LOUCKS

Drury Hotel
Bloomington

Stormwater Management Report

03/30/2020

I hereby certify that this report
was prepared by me or under my direct
supervision, and that I am a duly Registered
Professional Engineer under the laws of
the State of Minnesota

Valentina Anderson, P.E.

Date: 03/30/2020 Reg. No. 43423

STORMWATER MANAGEMENT REPORT
DRURY HOTEL
BLOOMINGTON, MN

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Summary

The parcel is situated in the northwest quadrant of France Avenue and W. 78th St. in the City of Bloomington, Minnesota. The existing site consists of a parking lot and large berm with trees. This site is part of an overall PUD Development. There is an existing office building to the west immediately adjacent to this site. There is retail to the south, office to the north and retail to the east. This development will include the Hotel with a future restaurant pad with associated improvements including a rainwater harvest and re-use system.

Existing

The existing site is 3.8 acres and is made up of a parking lot, grasses, and some trees. This site is the former dump site and contains contamination and debris. The portion of the site west of the berm drains to the northwest and is conveyed via storm sewer in Minnesota Drive. The portion north of the berm drains to Minnesota Drive and the portion east of the berm drains to France Avenue.

Proposed

The proposed plan is for a new 9-story hotel and future restaurant. There will be a two-story ramp that is a walk out to the northwest to tie into existing elevations. The site will add 1.337 acres of impervious surface for a total of 2.947 acres. Of the 2.947 acres of impervious, DA-2 and DA-3 consist mostly of public sidewalk with a proper vegetated strip between the road that is not changed from existing, this area is being removed as existing impervious already meeting requirements. So, the total modeled area for MIDS is 3.652 acres with 2.796 acres of impervious. We are proposing an underground detention storm water system to hold back storm water and use for irrigation. We are also proposing a hydrodynamic separator to meet water quality control.

Stormwater Management Requirements

The Nine Mile Creek Watershed has the following requirements based on Restricted Sites:

- **Rate Control:**
  - Limit peak flow rates to that from existing conditions for the 2-, 10- and 100-year storm events for all points where storm water discharge leaves the parcel.

- **Volume Control:**
  - Provide for the retention onsite of 0.55 inch of runoff from all impervious surfaces of the parcel.
  - Provide for retention to the maximum extent practicable.

- **Water Quality Control**
  - Provide for all runoff from the parcel from the 2.5-inch storm event be treated through onsite or offsite detention, to at least 60 percent annual removal for phosphorus and at least 90 percent removal of total suspended solids.

Rate Control

We are required to match or decrease the runoff rates from the 2-, 10- and 100-year storm events. We are proposing an underground pipe detention system for rate control and rain water harvesting. The proposed design meets or decreases rates for all required storm events. See the table below for rate control data.

EXISTING DRAINAGE

DRAINAGE AREA	2-YEAR (CFS)	10-YEAR (CFS)	100-YEAR (CFS)
TO MINNESOTA	0.66	1.38	3.1
TO FRANCE	0.94	2.04	4.73
TO STORM WEST	5.45	9.42	18.11
TOTAL	**7.05**	**12.84**	**25.94**

PROPOSED DRAINAGE

DRAINAGE AREA	2-YEAR (CFS)	10-YEAR (CFS)	100-YEAR (CFS)
TO MINNESOTA	0.66	1.36	3.05
TO FRANCE	0.81	1.63	3.57
TO STORM WEST	5.09	7.69	14.86
TOTAL	**6.56**	**10.68**	**21.48**

Volume Control

We are unable to provide infiltration to capture runoff since the MPCA disapproves of storm water infiltration through contaminated soils. We have included the letter from Braun indicating the extents of the contamination on-site. We have also forwarded a link to the Phase I, Phase II and DRAP reports from Braun to the watershed for review.

Due to the contamination due to previous landfill uses, we are unable to infiltrate on site. Therefore, we have provided detention for use in harvesting rain water for irrigation. The site has limited landscaped area to irrigate do to the use of the site.

The required volume retention is 0.55" from impervious surfaces. Calculations follow:

- 2.796 acres of impervious * 0.55" = 0.128 acft of volume reduction required.

The proposed design stores water from the 817.5 elevation up to the 820.15 elevation. The volume of the proposed system up to the 820.15 is 0.123 acre-feet.

The green areas of the site account for 39,205 s.f. irrigation. Based on 1-inch per week over the irrigated area:

- 37,460 s.f. green space * 1"/week = 3,121 cf (0.072 ac-ft).

The storage available is enough for almost 2 weeks' worth of irrigation.

- 0.128 ac-ft (storage)/0.072 ac-ft (1 week) = 1.78weeks irrigation storage

Because of the nature of the project and need to parking, additional irrigation area cannot be found on site. The irrigation rate is at the recommended rate for landscaping in the area and additional irrigation may detrimental to the plants and create more surface runoff from saturation.

- 3,121 cf is less than 5,576 cf, so the requirement for 0.55" cannot be met.

If the retention of at least 0.55" cannot be met, the next requirement is to retain to the maximum extent possible. Everything has been done with this site to retain water to the maximum extent that can be reused. The irrigation area is the limiting factor for this site. Based on one week of irrigation, the volume reduction is 56.3% of the total needed.

- 0.072 acft/0.128 acft * (100) = 56.3%
- 56.3% * 0.55" = 0.31" over the impervious area

Water Quality

We are utilizing a treatment train incorporating the Isolator Row within the Stormtech system, then partial volume reduction through irrigation and finally the Jellyfish treatment manhole. The removals values for the isolator row and Jellyfish manhole are taken from the information given by the manufacturer.

The value for the Jellyfish is based on the given 59% removal for TP and the information it is all particulate, given that and the fact 2/3rd of the phosphorus is particulate making the particulate removal 89%. Using the MIDS calculator, we are able to achieve 92% TSS reduction and 61% TP reduction. See the MIDS Results and product fact sheets for more detailed information.

- TSS required 90% < TSS MIDS 94%
- TP required 60% < TP MIDS 63%

Erosion Control

Best Management Practices will be followed for all erosion control measures. Silt fence will be used around the perimeter of the site where the green area drains off-site. The catch basins will have inlet protection. The flared end sections will be installed with rip rap at the outlets. We will have a rock construction entrance to reduce the amount of sediment leaving the site. Additional information on erosion control can be found in the Plan Set.

PL202000058 PL2020-58

Project Information

Calculator Version:	Version 3: January 2017
Project Name:	Drury
User Name / Company Name:	
Date:	
Project Description:	
Construction Permit?:	No

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55435
Annual Rainfall (inches):	31.1
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			0.856		0.856
				Impervious Area (acres)	2.796
				Total Area (acres)	3.652

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			0.265		0.265
				Impervious Area (acres)	2.796
				Total Area (acres)	3.061

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	11164	ft3
Volume removed by BMPs towards performance goal:	1283	ft^3
Percent volume removed towards performance goal	**11**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	6.6348	acre-ft
Annual runoff volume removed by BMPs:	1.2776	acre-ft
Percent annual runoff volume removed:	**19**	**%**
Post development annual particulate P load:	2.978	lbs
Annual particulate P removed by BMPs:	2.802	lbs
Post development annual dissolved P load:	2.436	lbs
Annual dissolved P removed by BMPs:	0.618	lbs
Percent annual total phosphorus removed:	**63**	**%**
Post development annual TSS load:	983.6	lbs
Annual TSS removed by BMPs:	925.4	lbs
Percent annual TSS removed:	**94**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Harvest and re-use/Cistern	1283	11164	1283	9882	11
1 - Constructed stormwater pond	0	11164	0	11164	0
1 - Water Quality JF	0	11164	0	11164	0

