

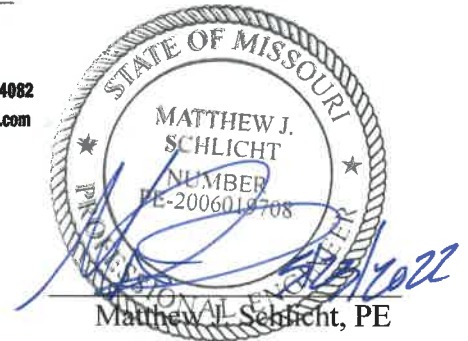
MACRO STORM WATER DRAINAGE STUDY

OFFICE/WAREHOUSE 950 NE POLLARD STREET

Site Acreage: 1.31 Acres

950 NE Pollard Street
Lee's Summit, MO

PREPARED BY:



Revision

Date	Comment	By
5-23-22	Revised per City Comments Dated May, 9 2022	AEP

MACRO STORM WATER DRAINAGE STUDY

OFFICE/WAREHOUSE 950 NE POLLARD STREET

Site Acreage: 1.31 Acres

950 NE Pollard Street
Lee's Summit, MO

PREPARED BY:



Revision

Date	Comment	By
5-23-22	Revised per City Comments Dated May, 9 2022	AEP

Matthew J. Schlicht, PE

TABLE OF CONTENTS

- 1. REPORT COVER SHEET**
- 2. TABLE OF CONTENTS**
- 3. GENERAL INFORMATION**
 - 3.1 FEMA FLOODPLAIN DETERMINATION**
 - 3.2 NRCS SOIL CLASSIFICATION**
- 4. METHODOLOGY**
- 5. EXISTING CONDITIONS ANALYSIS**
- 6. PROPOSED CONDITIONS ANALYSIS**
 - 6.1 DETENTION**
- 7. 40 HOUR EXTENDED DETENTION/INFILTRATION BMP**
- 8. CONCLUSIONS & RECOMMENDATIONS**
- 9. EXHIBITS**

3. GENERAL INFORMATION

This storm study has been prepared to evaluate potential hydrologic and hydraulic impacts related to the proposed development and recommend improvements designed to mitigate any anticipated negative downstream impacts. The proposed office/warehouse development is to sit on 1.31 acres of currently undeveloped land. The improvements will consist of a new building, parking lot, drive aisles and associated utility infrastructure. The site generally drains in three primary directions being the northwest, Northeast and South via sheet and shallow concentrated flow. See Exhibit A for an aerial image of the proposed project site along with an aerial image of the surrounding area. The existing site does not contain any storm sewer, water bodies, wetlands nor BMPs. The site is located in Section 36, Township 47N, Range 32W, Lee's Summit, Jackson County, Missouri.

3.1 FEMA FLOODPLAIN DETERMINATION

The property is located in an Area of Minimal Flood Hazard, Zone X, according to FEMA Firm Map Number 29095C0430G, dated January 20, 2017.

See Exhibit B for a FIRMette which includes the proposed project site.

3.2 NRCS SOIL CLASSIFICATION

Soil classifications published by the United States Department of Agriculture/National Resources Conservation Service (USDA/NRCS) website for Jackson County, Missouri, Version 22, May 29, 2020. The existing site contains one major soil type:

10000 Arisburg Silt Loam, 1 to 5 Percent Slopes
 Hydrologic Soils Group (HSG): Type C

See Exhibit C for a detailed soils report of the proposed project site.

4. METHODOLOGY

A field topographical survey was completed and used to create the Existing Drainage Area Map. The study conforms to the requirements of the City of Lee's Summit, Missouri "Design and Construction Manual" and all applicable codes and criteria referred to therein.

Using the above criteria, the proposed site was evaluated using the Soil Conservation Service, SCS TR-55 method to calculate storm runoff volumes, peak rates of discharge, pre and post developed hydrographs and required storage volumes for detention facilities. TR-55 was first introduced in 1975 by the SCS particularly for small urbanizing watersheds. The analysis contains results for the 2, 10 and 100-year design storms.

