, 1500, AND 1600 TO BE CONSTRUCTED PER PLAN SET. ALL OTHER STORM LINES SHOWN FOR REFERENCE ONLY.
- UNDERGROUND PRIVATE STORM PIPE SYSTEM DESIGNED TO CARRY MINIMUM 10 YEAR STORM EVENT PER CITY OF LEE'S SUMMIT 5600. STORM PIPE CALCULATIONS SHOWN ON SHEET C4.1.
- ALL STORM CONSTRUCTION TO BE DONE IN ACCORDANCE WITH CITY OF LEE'S SUMMIT SPECIFICATIONS.
- RUNOFF FROM AREAS 001-003 DRAIN DIRECTLY TO STORMWATER SWALE SHOWN IN PLAN. STORMWATER SWALE TO BE CONSTRUCTED PER MASS GRADING PLAN SET.
- RUNOFF FROM NORTH PORTION OF ROOF ADDED TO AREA 1401 FOR CALCULATIONS. NORTH ROOF DRAINS TO BE PIPED INTO STORM LINE 1400 BY ROOF DRAIN HEADER SYSTEM. RUNOFF FROM SOUTH PORTION OF ROOF ADDED TO AREA 003. SOUTH ROOF DRAINS TO BE PIPED VIA ROOF DRAIN HEADER SYSTEM AND DAYLIGHTED TO PROPOSED STORMWATER SWALE SHOWN IN PLAN. STORMWATER SWALE TO BE CONSTRUCTED PER MASS GRADING PLAN SET.
- PIPE LENGTHS SHOWN ON SHEET C5.1 ARE MEASURED FROM CENTER OF STRUCTURE OR TO THE END OF END SECTION. ALL PIPES SHALL BE FIELD STAKED TO THE INSIDE WALL FACE OF THE STRUCTURE.
- ALL PIPE SHALL BE PLACED IN TRENCH CONDITIONS. PLACE A MINIMUM OF 2 FEET OF FILL OVER PROPOSED PIPE BEFORE TRENCHING AND PIPE INSTALLATION. PROPOSED FILL SHALL BE PLACED IN ACCORDANCE WITH PROJECT REQUIREMENTS.
- UTILITY LINES AND STRUCTURES IN FILL AREAS BELOW PIPE GRADE SHALL NOT BE CONSTRUCTED UNTIL ALL CONSOLIDATION OF THE FILL IS COMPLETE AND SO APPROVED BY THE ON-SITE GEOTECHNICAL ENGINEER.
- THE DIMENSIONS FOR ALL STRUCTURES SHOWN ON C5.1 ARE FROM INSIDE FACE OF STRUCTURE TO INSIDE FACE OF STRUCTURE. STORM SEWER PIPE SHALL BE AS FOLLOWS UNLESS OTHERWISE NOTED.
- THE FIRST DIMENSION SHOWN IS THE "L" DIMENSION AND THE SECOND IS THE "W" DIMENSION ON RECTANGULAR STRUCTURES.
- ALL CURB INLETS AND OTHER STRUCTURE SET AT LOW POINTS ARE TO BE SET LEVEL. ALL OTHER CURB INLETS ARE TO BE SET WITH THE GRADE OF THE TOP OF CURB OR PAVEMENT.
- PRECAST STRUCTURES MAY BE USED AT CONTRACTOR'S OPTION. ALL STORM STRUCTURES SHALL HAVE A SMOOTH UNIFORM POURED CONCRETE INVERT FROM INVERT IN TO INVERT OUT.
- THE LIDS OF ALL PRECAST STRUCTURES SHALL BE GROUTED TO THE TOP OF THE WALLS.
- NORTHING AND EASTINGS SHOWN ON SHEET C5.1 ARE TO CENTER OF STRUCTURE OR TO END OF END SECTION.
- ALL HDPE PIPE SHALL BE ADS N-12, OR APPROVED EQUAL, MEETING AASHTO M294, TYPE S OR ASTM F2306. THE PIPE SHALL HAVE A SMOOTH INTERIOR AND ANNULAR EXTERIOR CORRUGATIONS. PIPE JOINTS SHALL BE JOINTED USING A BELL & SPIGOT JOINT MEETING AASHTO M252, AASHTO M294 OR ASTM F2306. THE JOINT SHALL BE WATER TIGHT ACCORDING TO THE REQUIREMENTS OF ASTM D3212 AND GASKETS SHALL MEET THE REQUIREMENTS OF ASTM F477. GASKETS SHALL BE INSTALLED BY THE PIPE MANUFACTURER AND COVERED WITH A REMOVABLE WRAP TO ENSURE THE GASKET IS FREE FROM DEBRIS. A JOINT LUBRICANT SUPPLIED BY THE MANUFACTURER SHALL BE USED ON THE GASKET AND BELL DURING ASSEMBLY.
- FITTINGS FOR PLASTIC PIPE SHALL CONFORM TO AASHTO M252, AASHTO M294, OR ASTM F2306 ALL WYES SHALL BE DUAL WALL WYES CONSISTENT WITH THE ADS N-12 PIPE WATER TIGHT CONNECTIONS.

STORMWATER SWALE  
BY SEPARATE PLANS

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VERY IMPORTANT: Conditions and drawings are preliminary. Construction of any structure shall be in accordance with the City of Lee's Summit specifications and other drawings may affect the final design. Refer to mass grading and site plan drawings for the final design of the site. The Contractor shall be responsible for the accuracy of the information provided to the Architect.

DESIGNER: GBA  
DATE: 10/15/2016  
SCALE: 1"=50'

project title  
 SHELL WAREHOUSE B  
 1407 SE Decker  
 Lees Summit, MO

key plan

project number  
 17105.002  
 drawing issuance  
 PERMIT  
 drawing revisions  
 No. Description: Date:

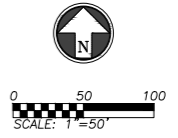
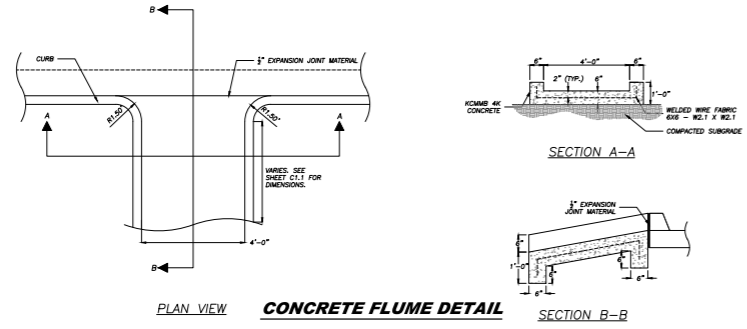
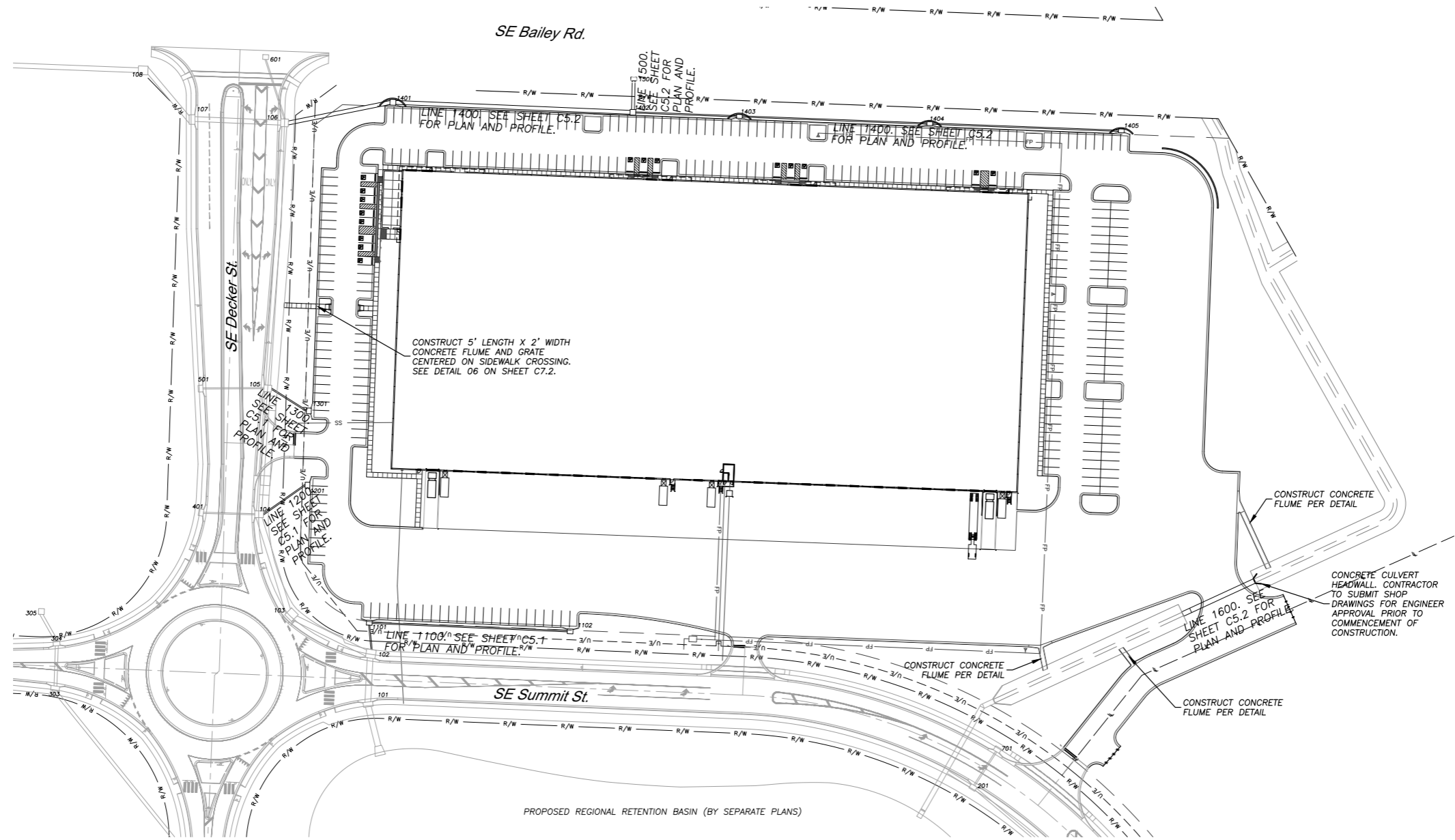
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drawing title  
 DRAINAGE MAP  
 drawing number

CIVIL ENGINEERING BY:  
**GBA**  
 9801 Renner Boulevard  
 Lenexa, Kansas 66219  
 913.492.0400  
 www.gbateam.com

**C4.0**



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**SHELL WAREHOUSE B**  
 1407 SE Decker  
 Lees Summit, MO

project title  
 key plan  
 project number  
 17105.002  
 drawing issuance  
 PERMIT  
 drawing revisions  
 No. Description: Date:

professional seal  
 PRELIMINARY  
 DRAWINGS IN PROGRESS  
 NOT FOR CONSTRUCTION  
 drawing title  
 STORM PLAN  
 drawing number  
**C5.0**

CIVIL ENGINEERING BY:  
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 9801 Renner Boulevard  
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DESIGNER: GBA is the lead designer of a multi-disciplinary design-build team. GBA is not responsible for the design or construction of any other disciplines.

project title

SHELL WAREHOUSE B

1407 SE Decker  
 Lees Summit, MO

key plan

project number  
 17105.002  
 drawing issuance  
 PERMIT  
 drawing revisions  
 No. Description Date

