

# PRELIMINARY STORMWATER STUDY

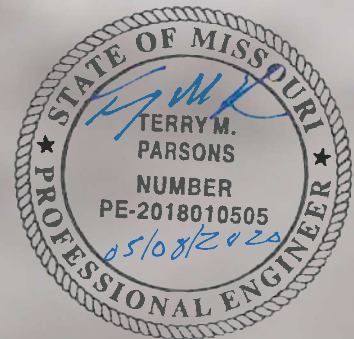
LS MIDDLE SCHOOL #4  
Lee's Summit, Jackson County, Missouri

**Prepared for:**

Lee's Summit School District  
Lee's Summit, Missouri

**Prepared By**

Olsson  
7301 W. 133<sup>rd</sup> Street, Suite 200  
Overland Park, Kansas 66213



May 2020

Olsson Project No. 020-0103



# TABLE OF CONTENTS

Summary .....	1
1. Introduction .....	2
1.1. Project Location and Description .....	2
1.2. Study Purpose .....	2
2. Methodology .....	2
2.1. General Criteria and References .....	2
2.2. Soils Description .....	3
3. Hydrologic/Hydraulic Analyses .....	3
3.1. Existing Conditions .....	3
3.2. Stream Protection and Buffer Zones .....	3
3.3. Proposed Conditions Analysis .....	4
3.4. Stormwater Detention .....	6
4. Storm water treatment requirements .....	6
5. cleanwater act section 404 permitting requirements .....	7
6. FEMA/DWR Permit Requirements .....	7
7. Conclusions and Recommendations .....	7

## LIST OF TABLES

Table 1. Post-Development Peak Flows.....	5
Table 2. Detention Basin Information .....	6

## APPENDICES

### Appendix A **Exhibits**

Existing Conditions

Stream Setback

Site Plan

Utility Plan

Stormwater Management Plan

### Appendix B **Accompanying Documents**

Soils Map

FEMA Firmette

### Appendix C **Detention Calculations**

## SUMMARY

This storm drainage study is being submitted on behalf of the Lee's Summit School District for the proposed development of the property located south of Bailey Road between Dalton Drive and Ranson Road, in Lee's Summit, Jackson County, Missouri. This property is an existing terraced row crop field with no existing buildings. This preliminary report is being submitted to the City of Lee's Summit with the Preliminary Development Plans for approval of this institutional development.

# 1. INTRODUCTION

This final stormwater management study is being submitted on behalf of Lee's Summit School District for a development on a 51.85 acre parcel of land generally located south of Bailey Road between Dalton Drive and Ranson Road, in Lee's Summit, Jackson County, Missouri.

## 1.1. Project Location and Description

The proposed site is located in the northeast quarter of Section 16, Township 47 North, Range 31 West. The existing site is currently undeveloped consisting of terraced row crop. The site drains to the southeast into an unnamed tributary that runs along the entirety of the east side of the property. The tributary flows south to Big Creek. The site is not located within the flood plain.

## 1.2. Study Purpose

The purpose of this report is to verify this development's conformance with the City of Lee's Summit Design Criteria and Plan Requirements for Public Improvement Plans 2019 edition. Storm water drainage facilities are designed according to section F of aforementioned criteria. This study will outline methods to mitigate impacts on storm water runoff resulting from the development for the 1, 10 and 100-year rainfall events and for treatment of stormwater runoff with the use of permanent stormwater treatment facilities.

# 2. METHODOLOGY

## 2.1. General Criteria and References

Analytical and design criteria conform to those of Division V - Section 5600 – "Storm Drainage Systems and Facilities" of the Kansas City Metropolitan Chapter of the American Public Works Association's "Standard Specifications and Design Criteria". Based on these criteria's, Post-development discharge rates for the 2, 10, and 100-year storm events will be limited to provisions in section 5608.4-C1 Performance Criteria – "Comprehensive Control". Post-development discharge rates are limited to 0.5 cfs per acre for 2-Year, 2.0 cfs per acre for 10-year, and 3.0 cfs per acre for 100-year storm events.

Post development flows from the site are shown below and were calculated using HEC-HMS for the 2, 10 and 100-year storm events. Existing and proposed hydrographs were calculated using the 24-hour SCS Type II rainfall distribution. Existing times of concentration were determined using Inlet Time and Travel Time equations found in Section 5602.7 of APWA Section 5600.

## 2.2. Soils Description

Soil classifications by the United States Department of Agriculture (USDA) on the Natural Resources Conservation Service (NRCS) Soils website for Johnson County, Kansas show the existing site consisting of the following soil types:

10117 – Sampsel Silty Clay Loams, 5 to 9 percent slopes – HSG Type C/D

10082 – Arisburg-Urban Land Complex, 1 to 5 percent slopes – HSG Type C

*\*HSG – Hydrologic Soils Group (The NRCS information is included in the Appendix B).*

## 3. HYDROLOGIC/HYDRAULIC ANALYSES

### 3.1. Existing Conditions

The property is bounded by residential lots to the west and north. Bailey Road is also located on the north side of the property. To the south and east the adjacent properties are currently undeveloped. A tributary to Big Creek, that flows to the south, lies along the entire east property line of the site. The storm drainage from the residential lots to the north comes under Bailey Road and empties into the north end of the tributary. The property currently contains no impervious area and runoff flows southeasterly to the tributary. An Exhibit of the Existing Conditions is included in Appendix A.

With the comprehensive control method is being used for drainage design, an existing curve number analysis is not required for the site.

### 3.2. Stream Protection and Buffer Zones

A portion of the property will be defined as a Stream Protection Buffer Zone. The proposed buffer zone will meet the requirements established in Section 5603.5 of the APWA Section 5600 Design Criteria.

The width of the setback is determined by the drainage area to the stream. Using USGS contours the drainage area for the stream was determined at different points. A minor tributary from the east is the location for Point 1. The drainage area to Point 1 is 138 acres. Therefore, a 60' offset from the ordinary high water mark (OHM), i.e. surveyed top of bank, is used to determine the buffer extent to that point. Point 2 is located where the stream exits at the southern edge of the property. The total drainage to this point is 210 acres. The setback from Point 1 to Point 2 is 100'. An exhibit of the stream setback drainage areas is included in Appendix A.

### 3.3. Proposed Conditions Analysis

Post development, the entirety of the of the property will continue to flow to the tributary to the east. The proposed site will include the middle school, a softball/baseball complex (with 4 fields), a track, practice fields, outdoor classrooms, parking, three extended dry detention basins, private storm, and associated utilities. Roof drains, private storm sewer pipe and inlets will allow adequate drainage of the proposed school, athletic facilities and parking areas. The private storm will drain into the detention basins and then be routed to the tributary. A private road will be constructed for access to the bus turnaround and parking areas. The road will connect to the existing Bailey Road on the north to proposed Cape Road on the south.

The proposed Cape Road will be located on the southern portion of the property. The right of way will be dedicated to the city with a portion the road being constructed to connect to existing Cape Road to the west. When the road is completely constructed a public storm system will drain to road to the tributary. Temporary provisions will be implemented to drain the constructed road to the stream.

The backyards of the residential subdivisions to the west also drain onto the existing sight. These 2.5 acres will drain to the proposed north-south private road and will enter into the proposed storm system for the road.

The site will be divided into four main drainage areas. An exhibit of the Stormwater Management Plan drainage areas is included in Appendix A. Each drainage area will have collection system and an extended dry detention basin with control structure. A general description of what is draining to each area is as follows:

Drainage Area 1 (6.3 acres)	Two north ball fields
Drainage Area 2 (8.6 acres)	Southeast ball field and north end of middle school
Drainage Area 3 (17.6 acres)	Southwest ball field, south end of middle school, north-south drive, main parking area, bus turnaround area, and practice fields
Drainage Area 4 (4.2 acres)	Track and track infield

Approximately 1.8 acres east of the proposed building and eastern drive will flow into the tributary. Improvement in this area are minimal so no detention will be required.

The ballfields and the track will have synthetic surfacing with underdrain systems. The current plan is for the two north fields to have synthetic turf on the infields and outfields. The two south fields will have synthetic turf on the infields only. If the budget allows, there is a possibility that the

two south fields will have also have synthetic turf in the outfields. For the purposes of this report, the ballfields will be treated as if they have a complete synthetic surface.

The synthetic surface will act as impervious surface. However, the underdrain system, with its aggregate subsurface rock layer and underdrain piping, will increase the time of concentration (Tc) for the runoff that is guided through the underdrain system. The increase in Tc will be from 30 to 45 minutes based on the final underdrain design. An increase of thirty minutes will be used for the purposes of the preliminary report. The HEC-HMS model based its Tc's on a time to inlet of 5 minutes and then an estimation of pipe travel time. This was used as the Tc for the impervious and pervious areas in the drainage area. The synthetic fields had an additional time of 30 minutes added to their Tc's.

Based on the completed models the peak flows for each area are included in the table below:

**Table 1. Post-Development Peak Flows**

Site Description	Total Area (ac)	CN	Storm Event	Runoff Q (cfs)
Area 1	6.3	79.4	2-YR	<b>10.2</b>
			10-YR	<b>15.4</b>
			100-YR	<b>22.4</b>
Area 2	8.6	90.6	2-YR	<b>12.4</b>
			10-YR	<b>29.1</b>
			100-YR	<b>42.9</b>
Area 3	17.6	90.5	2-YR	<b>33.1</b>
			10-YR	<b>78.1</b>
			100-YR	<b>115.2</b>
Area 4	4.2	80.7	2-YR	<b>8.3</b>
			10-YR	<b>13.3</b>
			100-YR	<b>20.4</b>



### 3.4. Stormwater Detention

As stated previously, a new detention basin will be constructed for each area to mitigate the increase in flow due to the increase in impervious area. A control structure will be located at the outlet of the basin. An orifice/weir plate in the control structure will limit outflow in the 2, 10, and 100-year storms.