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Harvest and re-use/Cistern	0	6.3316	1.2776	5.054	20
1 - Constructed stormwater pond	6.3316	0	0	6.3316	0
1 - Water Quality JF	0	6.3316	0	6.3316	0

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	0	0.05	0.0101	0.0399	20
1 - Constructed stormwater pond	2.8416	0	2.3869	0.4547	84
1 - Water Quality JF	0	0.4547	0.4047	0.05	89

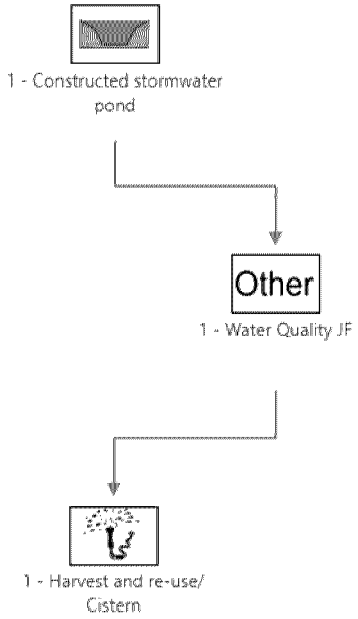
Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	0	2.139	0.4316	1.7074	20
1 - Constructed stormwater pond	2.325	0	0.186	2.139	8
1 - Water Quality JF	0	2.139	0	2.139	0

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	0	16.520000000	3.33	13.190000000	20
1 - Constructed stormwater pond	938.59	0	788.42	150.17	84
1 - Water Quality JF	0	150.17	133.65	16.520000000	89

BMP Schematic


1 - Constructed stormwater pond
Other
1 - Water Quality JF
1 - Harvest and re-use/ Cistern

Phase II Environmental Site Assessment

Proposed Minnesota Center Development
3901 Minnesota Drive
Bloomington, Minnesota

Prepared For

Frauenshuh Commercial Real Estate Group

May 31, 2016
Project B1602782

Braun Intertec Corporation

PL202000058 PL2020-58

BRAUN INTERTEC
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May 31, 2016

Project B1602782

Mr. Dean Williamson
Frauenshuh Commercial Real Estate Group
7101 West 78th Street, Suite 100
Bloomington, Minnesota 55439

Re: Phase II Environmental Site Assessment
Proposed Minnesota Center Development
3901 Minnesota Drive
Bloomington, Minnesota

Dear Mr. Williamson:

On behalf of Frauenshuh Commercial Real Estate Group, Braun Intertec Corporation conducted a Phase II Environmental Site Assessment (ESA) in conjunction with a geotechnical assessment of the Proposed Minnesota Center Development at 3901 Minnesota Drive in Bloomington, Minnesota (Site). The Phase II ESA was prepared to assess the Site for potential soil, soil gas and groundwater contamination that may affect planned future development.

If you have any questions or comments regarding this report, please call Jake Friederichs at 952.995.2474 or Ken Larsen at 952.995.2455.

Sincerely,

BRAUN INTERTEC CORPORATION

Jacob D. Friederichs
Staff Scientist

Kenneth A. Larsen, PE, PG
Principal – Principal Engineer

Attachment:
Phase II Environmental Site Assessment

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Figures

Tables

Appendices

A. Introduction

A.1. Authorization

On behalf of Frauenshuh Commercial Real Estate Group, Braun Intertec Corporation conducted a Phase II Environmental Site Assessment (ESA) in conjunction with a geotechnical assessment of the Proposed Minnesota Center Development at 3901 Minnesota Drive, Bloomington, Minnesota (Site). The purpose of the Phase II ESA was to assess the Site for potential soil, soil vapor and groundwater contamination that may affect planned future development. The Phase II ESA results are presented herein.

This Phase II ESA was prepared on behalf of, and for the use by, Frauenshuh Commercial Real Estate Group in accordance with the contract between Frauenshuh Commercial Real Estate Group and Braun Intertec. No other party has a right to rely on the contents of this investigation without written authorization by Braun Intertec.

A.2. Proposed Development

The proposed Minnesota Center Development will include construction of a four story office building, a separate two level parking structure, additional surface parking lots and drive lanes, below grade utilities, and a below grade storm water infiltration system. The proposed development configuration is depicting on Figure 2.

A.3. Project Objectives

The objectives of the Phase II ESA were to evaluate the recognized environmental conditions identified by the recently completed 2016 Phase I ESA (see Section B.3.b.) and to evaluate soil, groundwater, and soil vapor conditions at the Site in consideration of the future planned development. The results of the Phase II ESA will be used to develop a response action plan for addressing identified environmental impacts during development, and to support a request for liability assurances from the Minnesota Pollution Control Agency (MPCA) related to development of the Site.

B. Site Background

B.1. Site Location and Description

The Site is located in the southwest quadrant of 3901 Minnesota Drive, Bloomington, Minnesota. The Site consists of an irregular shaped parcel totaling approximately 3.8 acres. A grass and tree covered berm covers the entire east side of the Site, and an asphalt paved parking lot covers the west side of the Site. The Site is bordered in all directions with a mix of residential and commercial buildings. A Site location map and soil boring location sketch are included as Figure 1 and Figure 2, respectively. Summary information for the Site is summarized below:

Address:	3901 Minnesota Drive
City:	Bloomington
County:	Hennepin
State:	Minnesota
Property Identification Number:	06-027-24-11-0017
Construction Year:	No building
Owner:	3901 Minnesota Drive LLC
Latitude:	44.861 North
Longitude:	93.330 West
Section, Township, Range:	NE ¼ of the NE ¼ of the NE ¼ of Sec 61, T 27 N, R 24 W
Elevation:	Approximately 825 to 830 feet above mean sea level
Size:	3.8 acres

A recent boundary survey map completed for the property is included in Appendix A.

B.2. Site History

According to the 2016 Phase I ESA (see Section B.3.b), the Site was undeveloped and used as a hayfield until approximately the mid-1940s when sand mining and land backfilling activities began. The Site was part of an aggregate mining operation and landfill (i.e., part of the "France Avenue Dump") until the early 1960s. The Site was occupied by the Mann Drive-In Theater from the mid-1960s until the mid-1980s. The existing parking lot and landscaped area have occupied the Site since the mid-1980s.

B.3. Previous Site Investigations

B.3.a. Geotechnical Investigations

This Phase II ESA was completed by Braun Intertec concurrently with a geotechnical evaluation of the Site. The results of the geotechnical evaluation are presented under separate cover.

Previous geotechnical soil boring information related to the Site was reviewed for this Phase II ESA. The information included data from soil borings complete for a Soil Testing Report prepared by Braun Engineering Testing, Inc. (now Braun Intertec) dated May 5, 1988. The information also included data from soil borings completed by Braun Engineering Testing in 1985 and 1988, as well as by Soil Exploration Company in 1982. In general, the previous investigations reported that borings encountered landfill-related debris (i.e., wood, glass, paper, metal, concrete, shingles, etc.) from the ground surface to depths ranging from 7 feet to 19 feet and that "chemical odors" were noted in some of the previous borings. The landfill materials were underlain by a layer of peat and soft clay. Groundwater was encountered in the borings in water bearing sands beneath the peat and soft clay, and perched groundwater was encountered intermittently at the Site at shallower depths.

The approximate locations of the previous geotechnical soil borings are shown on Figure 2. Copies of the historic soil boring logs are included in Appendix B.