professional seal

PRELIMINARY  
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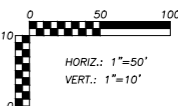
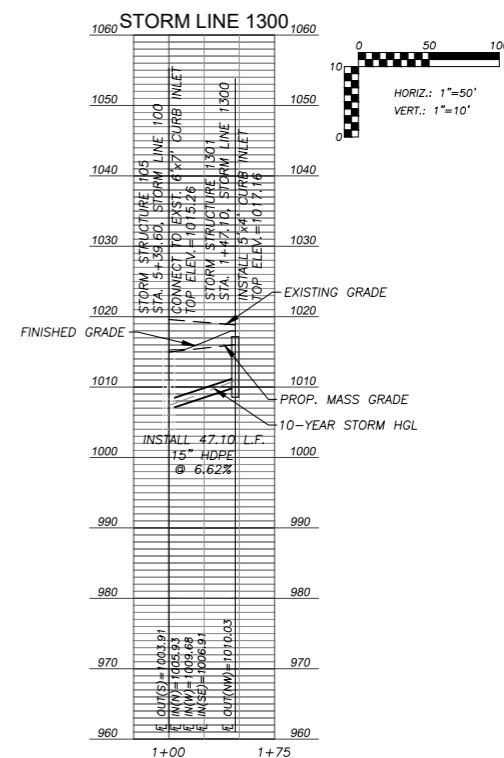
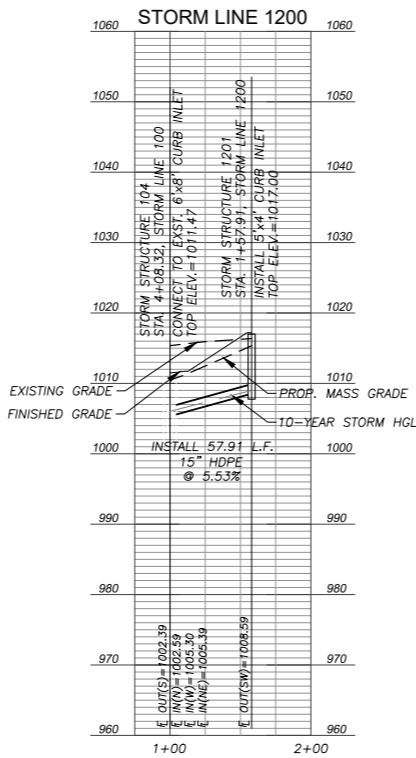
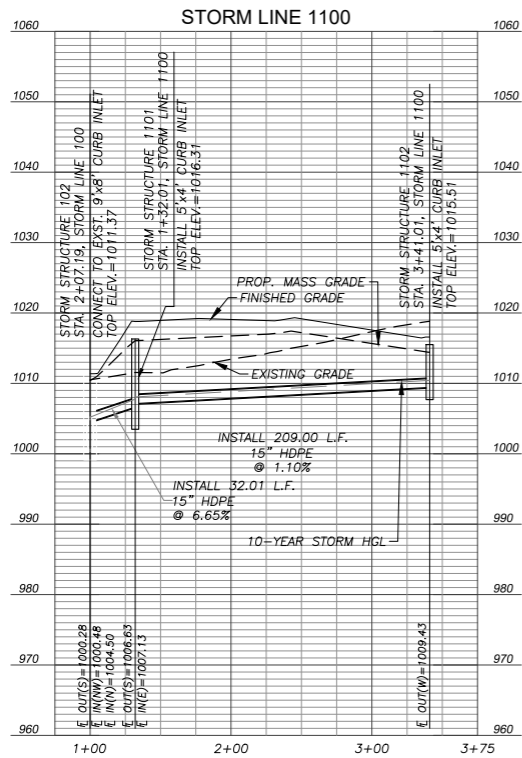
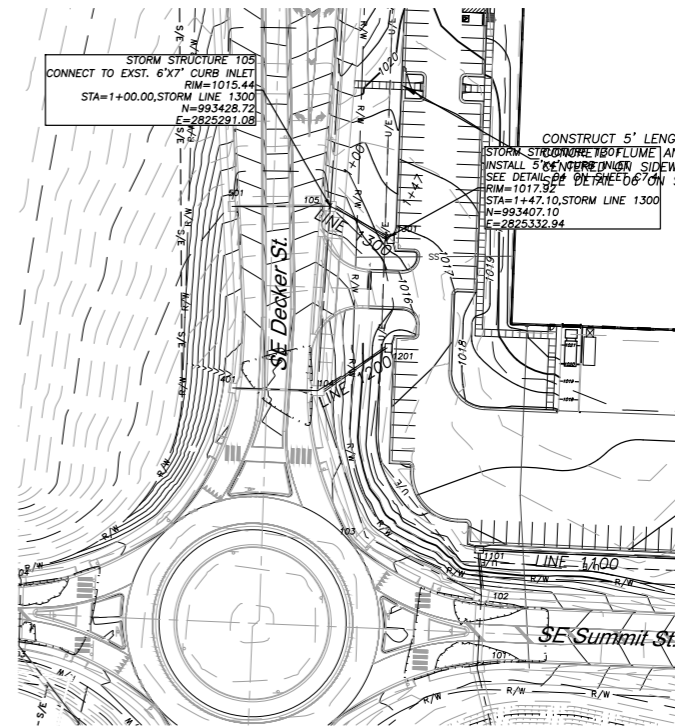
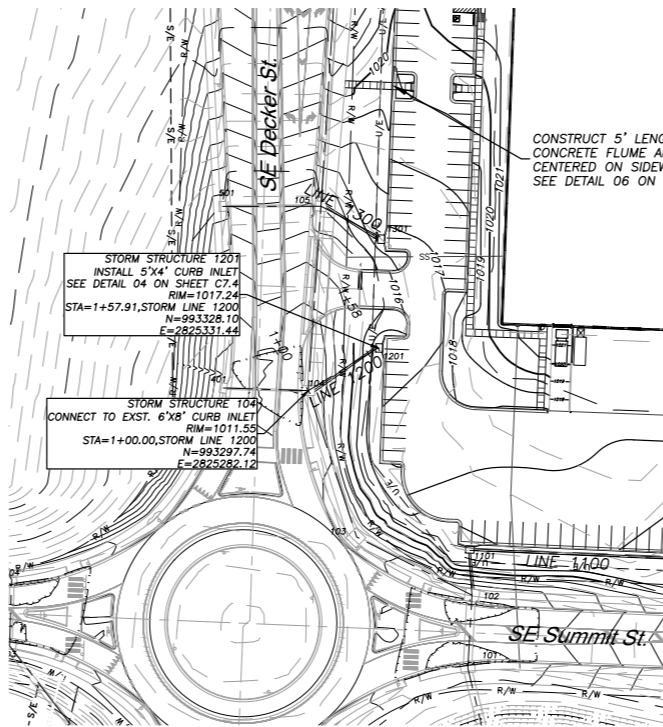
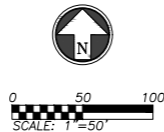
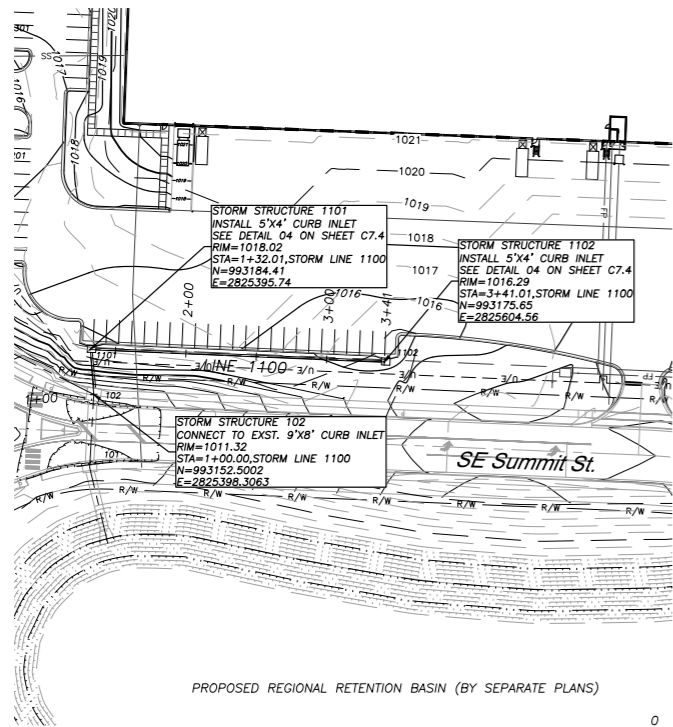
drawing title  
 STORM PLAN AND PROFILE (1)  
 drawing number

**C5.1**

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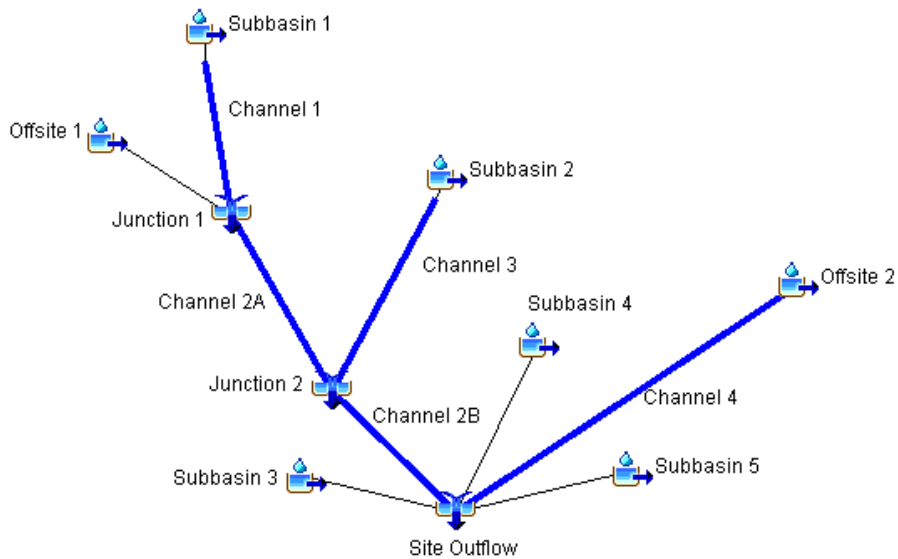