The control structure for each basin is designed to limit the outlet flow to the allowable release rate for each storm based on the Comprehensive Control Strategy. Hydrographs for the combined flows of the detained and undetained areas are shown in Appendix C.

To meet water treatment requirements, the basin will act as extended dry detention. The water quality volume (WQv) will be controlled by a series of 1" orifices at the bottom of the orifice plate. The conduit will release the water quality volume over a 40-hour period to allow pollutants to settle out of this precipitation event.

**Table 2. Detention Basin Information**

Area	Drainage Area (acres)	Storm Event	Allowable Release Rate (cfs)	Design Release Rate (cfs)	Storage Required (ac-ft)	WSE (ft elev)
1	6.3	2-YR	3.2	3.2	0.5	1010.4
		10-YR	12.6	10.6	0.7	1011.1
		100-YR	18.9	18.3	0.9	1011.5
2	8.6	2-YR	4.3	4.1	0.4	1001.7
		10-YR	17.2	14.7	1.0	1003.4
		100-YR	25.8	24.9	1.4	1004.3
3	17.6	2-YR	8.8	8.5	0.8	996.0
		10-YR	35.2	35.2	2.0	997.6
		100-YR	52.8	58.1	2.9	998.6
4	4.2	2-YR	2.1	2.1	0.1	997.2
		10-YR	8.4	7.6	0.3	998.4
		100-YR	12.6	12.3	0.4	999.0

## 4. STORM WATER TREATMENT REQUIREMENTS

As stated previously, the four detention basins will be designed to act as extended dry bottom detention facilities to treat stormwater per MARC water quality standards. The orifice plate for

the basin will be sized to release the water quality volume (1.37") over a 40-hour period to allow pollutants to settle from runoff before entering the public stormwater system.

## **5. CLEANWATER ACT SECTION 404 PERMITTING REQUIREMENTS**

Construction will not be occurring within jurisdictional Waters of the United States. Therefore, a Section 404 permit is not required.

## **6. FEMA/DWR PERMIT REQUIREMENTS**

No FEMA permitting or submittals will be required on this site because there are no FEMA delineated floodplains on the site. A copy of the FIRM map for this area has been included in Appendix B.

## **7. CONCLUSIONS AND RECOMMENDATIONS**

As outlined in the preceding report, increased runoff rates in the post-development conditions are mitigated by the detention basin. Drainage patterns on the site remain will relatively unchanged. Lastly, four extended dry detention basins will be designed to limit site runoff to comprehensive control rates and to improve the storm water quality. Based on these facts and other information provided herein, we request approval of this stormwater study.

