# MCC AUTOMOTIVE INSTITUTE
# MICRO DRAINAGE STUDY

**Lee's Summit, Jackson County, Missouri**

**FEBRUARY 16, 2024**

*Prepared by*

Taliaferro & Browne, Inc.
Engineering - Landscape Architecture - Surveying


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*Prepared for*

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**500 SW Longview Road**
**Lee's Summit, MO 64081**

# MCC Automotive Institute
# Micro Drainage Study

## Table of Contents

# MCC Automotive Institute
# Lee's Summit, Jackson County, Missouri
# Micro Drainage Study

## 1. INTRODUCTION

### A. Purpose

The purpose of this drainage study will be to evaluate the conditions in the drainage study area, to determine if storm water detention is warranted, and to determine the effect of the proposed development on the existing downstream drainage facilities. The site is shown below in red.

**Figure 1**

**EXISTING CONDITIONS**

## B. Study Area Description

The proposed project site is located in Lee's Summit, Jackson County, Missouri and is located on the Metropolitan Community College – Longview campus. It is bounded by Long Road on the North, the MCC-Longview High Technology building on the West, a tree line to the immediate South with SW County Park Road to the far South, and an existing MCC Longview parking lot on the East. The project site has a disturbed area of approximately 3.11 acres. The Jackson County Assessor Parcel Number (APN) for the site is 63-600-01-04-02-3-00-000. The site is within the Mouse Creek Watershed of Lee's Summit, MO. Soils on the site are classified as 'Greenton silty clay loam, with 5 to 9 Percent Slopes' and 'Urban land-Harvester complex, with 2 to 9 Percent Slopes'. The project area is not in a floodplain. The area is listed as an "Area with minimal hazard Zone X". See the FEMA Firmette and the USDA soils report in Appendix B. The existing site is mostly field grass along with trees and shrubs throughout site. The existing site is approximately 4.24% impervious. The construction of the new development includes a commercial building, concrete driveway, associated sidewalks, concrete courtyard, and landscaped areas. This will result in a site that is approximately 47.43% impervious. The remaining 52.57% of the site will be pervious (grass or landscaped).

## 2. DESIGN CRITERIA

### A. Methodology

The criteria for this evaluation is derived from the current "Standard Specifications and Design Criteria for the City of Kansas City, Missouri, Metropolitan Chapter of the American Public Works Association, Division V, Section 5600 - Storm Drainage Systems and Facilities" with Lee's Summit's supplemental design criteria. With the drainage area covering approximately 3.11 acres, the TR-55 SCS method was utilized to calculate peak runoff rates. TR-55 was also used to determine the volume of discharge for the 2 year, 10 year, and 100 year storms. All calculations are included in Appendix A of this report.

Rainfalls of 10-year and 100-year reoccurrence intervals will be utilized to evaluate and design the system. A 10-year rainfall return frequency, a storm having a ten percent probability of occurring during any given year, will be used to size any on-site storm sewer pipes, except for those areas that are "land locked". For those areas, a 100-year rainfall event (one percent probability) will be used for those on-site storm sewer pipes. The 100-year rainfall will be used to check the limits of the drainage system.

Based on the TR-55 method, the site will require a total of 15,855 cubic feet of storage. The detention basin will be underground storage, located on the East side of the site between the new building addition and the existing parking lot to the East. The basin will either be constructed out of HDPE pipe or chambers (contractor's choice). The detention calculations are contained in Appendix A

## 3. STORM DRAINAGE SYSTEM AND DEVELOPMENT OVERVIEW

### A. Existing Conditions

Stormwater from the existing site currently sheet flows in general from West to East. There are currently no existing public inlets on site. Roof drains from the existing Technology Building to the West as well as the courtyard between the existing and proposed building will be piped to the Southeast of the property around the new development which replicates the current site conditions. Runoff rate, runoff volume, and detention calculations are contained in Appendix A. Existing Runoff Calculation are shown below.

**Existing Runoff Calculations**

| Runoff | 2 Year Runoff | 10 Year Runoff | 100 Year Runoff |
|---|---|---|---|
| Runoff Rate | 4.40 c.f.s. | 9.49 c.f.s. | 17.53 c.f.s. |
| Runoff Volume | 14,695 c.f. | 30,408 c.f. | 53,921 c.f. |

## B. Proposed Conditions

The proposed development will consist of a new commercial building with associated sidewalks and a new driveway to the building. The proposed site plan is shown on Figure 3 - Proposed Site Plan.

The proposed runoff patterns are not significantly different from the existing, pre-development site condition. Runoff from the proposed site will continue to flow from West to East. Runoff from the roof of the new buildings will be piped to the proposed detention basin. Runoff from the grass and landscape areas will flow overland as in existing conditions. The detention basin has been sized to detain the 100-year storm event and all events lower than the 100-year event. Discharge from the detention basins will exit a detention control structure and be conveyed through a pipe with a headwall into an open grass field.