B.3.b. 2016 Phase I ESA

Braun Intertec competed a Phase I ESA of the Site in May 2016. The Phase I ESA identified the following recognized environmental conditions (REC) in connection with the Site:

- An aggregate mine operated on the Site and adjoining properties to the north, west, and south from the mid-1940s until the mid-1960s. Backfilling of the mined areas also occurred during that timeframe. The mined and backfilled area is known as the France Avenue Dump. Minnesota Pollution Control Agency (MPCA) Voluntary Investigation and Cleanup (VIC) files VP6140 and VP6141 are associated with the France Avenue Dump on property to the west and VP13540 is also associated with the France Avenue Dump extending onto an adjacent property to the north (across Minnesota Drive). The historic use of the Site as a dump and the identified releases of hazardous substances and petroleum products on the Site is considered a recognized environmental condition.

C. Scope of Services

The following tasks were conducted at the Site as part of this Phase II ESA:

- Advanced eight standard penetration test (SPT) soil borings in conjunction with a geotechnical investigation to evaluate soil at the Site.
- Screened soil samples collected from the soil borings for the presence of organic vapors using a photoionization detector (PID).
- Advanced three push probes to evaluate groundwater at the Site.
- Advanced four soil vapor probes.
- Collected soil, groundwater, and soil vapor samples for laboratory analyses.
- Evaluated the data and prepared this report.

D. Investigation Methods and Procedures

The fieldwork relating to the investigation was conducted on April 14, 15, 18, 21 and 27, 2016. Prior to beginning the field investigation, public utilities were cleared through Gopher State One Call and private utilities were cleared through a subcontracted private utility locator. The investigation locations are shown on Figure 2. Standard Operating Procedures (SOPs) using during the investigation are included in Appendix C.

D.1. Soil Borings

On April 14, 15, 18, and 21, 2016, Braun Intertec advanced eight SPT soil borings designated as ST-1-16 through ST-8-16. The soil borings were advanced using a truck mounted hollow stem auger rig. Seven of the soil borings were advanced to a depth between 25 feet below ground surface (bgs), and one soil boring was advanced to a depth of 120 feet bgs. In addition, three push probe soil borings were advanced adjacent to three of the SPT borings to facilitate collection of groundwater samples for laboratory analysis. All soil borings were sealed upon completion in accordance with Minnesota Department of Health (MDH) regulations.

D.2. Soil Vapor Probes

Soil vapor probes SV-1, SV-2, SV-3 and SV-4 were advanced adjacent to SPT borings ST-1-16, ST-2-16, SP-7-16 and ST-8-16 to facilitate collection of soil vapor samples for laboratory analysis.

D.3. Soil Classification

During advancement of the soil borings, soil samples were collected at 2.5-foot intervals to 20 feet bgs, at 5 foot intervals to 50 feet bgs, and then at 10 foot intervals to the termination depth. The soils encountered in the soil borings were visually and manually classified in the field by an environmental technician using American Society for Testing and Materials (ASTM) D 2487 "Unified Soils Classification System" and ASTM D 2488 "Recommended Practice for Visual and Manual Description of Soils." Additionally, soils were classified at the Braun Intertec soils laboratory by a geotechnical engineer using ASTM D 2487 and ASTM D 2488. Soil boring logs, with descriptions of the various soil strata encountered during the soil boring advancement, are contained in Appendix D. The depths shown as changes between the soil types are approximate. The actual changes may be transitional, and the transition depths are likely to be horizontally variable.

D.4. Soil Screening

Soil samples retrieved were examined by an environmental technician, who was a licensed asbestos inspector for unusual staining, odors, and other apparent signs of contamination. In addition, the soil samples were screened for the presence of organic vapors using a PID. The PID was equipped with a 10.6-electron-volt lamp and calibrated to an isobutylene standard. The PID was used to perform a headspace method of field-analyses, as recommended by the Minnesota Pollution Control Agency (MPCA) in Petroleum Remediation Program Guidance Document 4-04 (September 2008).

D.5. Sampling and Analytical Testing

D.5.a. Soil Samples

A total of 20 soil samples were collected for laboratory analysis from the soil borings. A shallow soil sample was collected from the upper 5 feet of each boring to characterize the fill that may be excavated during proposed Site redevelopment. Samples were collected to characterize the soils that might be encountered during development and at greater depths to document the condition of soils left in place at the Site following development.

The soil samples were analyzed for a combination of the following parameters:

- Volatile organic compounds (VOCs) using the United States Environmental Protection Agency (EPA) Method 8260.
- Semi-volatile organic compounds (SVOCs) using United States EPA Method 8270.
- Polychlorinated biphenyls (PCBs) using EPA method 8082.
- Priority pollutant metals using EPA Methods 6010 and 7471.
- Organochlorine (OC) pesticides using EPA method 8081.
- Gasoline Range Organics (GRO) using the Wisconsin Department of Natural Resources (WDNR) Method
- Diesel range organics (DRO) using the WDNR Method.
- Lead by Toxicity Characteristic Leaching Procedure (TCLP).
- Arsenic by TCLP.

D.5.b. Groundwater Samples

Following the observation of groundwater within select SPT soil borings, three push probes soil borings were advanced to the depth groundwater in the general vicinity of the SPT soil borings. Once the push probe had been advanced to groundwater, a 1 inch PVC temporary monitoring well was installed to collect a groundwater sample for laboratory analysis. The temporary well was constructed with new, one-inch diameter polyvinyl chloride (PVC) piping. Dedicated polyethylene tubing fitted with a stainless-steel check valve was used to collect the groundwater sample. The groundwater samples (ST-1W, ST-6W, and ST-8W) were placed in clean sample containers, preserved, labeled, and transported to Pace Analytical under refrigerated conditions using chain-of-custody procedures. The groundwater samples were analyzed for DRO, GRO, VOCs, SVOCs and dissolved metals.

D.5.c. Soil Vapor Samples

Soil vapor probes SV-1 through SV-4 were advanced to 8 feet bgs and then retracted to 6 feet bgs to facilitate collection of soil vapor samples for laboratory analysis. To collect the sample, new polyethylene tubing was attached to the top of the sampler. The sampling point and tubing were purged to remove two volumes of air prior to sample collection. After purging, the tubing was clamped closed, the sample canister was attached and the clamp released. The soil vapor sample was collected as a grab sample using laboratory-supplied negative pressurized air-sample collection canister in accordance with MPCA guidelines. The soil vapor samples were analyzed for VOCs using EPA Method TO-15 and methane using EPA Method TO-3.

E. Investigation Results

E.1. Geologic Conditions

Soil boring logs are included in Appendix D. The following is a summary of the subsurface geologic conditions encountered in the borings:

- Fill soil consisting of primarily silty sand, poorly graded sand, clayey sand, silt, and organic clay was encountered in all of the soil borings from just below the ground surface to depths ranging from 4 feet bgs in boring ST-3-16 to 23 feet bgs in boring ST-6-16. Debris including but not limited to concrete, brick, bituminous, glass, and wood was intermixed with the fill soil in all of the borings.

- The thickness of the fill materials with debris was generally consistent with ground surface elevation of the respective borings. That is, the borings with the highest ground surface elevation also had the greatest thickness of fill materials.

- Native soil, consisted primarily of poorly graded sand, peat, and lean clay were encountered below the fill.

- Groundwater was encountered in the soil borings at depths ranging from approximately 9 feet bgs in boring ST-5-16 to 25 feet bgs in boring ST-6-16. Where encountered, groundwater was generally present within the native soils/peat underlying the fill soils with debris. The depth to groundwater at the Site was also generally consistent relative to the ground surface elevation of the respective borings.

Soil encountered during the Phase II ESA were consistent with the soil encountered in previous geotechnical investigations. Historical soil boring logs are included in Appendix B.

E.2. Field Screening

The PID readings are included on the soil boring logs included in Appendix D. The following observations are provided regarding the data:

- The highest PID readings were detected in the soil samples from boring ST-1-16 (up to 830.7 ppm). A strong petroleum odor was observed in relation to the fill soils during completion of ST-1-16.