## **APPENDIX A**

### **Exhibits**

Existing Conditions

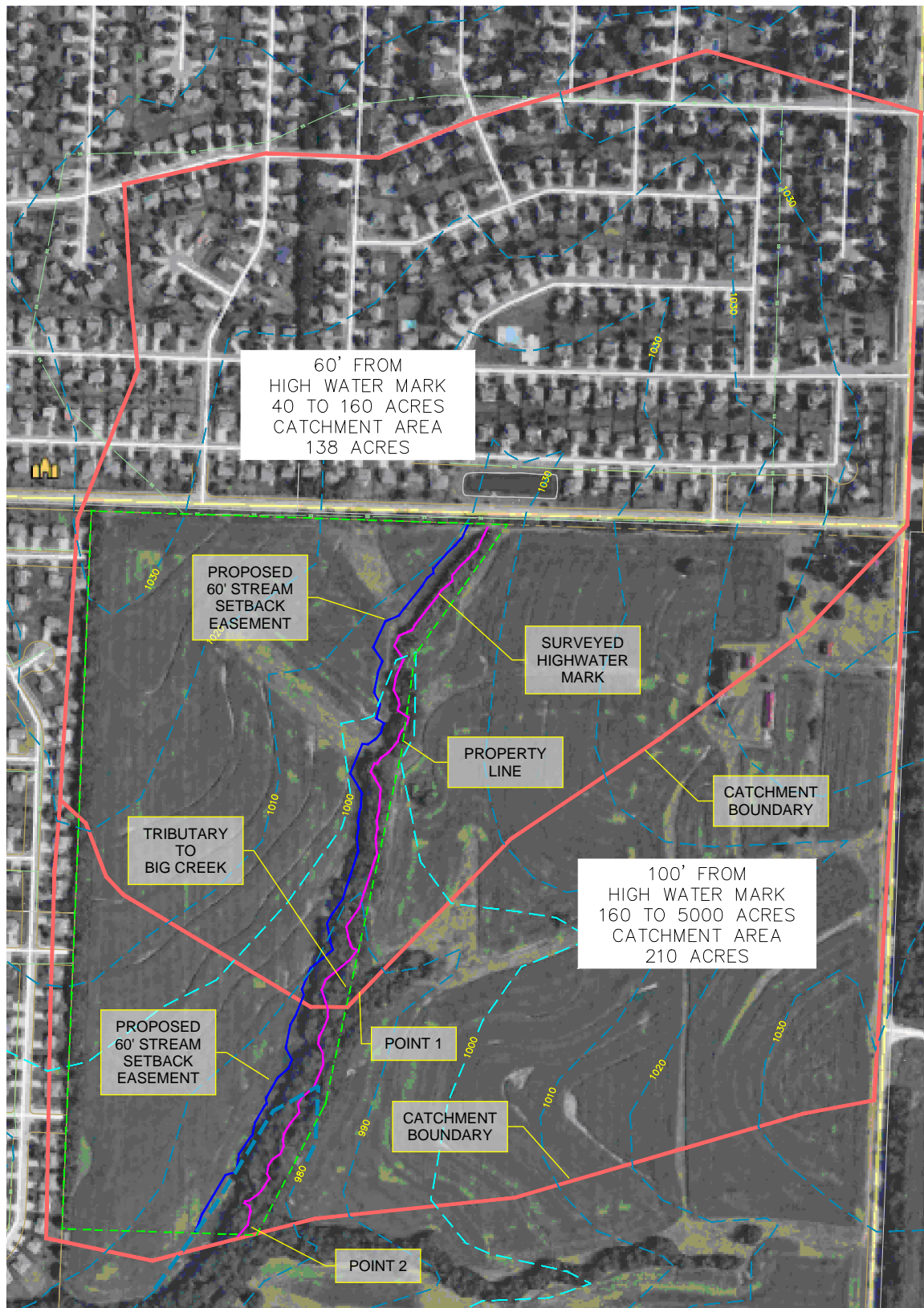
Stream Setback

Site Plan

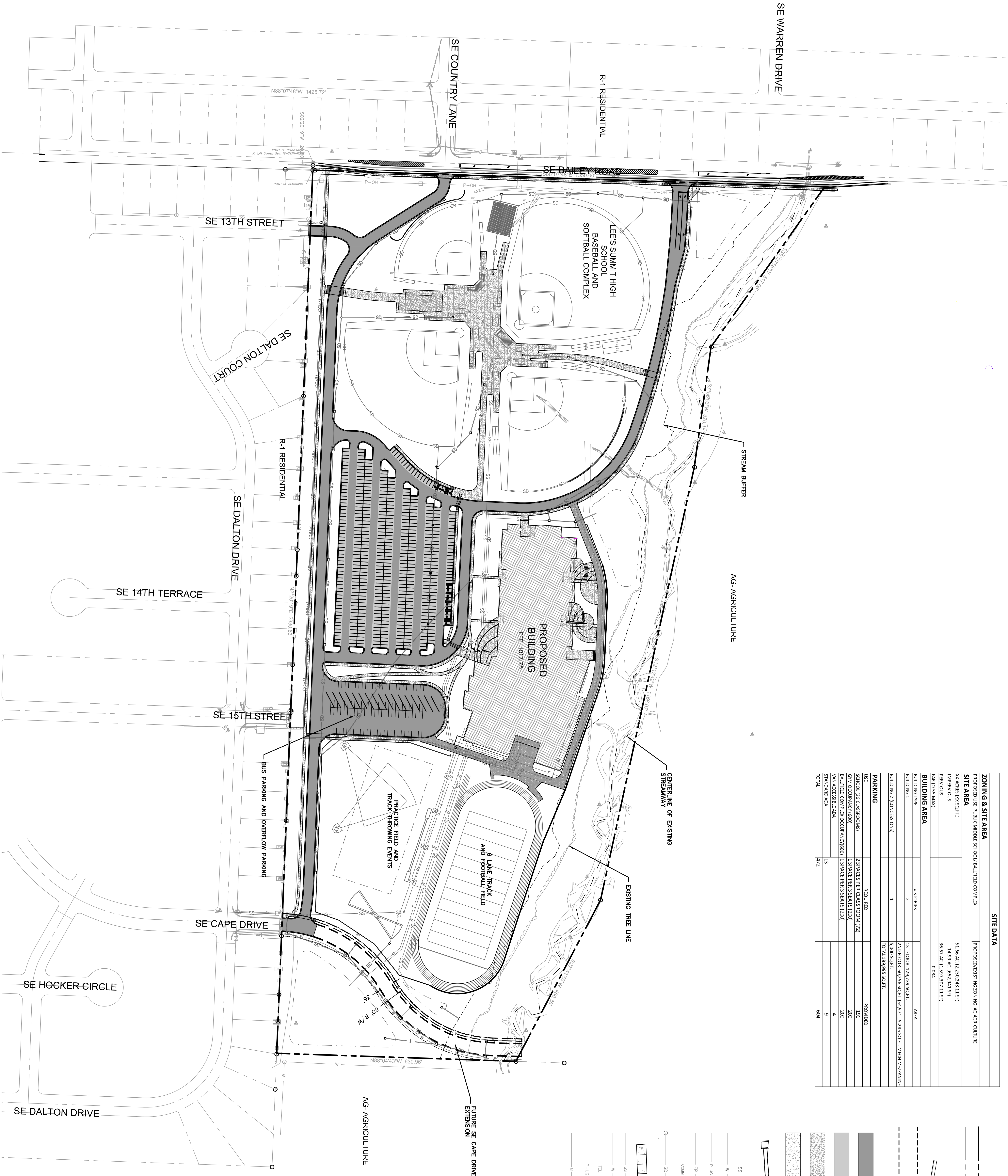
Utility Plan

Stormwater Management Plan

# LS MIDDLE SCHOOL #4 STREAM SETBACK EXHIBIT





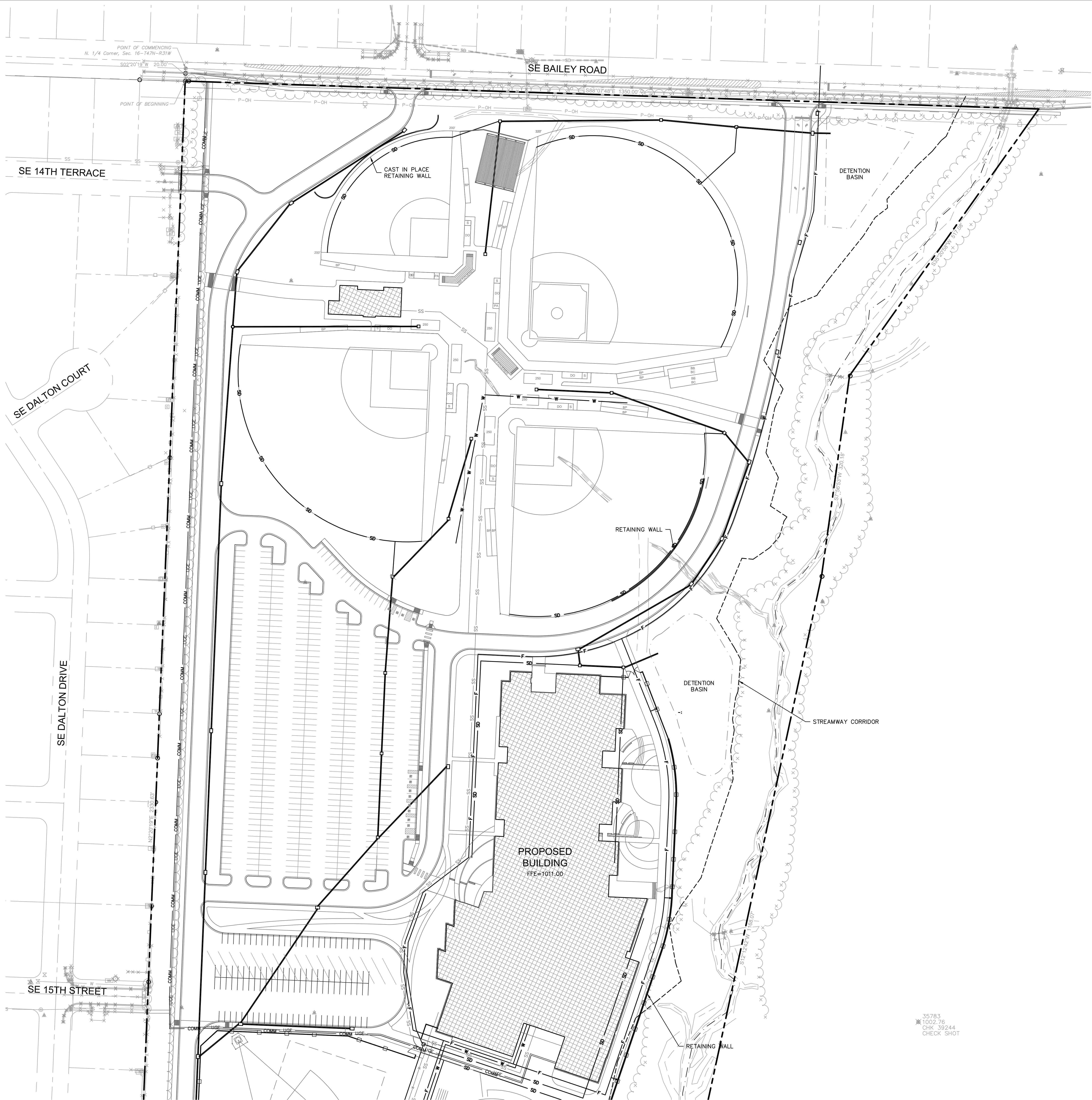


SITE DATA	
ZONING & SITE AREA	PROPOSED LEE'S PUBLIC MIDDLE SCHOOL BUILDING COMPLEX
SITE AREA	51.66 AC. (2,230,248.13 SQ. FT.)
ADJACENT AREAS	14.89 AC. (652,341.57 SQ. FT.)
ADJACENT AREAS	38.67 AC. (1,672,607.13 SQ. FT.)
ADJACENT AREAS	0.98 AC. (42,811.13 SQ. FT.)
BUILDING AREA	4,870 SQ. FT.
BUILDING 1	2
BUILDING 2 (CONNECTIONS)	1
TOTAL	189,995 SQ. FT.
USE	REQUIRED
SCHOOL USE (CLASSROOMS)	2 SPACES PER CLASSROOM (72)
GYM OCCUPANCY (600)	1 SPACE PER 3 SEATS (200)
BUILDING COMPLEX OCCUPANCY (600)	1 SPACE PER 3 SEATS (200)
VAN ACCESSIBLE ADA	13
STANDARD ADA	472
TOTAL	604

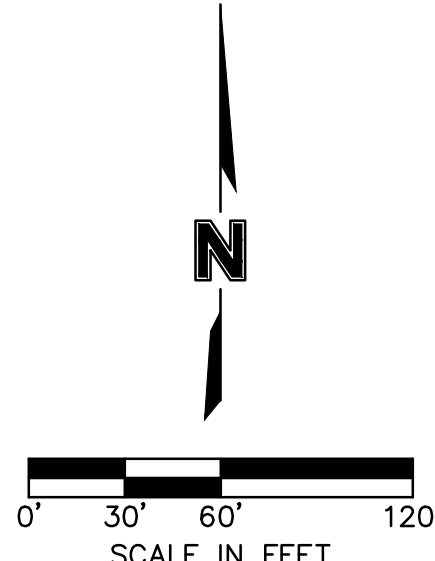
LEGEND	
PROPERTY LINE	---
LOT LINE	---
UTILITY EASEMENT	---
CONSTRUCT CONCRETE CURB & GUTTER	---
SAWCUT PAVEMENT FULL DEPTH	---
ADA PATH - SIDEWALKS NOT TO BE ADA COMPLIANT	---
HEAVY DUTY ASPHALT PAVEMENT	---
STANDARD DUTY ASPHALT PAVEMENT	---
HEAVY DUTY CONCRETE PAVEMENT	---
CONCRETE PAVEMENT	---
STORM SEWER	---
SANITARY SERVICE LINE	---
WATER SERVICE LINE	---
UNDERGROUND POWER SERVICE LINE	---
FIRE PROTECTION LINE	---
COMMUNICATIONS SERVICE LINE	---
LANDSCAPE/ROOF DRAIN	---
ADA CONCRETE SIDEWALK AND RAMP	---
EXISTING SANITARY SEWER MAIN	---
EXISTING WATER MAIN	---
EXISTING COMMUNICATIONS LINE	---
EXISTING ELECTRIC LINE	---
EXISTING GAS MAIN	---



DWG: F:\2020\0001-0500\020-0103\40-design\AutoCAD\preliminary plans\Sheets\GNVC\UTL01\_020103.dwg USER: sjallard  
DATE: May 08, 2020 11:22am XREFS: C:\BASE\_020103 C:\PBASE\_020103 V\_XB0U\_00103 C:\PTBLK\_020103



- LEGEND**
- PROPERTY LINE
  - LOT LINE
  - UTILITY EASEMENT
  - STORM SEWER
  - SANITARY SERVICE LINE
  - WATER SERVICE LINE
  - UNDERGROUND POWER SERVICE LINE
  - FIRE PROTECTION LINE
  - COMMUNICATIONS SERVICE LINE
  - TRENCH/LANDSCAPE/ROOF DRAIN
  - EXISTING SANITARY SEWER MAIN
  - EXISTING WATER MAIN
  - EXISTING COMMUNICATIONS LINE
  - EXISTING ELECTRIC LINE
  - EXISTING GAS MAIN