Developed runoff rates will increase from the pre-development conditions due to the increase in impervious area. Due to the size and layout of the project site, time of concentration for the site can be assumed to be 0.239 hours for existing conditions and 0.1 hours (for TR-55) or 5 minutes (for the Rational Method) for proposed conditions. Based on that time of concentration and the area of the site, the 2-year runoff rate from the overall site would be 9.70 c.f.s., the 10-year runoff rate would be 17.53 c.f.s. and the 100-year runoff rate would be 28.42 c.f.s. This calculates to an increase in the runoff rate of approximately 45.3% for the 2-year storm, 54.1% for the 10-year storm and 61.7% for the 100-year storm. TR-55 was used to calculate the runoff volumes.

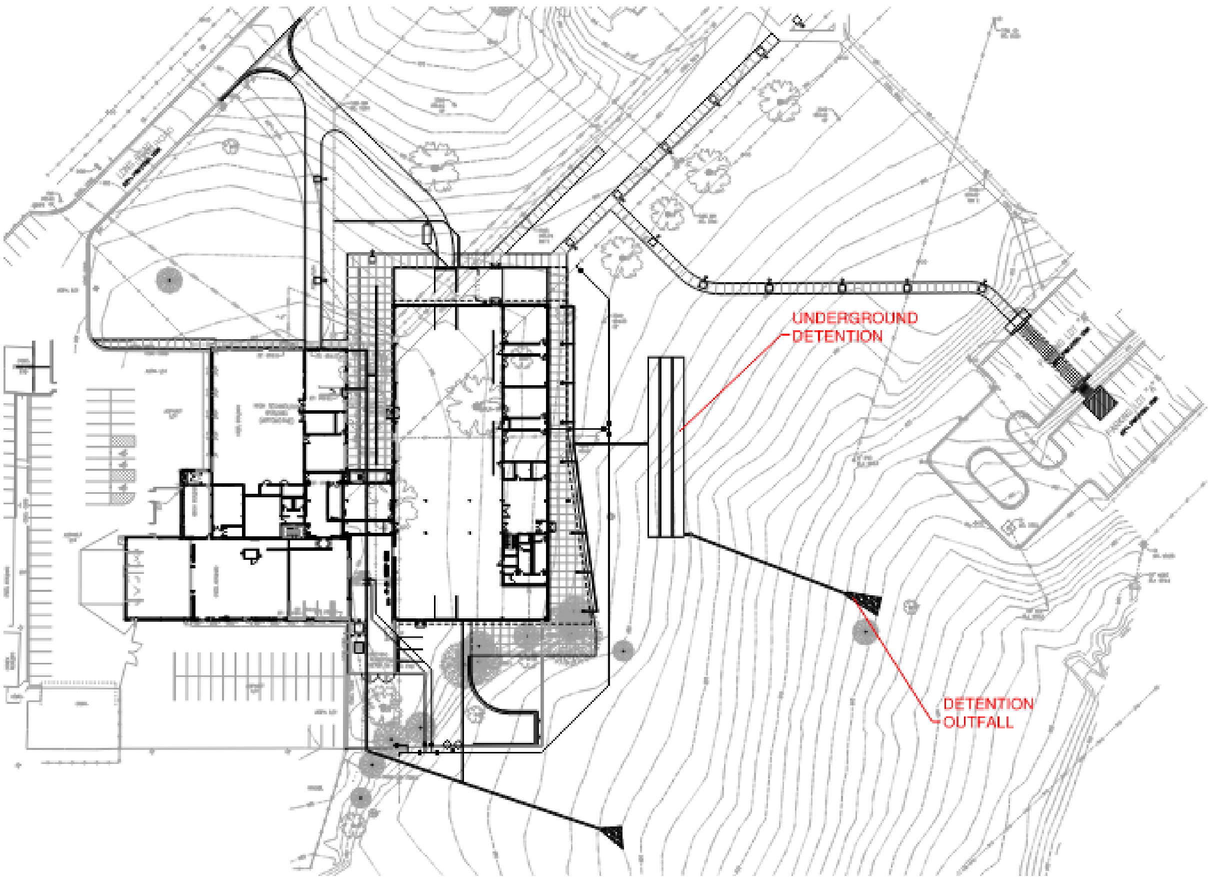


**Figure 2**

**PROPOSED SITE PLAN**

**Proposed Runoff Calculations**

| Runoff | 2 Year Runoff | 10 Year Runoff | 100 Year Runoff |
|---|---|---|---|
| Runoff Rate | 9.70 c.f.s. | 17.53 c.f.s. | 28.42 c.f.s. |
| Runoff Volume | 22,834 c.f. | 41,260 c.f. | 66,921 c.f. |

## 4. STORMWATER DETENTION

Since there is an increase in impervious area on the project site, stormwater detention will be designed to handle storm water runoff from the 100-year Storm. The project would require 15,855 cubic feet of storage due to the increased imperviousness of the site for the 100-year storm event. The discharge is limited to the pre -existing condition. With the proposed detention system, the effects of the increase in impervious area have been negated. Calculations are shown in Appendix A.