- Elevated PID readings were also detected in the soil samples from ST-3-16 (up to 14.2 ppm), ST-6-16 (up to 277.6 ppm), and ST-7-16 (up to 69.4 ppm).

- No PID above 10 ppm were detected in the soil samples from ST-2-16, ST-4-16, ST-5-16 and ST-8-16.

E.3. Soil Analytical Testing Results

The soil analytical testing results are summarized in Table 1 and Table 2. The complete laboratory analytical reports are included in Appendix E.

The soil analytical results can be compared with the Soil Reference Values (SRVs) and Screening Soil Leaching Values (SLVs) which are also listed in Table 1. SRVs and SLVs are allowable risk-based contaminant concentrations derived by the MPCA using risk assessment methodology, modeling, and risk management policy to guide investigation and cleanup actions. SRVs relate to direct-contact exposure scenarios and SLVs relate to potential leaching of contaminants to groundwater. The soil analytical results and related comparison criteria are all expressed in units of milligrams per kilogram (mg/kg).

Soil results presented in Table 2 are for several soil samples which were analyzed for future soil disposal characterization purposes using the TCLP method. Table 2 also lists the respective TCLP hazardous waste criteria. The TCLP results are expressed in units of milligrams per liter (mg/L).

The laboratory analysis results indicated that:

- Several VOCs were detected at or above the laboratory MRLs; however, none exceeded regulatory limits with the exception of n-butylbenzene, sec-butylbenzene, cis-1,2-dichloroethene, ethylbenzene, isopropylbenzene (cumene), naphthalene, n-propylbenzene, toluene, trichloroethene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, total xylenes. All of which exceed either the Residential or Industrial SRVs or SLVs.

- Several SVOCs were detected at or above the laboratory MRLs; however, none exceeded regulatory limits with the exception of naphthalene. Specifically, naphthalene was detected at a concentration of 1,020 mg/kg in sample ST-1-16 (5-6.5) exceeding the Industrial SRV and SLV and at a concentration of 7.6 mg/kg in sample ST-1-16 (10-11.5) exceeding the SLV. The calculated benzo(a)pyrene equivalent for sample ST-6-16 (7.5-9) was 9.5 mg/kg and sample ST-7-16 (22.5-24), both of which exceeded the Industrial SRV and SLV.

- Several priority pollutant metals were detected above laboratory MRLs; however, no concentrations exceeded SRVs or SLVs. Arsenic was detected at concentrations ranging from 7.5 mg/kg to 104 mg/kg, which exceeds either the Residential or Industrial SRVs and SLV. Copper was detected at concentrations ranging from 157 mg/kg to 9,790 mg/kg exceeding either the Residential or Industrial SRVs and SLVs. Lead was detected in samples from five of the soil borings at concentrations ranging from 322 mg/kg and 1,460 mg/kg exceeding either the Residential or Industrial SRV and SLV. Mercury was detected at concentrations ranging from 0.74 mg/kg to 0.97 mg/kg exceeding the Residential SRV. Selenium was detected at a concentration of 4.0 mg/kg exceeding the SLV. Zinc was detected at concentrations ranging from 408 mg/kg to 10,100 mg/kg exceeded the Residential SRV and SLV.

- Several organochlorine pesticides were detected above the MRLs in the samples analyzed for these parameters; however, none exceeded regulatory standards.

- PCBs were not detected at or above the laboratory method reporting limits (MRLs) in the samples analyzed for these parameters.

- GRO was detected at concentrations ranging from 28.1 mg/kg to 10,200 mg/kg. There is currently no regulatory standard for GRO; however, soil with GRO concentrations exceeding 100 mg/kg is considered to be "regulated fill" per current MPCA guidance.

- DRO was detected at concentrations ranging from 10.8 mg/kg to 213,000 mg/kg. There is currently no regulatory standard for DRO; however, soil with DRO concentrations exceeding 100 mg/kg is considered to be "regulated fill" per current MPCA guidance.

- The TCLP lead and arsenic results were below the hazardous waste criteria for the samples analyzed.

E.4. Groundwater Analytical Testing Results

The groundwater analytical testing results are summarized in Table 2 and the laboratory analytical reports including the chain-of-custody forms are included in Appendix E. For comparison purposes, the table also includes Drinking Water Criteria from MPCA Risk-Based Site Evaluation guidance. The Drinking Water Criteria includes MDH Health Risk Limits (HRLs), which are the allowable drinking water standards recommended by the MDH, MDH Health Based Values (HBVs), or Maximum Contaminant Levels (MCLs), which are established by the EPA. Drinking Water Criteria are expressed in micrograms per liter (ug/L). The laboratory analysis results indicated that:

- No GRO, SVOCs or PCBs were detected in the samples above the laboratory MRLs.
- Several VOCs were detected in the samples at or above the laboratory MRL; however, none exceeded the drinking water criteria for those compounds.
- Several priority pollutant metals were detected in the samples at or above the laboratory MRL; however, none exceeded the drinking water criteria for those compounds.
- DRO was detected at a concentration of 479 microgram per liter (ug/L) in sample ST-1W and 393 ug/L in sample ST-6W, which exceeded the drinking water criteria of 200 ug/L.

E.5. Soil Vapor Analytical Testing Results

The soil vapor analytical testing results are summarized in Table 3, and the laboratory analytical report is attached in Appendix E. The analytical results were compared to the MPCA Industrial Intrusion Screening Values (ISVs). The ISVs were developed by the MPCA to be used as screening values for evaluating risks posed by volatile compounds identified in indoor air when those compounds are present due to vapor intrusion. Per MPCA guidance, soil vapor results are compared to either ten times (10x) or one hundred times (100x) the ISVs. Soil vapor concentrations greater than 10x the ISV indicate a higher potential for risks associated with vapor intrusion, and per MPCA guidance, when vapor concentrations exceed the 10x ISV, sub-slab vapor samples and/or a building survey to identify entry points may need to be conducted. In cases where volatile compounds exceed the 100x ISV, the MPCA guidance indicates sub-slab vapor samples and indoor air samples be collected.

The laboratory analysis results indicated that:

- Tetrachloroethene exceeded 10X Industrial ISV in soil vapor sample SV-4.
- 1,2,4-Trimethylbenzene exceeded the 10X Industrial ISV in soil vapor sample SV-4 and the Industrial 100X ISV in soil vapor sample SV-1.
- Vinyl chloride exceeded the 10X Industrial ISV in soil vapor sample SV-4 and the Industrial 100X ISV in soil vapor sample SV-3.
- Methane was detected in SV-1, SV-3, and SV-4. Methane concentrations surpassed the lower explosive limit (LEL) in SV-3 and SV-4.

E.6. Quality Assurance/Quality Control

Samples were placed in clean, laboratory-supplied containers, preserved, labeled, and transported to the Pace Analytical laboratory under refrigerated conditions using chain-of-custody procedures. Analyses were performed using EPA or other recognized standard procedures.

All applicable Braun Intertec SOPs were followed as prescribed unless otherwise noted in this report. A data quality assessment of field procedures and laboratory reports was performed to determine the effect of any deviations on data quality and use to support project objectives. In summary, the data were reviewed prior to release, quality-control guidelines were generally met, and the data is considered usable for its intended purpose.