10 Year Storm

From	To	Runoff Calculations									Pipe Design										Design Checks							Comments				
		Direct Area (acre)	Line In (acre)	Total Area (acre)	C	K	Tc (min)	Flow Time (min)	Intensity (in/hr)	Design Q (cfs)	Description	Pipe length (lin ft)	Pipe Slope Slope, %	Pipe dia (in)	Manning's n Value	Q full (cfs)	Pipe Area, sf	V full fps	Design V fps	Hw/D	outlet head, H	HW, Inlet Control, (ft)	HW, Outlet Control, (ft)	Inlet Top Elevation	Upstream flowline	Downstream flowline	Inlet Drop (ft)		Downstream Water Elevation	Hydraulic Grade Elev. (Calculated)	Hydraulic Grade (Allowable)	
Line 100	111	29.74		29.74	0.66	1.00	12.00		5.68	111.5	Junction Box	174.35	2.90	36	0.01	148.06	7.07	20.95	22.96	4.0	11.01	1032.68	1049.42	1028.40	1020.76	1015.70		1038.41	1049.42	1027.90		
	110	0.00		29.74	0.78	1.00	5.00		7.35	111.5	HDPE																					
	109	0.83		30.57	0.66	1.00	12.13	0.03	5.66	111.1	HDPE	45.12	3.32	48	0.01	341.17	12.57	27.15	24.22	1.4	1.81	1020.49	1038.41	1024.59	1014.70	1013.20	1	1036.60	1038.41	1024.09		
	108	0.00		30.57	0.78	1.00	5.00		7.35	114.6	Junction Box	195.78	1.48	48	0.01	227.79	12.57	18.13	18.12	1.5	3.18	1019.00	1036.60	1024.14	1013.00	1010.10	0.2	1036.60	1036.60	1023.64		
	107	0.28		30.57	0.66	1.00	12.34	0.10	5.62	114.0	HDPE	72.15	0.51	48	0.01	133.72	12.57	10.64	11.92	1.5	2.13	1015.86	1033.42	1026.53	1009.90	1009.54	0.2	1033.42	1033.42	1026.03		
	106	0.76	15.79	30.85	0.66	1.00	5.00		7.35	114.8	RCP	96.21	0.50	48	0.013	101.84	12.57	8.10	11.84	1.5	2.91	1015.34	1031.30	1026.55	1009.34	1008.85	0.2	1031.30	1031.30	1026.05		
	105	0.36	1.30	47.40	0.78	1.00	5.00		7.35	186.3	Junction Box	276.99	0.87	54	0.01	239.09	15.90	15.03	16.59	1.9	5.81	1016.84	1028.38	1026.50	1008.35	1005.94	0.5	1028.38	1028.38	1026.00	Lines 600 and 1400 In	
	104	0.53	0.68	49.06	0.71	1.00	12.85	0.12	5.53	191.8	HDPE	131.28	1.01	54	0.01	257.61	15.90	16.20	17.71	2.0	4.34	1012.74	1022.58	1015.26	1003.92	1002.60	2.02	1022.58	1022.58	1014.76	Lines 500 and 1300 In	
	103	0.00		50.27	0.71	1.00	12.98	0.11	5.51	196.3	HDPE	109.83	0.85	54	0.01	236.33	15.90	14.86	16.58	2.0	4.27	1011.48	1018.23	1011.47	1002.40	1001.47	0.2	1018.23	1018.23	1010.97	Lines 400 and 1200 In	
	102	0.65	1.41	52.33	0.71	1.00	13.18	0.06	5.47	203.8	RCP	91.95	0.85	54	0.01	236.33	15.90	14.86	16.56	2.0	4.01	1010.31	1013.97	1011.37	1001.27	1000.48	0.2	1013.97	1013.97	1012.04		
	101	0.32		52.33	0.71	1.00	5.00		7.35	18	Curb Inlet	52.71	1.01	60	0.013	262.45	19.63	13.37	14.73	1.5	2.72	1007.93	1009.96	1011.31	1000.28	999.75	0.2	1009.96	1009.96	1010.87	Line 1100 In	
	100			52.65	0.71	1.00	13.24	0.04	5.46	204.8	HDPE	44.48	1.24	60	0.01	378.04	19.63	19.25	19.59	1.5	2.39	1007.24	1003.89	1011.31	999.55	999.00	0.2	1007.24	1007.24	1010.81		
Line 200	204	1.93		1.93	0.78	1.00	5.00		7.35	11.1	Curb Inlet	47.78	6.74	24	0.013	58.89	3.14	18.75	14.36	0.9	0.48	1012.24	1011.05	1014.35	1010.40	1007.18		1010.56	1010.56	1013.85		
	203	0.18		2.11	0.78	1.00	5.06	0.50	7.34	12.1	HDPE	245.77	0.78	24	0.01	26.04	3.14	8.29	8.12	1.0	1.19	1009.11	1010.56	1014.34	1007.18	1005.27	0	1009.37	1010.56	1013.84		
	202	0.19	3.00	5.30	0.78	1.00	5.56	0.23	7.18	29.7	HDPE	151.82	0.92	30	0.01	51.28	4.91	10.45	10.81	1.3	1.72	1007.90	1009.37	1011.66	1004.77	1003.37	0.5	1009.37	1009.37	1011.16	Line 800 In	
	201	0.32	1.80	7.42	0.78	1.00	5.00		7.35	1.8	Curb Inlet	29.74	1.11	30	0.01	56.33	4.91	11.48	12.50	1.8	1.97	1007.65	1006.06	1010.26	1003.17	1002.84	0.2	1007.65	1007.65	1009.76	Line 700 In	
	200			7.42	0.78	1.00	5.79	0.04	7.12	41.2	HDPE			30	0.01	56.33	4.91	11.48	12.50	1.8	1.97	1007.65	1006.06	1010.26	1003.17	1002.84	0.2	1007.65	1007.65	1009.76		
																																1004.09
Line 300	305	9.67		9.67	0.66	1.00	5.00		7.35	46.9	Area Inlet	36.70	1.25	36	0.01	97.20	7.07	13.75	13.60	1.3	1.06	1009.52	1010.11	1016.58	1005.75	1005.29		1009.05	1010.11	1016.08		
	304	1.09		10.76	0.78	1.00	5.04	0.04	7.35	6.3	Curb Inlet	46.91	3.97	36	0.013	133.25	7.07	18.85	17.75	1.4	1.71	1009.05	1007.93	1011.26	1004.79	1002.93	0.5	1009.05	1009.05	1010.76		
	303	0.85		11.61	0.68	1.00	5.09	0.32	7.33	57.8	HDPE	224.22	0.75	42	0.01	113.57	9.62	11.80	11.83	1.1	1.64	1006.22	1006.23	1011.35	1002.43	1000.75	0.5	1006.23	1006.23	1010.85		
	302	0.82		12.43	0.69	1.00	5.40	0.06	7.23	61.7	RCP	40.31	0.75	42	0.013	87.37	9.62	9.08	12.03	1.1	1.10	1004.23	1004.58	1010.69	1000.25	999.95	0.5	1004.58	1004.58	1010.19		
	301	0.20		12.63	0.69	1.00	5.46	0.13	7.21	62.7	HDPE	82.97	0.49	42	0.01	91.80	9.62	9.54	10.25	1.2	1.21	1003.48	1002.00	1010.66	999.45	999.04	0.5	1003.48	1003.48	1010.16		
	300			12.63	0.69	1.00	5.46	0.13	7.21	62.7	HDPE			42	0.01	91.80	9.62	9.54	10.25	1.2	1.21	1003.48	1002.00	1010.66	999.45	999.04	0.5	1003.48	1003.48	1010.16		
																																1000.79
Line 400	401	0.59		0.59	0.78	1.00	5.00		7.35	3.4	Curb Inlet	60.41	0.58	15	0.013	4.93	1.23	4.02	4.33	0.9	0.51	1006.79	1006.43	1011.69	1005.65	1005.30		1005.93	1006.79	1011.19		
	104			0.59	0.78	1.00	5.00	0.23	7.35	3.4	RCP			15	0.013	4.93	1.23	4.02	4.33	0.9	0.51	1006.79	1006.43	1011.69	1005.65	1005.30		1005.93	1005.93		Connect to Line 100	
Line 500	501	0.51		0.51	0.78	1.00	5.00		7.35	2.9	Curb Inlet	69.77	0.50	15	0.013	4.58	1.23	3.73	3.94	0.9	0.42	1011.09	1010.73	1015.31	1010.03	1009.68		1010.31	1011.09	1014.81		
	105			0.51	0.78	1.00	5.00	0.30	7.35	2.9	RCP			15	0.013	4.58	1.23	3.73	3.94	0.9	0.42	1011.09	1010.73	1015.31	1010.03	1009.68		1010.31	1010.31		Connect to Line 100	
Line 600	601	0.80		0.80	0.78	1.00	5.00		7.35	4.6	Curb Inlet	71.16	0.79	15	0.013	5.76	1.23	4.69	5.20	1.1	1.05	1011.27	1010.99	1028.78	1009.87	1009.31		1009.94	1011.27	1028.28		
	106			0.80	0.78	1.00	5.00	0.23	7.35	4.6	RCP			15	0.013	5.76	1.23	4.69	5.20	1.1	1.05	1011.27	1010.99	1028.78	1009.87	1009.31		1009.94	1009.94		Connect to Line 100	
Line 700	701	1.80		1.80	0.78	1.00	5.00		7.35	10.3	Curb Inlet	47.01	1.00	18	0.013	10.53	1.77	5.96	6.78	1.6	1.64	1007.20	1006.76	1010.25	1004.84	1004.37		1005.12	1007.20	1009.75		
	201			1.80	0.78	1.00	5.00	0.12	7.35	10.3	RCP			18	0.013	10.53	1.77	5.96	6.78	1.6	1.64	1007.20	1006.76	1010.25	1004.84	1004.37		1005.12	1005.12		Connect to Line 200	
Line 800	801	3.00		3.00	0.78	1.00	5.00		7.35	17.2	Curb Inlet	47.04	1.00	24	0.013	22.68	3.14	7.22	7.92	1.3	1.16	1008.27	1007.42	1011.67	1005.73	1005.26		1006.26	1008.27	1011.17		
	202			3.00	0.78	1.00	5.00	0.10	7.35	17.2	RCP			24	0.013	22.68	3.14	7.22	7.92	1.3	1.16	1008.27	1007.42	1011.67	1005.73	1005.26		1006.26	1006.26		Connect to Line 200	
Line 1000 RCB	1002	25.05		25.05	0.66	1.00	11.28		5.82	96.2	RCB Headwall	13.57	4.19	4x5' RCB	0.013	501.99	20.00	25.10	16.64	1.3	1.23	1014.12	1014.77		1009.10	1008.53		1013.55	1013.55	N/A		
	1001	0.00		25.05	0.66	1.00	11.28	0.01	5.82	96.2	RCP			4x5' RCB	0.013	501.99	20.00	25.10	16.64	1.3	1.23	1014.12	1014.77		1009.10	1008.53	0	1013.55	1013.55	N/A		
				25.05	0.66																											

Line 1300	1301		0.79		0.78	1.00	5.00		7.35	4.5	Curb Inlet										1017.16				1011.41	1016.66											
		105			0.79	0.78	1.00	5.00	0.06	7.35	4.5	HDPE	47.10	6.62	15	0.01	21.66	1.23	17.65	13.91	1.1	0.56	1011.41	1008.09		1010.03	1006.91		1007.54		1007.54		Connect to Line 100				
Line 1400	1405		0.43		0.78	1.00	5.00		7.35	2.5	Curb Inlet																	1018.97	1019.05								
		1404			0.43	0.78	1.00	5.00	0.72	7.35	2.5	HDPE	199.40	0.50	15	0.01	5.95	1.23	4.85	4.63	0.8	0.45	1017.90	1018.97	1019.55	1016.90	1015.90		1018.51								
		1404		0.49		0.78	1.00	5.00		7.35	2.8	Curb Inlet																									
		1403			0.92	0.78	1.00	5.72	0.60	7.14	5.1	HDPE	198.00	0.50	24	0.01	20.85	3.14	6.64	5.47	0.7	0.18	1016.60	1018.51	1020.50	1015.15	1014.16	0.75	1018.33	1018.51	1020.00						
		1403		0.73		0.78	1.00	5.00		7.35	4.2	Curb Inlet																									
		1402			1.65	0.78	1.00	6.32	0.29	6.97	9.0	HDPE	110.86	0.50	24	0.01	20.85	3.14	6.64	6.38	0.8	0.38	1015.83	1018.33	1020.60	1014.16	1013.61	0	1017.95	1018.33	1020.10						
		1402		0.00	10.40	0.78	1.00	5.00		7.35	0.0	Junction Box																									
		1401			12.05	0.78	1.00	6.61	0.40	6.89	64.7	RCP	249.74	0.50	48	0.013	101.84	12.57	8.10	10.45	0.9	1.61	1017.26	1017.95	1021.11	1013.52	1012.27	0.09	1016.34	1017.95	1020.61						
	1401		2.94		0.78	1.00	5.00		7.35	16.9	Curb Inlet																										
	106			14.99	0.78	1.00	7.01	0.17	6.78	79.3	HDPE	114.00	0.50	48	0.01	132.40	12.57	10.54	10.99	1.1	1.20	1016.34	1014.70	1019.71	1012.07	1011.50	0.2	1013.50	1016.34	1019.21		Connect to Line 100					
																																	1013.50				
Line 1500	1501		10.40		0.78	1.00	5.00		7.35	59.6	Curb Inlet																						1017.80	1029.00			
		1402			10.40	0.78	1.00	5.00	0.04	7.35	59.6	HDPE	35.27	1.42	48	0.01	223.12	12.57	17.76	15.00	0.9	0.50	1017.80	1016.22	1029.50	1014.22	1013.72		1015.72				1015.72				
Line 1600 RCB	1601		24.02		0.66	1.00	11.10		5.85	92.8	Curb Inlet																							1017.09	1017.50		
		1600			24.02	0.66	1.00	11.10	0.14	5.85	92.8	RCP	73.46	1.55	4'x3' RCB	0.013	154.09	12.00	12.84	8.52	3.0	6.35	1021.65	1019.49	1018.00	1012.78	1011.64		1013.14				1013.14				
Retention Basin Outflow (100 Year)	Outflow		106.89		0.66	1.00	5.00		10.32	191.1	Outflow Structure																								1007.75		
		Sta 4+59			106.89	0.66	1.00	5.00	0.03	10.32	191.1	HDPE	30.17	0.93	48	0.01	193.70	12.57	15.41	16.16	3.0	5.01	1008.82	1011.51	1007.75	996.92	996.64	0	1006.50	1010.04	1011.04				Calculation shown for one of three pipes		
		Sta 4+59		0.00	0.00	0.78	1.00	5.00		10.32	0.0	Junction Box																								1007.70	
		Sta 2+86			106.89	0.66	1.00	5.03	0.14	10.32	191.1	HDPE	173.09	1.66	48	0.01	254.07	12.57	20.22	20.92	3.0	8.31	1008.54	1010.11	1007.75	996.64	993.77	0	1001.80	1006.50	1007.20				Calculation shown for one of three pipes		
	Sta 2+86		0.00	0.00	0.78	1.00	5.00		10.32	0.0	Junction Box																								1002.76		
	Sta 0+67			106.89	0.66	1.00	5.17	0.22	10.32	191.1	HDPE	219.00	1.00	48	0.01	200.86	12.57	15.98	16.92	3.0	9.38	1005.67	1002.96	1007.75	993.77	991.58		993.58						Calculation shown for one of three pipes			
																																		993.58			

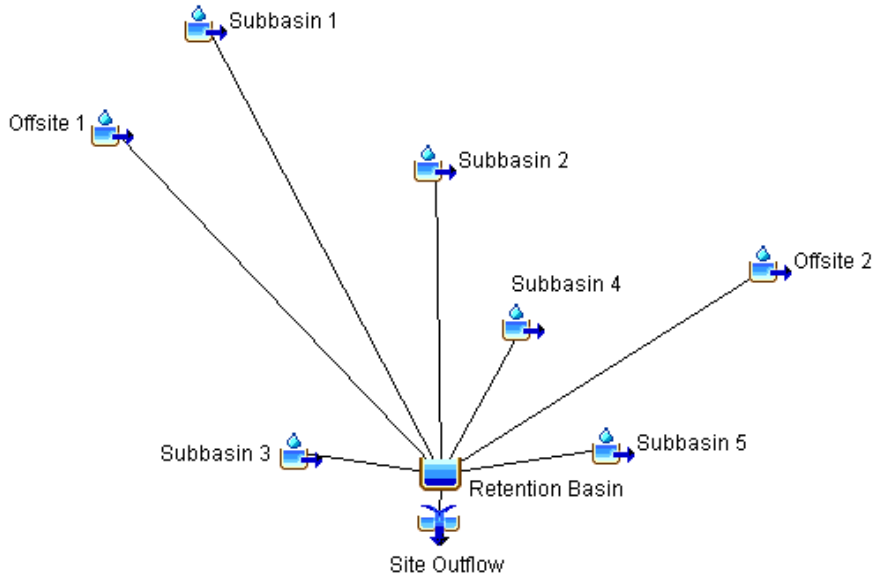
**Exhibit 5 – Existing Conditions HEC-HMS Model Summary**



	Sub-Basin	Area	Existing CN	Existing Tc (min.)
North of SE Bailey Rd	1	17.82	74	16.67
	2	19.07	74	24.55
South of SE Bailey Rd	3	19.38	74	37.08
	4	8.69	81	26.46
	5	14.87	74	28.41
Offsite	Off 1	15.84	86	12.78
	Off 2	11.22	74	11.28

Channel 1 Travel Time = 8.83 minutes  
 Channel 2A Travel Time = 10.69 minutes  
 Channel 2B Travel Time = 6.77 minutes  
 Channel 3 Travel Time = 5.4 minutes  
 Channel 4 Travel Time = 12.08 minutes

**Exhibit 9 – Proposed HEC-HMS Model Summary**



	Sub-Basin	Area	Proposed CN	Proposed Tc (min.)
North of SE Bailey Rd	1	17.82	94	5
	2	19.07	88	5
South of SE Bailey Rd	3	19.38	89	5
	4	8.69	90	5
	5	14.87	87	5
Offsite	Off 1	15.84	86	5
	Off 2	11.22	74	5