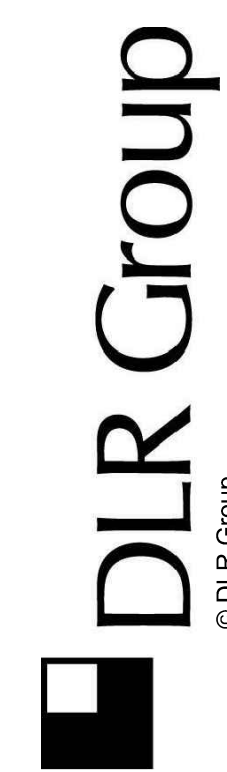


LEE'S SUMMIT MIDDLE SCHOOL #4

PRELIMINARY  
DEVELOPMENT  
PLAN  
Issue Date 05.08.20  
REVISIONS

13-20102-00  
UTILITY PLAN

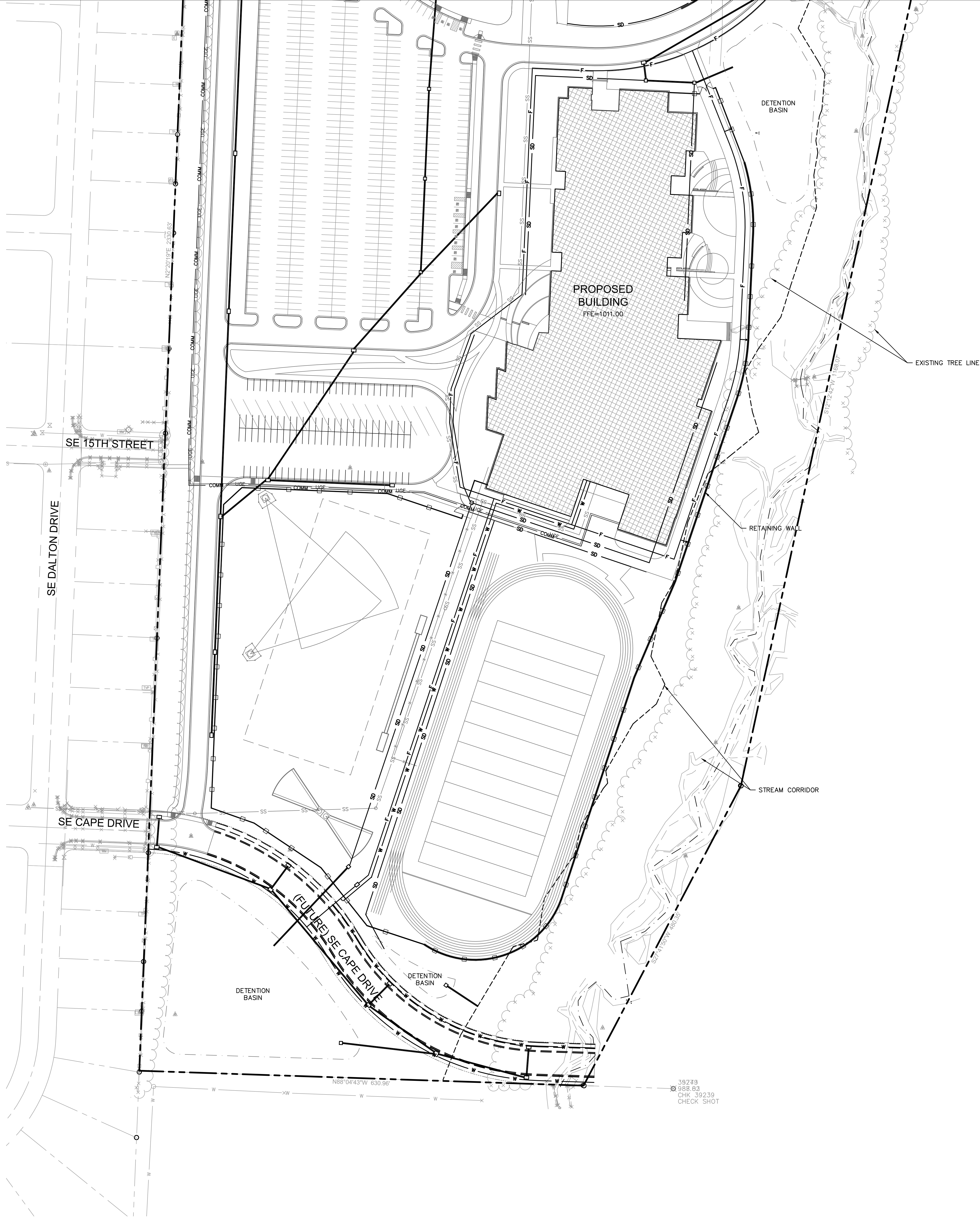
1006



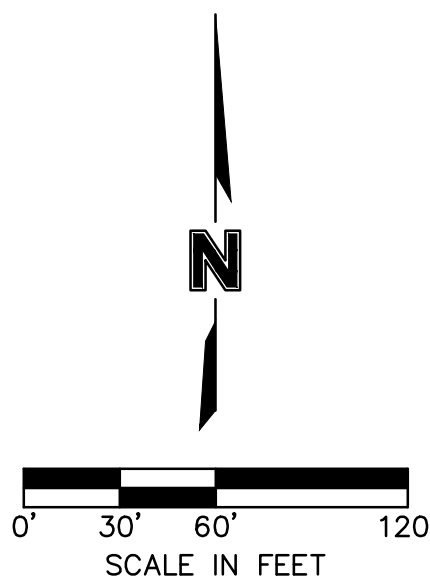
**olsson**  
7301 West 133rd Street, Suite 200  
Overland Park, KS 66213-4750  
TEL 913.381.1170  
www.olsosn.com



DWG: F:\2020\0001-0500\020-0103\40-design\AutoCAD\preliminary plans\Sheets\GNVC\UTL01\_0200103.dwg USER: sgillard  
DATE: May 08, 2020 11:23am XREFS: C:\BASE\_0200103 C:\BASE\_0200103 V\_XB0U\_00103 C:\PTBLK\_0200103



LEGEND	
	PROPERTY LINE
	LOT LINE
	UTILITY EASEMENT
	STORM SEWER
	SANITARY SERVICE LINE
	WATER SERVICE LINE
	UNDERGROUND POWER SERVICE LINE
	FIRE PROTECTION LINE
	COMMUNICATIONS SERVICE LINE
	TRENCH/LANDSCAPE/ROOF DRAIN
	EXISTING SANITARY SEWER MAIN
	EXISTING WATER MAIN
	EXISTING COMMUNICATIONS LINE
	EXISTING ELECTRIC LINE
	EXISTING GAS MAIN



LEE'S SUMMIT MIDDLE SCHOOL #4

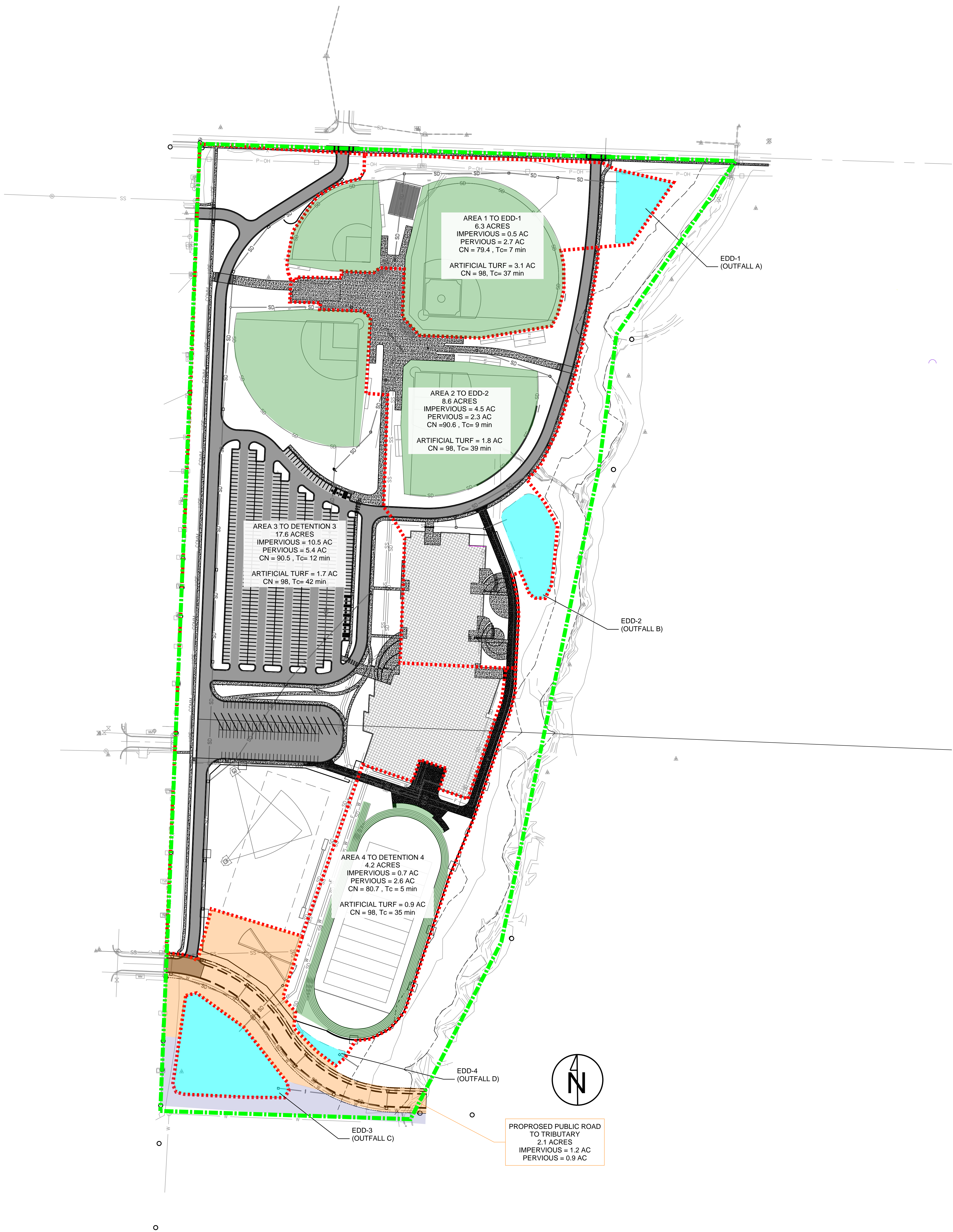
PRELIMINARY  
DEVELOPMENT  
PLAN  
Issue Date 05.08.20  
REVISIONS

13-20102-00  
UTILITY PLAN



# LS MIDDLE SCHOOL #4

## STORMWATER MANAGEMENT PLAN





## **APPENDIX B**

### **Accompanying Documents**

Soils Map

FEMA Firmette

# Soil Map—Jackson County, Missouri (LS MIDDLE SCHOOL #4)



Map Scale: 1:4,630 if printed on A portrait (8.5" x 11") sheet.