F. Conclusions and Recommendations

Based on the results of this investigation, we conclude the following:

- Fill soil consisting of primarily silty sand, poorly graded sand, clayey sand, silt, and organic clay was encountered in all of the soil borings from just below the ground surface to depths ranging between 4 feet bgs and 23 feet bgs. Debris including concrete, brick, bituminous, glass, and wood was encountered intermixed with the fill soil in each soil boring. The fill soil and intermixed debris are likely related to the historic use of the Site as part of the France Avenue Dump. Native soil, consisted primarily of poorly graded sand, peat, and lean clay were encountered below the fill. Some debris was also observed in the upper portions of the native soil.
- Laboratory analysis identified both petroleum and non-petroleum related soil contamination at the Site including VOCs, SVOCs, metals and DRO. VOC, SVOCs, and metals concentrations from a number of samples exceeded the Residential SRVs and/or SLVs; DRO concentrations in a number of samples exceeded the MPCA unregulated fill criterion of 100 mg/kg.
- Groundwater was encountered in the soil borings at depths ranging from approximately 9 feet bgs in boring ST-5-16 to 25 feet bgs in boring ST-6-16. The depth to groundwater at the Site was also generally consistent relative to the ground surface elevation of the respective borings. DRO was detected in groundwater samples collected during this investigation at concentrations exceeding Drinking Water Criteria.
- Laboratory analysis detected various petroleum and non-petroleum related VOCs and methane in subsurface soil vapors at the Site. Specifically, elevated concentrations of

benzene, methylene chloride, naphthalene, trichloroethene, tetrachloroethene, 1,2,4-trimethylbenzene, and vinyl chloride were detected in soil vapor samples exceeding regulatory criteria. Methane was detected in two soil vapor samples at concentrations exceeding the LEL.

Based on the results of the investigation, we recommend that the Site be entered into the MPCA's Voluntary Investigation and Cleanup (VIC) Program and Petroleum Brownfield (PB) Program to facilitate obtaining appropriate regulatory approvals for the project moving forward. We also recommend that prior to construction, a response action plan and construction contingency plan (RAP/CCP) be prepared and submitted for MPCA review and approval. The RAP/CCP is intended to provide methods and procedures to manage the removal, management, storage, handling and disposition of impacted soil with debris excavated and/or disturbed as part of the redevelopment. Due to the widespread fill soil with debris present at the Site, it is likely that the majority of soils excavated for redevelopment will require offsite disposal at a permitted landfill. In addition, the MPCA will require that vapor mitigation systems be incorporated into the future building designs and utility corridors to address the elevated subsurface methane and VOC concentrations.

G. Assessment Limitations

The analyses and recommendations submitted in this report are based on our field observations and the results of laboratory chemical analyses of samples collected for this project. It is important to note that our investigation is limited to the diameter or limits of our investigation locations and cannot be assumed to be completely representative of the conditions throughout the Site.

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty express or implied, is made.

PL202000058 PL2020-58

BRAUN INTERTEC
The Science You Build On.

Braun Intertec Corporation
11001 Hampshire Avenue S
Minneapolis, MN 55438

Phone: 952.995.2000
Fax: 952.995.2020
Web: braunintertec.com

October 13, 2017

Mr. Larry Westrich
Drury Southwest, Inc.
101 S. Farrar Drive
Cape Girardeau, MO 63701

RE: Storm Water Infiltration Limitations
Proposed Minnesota Center Development
3901 Minnesota Drive
Bloomington, Minnesota 55435 (the Site)

Dear Mr. Westrich:

Pursuant to your request, Braun Intertec Corporation has prepared this letter discussing storm water infiltration limitations related to the proposed development on the 3901 Minnesota Drive property (the Site). The infiltration limitations are related to the environmental conditions at the Site and expected requirements by the Minnesota Pollution Control Agency (MPCA) to allow development to proceed.

Proposed Development

The proposed development will include construction of a 9-story hotel building with a footprint of about 12,000 square feet on the northern portion of the Site, and a 2-level partially open sided parking structure on the remainder of the Site. The upper level of the parking structure will include a 7,000 square foot restaurant. Both structures will be completed at or near current grades with no below grade levels. The development will also include paved access driveways, landscaping, new underground utilities, and storm water control structures.

A preliminary Site Plan diagram showing the proposed development configuration is attached to this letter.

Summary of Site Environmental Conditions

Braun Intertec previously conducted Phase I and Phase II environmental site assessments (ESAs) of the Site. The results of this work were presented in the following reports:

- *Phase I Environmental Site Assessment, Proposed Minnesota Center Development, 3901 Minnesota Drive, Bloomington, Minnesota*, dated August 18, 2017 (2017 Phase I ESA).

- *Phase II Environmental Site Assessment, Proposed Minnesota Center Development, 3901 Minnesota Drive, Bloomington, Minnesota*, dated May 31, 2016 (2016 Phase II ESA).

According to the 2017 Phase I ESA, the Site was operated as an aggregate mining operation from the mid-1940s until the mid-1960s. Backfilling of the mined areas also occurred during that timeframe. The mined and backfilled area is known as the former "France Avenue Dump". The Site was occupied by the Mann Drive-In Theater from the mid-1960s until the mid-1980s. The existing parking lot and landscaped area have occupied the Site since the mid-1980s.

The 2016 Phase II ESA identified fill soils across the Site ranging in thickness from 4 to 23 feet below ground surface (bgs). Evidence of debris including concrete, brick, bituminous, glass, paper, and wood was observed intermixed with the fill soil in most soil borings completed at the Site. The fill soils and debris are likely related to the historic use of the Site as a dump. Native swampy materials and deeper glacial outwash deposits were encountered below the fill materials and debris. Groundwater was encountered at the Site at depths as shallow as approximately 9 feet bgs.

Fill soils with extensive debris, associated with former use of the Site as the France Avenue Dump, are present across the Site – nearly every previously completed soil boring encountered debris. The debris-laden fill soil contains elevated concentrations polycyclic aromatic hydrocarbons (PAHs), Diesel Range Organics (DRO), Volatile Organic Compounds (VOCs), and/or metals, including arsenic, copper, lead, mercury, and zinc. Although several soil samples exhibited contaminant concentrations less than their respective MPCA Soil Reference Values (SRVs), Soil Leaching Values (SLVs), and MPCA unregulated fill criteria, all fill soil samples exhibited elevated contaminant concentrations. Based on the results of the 2016 Phase II ESA and the intermixed nature of the fill materials, all fill soil at the Site should be considered to be impacted. Additionally, two out of three groundwater samples exhibited DRO concentrations greater than Minnesota Department of Health (MDH) Health Based Values.

The 2017 Phase I ESA and 2016 Phase II ESA reports should be reviewed for additional information related to the specific findings.

Anticipated MPCA Requirements

The MPCA generally disapproves of storm water infiltration at sites where such actions have the potential to adversely affect existing soil or groundwater contamination. Typical MPCA concerns include avoiding storm water infiltration through contaminated soils or debris (to avoid leaching of additional contaminants to groundwater), and avoiding changing groundwater flow characteristics at a site (to avoid spreading contamination off-site to new areas).

Based on the environmental conditions at the Site and past experience, including with the currently ongoing redevelopment at 7700 France Avenue South, it is our opinion that the MPCA will not allow storm water infiltration at areas of the Site where dump materials will remain in place and where known shallow groundwater impacts are present. Based on the available historical information, including the results of the 2016 Phase II ESA and previous geotechnical soil boring information, this would apply to the entirety of the Site. The MPCA will likely require that the storm water ponds be lined to prevent infiltration through remaining contaminated soil and avoid changing groundwater flow conditions in areas with existing shallow contamination.

Response Action Plan

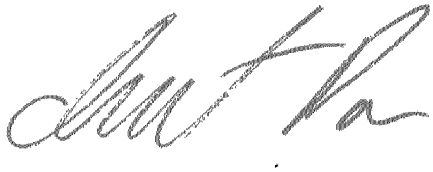
A response action plan (RAP) has been prepared by Braun Intertec for the proposed redevelopment and has been submitted to the MPCA Voluntary Investigation and Cleanup (VIC) and Petroleum Brownfields (PB) programs for review and approval. The RAP summarizes the results of the previously completed Phase I and Phase II environmental site assessments for the Site, discusses the contamination-related issues affecting the proposed development, presents a framework for managing contaminated soil/materials excavated for development, outlines requirements for environmental monitoring and testing during construction, and provides a conceptual sub-slab vapor control system design for the project to address the soil gas impacts.