## 5. CONCLUSIONS

- The proposed project increases the impervious area of the existing site, thus increasing the runoff rates and the runoff volumes.

- Using TR-55, the 100-year peak discharge from the proposed development will increase from 17.53 c.f.s to 28.42 c.f.s.

- Stormwater detention will be provided to the East of the new building expansion and will detain the runoff from storm events up to the 100 year storm based on the increase in impervious area. Total storage provided on the site will be 15,855 cubic feet. The detention system has been designed to provide enough storage to restrict the discharge from the 100-year storm to not exceed the predevelopment condition.

- Overall, the proposed site improvements for the MCC Automotive Institute project will have no effect on the site due to the inclusion of the stormwater detention system. With the inclusion of the stormwater detention system, the calculations show that there will be no change in the 2-year, 10-year, and 100-year post-development conditions when compared to the pre-development conditions.  The proposed design is appropriate for the site and follows current Lee's Summit criteria.

# Appendix A – Calculations

Sheet _____ of _______

**Taliaferro & Browne, Inc.**
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Tel. (816) 283-3456 Fax (816) 283-0810

Project MCC Longview AMI Job No. 74-0930 BG
Date 12/8/23 Crew
Notes
STORM DRAINAGE

DETERMINE the detention requirements for the MCC - Longview Automotive Institute project

Existing Conditions:

Total Area = 135,650 SF = 3.114 ac
- Impervious = 5735 SF = 0.132 ac
- Woods / Grass = 6,710 SF = 0.154 ac
- Open Space Good Condition = 123,205 SF = 2.828 AC

Soil Type C

Per TR-55

Peak Discharge: 2 Year = 4.40 cfs
10 Year = 9.49 cfs
100 Year = 17.53 cfs

Proposed Conditions

Total Area = 135,650 SF = 3.114 AC
Impervious = 64,345 SF = 1.477 AC
Woods / Grass = 1,000 SF = 0.023 AC
Open Space, Good Condition = 70,305 SF = 1.614 AC

Soil Type C

Per TR-55

Peak Discharge = 2 Year = 9.70 cfs
10 Year = 17.53 cfs
100 Year = 28.42 cfs

* Per TR-55

Storage Needed = 15,855 CF

Worksheet 2: Runoff curve number and runoff

Project MCC Longview - Auto Institute By RMG Date 12/8/23

Location Lee's Summit, MO Checked ____ Date ____

Circle one: Present Developed

1. Runoff curve number (CN)

| Soil name and hydrologic group (appendix A) | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio) | CN 1/ Table 2-2 | CN 1/ Fig. 2-3 | CN 1/ Fig. 2-4 | Area ☒ acres ☐ $mi^2$ ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| Type C | Open Space, Good Cond. | 74 | | | 2.828 | 209.27 |
| Type C | Impervious | 98 | | | 0.132 | 12.94 |
| Type C | Woods/Grass, Good Cond | 72 | | | 0.154 | 11.09 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | Totals = | 3.114 | 233.30 |

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{233.30}{3.114} = 74.92$; Use CN = $\boxed{75}$

2. Runoff

| | | Storm #1 | Storm #2 | Storm #3 |
|---|---|---|---|---|
| Frequency | yr | 2 | 10 | 100 |
| Rainfall, P (24-hour) | in | 3.5 | 5.3 | 7.7 |
| Runoff, Q (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.) | in | 1.30 | 2.69 | 4.77 |

# Worksheet 3: Time of concentration ($T_c$) or travel time ($T_t$)

Project MCC Lakeview - Auto Institute By RMG Date 12/8/23

Location Lee's Summit, MO Checked ______ Date ______

Circle one: Present Developed

Circle one: $T_c$ $T_t$ through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

| Sheet flow (Applicable to $T_c$ only) | | Segment ID | AB | | | |
|---|---|---|---|---|---|---|
| 1. Surface description (table 3-1) ............ | | | Dense Grass | | | |
| 2. Manning's roughness coeff., n (table 3-1) .. | | | 0.24 | | | |
| 3. Flow length, L (total L $\le$ 300 ft) .......... | ft | | 100 | | | |
| 4. Two-yr 24-hr rainfall, $P_2$ .................. | in | | 3.5 | | | |
| 5. Land slope, s ............................. | ft/ft | | 0.02 | | | |
| 6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute $T_t$ ...... | hr | | 0.227 | + | | = 0.227 |

| Shallow concentrated flow | | Segment ID | BC | | | |
|---|---|---|---|---|---|---|
| 7. Surface description (paved or unpaved) ..... | | | Unpaved | | | |
| 8. Flow length, L ............................ | ft | | 180 | | | |
| 9. Watercourse slope, s ...................... | ft/ft | | 0.667 | | | |
| 10. Average velocity, V (figure 3-1) ........... | ft/s | | 4.15 | | | |
| 11. $T_t = \frac{L}{3600\,V}$ Compute $T_t$ ...... | hr | | | + | | = 0.012 |