Hydraflow Hydrographs Extension for AutoCAD Civil 3D was utilized to model the various SCS TR-55 stormwater rainfall runoff events. The following SCS TR-55 Unit Hydrograph variables were utilized;

- AMC II Soil Moisture Conditions
- 24-Hour SCS Type II Rainfall Distribution (Shape Factor 484)
- SCS Runoff Curve Numbers per SCS TR-55 (Tables 2-2a to 2-2c)
- Precipitation Data: SCS 24-hr Precip (in); 2-yr = 3.50, 10-yr = 5.20, 100-yr = 7.70

Time of Concentration has been calculated using the following formulas:

- Sheet Flow (Max. 100 LF): APWA 5602.5 Time Inlet, $T_1 = 1.8 * (1.1-C) * L^{1/2} / S^{1/3}$

- Shallow Concentrated Flow: SCS TR-55 Appendix F:

Unpaved	$V=16.1345(S)^{0.5}$
Paved	$V=20.3282(S)^{0.5}$
- Shallow Concentrated Travel Time (min): SCS TR-55 Eq-3-1, $T_t = L / V \times 60$
- Channel Flow Improved: Manning's Equation (Full Flow)
- Channel Flow Unimproved: APWA 5602.7.A. Travel Time, Table 5602-6

Avg. Channel Slope (%)	Velocity (fps)
< 2	7
2 to 5	10
>5	15

5. EXISTING CONDITIONS ANALYSIS

The existing site located at 950 NE Pollard Street is located in a planned community commercial and planned industrial area. The site is undergoing rezoning from planned community commercial to planned industrial. The site is currently undeveloped. The drainage on the site is split and generally drains in three directions. The west side of the site referred to as Sub-basin W drains to the northwest corner of the property to Point of Interest (POI) W via sheet and shallow concentrated flow. The southern portion of the property, Sub-basin S, drains via sheet flow to NE Pollard Street where it is collected by the north curb and gutter system for further conveyance downstream to the east. The remainder and majority of the site generally located in the east and referred to as Sub-basin E drains to the north east corner of the property to POI E via sheet and shallow concentrated flow. The Existing Drainage Area Map is located in Exhibit D.

The following tables summarize the results of the Existing Conditions analysis. Composite curve number calculations by sub-basin may be found in Exhibit E. Time of concentration calculations by sub-basin may be found in Exhibit F. A complete breakdown of TR-55 unit hydrographs may be found in Exhibit G.

Table 5-1 Existing Conditions Sub-basin Data

Sub-basin	Area (ac.)	CN	Tc (min.)
W	0.34	74	10.6
S	0.17	74	9.6
E	0.80	74	11.3

Table 5-2 Existing Conditions Sub-basin/Point of Interest Peak Discharge Rates

Sub-basin	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
W	0.64	1.31	2.40
S	0.34	0.69	1.26
E	1.49	3.09	5.65

Per APWA 5608.4 and City of Lee's Summit criteria, post development peak discharge rates from the site shall not exceed those indicated below:

- 50% storm peak rate less than or equal to 0.5 cfs per site acre
- 10% storm peak rate less than or equal to 2.0 cfs per site acre
- 1% storm peak rate less than or equal to 3.0 cfs per site acre

Allowable release rates were calculated at POI W, S and E. The proposed Development (1.31 acres) runoff shall not be more than the peak discharge rates stated above.

Allowable Release Example Calculations:

Sub-basin W (2-Yr): $(0.34 \times 0.5) = \underline{0.17 \text{ cfs}}$

Table 5-3 Existing Conditions Sub-basin/Point of Interest Allowable Peak Discharge Release Rates

Sub-basin	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
W	0.17	0.68	1.02
S	0.08	0.34	0.51
E	0.40	1.60	2.40

6. PROPOSED CONDITIONS ANALYSIS

The Development will contain an office/warehouse facility as described in the general information section. A conceptual layout for the proposed Development may be found in Exhibit I which includes the proposed location of the earthen detention basin located in the north east section of the property. A single stage earthen detention basin will be utilized in Sub-basin E(1) to attenuate runoff at POI E below allowable peak discharge rates as shown in Table 5-3. The Proposed Drainage Area Map is located in Exhibit H.