Closing Remarks

If you have any questions regarding this letter, please contact Ken Larsen at 952.995.2455 or Imants Pone at 952.995.2665.

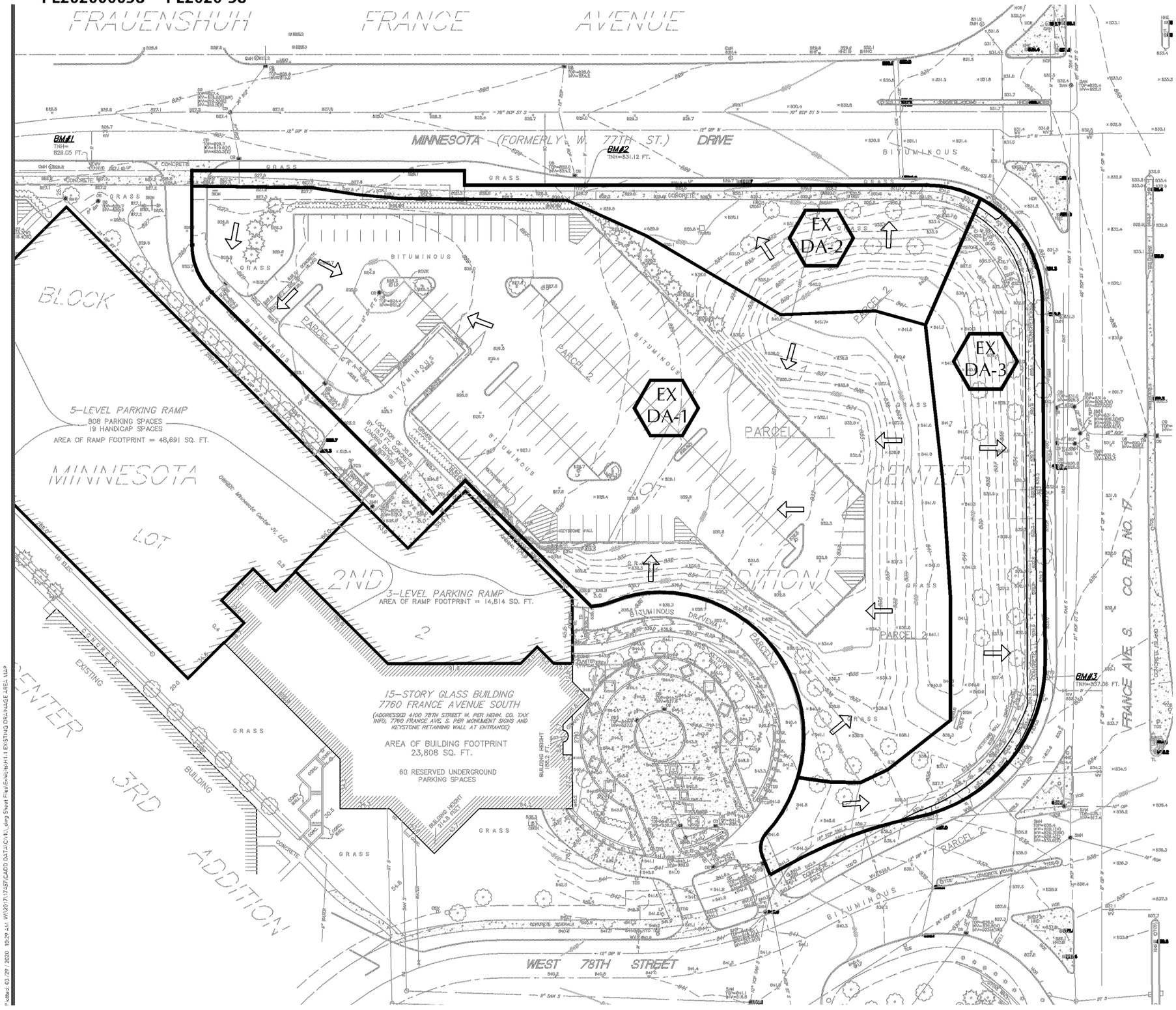
Sincerely,
BRAUN INTERTEC CORPORATION

Kenneth Larsen, P.E., P.G.
Principal Engineer



Imants Pone
Senior Scientist

PL202000058 PL2020-58



DRURY HOTEL
3901 MINNESOTA DRIVE
BLOOMINGTON, MINNESOTA

Drury Southwest, Inc.
101 S. Range Drive
Cape Girardeau, Missouri, 63701

LOUCKS
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CADD QUALIFICATION

CADD files prepared by the Consultant for this project are instruments of the Consultant professional services for use solely with respect to this project. These CADD files shall not be used on other projects, for additions to this project, or for completion of this project by others without written approval by the Consultant. With the Consultant's approval, others may be permitted to obtain copies of the CADD files. Files for information and reference only. All electronic or watercolor revisions, additions, or deletions to these CADD files shall be made at the full risk of that party making such revisions, additions or deletions and that party shall hold harmless and indemnify the Consultant from any & all responsibilities, claims, and liabilities.

SUBMITTAL/REVISIONS

04/17/18	WATERSHED SUBMITTAL
05/20/18	PHASE 1 GRADING PERMIT
12/17/18	UTILITY COORDINATION
02/07/19	UTILITY COORDINATION
04/01/20	PRELIM DRC SUBMITTAL