| Channel flow | | Segment ID | | | | |
|---|---|---|---|---|---|---|
| 12. Cross sectional flow area, a ............... | $ft^2$ | | | | | |
| 13. Wetted perimeter, $P_w$ ...................... | ft | | | | | |
| 14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ....... | ft | | | | | |
| 15. Channel slope, s .......................... | ft/ft | | | | | |
| 16. Manning's roughness coeff., n .............. | | | | | | |
| 17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ....... | ft/s | | | | | |
| 18. Flow length, L ............................ | ft | | | | | |
| 19. $T_t = \frac{L}{3600\,V}$ Compute $T_t$ ...... | hr | | | + | | = |

20. Watershed or subarea $T_c$ or $T_t$ (add $T_t$ in steps 6, 11, and 19) ....... hr 0.239

Worksheet 4: Graphical Peak Discharge method

Project MCC Longview - Auto Institute By RMG Date 12/8/23

Location Lee's Summit, MO Checked ____ Date ____

Circle one: Present Developed

1. Data:

Drainage area .......... $A_m$ = 0.0049 mi$^2$ (acres/640) ✓

Runoff curve number .... CN = 75 (From worksheet 2)

Time of concentration .. $T_c$ = 0.239 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, II, III)

Pond and swamp areas spread throughout watershed ...... = 0 percent of $A_m$ (____ acres or mi$^2$ covered)

| | | Storm #1 | Storm #2 | Storm #3 |
|---|---|---|---|---|
| 2. Frequency .................................. | yr | 2 | 10 | 100 |
| 3. Rainfall, P (24-hour) .................. | in | 3.5 | 5.3 | 7.7 |
| 4. Initial abstraction, $I_a$ .................. (Use CN with table 4-1.) | in | 0.667 | 0.667 | 0.667 |
| 5. Compute $I_a/P$ ............................ | | 0.191 | 0.126 | 0.087 |
| 6. Unit peak discharge, $q_u$ .................. (Use $T_c$ and $I_a/P$ with exhibit 4-II) | csm/in ✓ | 690 | 720 | 750 |
| 7. Runoff, Q ................................ (From worksheet 2). | in ✓ | 1.3 | 2.69 | 4.77 |
| 8. Pond and swamp adjustment factor, $F_p$ .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.) | ✓ | 1.0 | 1.0 | 1.0 |
| 9. Peak discharge, $q_p$ ....................... (Where $q_p = q_u A_m Q F_p$) | cfs | 4.40 | 9.49 | 17.53 |



(210-VI-TR-55, Second Ed., June 1986)

# Worksheet 2: Runoff curve number and runoff

Project: MCC Longview - Auto Institute By: RMG Date: 12/8/23

Location: Lee's Summit, MO Checked: ______ Date: ______

Circle one: Present Developed

## 1. Runoff curve number (CN)

| Soil name and hydrologic group (appendix A) | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio) | CN [1/] Table 2-2 | CN [1/] Fig. 2-3 | CN [1/] Fig. 2-4 | Area ☒ acres ☐ $mi^2$ ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| Type C | Open Space, Good Condition | 74 | | | 1.614 | 119.44 |
| Type C | Impervious | 98 | | | 1.477 | 144.75 |
| Type C | Woods/Grass Good Cond. | 72 | | | 0.023 | 1.66 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | Totals = | 3.114 | 265.84 |

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{265.84}{3.114} = 85.36$; Use CN = $\boxed{85}$

## 2. Runoff

| | | Storm #1 | Storm #2 | Storm #3 |
|---|---|---|---|---|
| Frequency .............................. | yr | 2 | 10 | 100 |
| Rainfall, P (24-hour) .................. | in | 3.5 | 5.3 | 7.7 |
| Runoff, Q .............................. (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.) | in | 2.02 | 3.65 | 5.92 |

## Worksheet 3: Time of concentration ($T_c$) or travel time ($T_t$)

Project MCC Longview - Auto Institute By RMG Date 12/8/23

Location Lee's Summit, MO Checked ____ Date ____

Circle one: Present Developed

Circle one: $T_c$ $T_t$ through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

| Sheet flow (Applicable to $T_c$ only) | Unit | | | |
|---|---|---|---|---|
| Segment ID | | AB | BC | |
| 1. Surface description (table 3-1) ............ | | Conc. | Dense Grass | |
| 2. Manning's roughness coeff., n (table 3-1) .. | | 0.011 | 0.24 | |
| 3. Flow length, L (total L $\leq$ 300 ft) .......... | ft | 25 | 75 | |
| 4. Two-yr 24-hr rainfall, $P_2$ .................. | in | 3.5 | 3.5 | |
| 5. Land slope, s .............................. | ft/ft | 0.01 | 0.0967 | |
| 6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute $T_t$ ...... | hr | 0.008 | + 0.0962 | = 0.104 |