Table 6-1 Proposed Conditions Sub-basin Data

Sub-basin	Area (ac.)	Composite CN	Tc (min.)
W	0.05	74	5.0
S	0.12	88	8.6
E	0.16	74	11.8
E(1)	0.97	88	7.1

Table 6-2 Proposed Conditions Sub-basin/Point of Interest Peak Discharge Rates

Sub-basin	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
W	0.12	0.23	0.42
S	0.43	0.71	1.12
E	0.28	0.57	1.05
E(1)	3.60	5.96	9.39

As shown above in Table 6-2 Sub-basins E + E(1) will require detention to attenuate peak discharge rates below Allowable Release Rates as shown in Table 5-3 for Sub-basin/POI E. Sub-basin W will be reduced below allowable for all design storms due to reduction in drainage area. Sub-basin S is peripheral to the site and is adjacent to NE Pollard Street. Sub-basin S includes minimal improvement consisting of portions of each entrance drive. Sub-basin S proposed runoff is below existing but does not meet allowable discharge rates however its location and consistent drainage pattern is not anticipated to negatively affect downstream drainage. A waiver will be requested for Sub-basin S peripheral to the site for the 2, 10 and 100-year allowable storm events.

6.1 DETENTION

A new single stage earthen detention basin is being proposed in Sub-basin E(1) to attenuate proposed peak discharge rates. Following are a list of design parameters for the detention system.

Designation: Detention Basin E(1)
 Type: Earthen Basin
 Side Slopes: 3:1 Max.
 Bottom Slope: 1% Min., Turf Lined

point of diminishing returns as shown by the reduction in all three storm events. Extended detention is being met with a series of vertical 1 inch orifices. The existing 2-year peak discharge at POI E will be reduced by 67.8%. Based on this information a waiver will be requested for the Allowable 2-year storm event.

7. 40 HOUR EXTENDED DETENTION/INFILTRATION BMP

In addition to mitigation of peak flow rates, APWA Section 5608.4 also requires 40 hour extended detention of runoff from the local 90% mean annual event (1.37"/24-hour rainfall). The proposed detention facility will release the water quality event over a period of 40-72 hours. See Exhibit J for Detention Basin E(1) extended detention calculations. The Water Quality Volume is released in approximately 40 hours from Basin E(1).

8. CONCLUSIONS & RECOMMENDATIONS

This macro storm water drainage study shows that the proposed development will not generate any negative downstream hydraulic impacts. A new earthen detention basin will be required to provide detention for the proposed development.

In conclusion, proposed peak discharge rates for POI E are below allowable release rates except for the 2-year. As discussed in the body of the report a Waiver will be requested for the POI E Allowable 2-year Event. The study is in conformance with all applicable City of Lee's Summit design standards and criteria therefore Engineering Solutions recommends approval of this macro storm water drainage study.

WAIVERS:

- 1) Sub-basin E 2-year allowable storm event. A 68% reduction has been achieved from the Existing Peak.
- 2) Sub-basin S peripheral to the site for the 2, 10 and 100-year allowable storm events. Minor area peripheral to the site and adjacent to the street right-of-way. Proposed peaks have been reduced below existing. The existing drainage pattern is not being affected.

Exhibit A

Aerial Image & Aerial Image of Surrounding Area



PROJECT SITE

NE Pollard St

NE Pollard St



NE Independence

470

NE Rice Rd

NE Colbern Rd

NE Colbern Rd

NE Colbern Rd

NE Colbern Rd

NE Colbern Rd

NE C

NE Missouri Rd

NE Independence Ave

SITE

NE Ball Dr

ambridge Dr

ance Ave

NE Cedar St

291

NE Rice Rd

NE Ridgeview Dr

NE Cedar St

estwing Dr

NE Ball Dr

NE Muberry St

Exhibit B

FEMA FIRMeTte

National Flood Hazard Layer FIRMMette



94°21'46"W 38°56'52"N



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		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Profile Baseline
	Hydrographic Feature	

MAP PANELS		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 **4/21/2022 at 5:45 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.