**Basin Elevation-Area**

Elevation (FT)	Area (AC)	Incremental Storage (AC-FT)	Cumulative Storage (AC-FT)
1000	2.6	0	0
1002	2.8	5.4	5.4
1004	3.25	6.05	11.45
1006	3.885	7.135	18.585
1007	4.625	8.51	27.095
1008	4.833	9.458	36.553

### Basin Elevation-Discharge

Elevation (FT)	Depth (Ft)	Discharge (Combined) (CFS)	8" Opening (CFS)	10'x1' Opening (CFS)	6x'1.5' Opening (CFS)	(3) 10' Opening (CFS)
1000.00	0	0.00	0.00	0.00	0.00	0.00
1000.25	0.25	0.51	0.51	0.00	0.00	0.00
1000.50	0.5	2.74	2.74	0.00	0.00	0.00
1000.75	0.75	4.34	4.34	0.00	0.00	0.00
1001.00	1	5.49	5.49	0.00	0.00	0.00
1001.25	1.25	6.44	6.44	0.00	0.00	0.00
1001.50	1.5	7.26	7.26	0.00	0.00	0.00
1001.75	1.75	8.00	8.00	0.00	0.00	0.00
1002.00	2	8.68	8.68	0.00	0.00	0.00
1002.25	2.25	9.31	9.31	0.00	0.00	0.00
1002.50	2.5	9.90	9.90	0.00	0.00	0.00
1002.75	2.75	10.45	10.45	0.00	0.00	0.00
1003.00	3	10.98	10.98	0.00	0.00	0.00
1003.25	3.25	20.22	11.48	6.24	2.50	0.00
1003.50	3.5	36.68	11.96	17.66	7.06	0.00
1003.75	3.75	57.85	12.43	32.44	12.98	0.00
1004.00	4	66.90	12.87	34.05	19.98	0.00
1004.25	4.25	82.92	13.31	41.70	27.92	0.00
1004.50	4.5	99.40	13.72	48.15	37.53	0.00
1004.75	4.75	111.30	14.13	53.83	43.33	0.00
1005.00	5	121.94	14.52	58.97	48.45	0.00
1005.25	5.25	131.68	14.91	63.70	53.07	0.00
1005.50	5.5	140.70	15.28	68.09	57.33	0.00
1005.75	5.75	161.53	15.65	72.22	61.28	12.38
1006.00	6	192.14	16.00	76.13	65.00	35.00
1006.25	6.25	229.02	16.35	79.85	68.52	64.30
1006.50	6.5	270.96	16.69	83.40	71.86	99.00
1006.75	6.75	317.25	17.03	86.80	75.06	138.36
1007.00	7	367.44	17.36	90.08	78.12	181.87
1007.25	7.25	421.18	17.68	93.24	81.07	229.19
1007.50	7.5	478.23	18.00	96.30	83.92	280.01
1007.75	7.75	527.24	18.31	99.26	86.67	323.00
1008.00	8	563.92	18.62	102.14	89.34	353.83

### **Emergency Bypass Elevation-Discharge**

Elevation (FT)	Discharge (CFS)
1007.75	0.00
1008.00	20.63
1008.25	58.34
1008.50	107.17
1008.75	165.00
1009.00	230.59
1009.25	303.12
1009.50	381.98
1009.75	466.69
1010.00	556.88
1010.25	652.22

Project: The Grove 13958 Simulation Run: Proposed 2 Yr

Start of Run: 03Mar2018, 10:00

Basin Model: Proposed

End of Run: 04Mar2018, 10:06

Meteorologic Model: 2 Year

Compute Time: 03Apr2018, 10:33:50

Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI <sup>2</sup> )	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Subbasin 3	0.0302812	64.20	03Mar2018, 21:54	3.81
Subbasin 2	0.0297969	60.93	03Mar2018, 21:54	3.60
Subbasin 1	0.027844	68.87	03Mar2018, 21:54	4.21
Offsite 1	0.02475	39.97	03Mar2018, 22:00	2.77
Subbasin 5	0.0232344	45.76	03Mar2018, 21:54	2.70
Offsite 2	0.0175313	16.94	03Mar2018, 22:00	1.16
Subbasin 4	0.0135781	29.80	03Mar2018, 21:54	1.77
Retention Basin	0.1670159	49.11	03Mar2018, 22:24	14.92
Site Outflow	0.1670159	49.11	03Mar2018, 22:24	14.92

Project: The Grove 13958      Simulation Run: Proposed 2 Yr  
Reservoir: Retention Basin

Start of Run: 03Mar2018, 10:00	Basin Model: Proposed
End of Run: 04Mar2018, 10:06	Meteorologic Model: 2 Year
Compute Time: 03Apr2018, 10:33:50	Control Specifications: Control 1

Volume Units: AC-FT

#### Computed Results

Peak Inflow: 309.60 (CFS)	Date/Time of Peak Inflow: 03Mar2018, 21:54
Peak Discharge: 49.11 (CFS)	Date/Time of Peak Discharge: 03Mar2018, 22:24
Inflow Volume: 20.02 (AC-FT)	Peak Storage: 10.32 (AC-FT)
Discharge Volume: 14.92 (AC-FT)	Peak Elevation: 1003.65 (FT)

Project: The Grove 13958 Simulation Run: Proposed 10 Yr

Start of Run: 03Mar2018, 10:00

Basin Model: Proposed

End of Run: 04Mar2018, 10:06

Meteorologic Model: 10 Year

Compute Time: 03Apr2018, 10:33:43

Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI <sup>2</sup> )	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Subbasin 3	0.0302812	108.71	03Mar2018, 21:54	6.55
Subbasin 2	0.0297969	104.72	03Mar2018, 21:54	6.28
Subbasin 1	0.027844	109.07	03Mar2018, 21:54	6.84
Offsite 1	0.02475	70.43	03Mar2018, 22:00	4.94
Subbasin 5	0.0232344	79.84	03Mar2018, 21:54	4.77
Offsite 2	0.0175313	36.69	03Mar2018, 22:00	2.43
Subbasin 4	0.0135781	49.74	03Mar2018, 21:54	3.02
Retention Basin	0.1670159	137.18	03Mar2018, 22:12	28.19
Site Outflow	0.1670159	137.18	03Mar2018, 22:12	28.19

Project: The Grove 13958      Simulation Run: Proposed 10 Yr  
Reservoir: Retention Basin

Start of Run: 03Mar2018, 10:00	Basin Model: Proposed
End of Run: 04Mar2018, 10:06	Meteorologic Model: 10 Year
Compute Time: 03Apr2018, 10:33:43	Control Specifications: Control 1

Volume Units: AC-FT

#### Computed Results

Peak Inflow: 530.78 (CFS)	Date/Time of Peak Inflow: 03Mar2018, 21:54
Peak Discharge: 137.18 (CFS)	Date/Time of Peak Discharge: 03Mar2018, 22:12
Inflow Volume: 34.83 (AC-FT)	Peak Storage: 16.32 (AC-FT)
Discharge Volume: 28.19 (AC-FT)	Peak Elevation: 1005.40 (FT)

Project: The Grove 13958 Simulation Run: Proposed 100 Yr

Start of Run: 03Mar2018, 10:00 Basin Model: Proposed  
End of Run: 04Mar2018, 10:06 Meteorologic Model: 100 Year  
Compute Time: 03Apr2018, 10:33:47 Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI <sup>2</sup> )	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Subbasin 3	0.0302812	167.57	03Mar2018, 21:54	10.32
Subbasin 2	0.0297969	162.82	03Mar2018, 21:54	9.97
Subbasin 1	0.027844	161.95	03Mar2018, 21:54	10.37
Offsite 1	0.02475	111.20	03Mar2018, 22:00	7.96
Subbasin 5	0.0232344	125.25	03Mar2018, 21:54	7.63
Offsite 2	0.0175313	65.44	03Mar2018, 22:00	4.35
Subbasin 4	0.0135781	76.03	03Mar2018, 21:54	4.71
Retention Basin	0.1670159	381.65	03Mar2018, 22:06	47.38
Site Outflow	0.1670159	381.65	03Mar2018, 22:06	47.38

Project: The Grove 13958      Simulation Run: Proposed 100 Yr  
Reservoir: Retention Basin

Start of Run: 03Mar2018, 10:00	Basin Model: Proposed
End of Run: 04Mar2018, 10:06	Meteorologic Model: 100 Year
Compute Time: 03Apr2018, 10:33:47	Control Specifications: Control 1

Volume Units: AC-FT

#### Computed Results

Peak Inflow: 826.87 (CFS)	Date/Time of Peak Inflow: 03Mar2018, 21:54
Peak Discharge: 381.65 (CFS)	Date/Time of Peak Discharge: 03Mar2018, 22:06
Inflow Volume: 55.32 (AC-FT)	Peak Storage: 23.15 (AC-FT)
Discharge Volume: 47.38 (AC-FT)	Peak Elevation: 1007.07 (FT)

Project: The Grove 13958 Simulation Run: Emergency Bypass 100 Yr

Start of Run: 03Mar2018, 10:00

Basin Model: Emergency Bypass

End of Run: 04Mar2018, 10:06

Meteorologic Model: 100 Year

Compute Time: 08Jun2018, 09:02:25

Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI <sup>2</sup> )	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Subbasin 3	0.0302812	167.57	03Mar2018, 21:54	10.32
Subbasin 2	0.0297969	162.82	03Mar2018, 21:54	9.97
Subbasin 1	0.027844	161.95	03Mar2018, 21:54	10.37
Offsite 1	0.02475	111.20	03Mar2018, 22:00	7.96
Subbasin 5	0.0232344	125.25	03Mar2018, 21:54	7.63
Offsite 2	0.0175313	65.44	03Mar2018, 22:00	4.35
Subbasin 4	0.0135781	76.03	03Mar2018, 21:54	4.71
Retention Basin	0.1670159	573.35	03Mar2018, 22:06	54.80
Site Outflow	0.1670159	573.35	03Mar2018, 22:06	54.80

Project: The Grove 13958      Simulation Run: Emergency Bypass 100 Yr  
Reservoir: Retention Basin

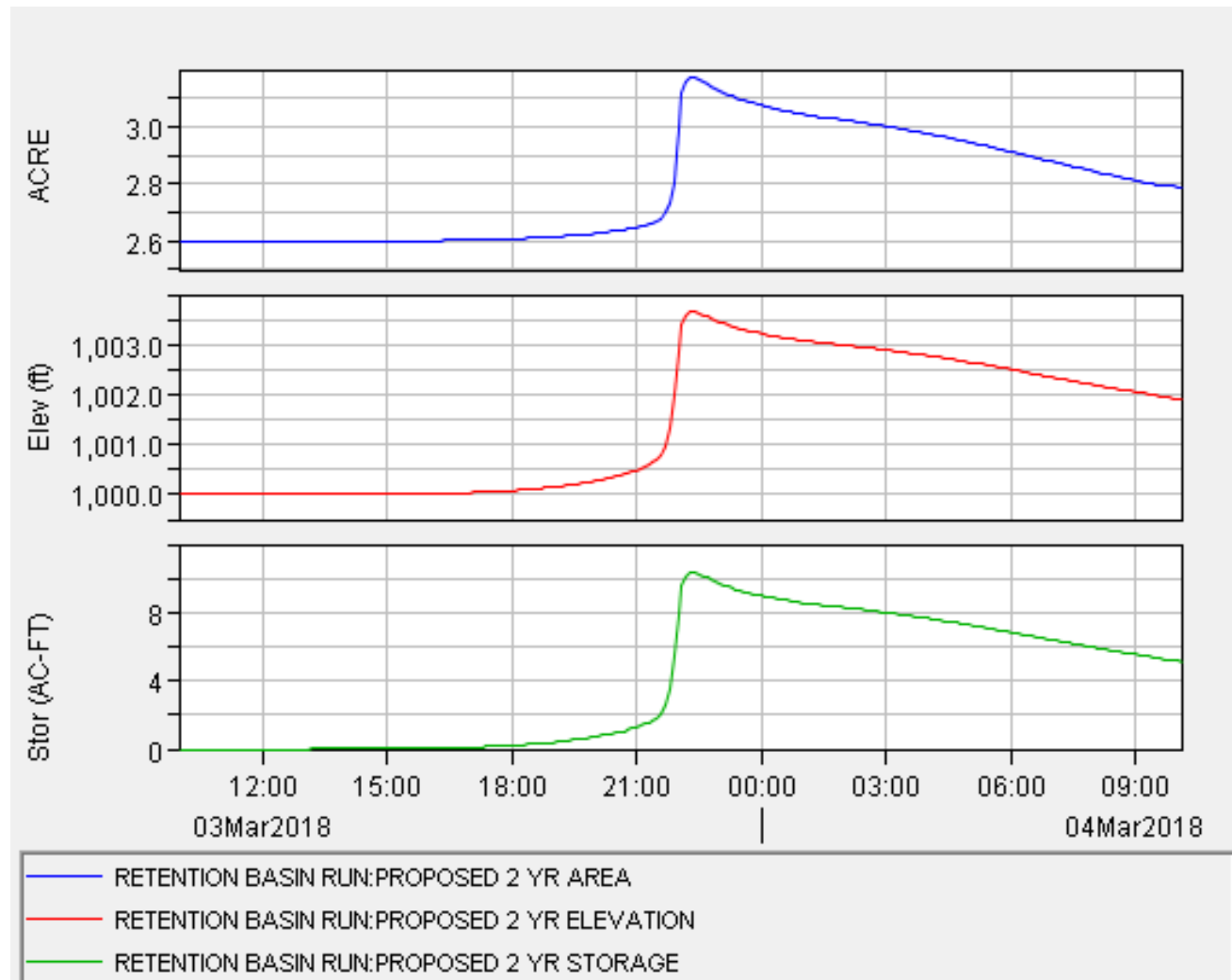
Start of Run: 03Mar2018, 10:00	Basin Model: Emergency Bypass
End of Run: 04Mar2018, 10:06	Meteorologic Model: 100 Year
Compute Time: 08Jun2018, 09:02:25	Control Specifications: Control 1