| Shallow concentrated flow | Unit | | | |
|---|---|---|---|---|
| Segment ID | | CD | | |
| 7. Surface description (paved or unpaved) ..... | | Unpaved | | |
| 8. Flow length, L ............................. | ft | 60 | | |
| 9. Watercourse slope, s ....................... | ft/ft | 0.0825 | | |
| 10. Average velocity, V (figure 3-1) ........... | ft/s | 4.65 | | |
| 11. $T_t = \frac{L}{3600\ V}$ Compute $T_t$ ...... | hr | 0.004 | + | = 0.004 |

| Channel flow | Unit | | | |
|---|---|---|---|---|
| Segment ID | | | | |
| 12. Cross sectional flow area, a ............... | $ft^2$ | | | |
| 13. Wetted perimeter, $p_w$ ...................... | ft | | | |
| 14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ....... | ft | | | |
| 15. Channel slope, s ........................... | ft/ft | | | |
| 16. Manning's roughness coeff., n .............. | | | | |
| 17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V ....... | ft/s | | | |
| 18. Flow length, L ............................. | ft | | | |
| 19. $T_t = \frac{L}{3600\ V}$ Compute $T_t$ ...... | hr | | + | = |

20. Watershed or subarea $T_c$ or $T_t$ (add $T_t$ in steps 6, 11, and 19) ....... hr 0.108

## Worksheet 4: Graphical Peak Discharge method

Project MCC Longview - Auto Institute By RMG Date 12/8/23

Location Lee's Summit, MO Checked ____ Date ____

Circle one: Present Developed

1. Data:

Drainage area .......... $A_m$ = 0.0049 $mi^2$ (acres/640) ✓

Runoff curve number .... CN = 85 (From worksheet 2)

Time of concentration .. $T_c$ = 0.113 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, II, III)

Pond and swamp areas spread throughout watershed ...... = 0 percent of $A_m$ (____ acres or $mi^2$ covered)

| | | | Storm #1 | Storm #2 | Storm #3 |
|---|---|---|---|---|---|
| 2. | Frequency .............................. | yr | 2 | 10 | 100 |
| 3. | Rainfall, P (24-hour) .................. | in | 3.5 | 5.3 | 7.7 |
| 4. | Initial abstraction, $I_a$ ................. (Use CN with table 4-1.) | in | 0.353 | 0.353 | 0.353 |
| 5. | Compute $I_a/P$ ........................... | | 0.101 | 0.067 | 0.046 |
| 6. | Unit peak discharge, $q_u$ ................. (Use $T_c$ and $I_a/P$ with exhibit 4-II) | csm/in ✓ | 980 | 980 | 980 |
| 7. | Runoff, Q .............................. (From worksheet 2). | in ✓ | 2.02 | 3.65 | 5.92 |
| 8. | Pond and swamp adjustment factor, $F_p$ .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.) | ✓ | 1.0 | 1.0 | 1.0 |
| 9. | Peak discharge, $q_p$ ...................... (Where $q_p = q_u A_m Q F_p$) | cfs | 9.70 | 17.53 | 28.42 |



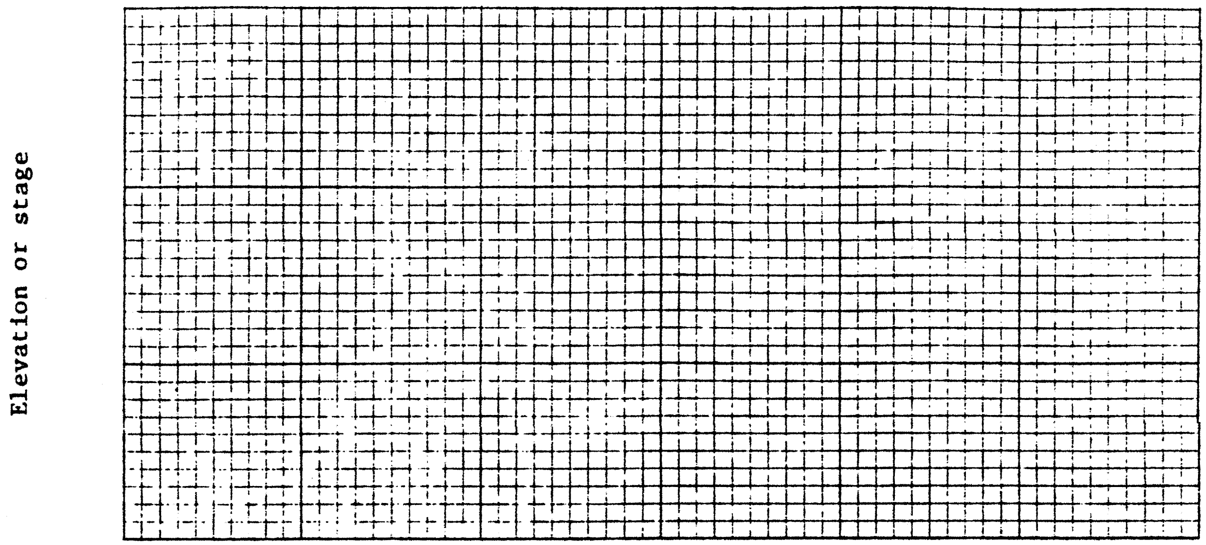
(210-VI-TR-55, Second Ed., June 1986)