PROFESSIONAL SIGNATURE

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

PRELIMINARY NOT FOR CONSTRUCTION

Name: NICHOLAS M. MARTINSON, PE
License No. 41352
Date -

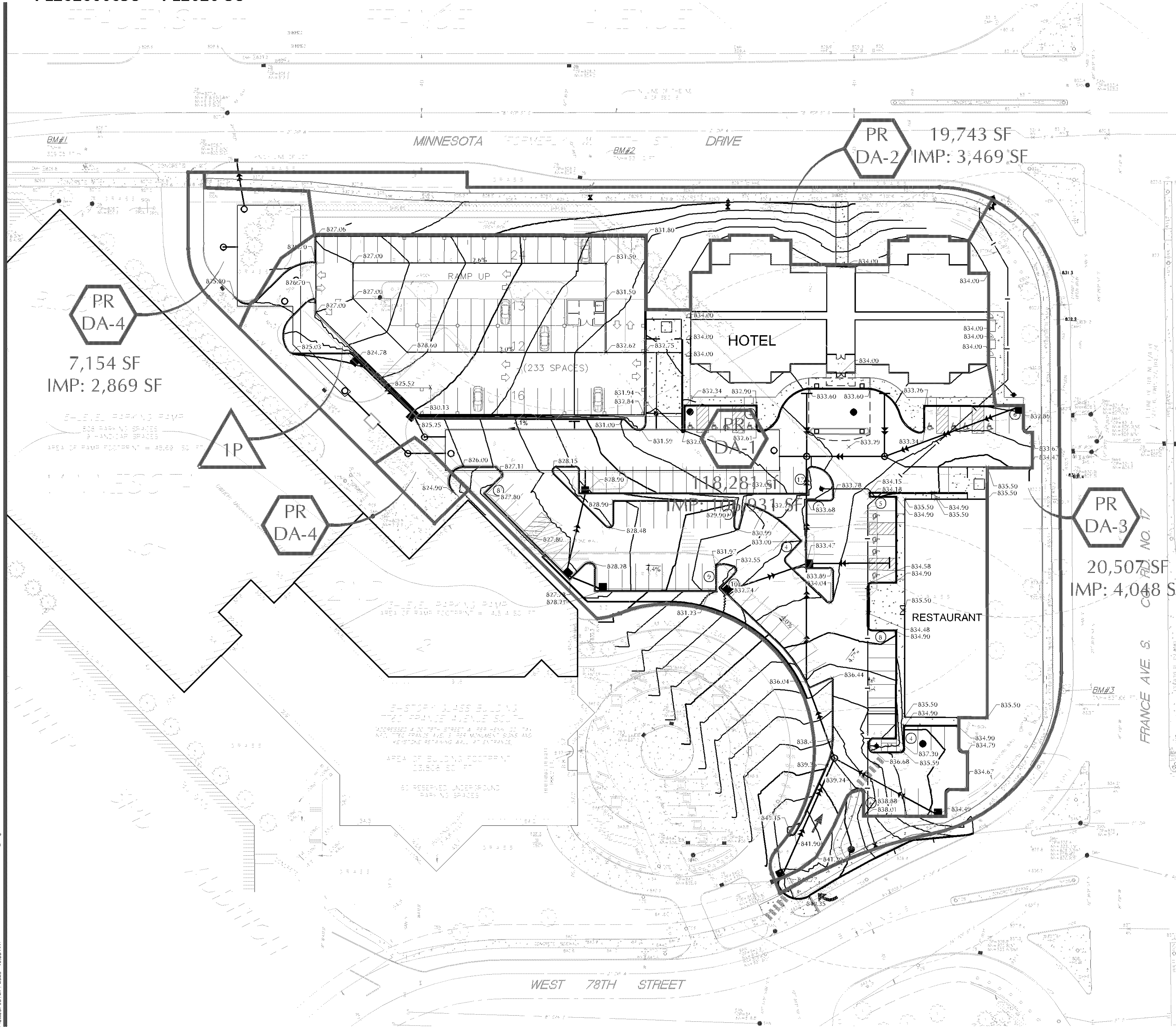
QUALITY CONTROL

Loucks Project No.	17457.00
Project Lead	VJV
Drawn By	CDL
Checked By	NMM
Review Date	03/25/20

SHEET INDEX

EXISTING DRAINAGE MAP
H1-1

PL202000058 PL2020-58



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04/17/18	WATERSHED SUBMITTAL
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12/17/18	UTILITY COORDINATION
02/07/19	UTILITY COORDINATION
04/01/20	PRELIM DRC SUBMITTAL

PROFESSIONAL SIGNATURE

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

PRELIMINARY NOT FOR CONSTRUCTION

License No. 24650
Date -

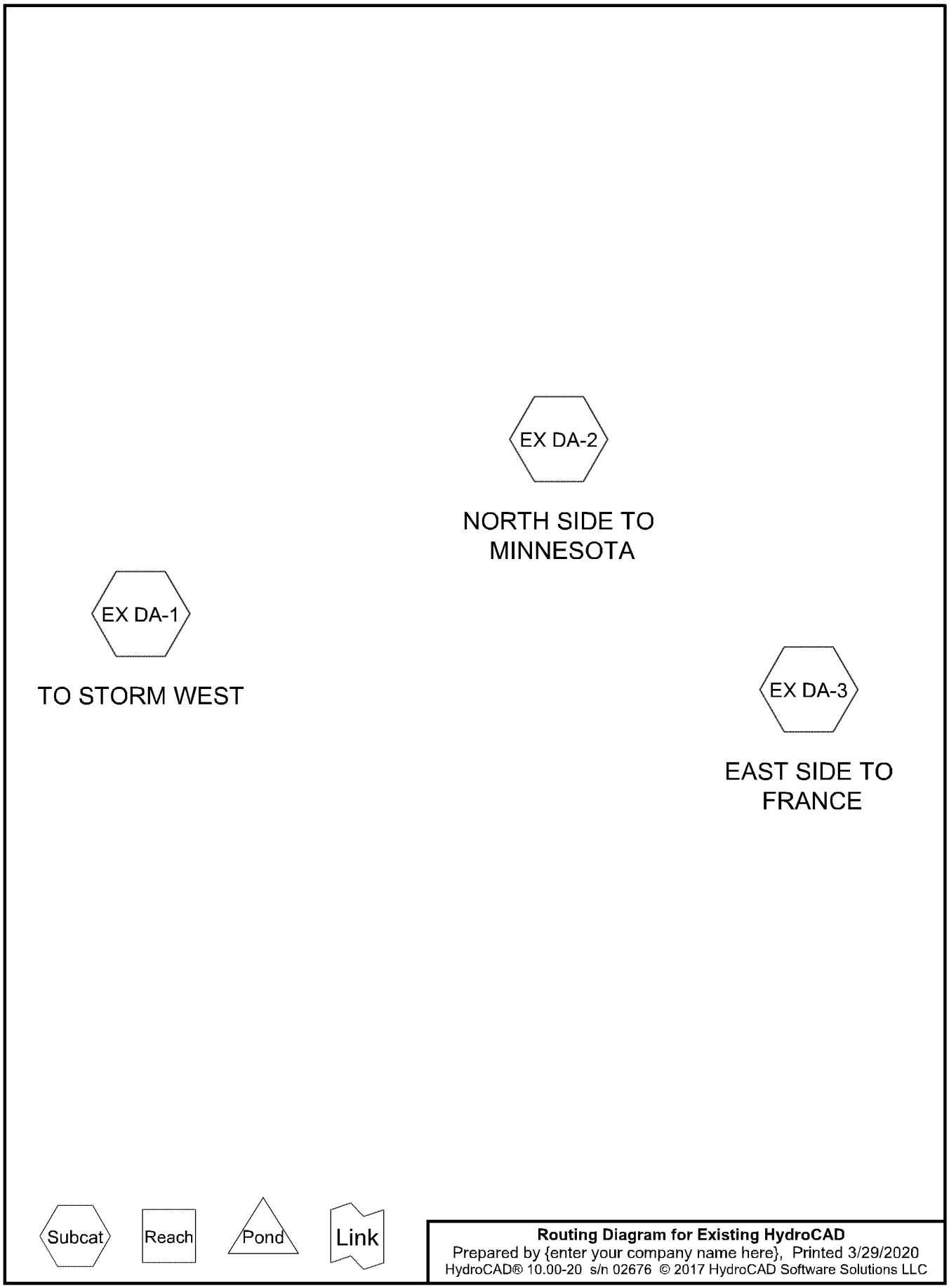
QUALITY CONTROL

Loucks Project No.	17457.00
Project Lead	VJV
Drawn By	GDU
Checked By	NMM
Review Date	03/25/20

SHEET INDEX

PROPOSED DRAINAGE MAP

H2-1


EX DA-2
NORTH SIDE TO MINNESOTA
EX DA-1
TO STORM WEST
EX DA-3
EAST SIDE TO FRANCE
Subcat
Reach
Pond
Link
Routing Diagram for Existing HydroCAD
Prepared by {enter your company name here}, Printed 3/29/2020
HydroCAD® 10.00-20 s/n 02676 © 2017 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.194	74	>75% Grass cover, Good, HSG C (EX DA-1, EX DA-2, EX DA-3)
1.610	98	Paved parking, HSG C (EX DA-1, EX DA-2, EX DA-3)

Summary for Subcatchment EX DA-1: TO STORM WEST

Runoff = 5.45 cfs @ 12.08 hrs, Volume= 0.339 af, Depth> 1.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=2.86"

Area (sf)	CN	Description
64,662	98	Paved parking, HSG C
48,586	74	>75% Grass cover, Good, HSG C
113,248	88	Weighted Average
48,586		42.90% Pervious Area
64,662		57.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	48	0.0500	0.09		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 2.86"
3.4	20	0.1000	0.10		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 2.86"
0.4	70	0.0350	2.81		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
1.1	109	0.0320	1.60		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"
2.3	210	0.0200	1.51		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"
16.1	457	Total			

