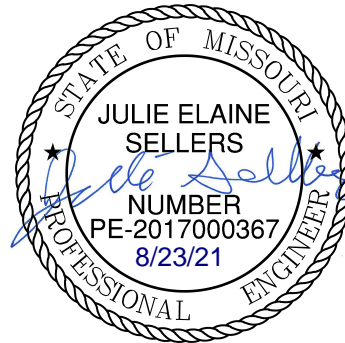


SUMMIT PARK CHURCH MICRO STORM DRAINAGE STUDY

Prepared for:

Summit Park Church
1499 SW Market Street
Lee's Summit, MO 64081



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Olsson Project No. A21-03377



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1. GENERAL INFORMATION

Summit Park Church Expansion project is an 8.02 acre site consisting of multiple existing parking lots, a church building and associated utilities. The project proposes to add a daycare room to the existing building, along with an additional atrium and auditorium. Together, they will add 24,900 sf to the existing building, along with an additional parking lot to be constructed. The site currently discharges to the northeast part of the site into an existing drainage basin. A small floodplain exists on the north side that the basin discharges into.

Stormwater runoff from the project site is tributary to Cedar Creek, approximately 1.5 miles downstream of the study area.

1.1 Project Location

The site is located entirely in the city of Lee's Summit, Missouri. The site is bounded by residential private property to the south, SW Lakeview Blvd to the west, Oldham Pkwy to the north, and SW Allendale Blvd to the east.



Figure 1. Summit Park Church Location Map

1.2 Federal Emergency Management Agency Floodplain Classification

A stream that runs through the northwest area of the site is located within the 1% annual chance flood hazard area (Zone AE) and 0.2% annual chance flood hazard area (Zone X) as depicted on the FEMA Flood Insurance Rate Map (FIRM) Community Panel No 29095C0419G (Jackson County, MO), revised January 20th, 2017. An existing detention basin, located at the northwest corner of the site, is located within the Zone AE and Zone X floodplain boundaries. Proposed conditions for the site includes placing fill and regrading the existing detention basin to provide additional area for parking. The proposed conditions are not expected to cause a rise in base flood elevations (BFEs) as this portion of the floodplain appears to be ineffective flow area caused by backwater from the main channel, which would not contribute to conveyance of stormwater. A small portion of the proposed grading at the southwest corner of the site is located outside of the Zone AE floodplain but within the limits of the Zone X floodplain. A flood study will be provided with the final plans submittal to verify that no rise in base flood elevations will be caused as a result of the proposed project. Refer to Site Plans for location of the existing floodplain boundaries on site.

1.3 Soil Classifications

A geotechnical investigation has not been completed for this site. Soil Maps published in the NRCS Web Soils Survey for Jackson County, Missouri categorizes soils in the watershed as:

Table 1. Soil Classifications

Symbol	Name	Slopes	Hydrologic Soil Group
10082	Arisburg-Urban land complex	1-5%	C
10181	Udarents-Urban land-Samsel complex	5-9%	C

NRCS Runoff Curve Numbers (CN's) in this study have been assigned to tributary areas onsite based upon these Hydrologic Soil Groups and associated existing and proposed land use. Land uses were determined using zoning maps, aerial photos, and site visits. A copy of the NRCS printout is included in Appendix E.

2. METHODOLOGY

The storm drainage study will be analyzed in accordance with the February 16, 2011 edition of the Kansas City Metropolitan Chapter, American Public Works Association, (KCAPWA) Construction and Material Specifications, Section 5601.5.A.4.

“New development or redevelopment as defined in Section 5601.2 shall incorporate stormwater management measures to control runoff from the site. Allowable runoff from a site may be limited by the need to minimize downstream flood damage, prevent erosion, and/or minimize impacts to the ecology and water quality of the downstream drainage system.”

“...peak runoff control is provided for the 1%, 10% and 50% chance storms and volumetric and/or extended detention control of the 90% mean annual event storm for broad protection of the receiving system”

The Existing Conditions hydrology will be evaluated in Section 3, and Proposed Conditions hydrology will be computed in Section 4. The Proposed Conditions discharge data for each stage of development will be compared to the Existing Conditions results; variations in quantity and rate of stormwater discharge between these models will represent the hydrologic impact generated by the proposed development. The overall stormwater management plan will be designed utilizing this information. Section 3 assumes current land use within the tributary sub-watersheds, and pre-development conditions within the project boundary. Section 4 assumes current land use within the tributary sub-watersheds, and fully developed conditions within the project area boundary.