# Worksheet 6a: Detention basin storage, peak outflow discharge ($q_o$) known

Project MCC Longview - Auto Institute By RMG Date 12/8/23

Location Lee's Summit, MO Checked ____ Date ____

Circle one: Present Developed ____________________




## Detention basin storage

1. Data:
   Drainage area ....... $A_m$ = 0.0049 $mi^2$
   Rainfall distribution type (I, IA, II, III) = II

| | 1st stage | 2nd stage | 3rd |
|---|---|---|---|
| 2. Frequency ...... yr | 2 | 10 | 100 |
| 3. Peak inflow discharge, $q_i$ .... cfs (From worksheet 4 or 5b) | 9.70 | 17.53 | 28.42 |
| 4. Peak outflow discharge, $q_o$ .... cfs [1/] | 4.40 | 9.49 | 17.53 |
| 5. Compute $\frac{q_o}{q_i}$ ........ | 0.454 | 0.541 | 0.617 |
| 6. $\frac{V_s}{V_r}$ ............... (Use $\frac{q_o}{q_i}$ with figure 6-1) | 0.296 | 0.261 | 0.235 |
| 7. Runoff, Q ...... in (From worksheet 2) | 2.02 | 3.65 | 5.92 |
| 8. Runoff volume, $V_r$ .......... ac-ft ($V_r$ = $QA_m$53.33) | 0.528 | 0.954 | 1.547 |
| 9. Storage volume, $V_s$ .......... ac-ft ($V_s = V_r(\frac{V_s}{V_r})$) | 0.156 | 0.249 | 0.364 |
| 10. Maximum stage, $E_{max}$ (From plot) | | | |

1/ 2nd stage $q_o$ includes 1st stage $q_o$.

0.364 AC-FT
= 15,855 CF

Sheet ____ of ______

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Tel. (816) 283-3456 Fax (816) 283-0810

Project MCC LONGVIEW Job No. 74-0930 BG ______
Date 2/15/24 Crew ______
Notes Storm Drainage - Runoff Volumes

# CALCULATE RUNOFF VOLUMES

Existing Conditions
From TR-55

Runoff Q: 2 Year = 1.30 in
10 Year = 2.69 in
100 Year = 4.77 in
Area = 135,650 SF

VOLUME:

$$2\text{ Year} = 1.30\text{ in} \times \frac{1\text{ ft}}{12\text{ in}} \times 135{,}650\text{ ft}^2 = 14{,}695\text{ ft}^3$$

$$10\text{ Year} = 2.69\text{ in} \times \frac{1\text{ ft}}{12\text{ in}} \times 135{,}650\text{ ft}^2 = 30{,}408\text{ ft}^3$$

$$100\text{ Year} = 4.77\text{ in} \times \frac{1\text{ ft}}{12\text{ in}} \times 135{,}650\text{ ft}^2 = 53{,}921\text{ ft}^3$$

Proposed Conditions
From TR-55

Runoff Q: 2 Year = 2.02 in
10 Year = 3.65 in
100 Year = 5.92 in
Area = 135,650 SF

VOLUME:

$$2\text{ Year} = 2.02\text{ in} \times \frac{1\text{ ft}}{12\text{ in}} \times 135{,}650\text{ ft}^2 = 22{,}834\text{ ft}^3$$

$$10\text{ Year} = 3.65\text{ in} \times \frac{1\text{ ft}}{12\text{ in}} \times 135{,}650\text{ ft}^2 = 41{,}260\text{ ft}^3$$

$$100\text{ Year} = 5.92\text{ in} \times \frac{1\text{ ft}}{12\text{ in}} \times 135{,}650\text{ ft}^2 = 66{,}921\text{ ft}^3$$

Sheet ____ of ______

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Tel. (816) 283-3456 Fax (816) 283-0810

Project MCC - Auto Inst. Job No. 74-0930 BG ______
Date 1/30/24 Crew ______
Notes
Courtyard Drainage

* CALCULATE TOTAL FLOW IN COURTYARD AREA

TOTAL AREA = 11,500 SF (0.264 AC)
- Area is all impervious

- Calculate rainfall intensity for 2, 10, + 100 Year Storms
- Assume $T_c$ = 5 MIN.

2 Yr = $\frac{119}{5+17}$ = 5.41 in/hr

10 Yr = $\frac{175}{5+18.8}$ = 7.35 in/hr

100 Yr = $\frac{256}{5+19.8}$ = 10.32 in/hr

CALCULATE RUNOFF (Q = KCiA)

2 Year = (1.0)(0.9)(5.41)(0.264) = 1.29 cfs

10 Year = (1.0)(0.9)(7.35)(.264) = 1.75 cfs

100 Year = (1.0)(10.35)(0.264) = 2.73 cfs

• A 12" Pipe @ 1.0%, n = 0.013 has a maximum discharge of 3.55 cfs.