Volume Units:IN

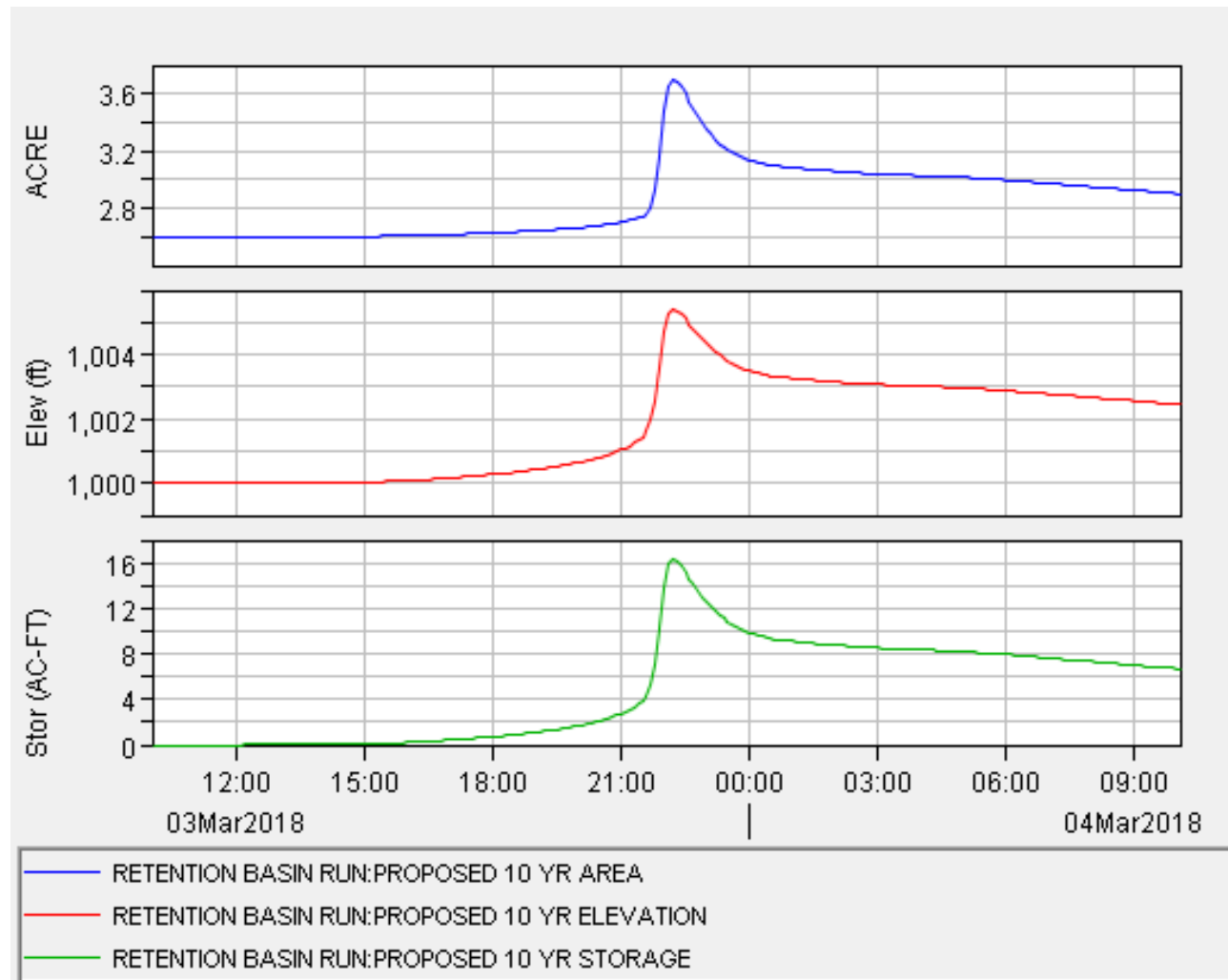
#### Computed Results

Peak Inflow: 826.87 (CFS)	Date/Time of Peak Inflow: 03Mar2018, 21:54
Peak Discharge: 573.35 (CFS)	Date/Time of Peak Discharge: 03Mar2018, 22:06
Inflow Volume: 6.21 (IN)	Peak Storage: 11.08 (AC-FT)
Discharge Volume: 6.15 (IN)	Peak Elevation: 1010.04 (FT)

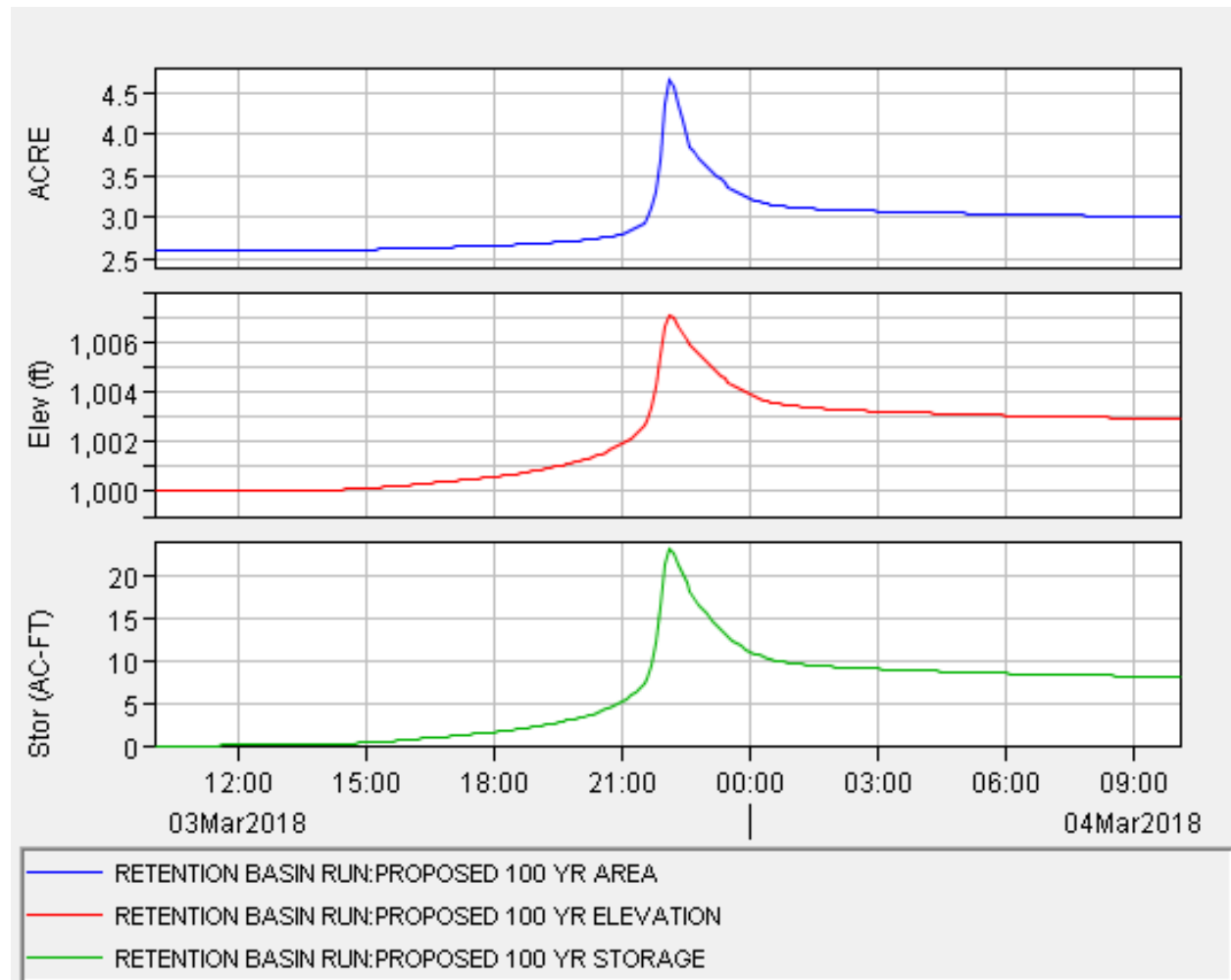
**Proposed Retention Basin Elevation-Area-Storage – 2 Year**



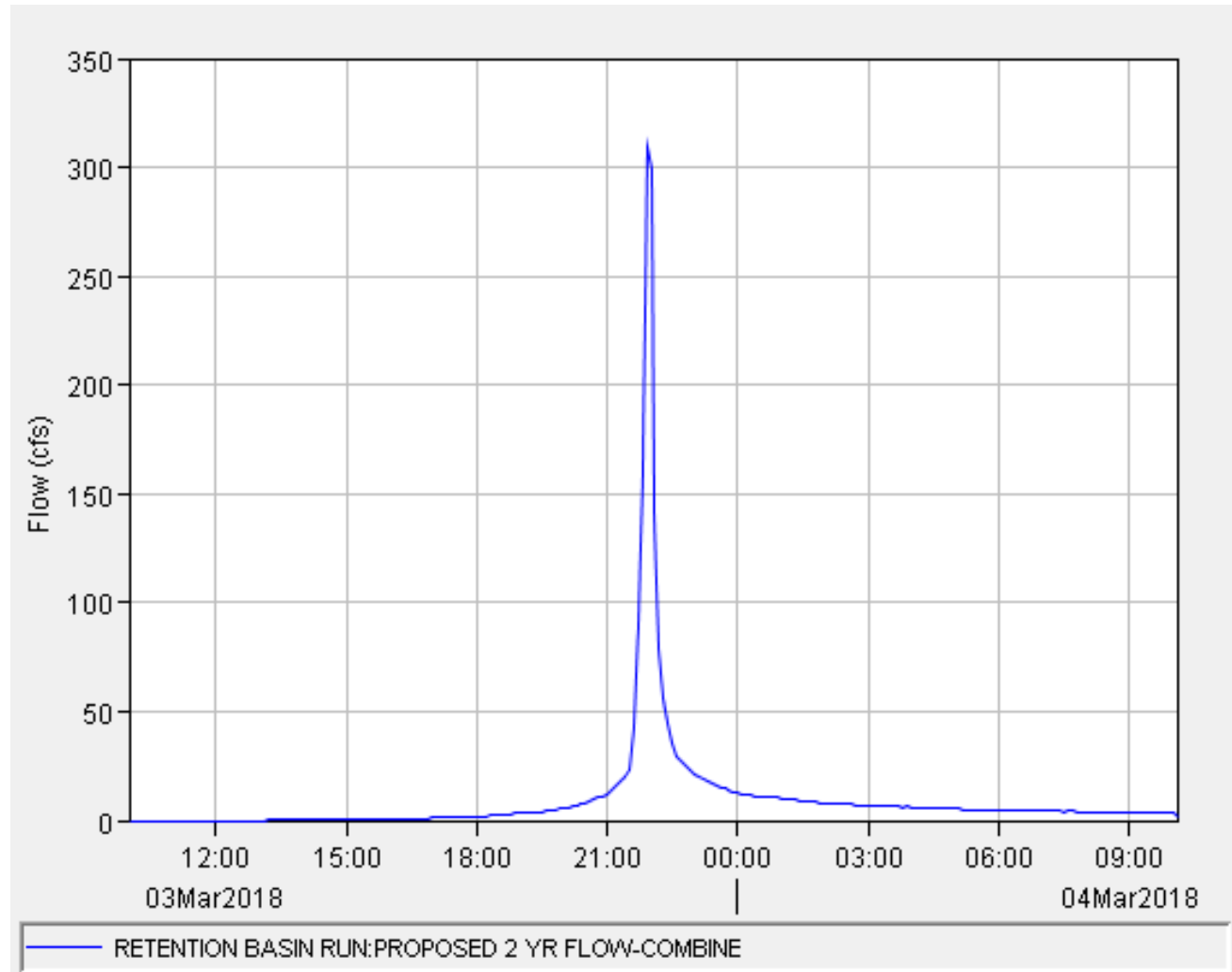
**Proposed Retention Basin Elevation-Area-Storage – 10 Year**