0 50 100 200 300 Meters

0 200 400 800 1200 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84



**Natural Resources  
Conservation Service**

Web Soil Survey  
National Cooperative Soil Survey

5/5/2020  
Page 1 of 3


## 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



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

### Water Features



Streams and Canals

### Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

### Background



Aerial Photography

## 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 20, Sep 16, 2019

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

Date(s) aerial images were photographed: Sep 6, 2019—Nov 16, 2019

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	28.5	61.1%
10117	Sampsel silty clay loam, 5 to 9 percent slopes	18.1	38.9%
<b>Totals for Area of Interest</b>		<b>46.6</b>	<b>100.0%</b>

## Jackson County, Missouri

### 10117—Sampsel silty clay loam, 5 to 9 percent slopes

#### Map Unit Setting

*National map unit symbol:* 2qkzz

*Elevation:* 600 to 900 feet

*Mean annual precipitation:* 33 to 41 inches

*Mean annual air temperature:* 50 to 55 degrees F

*Frost-free period:* 177 to 220 days

*Farmland classification:* Prime farmland if drained

#### Map Unit Composition

*Sampsel and similar soils:* 85 percent

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

#### Description of Sampsel

##### Setting

*Landform:* Hillslopes

*Landform position (two-dimensional):* Shoulder

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

*Down-slope shape:* Concave

*Across-slope shape:* Convex, concave

*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

## Data Source Information

Soil Survey Area: Jackson County, Missouri

Survey Area Data: Version 20, Sep 16, 2019

## 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**

#### **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

#### **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

## **Data Source Information**

Soil Survey Area: Jackson County, Missouri  
Survey Area Data: Version 20, Sep 16, 2019



# National Flood Hazard Layer FIRMette



## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
MAP PANELS		Profile Baseline
		Hydrographic Feature
		Digital Data Available
		No Digital Data Available
		Unmapped



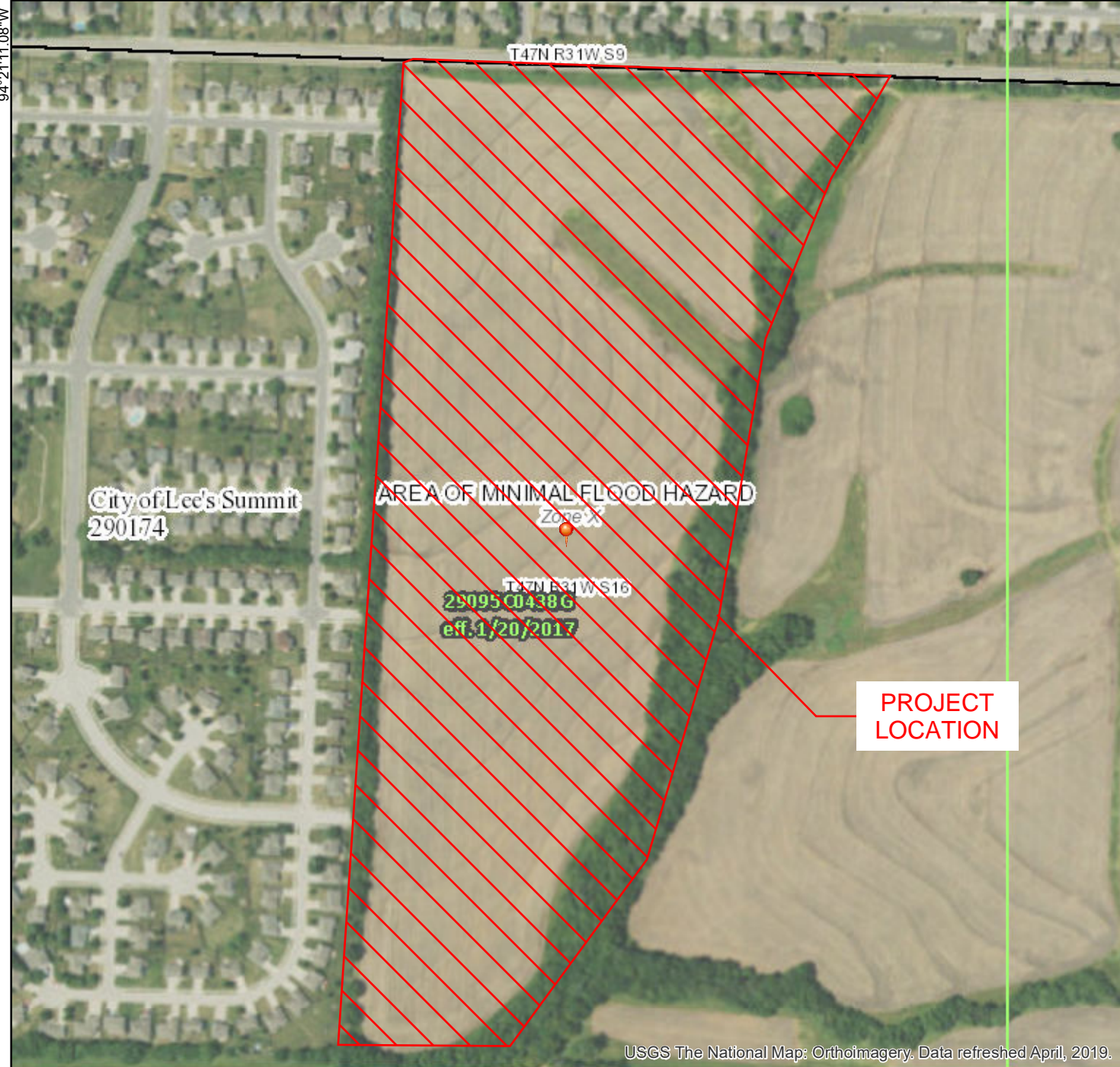
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 5/5/2020 at 4:01:03 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

38°53'44.76"N



0 250 500 1,000 1,500 2,000 Feet 1:6,000

38°53'16.76"N

94°20'33.63"W

## **APPENDIX C**

### **Detention Calculations**

# LS MIDDLE SCHOOL #4

## EXTENDED DRY DETENTION BASIN 1

### HEC-HMS OUTPUT

Summary Results for Reservoir "EDD-1"

Project: Area 1 Turf    Simulation Run: 02-Year Proposed  
Reservoir: EDD-1

Start of Run: 01Jan2018, 00:00    Basin Model: Proposed  
End of Run: 02Jan2018, 00:15    Meteorologic Model: 2-Year  
Compute Time: 07May2020, 19:06:22    Control Specifications: Control 1

Volume Units: ☒ IN    ☐ AC-FT

Computed Results

Peak Inflow:	9.6 (CFS)	Date/Time of Peak Inflow:	01Jan2018, 12:30
Peak Discharge:	3.2 (CFS)	Date/Time of Peak Discharge:	01Jan2018, 13:00
Inflow Volume:	3.15 (IN)	Peak Storage:	0.5 (AC-FT)
Discharge Volume:	3.14 (IN)	Peak Elevation:	1010.4 (FT)

Reach-1

Summary Results for Reservoir "EDD-1"

Project: Area 1 Turf    Simulation Run: 10-Year Proposed  
Reservoir: EDD-1

Start of Run: 01Jan2018, 00:00    Basin Model: Proposed  
End of Run: 02Jan2018, 00:15    Meteorologic Model: 10-Year  
Compute Time: 07May2020, 19:06:23    Control Specifications: Control 1

Volume Units: ☒ IN    ☐ AC-FT

Computed Results

Peak Inflow:	14.6 (CFS)	Date/Time of Peak Inflow:	01Jan2018, 12:30
Peak Discharge:	10.6 (CFS)	Date/Time of Peak Discharge:	01Jan2018, 12:45
Inflow Volume:	4.89 (IN)	Peak Storage:	0.7 (AC-FT)
Discharge Volume:	4.92 (IN)	Peak Elevation:	1011.1 (FT)

Summary Results for Reservoir "EDD-1"