# Appendix B – Background Information

# National Flood Hazard Layer FIRMette

FEMA

94°27'40"W 38°54'39"N


94°27'2"W 38°54'11"N

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

1:6,000

*Basemap Imagery Source: USGS National Map 2023*

## 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 | NO SCREEN Area of Minimal Flood Hazard *Zone X* |
| | Effective LOMRs |
| | Area of Undetermined Flood Hazard *Zone D* |
| GENERAL STRUCTURES | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| OTHER FEATURES | B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation |
| | 8 Coastal Transect |
| | 513 Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| MAP PANELS | Digital Data Available |
| | No Digital Data Available |
| | Unmapped |

N

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 2/7/2024 at 11:04 AM 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.

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

## MCC Longview Auto Institute


December 8, 2023

# Preface

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).

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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# Contents

# How Soil Surveys Are Made

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 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 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

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.

Soil Map


94° 27' 25" W
94° 27' 13" W
38° 54' 28" N
38° 54' 22" N
373670
373700
373730
373760
373790
373820
373850
373880
373910
373940
4307570
4307540
4307510
4307480
4307450
4307420
4307390
30080
60025
30080
Soil Map may not be valid at this scale.
Map Scale: 1:1,320 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 15 30 60 90
Feet
0 50 100 200 300
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

## 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 25, Aug 22, 2023

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

Date(s) aerial images were photographed: Aug 30, 2022—Sep 8, 2022

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 |
|---|---|---|---|
| 30080 | Greenton silty clay loam, 5 to 9 percent slopes | 2.2 | 52.9% |
| 60025 | Urban land-Harvester complex, 2 to 9 percent slopes | 2.0 | 47.1% |
| **Totals for Area of Interest** | | **4.2** | **100.0%** |

# 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 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

## 30080—Greenton silty clay loam, 5 to 9 percent slopes

### Map Unit Setting

*National map unit symbol:* 2xjd9
*Elevation:* 640 to 1,120 feet
*Mean annual precipitation:* 35 to 41 inches
*Mean annual air temperature:* 50 to 57 degrees F
*Frost-free period:* 177 to 209 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Greenton and similar soils:* 90 percent
*Minor components:* 10 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Greenton

#### Setting

*Landform:* Hillslopes
*Landform position (two-dimensional):* Shoulder
*Landform position (three-dimensional):* Interfluve
*Down-slope shape:* Convex
*Across-slope shape:* Convex
*Parent material:* Loess over residuum weathered from limestone and shale

#### Typical profile

*Ap - 0 to 12 inches:* silty clay loam
*Bt - 12 to 28 inches:* silty clay
*2Bt - 28 to 30 inches:* silty clay
*2C - 30 to 79 inches:* silty clay

#### Properties and qualities

*Slope:* 5 to 9 percent
*Depth to restrictive feature:* More than 80 inches
*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 12 to 30 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum content:* 10 percent
*Maximum salinity:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
*Available water supply, 0 to 60 inches:* High (about 9.6 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 3e
*Hydrologic Soil Group:* C/D
*Ecological site:* R109XY002MO - Loess Upland Prairie
*Hydric soil rating:* No

### Minor Components

#### Sampsel

*Percent of map unit:* 10 percent
*Landform:* Hillslopes
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Side slope
*Down-slope shape:* Convex
*Across-slope shape:* Convex
*Ecological site:* R109XY002MO - Loess Upland Prairie
*Hydric soil rating:* Yes

## 60025—Urban land-Harvester complex, 2 to 9 percent slopes

### Map Unit Setting

*National map unit symbol:* 30yy2
*Elevation:* 390 to 820 feet
*Mean annual precipitation:* 36 to 47 inches
*Mean annual air temperature:* 52 to 57 degrees F
*Frost-free period:* 184 to 228 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Urban land:* 55 percent
*Harvester and similar soils:* 40 percent
*Minor components:* 5 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Urban Land

#### Setting

*Down-slope shape:* Linear
*Across-slope shape:* Linear

#### Interpretive groups

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

### Description of Harvester

#### Setting

*Landform:* Hillslopes
*Landform position (two-dimensional):* Summit
*Landform position (three-dimensional):* Interfluve
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Human-transported material over loess

**Typical profile**

*^Au - 0 to 4 inches:* silt loam
*^Cu - 4 to 32 inches:* silty clay loam
*2Bb - 32 to 79 inches:* silty clay loam

**Properties and qualities**

*Slope:* 2 to 9 percent
*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Moderately well drained
*Runoff class:* Medium
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.57 in/hr)
*Depth to water table:* About 30 to 40 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Maximum salinity:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
*Available water supply, 0 to 60 inches:* High (about 10.1 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2s
*Hydrologic Soil Group:* C
*Ecological site:* F115XB061MO - Anthropic Deep Loess Upland
*Hydric soil rating:* No