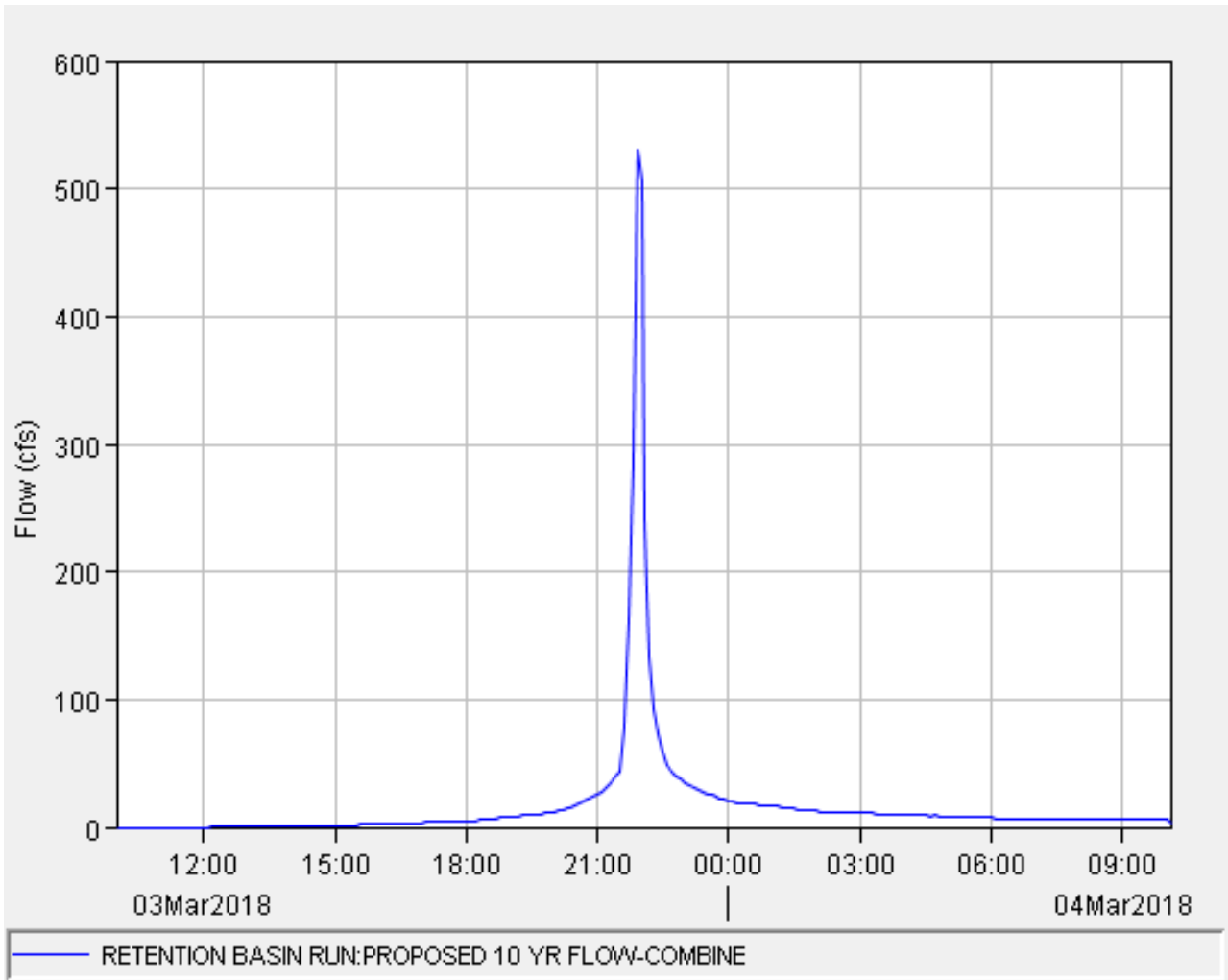
**Proposed Retention Basin Elevation-Area-Storage – 100 Year**