Project: Area 1 Turf    Simulation Run: 100-Year Proposed  
Reservoir: EDD-1

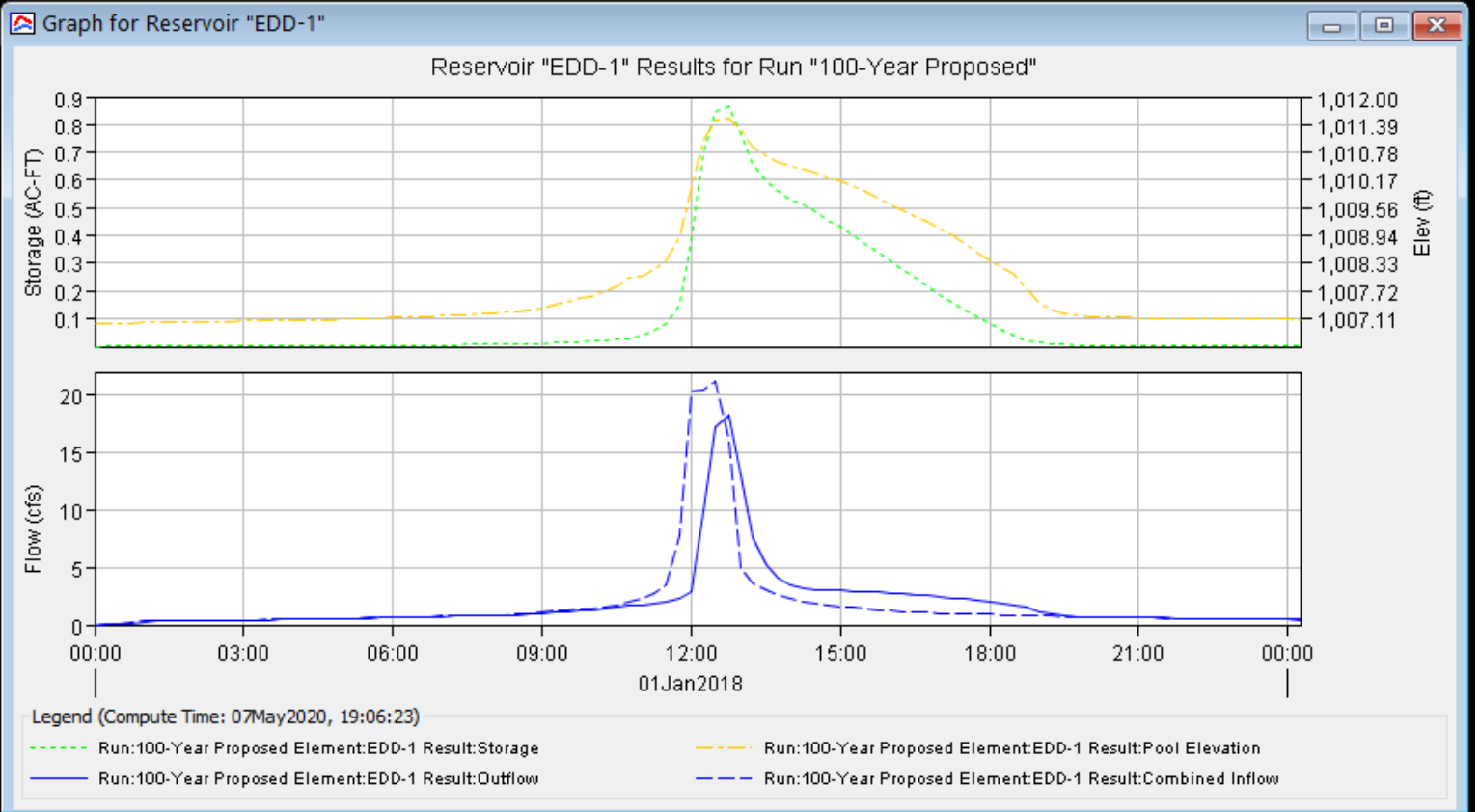
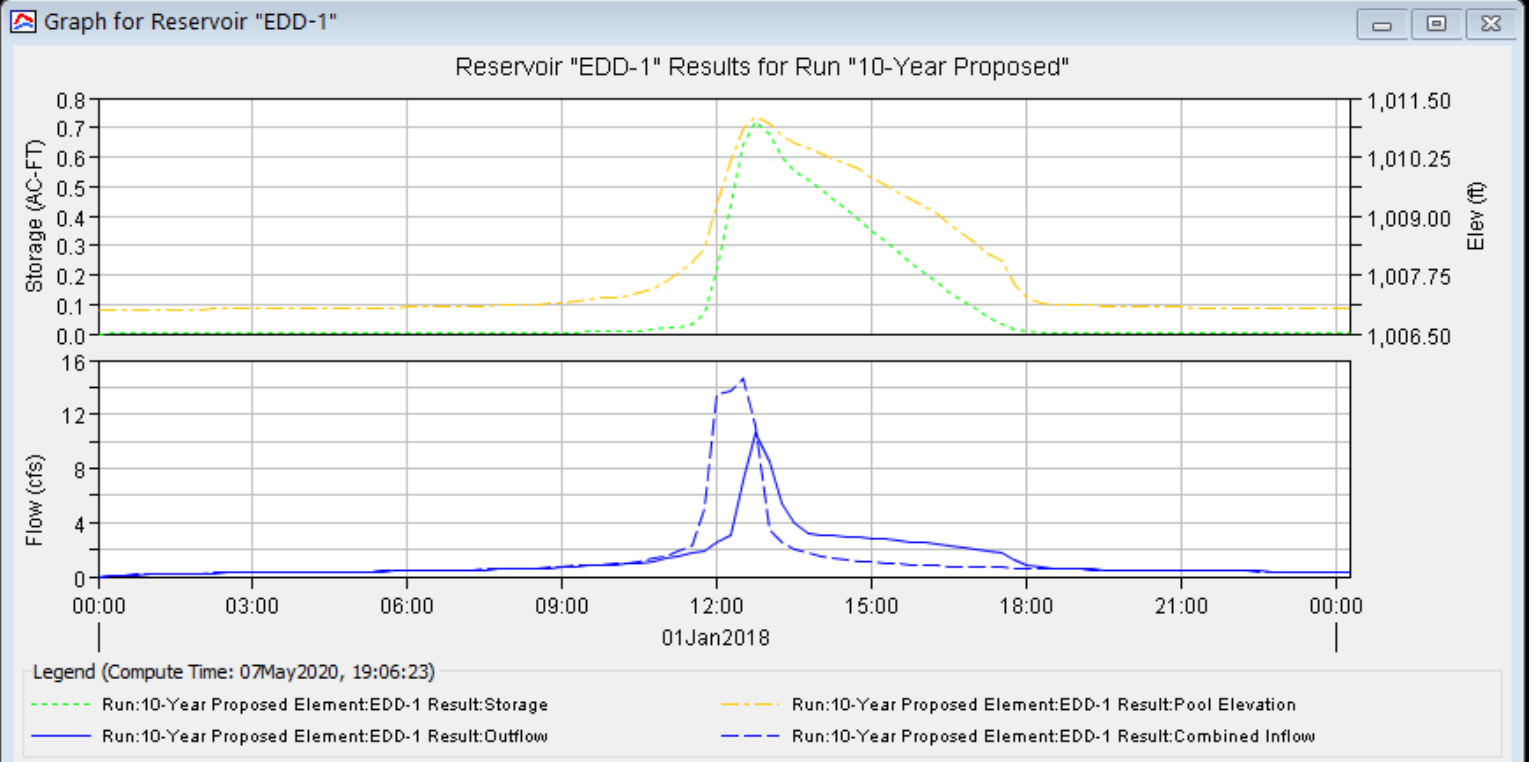
Start of Run: 01Jan2018, 00:00    Basin Model: Proposed  
End of Run: 02Jan2018, 00:15    Meteorologic Model: 100-Year  
Compute Time: 07May2020, 19:06:23    Control Specifications: Control 1

Volume Units: ☒ IN    ☐ AC-FT

Computed Results

Peak Inflow:	21.2 (CFS)	Date/Time of Peak Inflow:	01Jan2018, 12:30
Peak Discharge:	18.3 (CFS)	Date/Time of Peak Discharge:	01Jan2018, 12:45
Inflow Volume:	7.25 (IN)	Peak Storage:	0.9 (AC-FT)
Discharge Volume:	7.31 (IN)	Peak Elevation:	1011.5 (FT)