### Minor Components

**Winfield**

*Percent of map unit:* 5 percent
*Landform:* Hillslopes
*Landform position (two-dimensional):* Summit, shoulder
*Landform position (three-dimensional):* Side slope
*Down-slope shape:* Convex
*Across-slope shape:* Convex
*Ecological site:* F115XB001MO - Deep Loess Upland Woodland
*Hydric soil rating:* No

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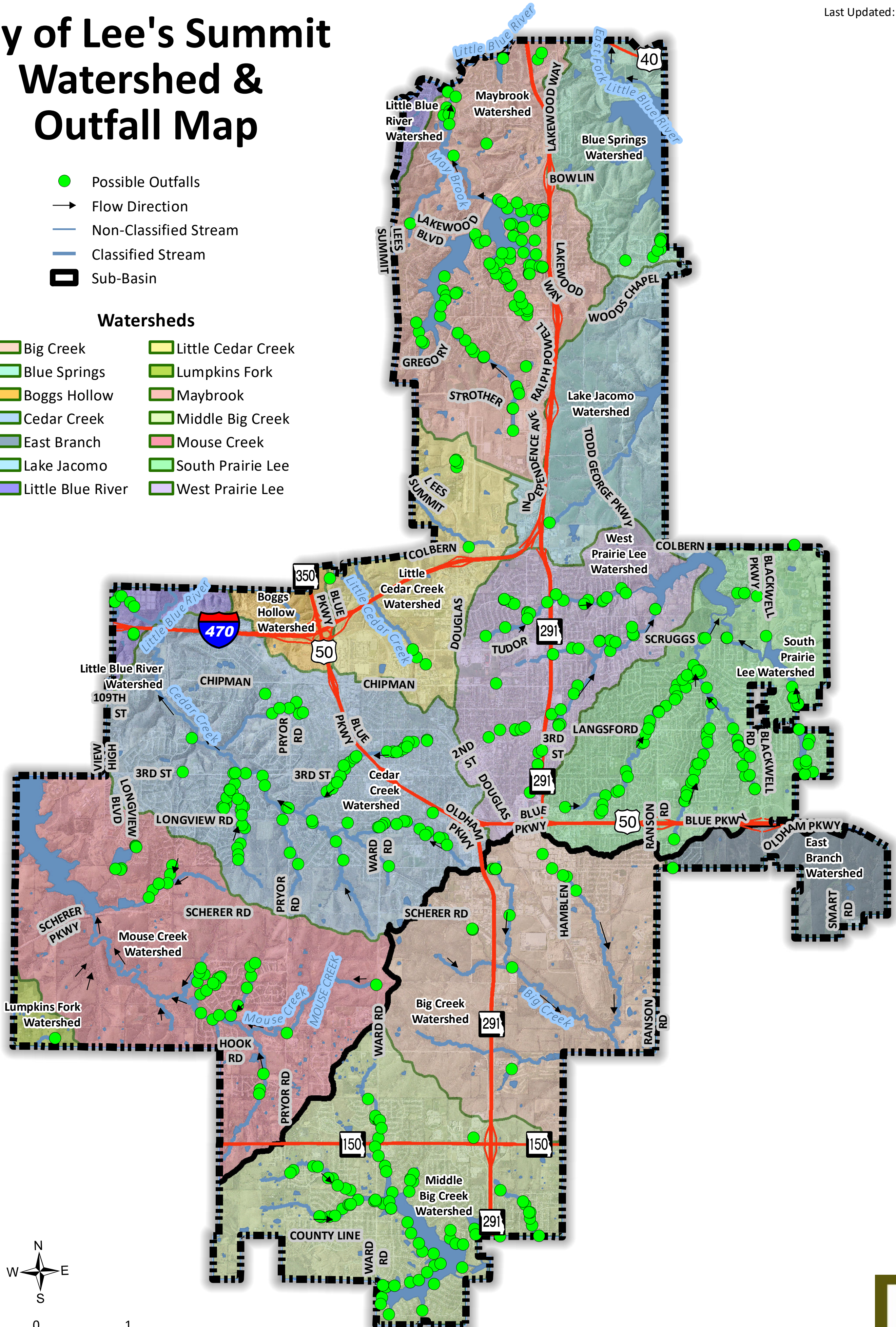
Last Updated: January 2024

# City of Lee's Summit Watershed & Outfall Map

- Possible Outfalls
- Flow Direction
- Non-Classified Stream
- Classified Stream
- Sub-Basin

## Watersheds

- Big Creek
- Blue Springs
- Boggs Hollow
- Cedar Creek
- East Branch
- Lake Jacomo
- Little Blue River
- Little Cedar Creek
- Lumpkins Fork
- Maybrook
- Middle Big Creek
- Mouse Creek
- South Prairie Lee
- West Prairie Lee




1 0.5 0 1
Miles