Runoff rates and detention hydraulics were analyzed using Autodesk Storm and Sanitary Analysis 2018 (SSA). SSA utilizes the following approved methods to model Existing and Proposed Conditions for stormwater runoff.

- NRCS TR-55 Unit Hydrograph Method
- 2-,10-, and 100-year Return Frequency, 24-hr. Storm Precip. Depths (TP-40)
- ARC Type II Soil Moisture Conditions
- 24-Hour NRCS Type II Rainfall Distribution
- Runoff Curve Numbers per NRCS TR-55 (Tables 2-2a - 2-2c) and KCAPWA Section 5602.3
- NRCS TR-55 Methods for determination of Time of Concentration and Travel Time.

NOTE: SSA models use “Time of Concentration” rather than “Lag Time” for computing subarea hydrology.

Stormwater runoff models were created for the 2%, 10%, and 100% design storm events. The precipitation depths used in the analyses have been interpolated from the “Technical Paper

No.40 Rainfall Frequency Atlas of the United States” (TP-40) isopluvial maps (May 1961). The following Table 2 summarizes the rainfall depths used in this analysis:

Table 2. Precipitation Depths.

Return Period	24-Hour Precipitation Depth (in.)
Water Quality Storm* (WQ)	1.37
2-Year (50% Storm)	3.5
10-Year (10% Storm)	5.3
100-Year (1% Storm)	7.7

*The “Water Quality Storm” is defined in the MARC & APWA “Manual of Best Management Practices for Stormwater Quality” as a 24-hour 1.37” rainfall depth. This particular storm event is utilized for proposed water quality analysis.

The following is a summary of the primary points of interest to the watersheds modeled in this report:

- **Outfall 1** is the discharge point for the Summit Park Church basin, located in the northwest area of the site. This project will provide upstream control via site grading to restrict runoff so there is no increase in peak flowrates to the outfall point 1.

3. EXISTING CONDITIONS

3.1 Existing Site Description

The existing site consists of an existing church building, multiple parking lots, and open grass/turfed areas. An existing basin exists on site. The basin was constructed at an unknown time, and as such, there is no known stormwater study that relates to the existing basin. The total onsite Project Area encompasses 8.02 acres. The proposed project entails filling in the existing basin by placing a parking lot in the area where the basin was. Underground detention will be used to replace the basin. Due to the removal and replacement of the basin, the existing conditions will determine the area tributary to the basin as undeveloped to ensure the effectiveness of the proposed underground detention.

3.2 Existing Site Hydrology

Site topography and hydrology for project areas that are tributary to each outfall are as follows:

Area 1

Project area that is tributary to Outfall 1 flows from southeast to northwest. Runoff is conveyed by sheet flow, shallow concentrated flow, and channel flow through existing private storm sewer. The area encompasses all area that is tributary to the basin.

Existing site Data is summarized in Table 3-1, below. Refer to the Existing Conditions Drainage Area Map (Exhibit 300) located in Appendix A and model calculations located in Appendix D for Runoff Curve Number (CN) and Time of Concentration (Tc) calculations.

Table 3-1. Existing Site Data

Existing Site Data			
Subbasin	Drainage Area (ac.)	CN	Tc (min)
Area1	6.41	74	15.80

These routings, drainage area, CN and Tc values for the corresponding areas were used as input to the Existing Conditions model to evaluate the existing stormwater hydrology for the project. The resulting peak flows of the hydrologic routing are provided in Table 3-2, below. Hydrographs can be found in Appendix B and model output data can be found in its entirety in Appendix D.

Table 3-2. Existing Peak Discharge Rates

Existing Peak Discharge Rates			
Outfall	Q₂ (cfs)	Q₁₀ (cfs)	Q₁₀₀ (cfs)
Outfall 1	9.48	20.36	36.22

Per APWA Section 5608.4 and the City of Lee's Summit criteria, the performance criteria for comprehensive control is to provide detention to limit peak flow rates at downstream points of interest to maximum release rates:

- 50 percent storm peak rate less than or equal to 0.5 cubic feet per second (cfs) per site acre
- 10 percent storm peak rate less than or equal to 2.0 cfs per site acre
- 1 percent storm peak rate less than or equal to 3.0 cfs per site acre

Extended detention of the 90% mean annual event is also required for comprehensive control per APWA Section 5608.4

Table 3-3 below summarizes the allowable peak flow rates.

Table 3-3. Allowable Peak Flow Rates

Allowable Peak Flow Rates			
Outfall	Q₂ (cfs)	Q₁₀ (cfs)	Q₁₀₀ (cfs)
Outfall 1	3.2	12.82	19.23

4. PROPOSED CONDITIONS ANALYSIS

The proposed Summit Park Church expansion constructs an additional auditorium, atrium, and daycare to the existing building while adding a parking lot to the north of the site. There will be no tributary shifts by this project, only a change in CN values and Tc.