# LS MIDDLE SCHOOL #4 EXTENDED DRY DETENTION BASIN 1 HEC-HMS STAGE-STORAGE & INFLOW-OUTFLOW HYDROGRAPHS

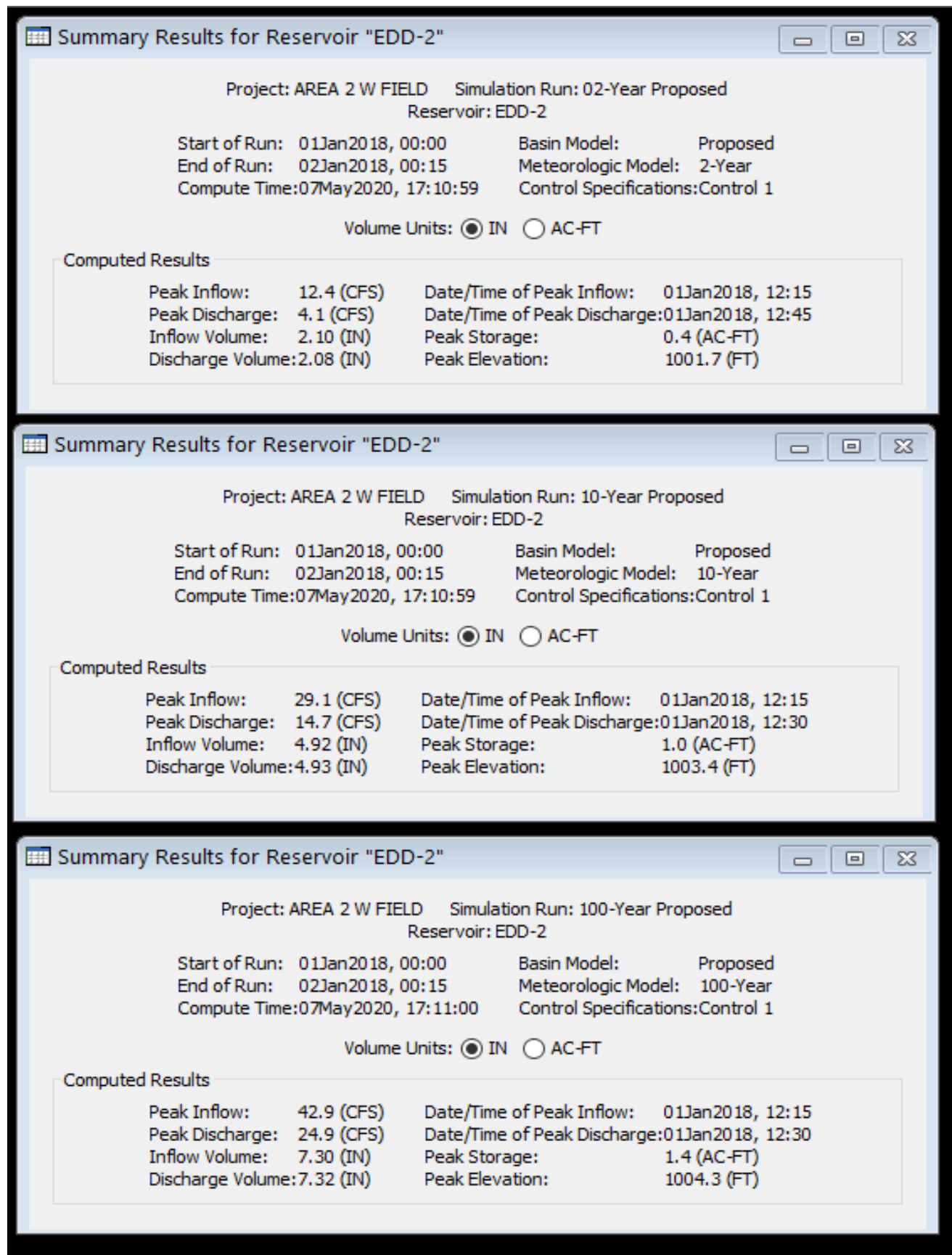




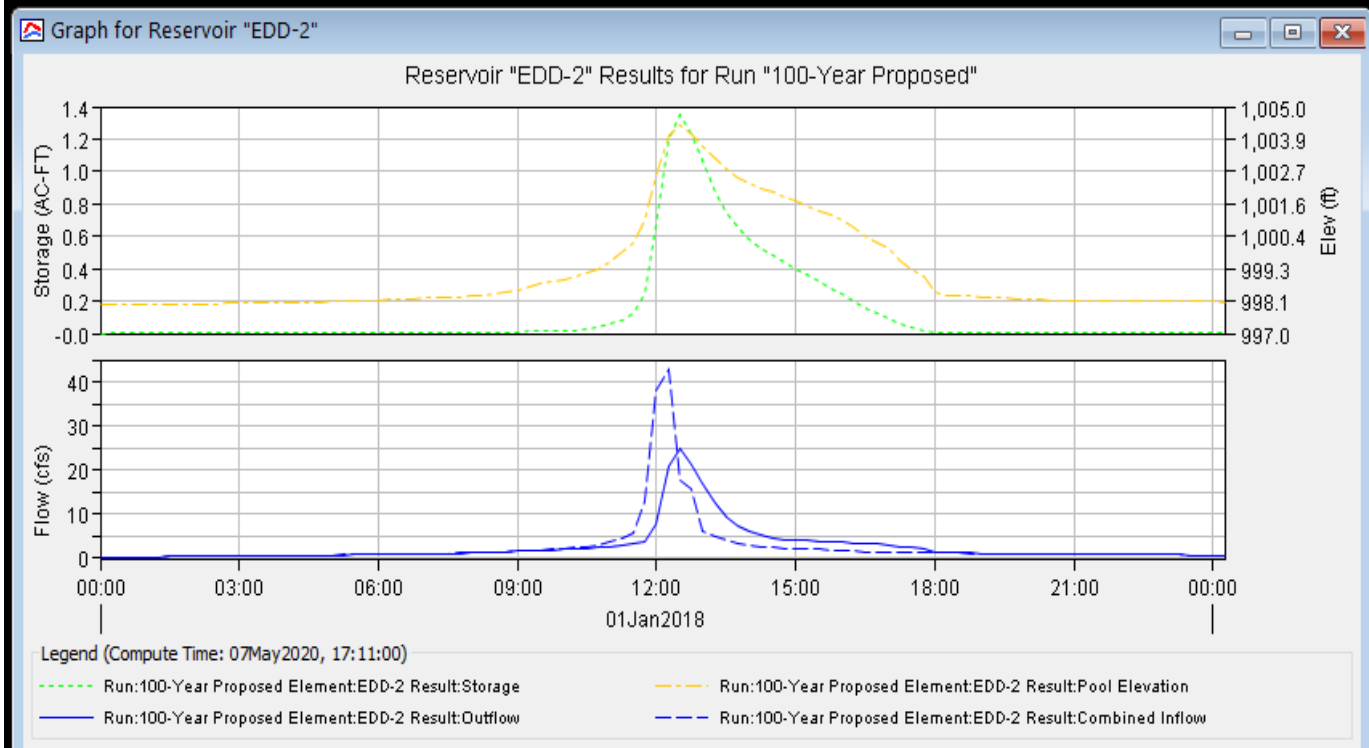
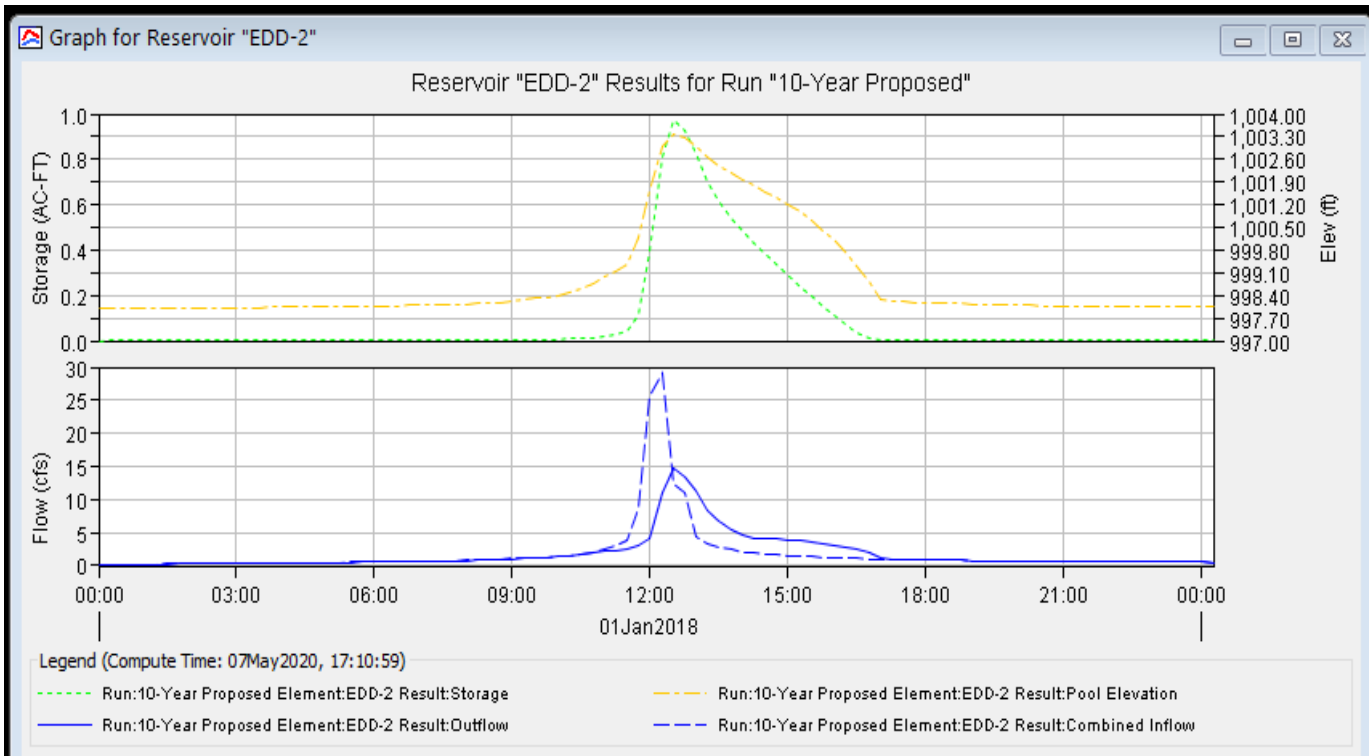
# LS MIDDLE SCHOOL #4

## EXTENDED DRY DETENTION BASIN 2

### HEC-HMS OUTPUT



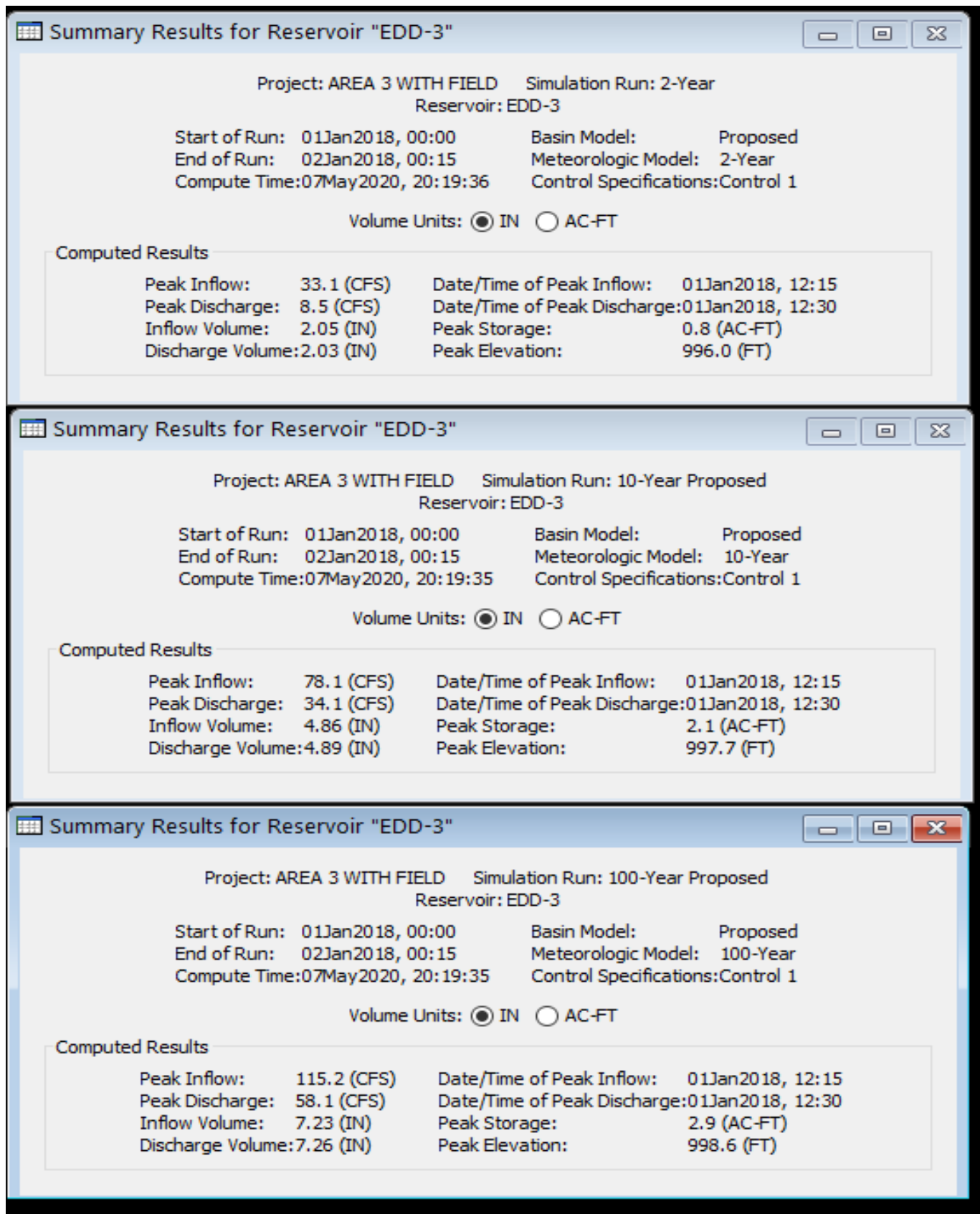
# LS MIDDLE SCHOOL #4 EXTENDED DRY DETENTION BASIN 2 HEC-HMS STAGE-STORAGE & INFLOW-OUTFLOW HYDROGRAPHS