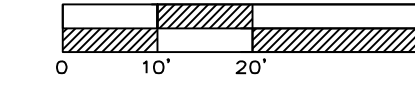
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory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

Exhibit D

Existing Drainage Map

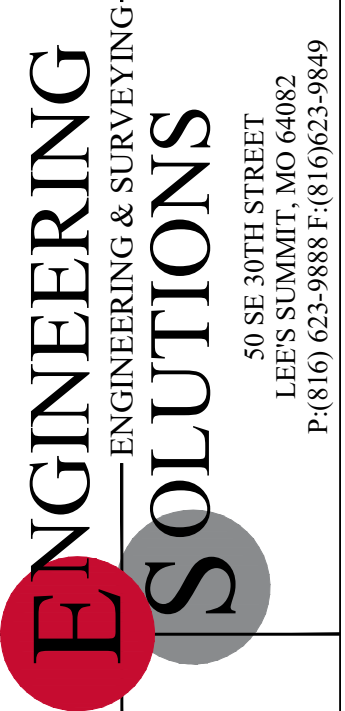


North



EXISTING DRAINAGE MAP

SCALE: 1" = 20'



Professional Registration
Missouri
Engineering 2005002186-D
Surveying 2005008319-D
Kansas
Engineering E-1685
Surveying LS-218
Oklahoma
Engineering S254
Nebraska
Engineering CA2821

Project:
950 Pollard
Issue Date:
April 21, 2022

950 Pollard Street
LEE'S SUMMIT, JACKSON COUNTY, MISSOURI

Existing Drainage Map
Preliminary Plans for:
950 Pollard Street
Lee's Summit, Jackson County, Missouri

Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226
NE PE E-14335

REVISIONS

No.	Description	Date

Exhibit

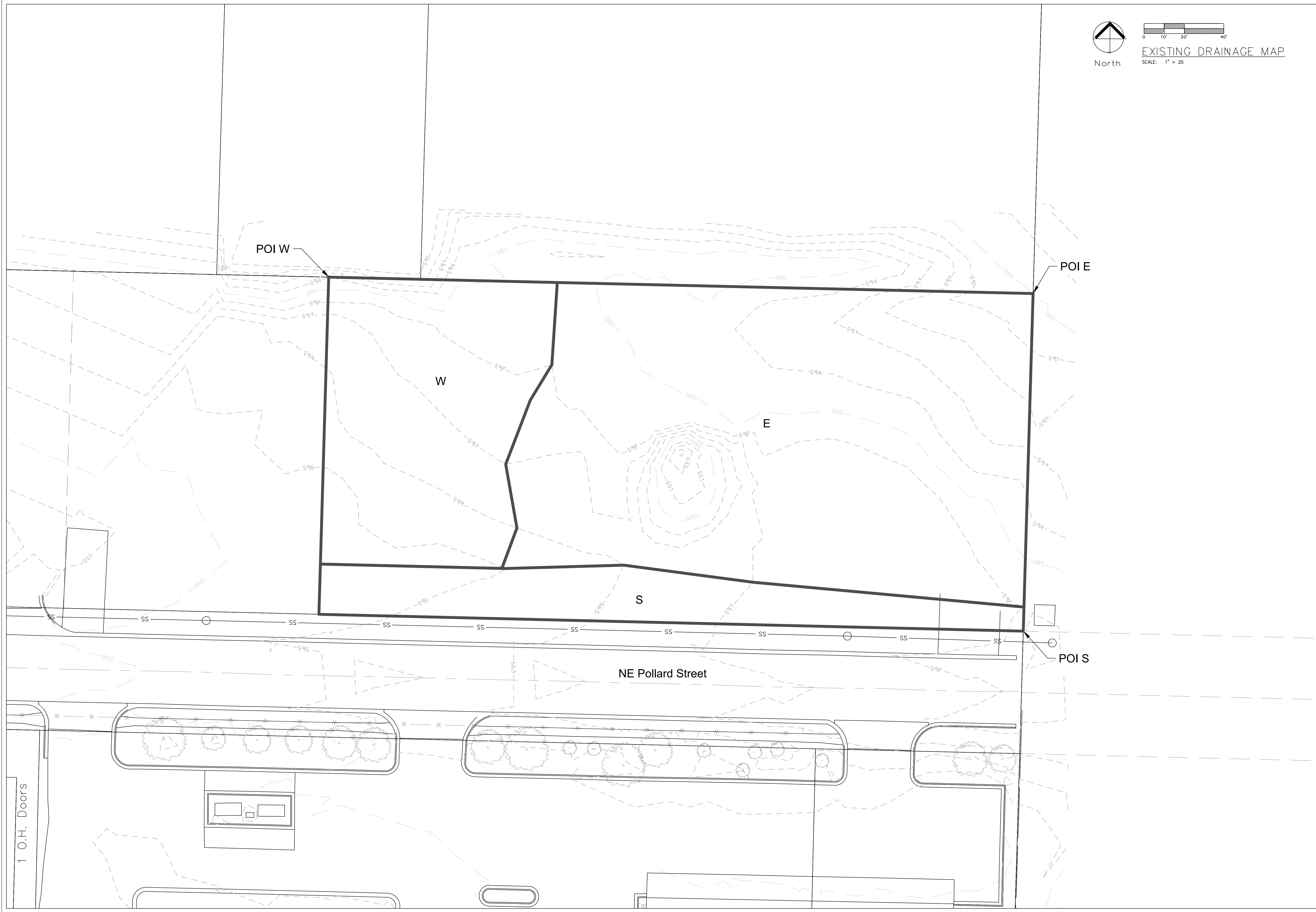


Exhibit E

Composite Curve Number Calculations

950 NE POLLARD STREET
 IMPERVIOUS AREA CALCUALTIONS

EXISTING	Area (ac.)	CN	Area x CN
Impervious Area	0.00	98	0
Pervious Area	1.31	74	96.94
Total Area	1.31		96.94
Composite CN	74		
PROPOSED	Area (ac.)	CN	Area x CN
Impervious Area	0.76	98	74.48
Pervious Area	0.55	74	40.7
Total Area	1.31		115.18
Composite CN	88		

Exhibit F

Time of Concentration Calculations

APWA STORM DRAINAGE "TC" COMPUTATIONS FOR : 950 NE POLLARD STREET

		yellow areas are self computing overwrite if necessary				Surface types: Asp/Conc Bus/Com Dirt Grass/Park Lake MultFam SnglFam Undev Other																	
						SURFACE CODES A B D G L M S U Z																	
						"C" Values 0.90 0.87 0.60 0.30 0.90 0.66 0.51 0.3											TC COMPUTATION						
		TOTAL WATERSHED				SURFACE CODE P=Paved U=Unpaved											Overwrite Slope or Elevations if necessary						
						OVERLAND FLOW - 100' MAX											CHANNEL FLOW - FIRST REACH						
AREA ID	TOTAL SQ.FT.	TOTAL ACRES	WTRSHD LENGTH	UP ELEV	DN ELEV	SURFACE CODE	"C" VALUE	OVRLND LENGTH	UP ELEV	DN ELEV	SLOPE %	SURFACE CODE or U	CHANNEL LENGTH	UP ELEV	DN ELEV	SLOPE %	VELOCITY F/S	Overland Flow T(I)	Used Min 5 Max 15 T(I)	Cal Channel One T(T)	Cal Channel Two T(T)	Total T@ 10	AREA ID
EX.																							EX.
W	14594.93	0.34	149.39	989.65	980.95	U	0.30	100.0	989.7	987.00	2.6	U	49.4	987.0	981.0	12.25	5.6	10.4	10.4	0.1	0.0	10.6	W
S	7441.22	0.17	370.57	989.65	985.41	U	0.30	37.5	989.7	988.89	2.0	P	333.1	988.9	985.4	1.04	2.1	7.0	7.0	2.7	0.0	9.6	S
E	34961.40	0.80	333.07	989.05	980.00	U	0.30	100.0	989.1	985.85	3.2	U	233.1	985.9	980.0	2.51	2.6	9.8	9.8	1.5	0.0	11.3	E
PROP.																							PROP.
W	2328.19	0.05	44.67	988.00	984.00	U	0.30	44.7	988.0	984.00	9.0							4.6	5.0	0.0	0.0	5.0	W
S	5284.63	0.12	285.56	988.67	985.41	U	0.30	33.4	988.7	988.00	2.0	P	252.2	988.0	985.4	1.03	2.1	6.6	6.6	2.0	0.0	8.6	S
E	7058.56	0.16	429.50	988.00	980.00	U	0.30	87.0	988.0	985.00	3.4	U	342.5	985.0	980.0	1.46	1.9	8.9	8.9	2.9	0.0	11.8	E
E(1)	42319.93	0.97	446.50	988.25	980.00	Z	0.81	100.0	988.3	986.50	1.8	P	346.5	986.5	980.0	1.88	2.8	4.3	5.0	2.1	0.0	7.1	E(1)