The existing basin will be removed and replaced by underground detention in the same location.

4.1 Proposed Conditions Site Hydrology

The proposed model will remain the same as the existing model. Area 1 will relate to the majority of the site which will flow into the proposed underground detention. No area will be disturbed/alterd that does not flow into the basin, thus only flows into Outfall 1 are considered. the Proposed Conditions Drainage Area Map (Exhibit 301) located in Appendix A and model calculations located in Appendix D for Runoff Curve Number (CN) and Time of Concentration (Tc) calculations.

With the existing basin being removed and replaced, underground detention is proposed to handle all flows on site. The underground detention will be located at the same location as the original basin, discharging into the same location the original basin discharged to. A StormTech System using 350 chambers, discharging to a multi-stage outfall structure is proposed.

Details of the underground detention basin are provided below.

Basin 1

- Top of Basin Elevation = 995.74
- Minimum Basin Elevation = 990.24
- 350 Chambers
- Primary Outfall:
 - 24" Outfall Pipe Elevation = 990.24
 - 4'x4' Control Structure with: 9" circular orifice at 990.24 and 4'x0.4' weir at 992.35.

Table 4-1. Proposed Site Data

Proposed Site Data			
Subbasin	Drainage Area (ac.)	CN	T _c (min)
Area1	6.41	92	5

Table 4-2. Proposed Conditions Updated Subbasin Runoff Results

Sub-Basin	Q ₂ (cfs)	T _{P-2} (hr)	Q ₁₀ (cfs)	T _{P-10} (hr)	Q ₁₀₀ (cfs)	T _{P-100} (hr)
Area1	25.89	11.93	41.81	11.94	62.73	11.94

Table 4-3. Proposed Conditions Detention Basin Data

	Peak Q In (cfs)	T _P In (hr.)	Peak Q Out (cfs)	T _P Out (hr.)	Max V _R (ac-ft)	Peak W.S.E. (ft)
Basin 1						
2-Year	25.89	11.93	3.11	12:31	0.65	992.43
10-Year	41.81	11.94	10.35	12:11	0.99	993.47
100-Year	62.73	11.94	17.53	12:11	1.47	995.67

With the updates to the subbasin areas and corresponding reactions from the stormwater detention basins, Table 5-4 below shows the updated runoff results to the points of interest for the watershed.

Table 4-4. Proposed Conditions Updated Subbasin Runoff Results

Sub-Basin	Q ₂ (cfs)	T _{P-2} (hr)	Q ₁₀ (cfs)	T _{P-10} (hr)	Q ₁₀₀ (cfs)	T _{P-100} (hr)
Area1	3.11	12.31	10.35	12.11	17.53	12.11

Comparing the proposed flowrates for the point of interest shown above with the corresponding point within the Existing Conditions results, it is shown that flowrates for Outfall 1 is reduced from existing conditions along with reduction below allowable flows. Cumulative runoff volume curves that depict the proposed effects of the stormwater management facilities and compare existing and proposed conditions hydrographs at the outfall locations are provided in Appendix B of this report.

4.2 Water Quality

Per the City of Lee's Summit requirements, the 1.37" storm (WQv) is required to be treated on site. As part of the underground detention system, a series of isolator rows are to be installed to treat the 1.37" storm. See Appendix B for WQv calculations.

5. RESULTS

As shown in the discussion and tables in the previous sections, the proposed detention basin adequately reduces the peak stormwater rate and does not negatively impact downstream areas of Outfall 1. Table 5-1, below, summarizes Proposed, Allowable, and Existing conditions results and compares them.

Table 5-1. Proposed Conditions Point of Interest Discharge Comparison

		Q₂ (cfs)	Q₁₀ (cfs)	Q₁₀₀ (cfs)
1	Existing	11.85	25.46	45.29
	Proposed	3.11	10.35	17.53
	Difference	-8.74	-15.11	-27.76
1	Allowable	3.20	12.82	19.23
	Proposed	3.11	10.35	17.53
	Difference	-0.09	-2.47	-1.70

6. CONCLUSION

This Stormwater Drainage Study has been prepared for the proposed project to establish a comprehensive stormwater management plan for the site. The proposed stormwater management plan has been designed to achieve compliance with current design criteria in effect for the City of Lee's Summit, Missouri.

The proposed isolator rows treat the 1.37" storm, thus meeting BMP requirements.

This study demonstrated the overall compliance with KCAPWA Section 5600.