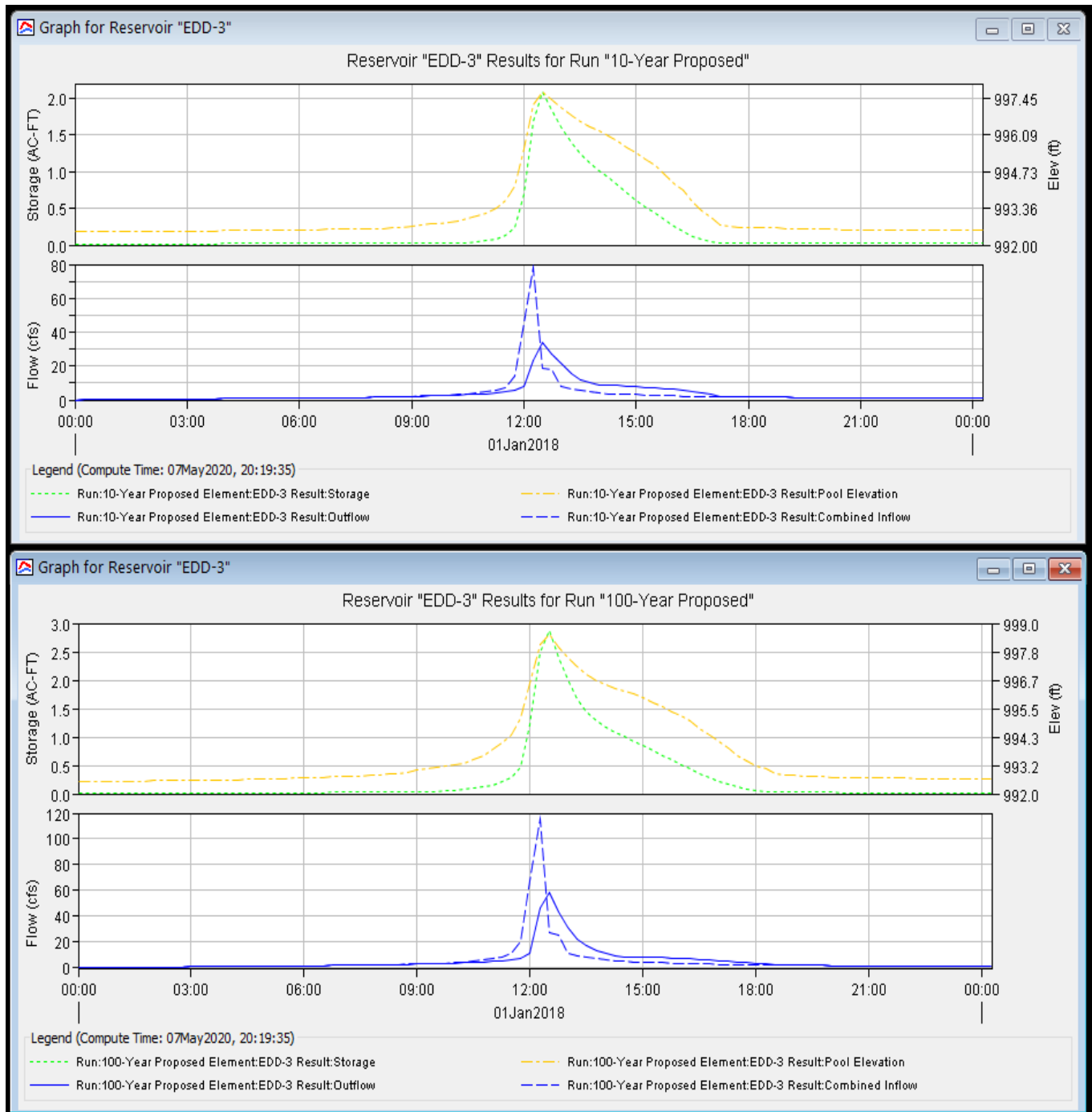
# LS MIDDLE SCHOOL #4

## EXTENDED DRY DETENTION BASIN 3

### HEC-HMS OUTPUT



# LS MIDDLE SCHOOL #4 EXTENDED DRY DETENTION BASIN 3 HEC-HMS STAGE-STORAGE & INFLOW-OUTFLOW HYDROGRAPHS

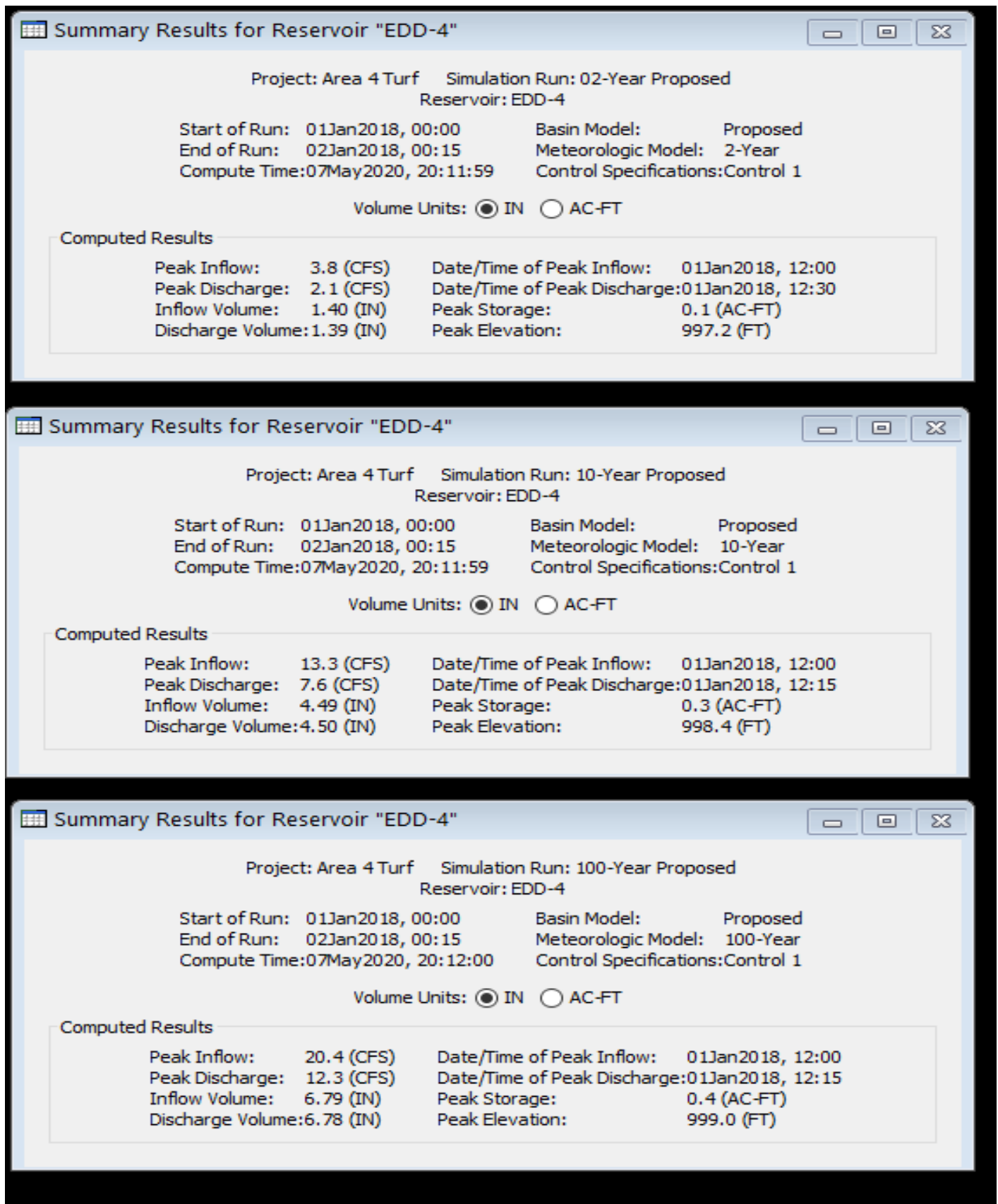




# LS MIDDLE SCHOOL #4

## EXTENDED DRY DETENTION BASIN 4

### HEC-HMS OUTPUT



# LS MIDDLE SCHOOL #4 EXTENDED DRY DETENTION BASIN 4 HEC-HMS STAGE-STORAGE & INFLOW-OUTFLOW HYDROGRAPHS