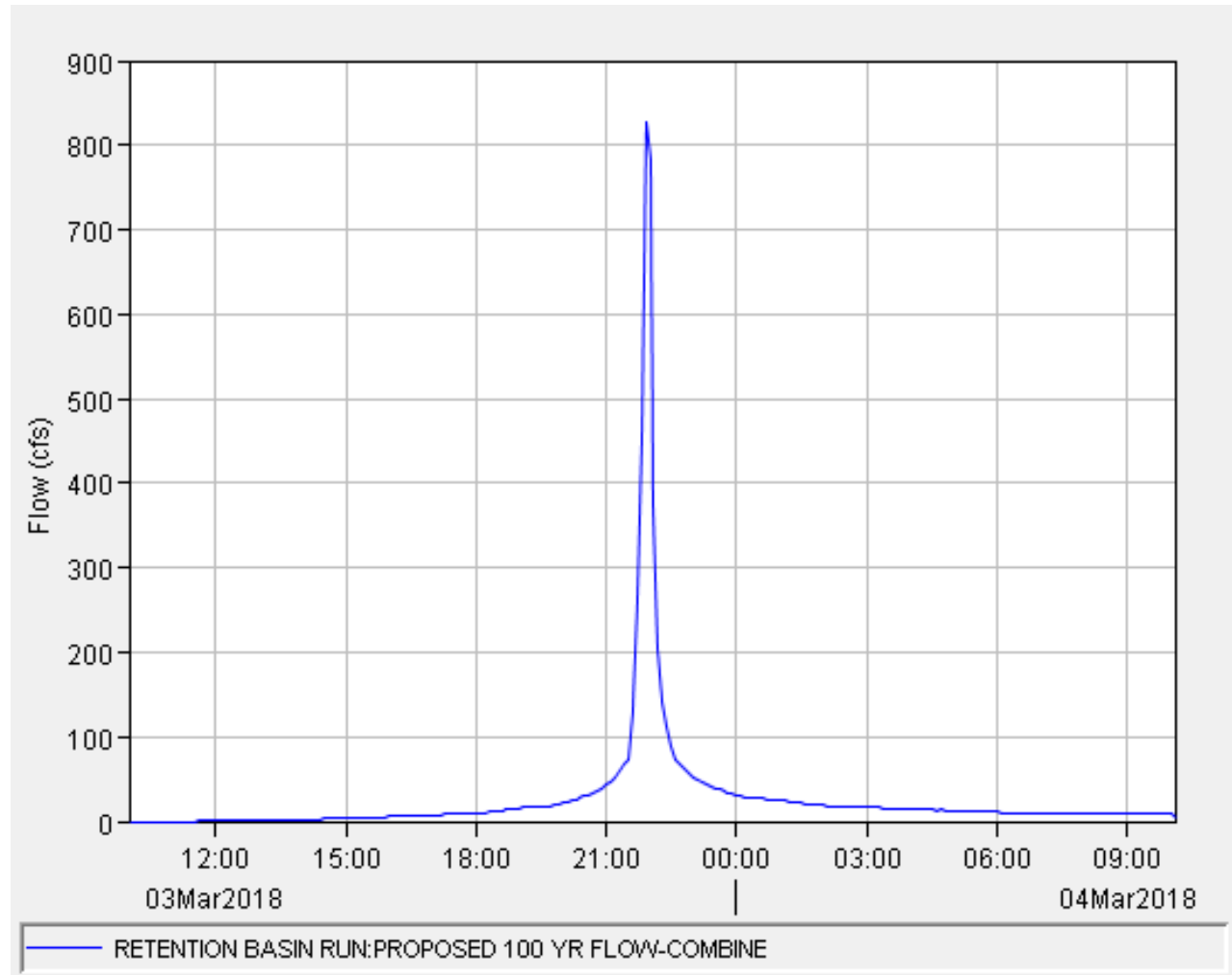
**Retention Basin Inflow – 2 Year**



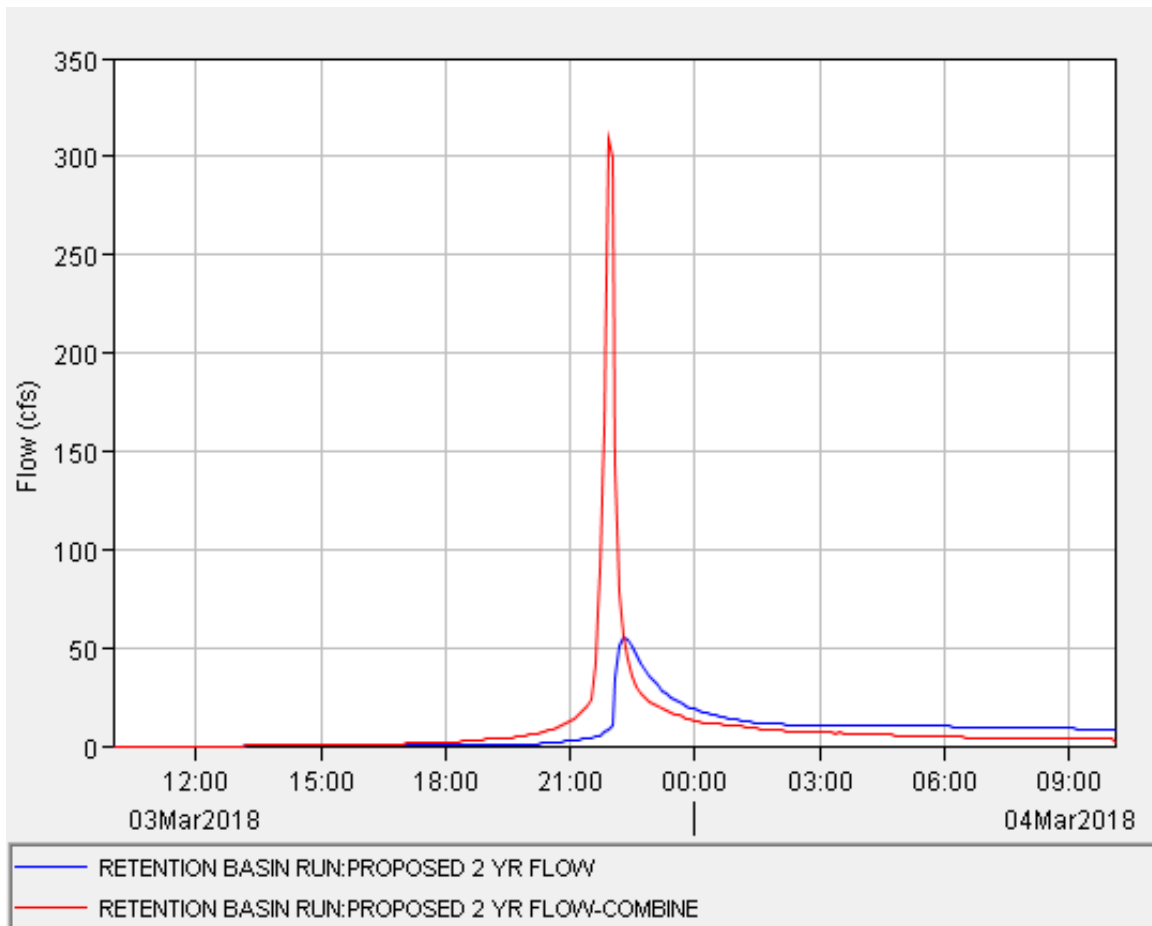
**Retention Basin Inflow – 10 Year**

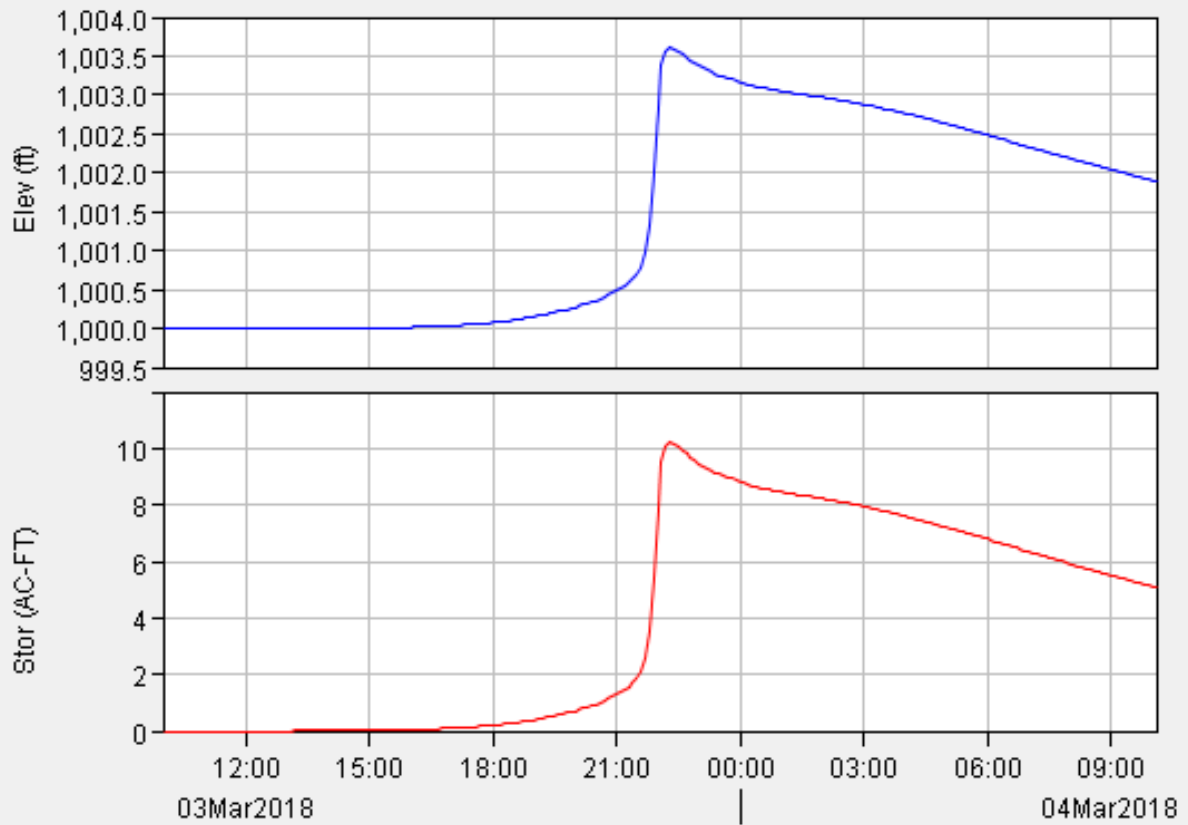


**Retention Basin Inflow – 100 Year**



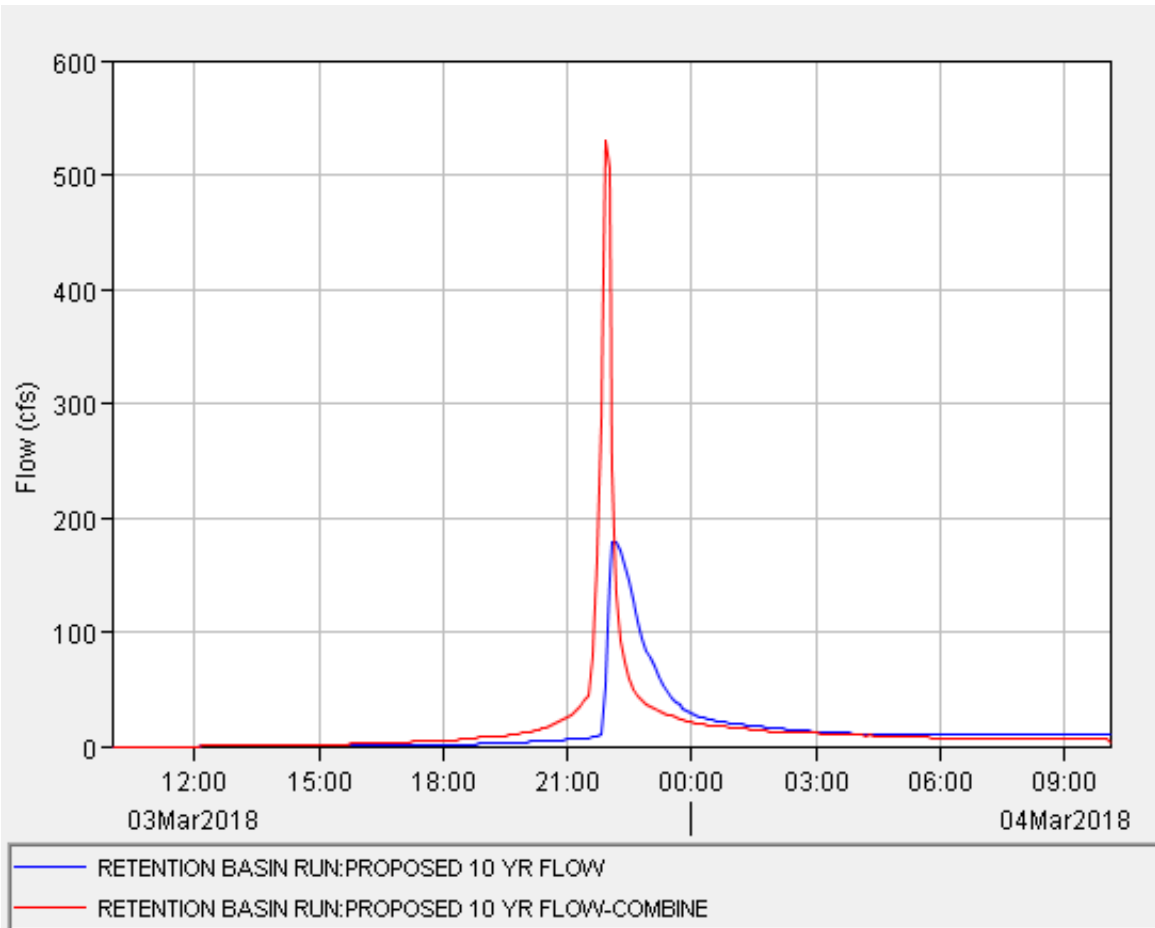
## 2 Year Storm

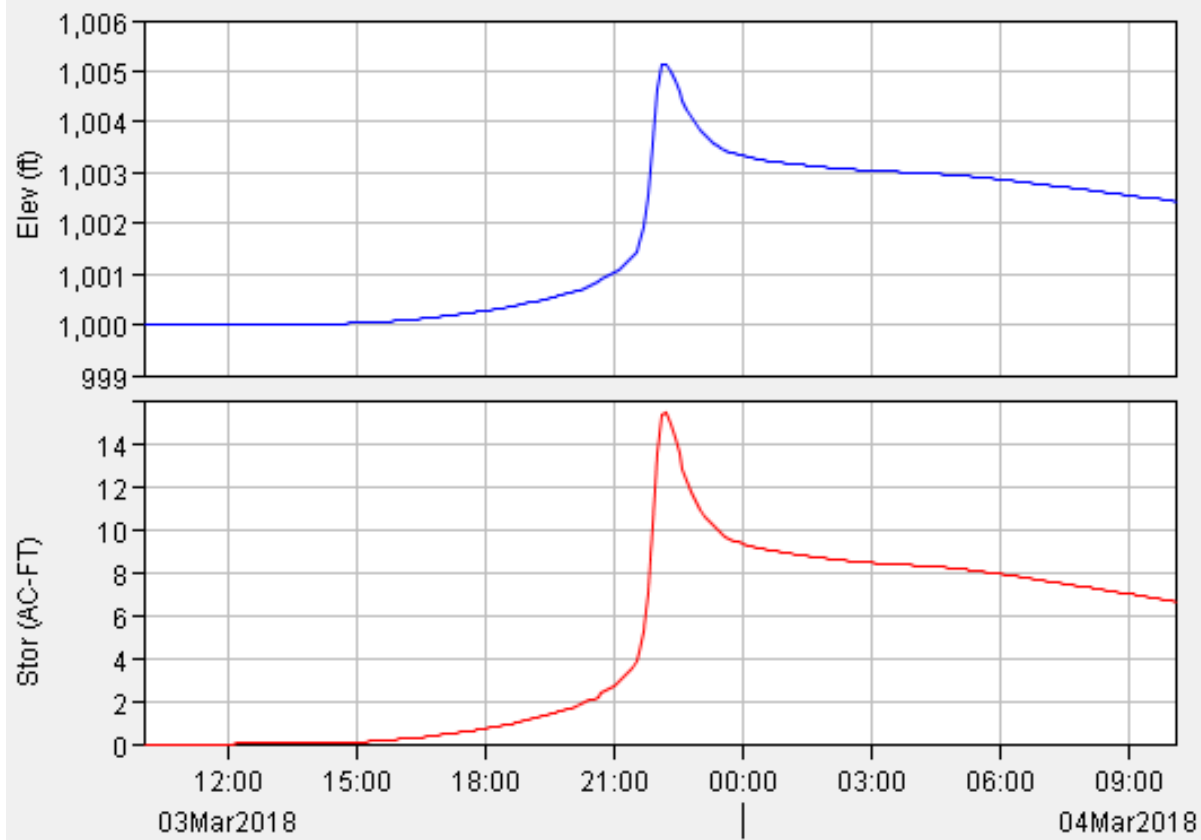




— RETENTION BASIN RUN:PROPOSED 2 YR ELEVATION  
— RETENTION BASIN RUN:PROPOSED 2 YR STORAGE

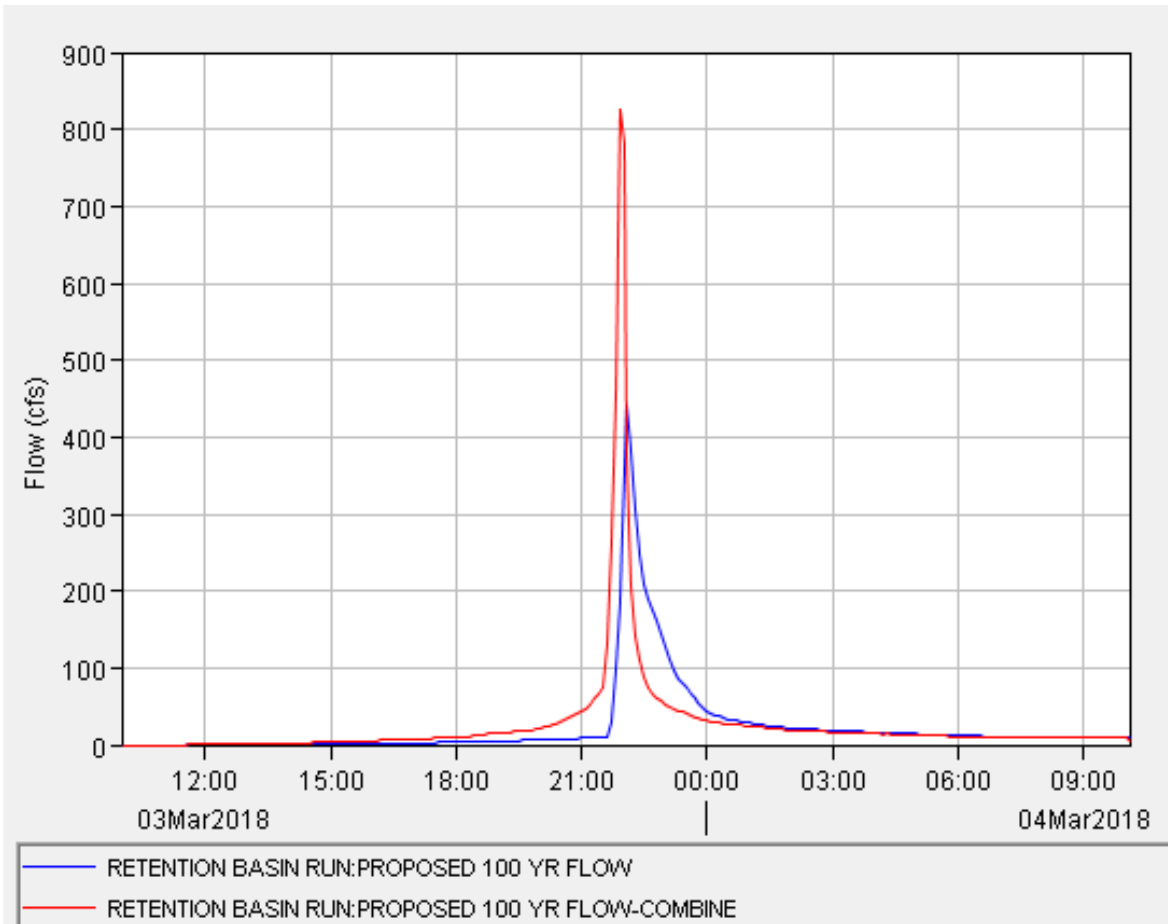
**10 Year Storm**

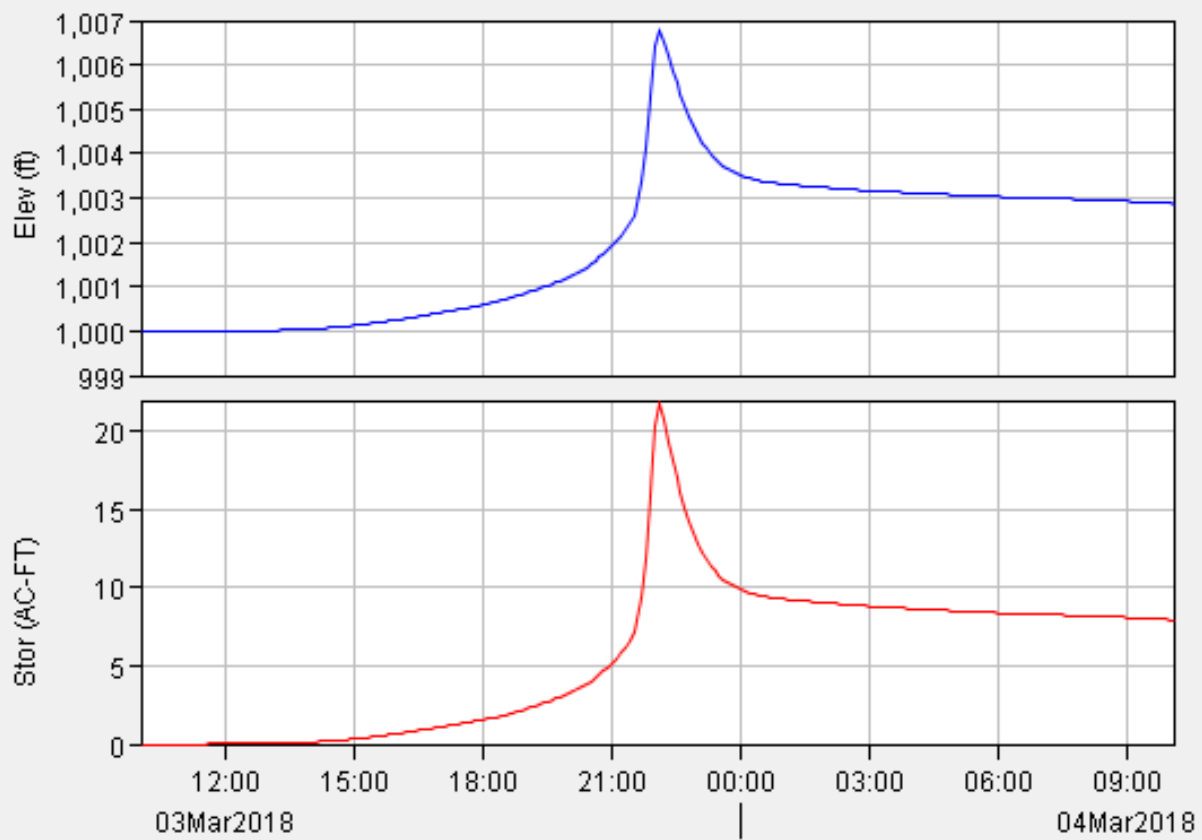




— RETENTION BASIN RUN:PROPOSED 10 YR ELEVATION  
— RETENTION BASIN RUN:PROPOSED 10 YR STORAGE

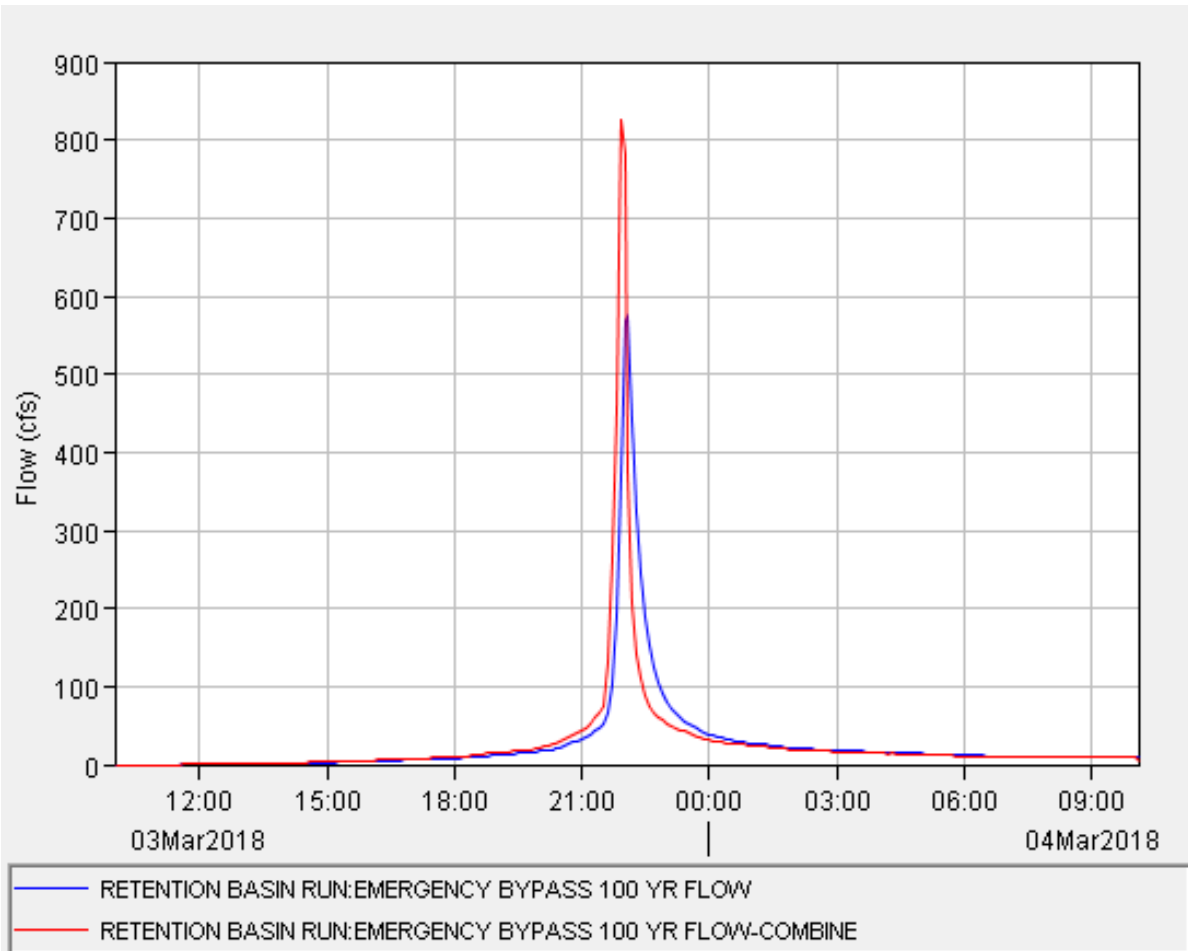
# 100 Year Storm

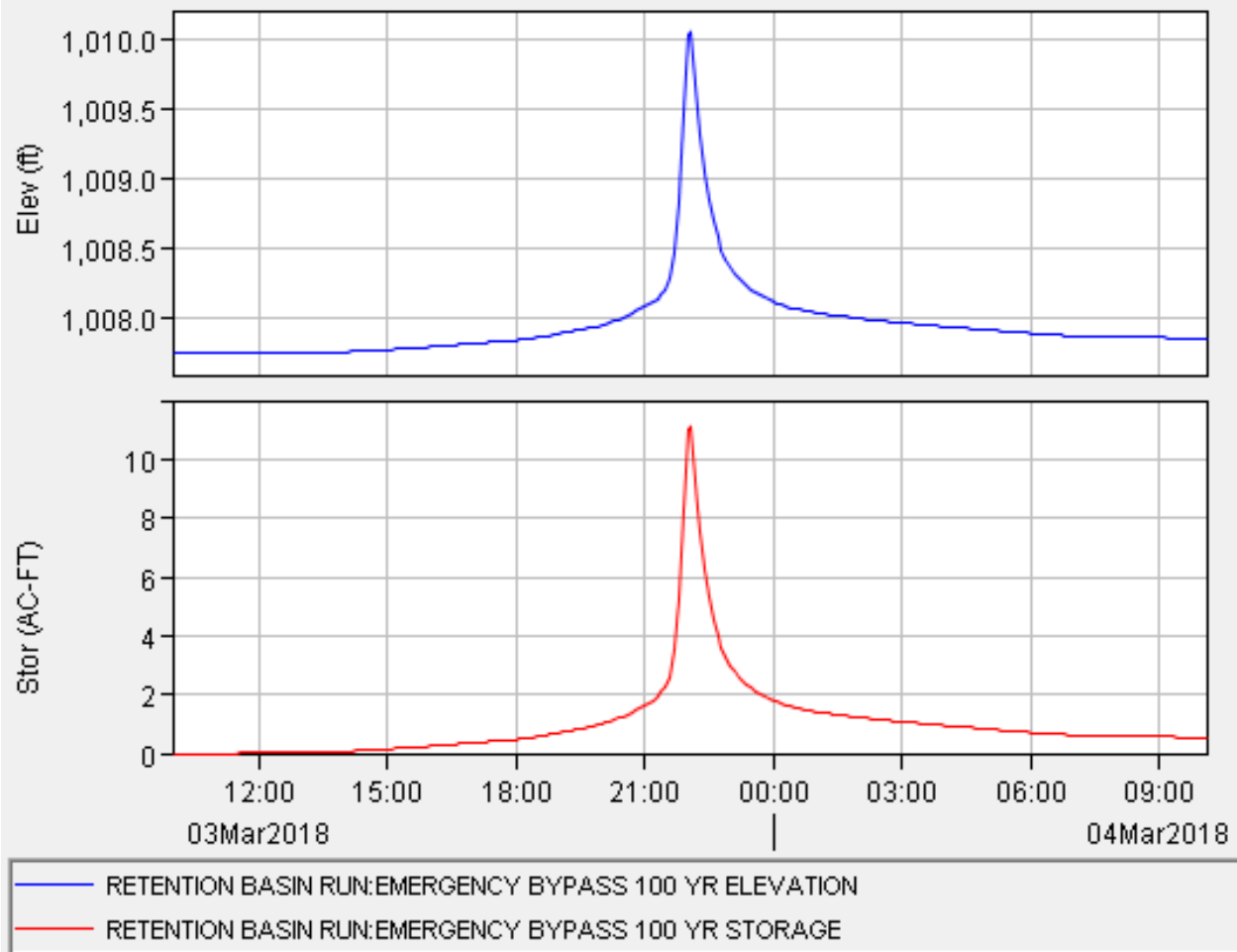




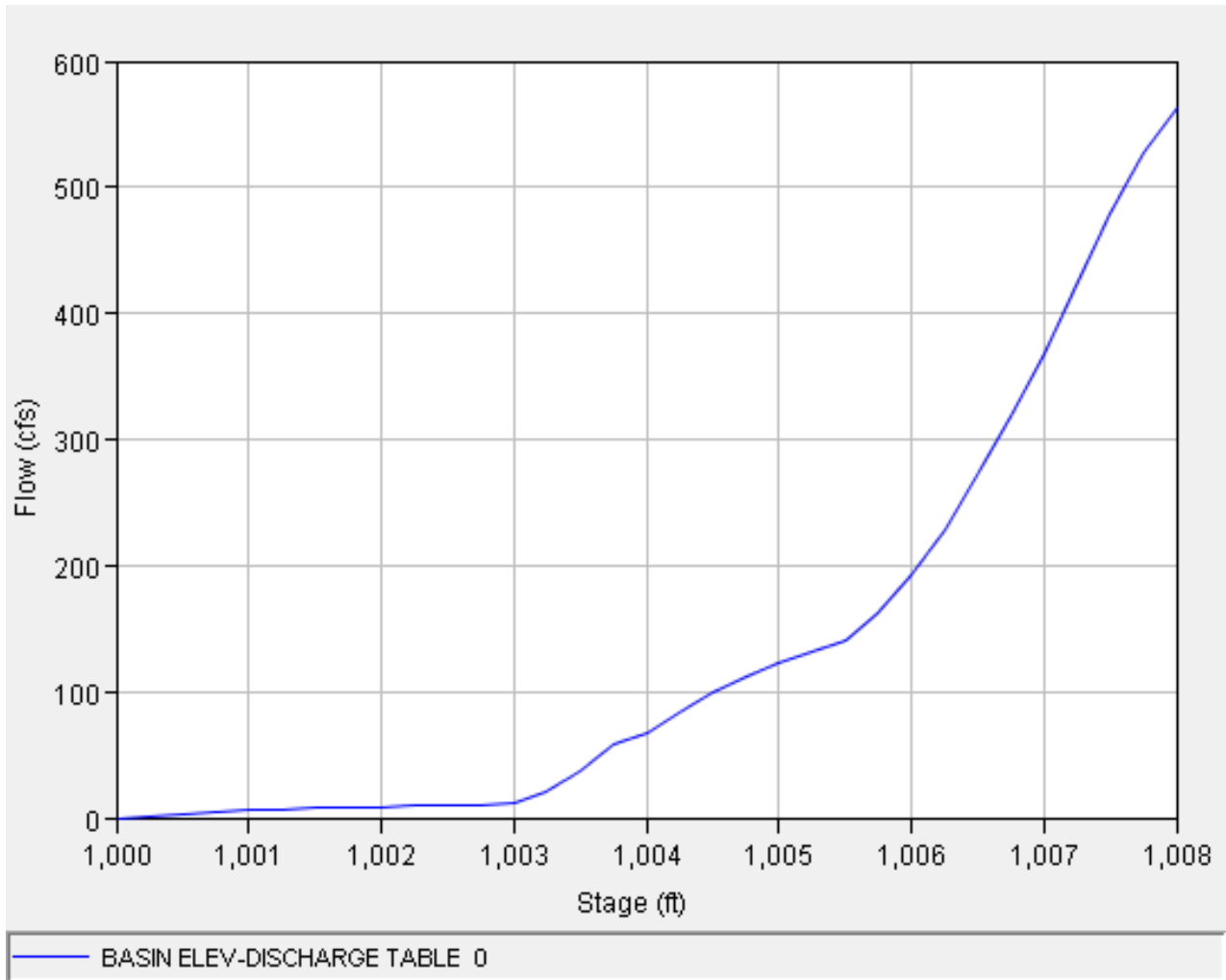
— RETENTION BASIN RUN:PROPOSED 100 YR ELEVATION  
— RETENTION BASIN RUN:PROPOSED 100 YR STORAGE

**100 Year Bypass**





**Retention Basin Combined Outflow Elevation Discharge**



## **Exhibit 10 – Water Quality Volume and Sedimentation Calculations**

Water Quality Volume = WQv = P x Rv

P = 1.37"

Rv = 0.05 + 0.009( % Impervious)

Rv = 0.05 + 0.009(40)

Rv = 0.41

WQv = 1.37 x 0.41 = 0.5617 inches

WQv = 0.5617 inches x 79.83 acres (development) = **3.74 AC-FT**  
= **162,771 CF**

### 40 Hour Draw Down Calculation

WQv at elevation 1001.39'

Average Head = 0.70'

40 hours = 144,000 seconds

Average Q = WQv / 40 Hours = 162,771 CFS / 144,000 seconds = 1.13 CFS

Average Head & Average Discharge → **Requires 8" orifice**

### Sedimentation Calculation

Drainage Area = 106.89 acres

C = 0.66 (CN=87.5)

Per APWA Figure 5608-1, Sediment Storage Required = 67 CF / Acre / Year

Total Sediment Storage = (106.89 acres) x (67 CF/AC/YR) = **7,162 CF / Year**

5 Year Sediment Storage = (5 Years) x (7162 CF/Year) = **35,810 CF = 0.822 AC-FT**

5 Year Sediment Storage achieved in approximately 6 inches of depth in retention basin.

Total Permanent Pool Depth = 8 feet.