Summary for Subcatchment EX DA-2: NORTH SIDE TO MINNESOTA

Runoff = 0.66 cfs @ 12.06 hrs, Volume= 0.038 af, Depth> 0.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=2.86"

Area (sf)	CN	Description
3,312	98	Paved parking, HSG C
17,959	74	>75% Grass cover, Good, HSG C
21,271	78	Weighted Average
17,959		84.43% Pervious Area
3,312		15.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	27	0.0480	0.08		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 2.86"
6.0	54	0.1700	0.15		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 2.86"
0.1	6	0.0200	0.74		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"
1.8	4	0.0200	0.04		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 2.86"
13.6	91	Total			

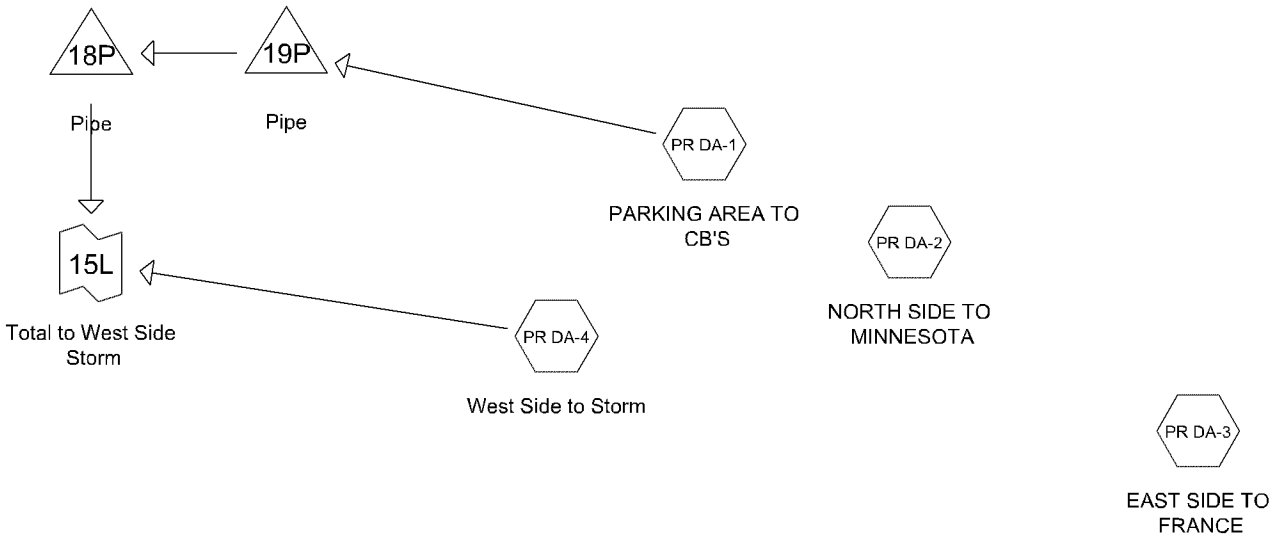
Summary for Subcatchment EX DA-3: EAST SIDE TO FRANCE

Runoff = 0.92 cfs @ 12.05 hrs, Volume= 0.049 af, Depth> 0.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=2.86"

Area (sf)	CN	Description
2,175	98	Paved parking, HSG C
29,004	74	>75% Grass cover, Good, HSG C
31,179	76	Weighted Average
29,004		93.02% Pervious Area
2,175		6.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	23	0.0700	0.09		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 2.86"
4.8	42	0.1800	0.15		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 2.86"
0.2	7	0.0200	0.76		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"
2.4	6	0.0200	0.04		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 2.86"
11.7	78	Total			



Subcat Reach Pond Link

Routing Diagram for Proposed HydroCAD 20 03-24
Prepared by {enter your company name here}, Printed 3/29/2020

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.856	74	>75% Grass cover, Good, HSG C (PR DA-1, PR DA-2, PR DA-3, PR DA-4)
2.947	98	Paved parking, HSG C (PR DA-1, PR DA-2, PR DA-3, PR DA-4)

Summary for Subcatchment PR DA-1: PARKING AREA TO CB'S

Runoff = 21.33 cfs @ 12.06 hrs, Volume= 1.596 af, Depth= 7.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.03 hrs
Type II 24-hr 100-Year Rainfall=7.32"

Area (sf)	CN	Description
116,163	98	Paved parking, HSG C
1,643	74	>75% Grass cover, Good, HSG C
117,806	98	Weighted Average
1,643		1.39% Pervious Area
116,163		98.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Summary for Subcatchment PR DA-2: NORTH SIDE TO MINNESOTA

Runoff = 2.78 cfs @ 12.02 hrs, Volume= 0.157 af, Depth= 4.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.03 hrs
Type II 24-hr 100-Year Rainfall=7.32"

Area (sf)	CN	Description
2,978	98	Paved parking, HSG C
14,203	74	>75% Grass cover, Good, HSG C
17,181	78	Weighted Average
14,203		82.67% Pervious Area
2,978		17.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	33	0.0250	0.06		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 2.86"
0.1	6	0.0200	0.74		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"
1.8	4	0.0200	0.04		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 2.86"
10.6	43	Total			

Summary for Subcatchment PR DA-3: EAST SIDE TO FRANCE

Runoff = 3.47 cfs @ 12.00 hrs, Volume= 0.183 af, Depth= 4.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.03 hrs
Type II 24-hr 100-Year Rainfall=7.32"

Area (sf)	CN	Description
3,180	98	Paved parking, HSG C
16,925	74	>75% Grass cover, Good, HSG C
20,105	78	Weighted Average
16,925		84.18% Pervious Area
3,180		15.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	35	0.0700	0.10		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 2.86"
0.2	7	0.0200	0.76		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"
2.4	6	0.0200	0.04		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 2.86"
8.7	48	Total			

Summary for Subcatchment PR DA-4: West Side to Storm

Runoff = 2.67 cfs @ 11.91 hrs, Volume= 0.120 af, Depth= 5.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.03 hrs
Type II 24-hr 100-Year Rainfall=7.32"

Area (sf)	CN	Description
6,061	98	Paved parking, HSG C
4,531	74	>75% Grass cover, Good, HSG C
10,592	88	Weighted Average
4,531		42.78% Pervious Area
6,061		57.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	116	0.0200	1.34		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"

Summary for Pond 18P: Pipe

Inflow Area = 2.704 ac, 98.61% Impervious, Inflow Depth = 7.08" for 100-Year event
Inflow = 14.61 cfs @ 12.18 hrs, Volume= 1.596 af
Outflow = 14.58 cfs @ 12.18 hrs, Volume= 1.466 af, Atten= 0%, Lag= 0.1 min
Primary = 14.58 cfs @ 12.18 hrs, Volume= 1.466 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.03 hrs / 3
Peak Elev= 823.94' @ 12.18 hrs Surf.Area= 0.084 ac Storage= 0.228 af

Plug-Flow detention time= 100.9 min calculated for 1.465 af (92% of inflow)
Center-of-Mass det. time= 55.1 min (816.2 - 761.0)

Volume	Invert	Avail.Storage	Storage Description
#1B	817.00'	0.000 af	**44.50'W x 82.00'L x 6.00'H Field B** 0.503 af Overall - 0.228 af Embedded = 0.275 af x 0.0% Voids
#2B	817.50'	0.228 af	**CMP Round 60** x 18 Inside #1 Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf Overall Size= 60.0"W x 60.0"H x 20.00'L Row Length Adjustment= +10.00' x 19.63 sf x 6 rows 42.50' Header x 19.63 sf x 2 = 1,669.0 cf Inside
#3	823.15'	0.001 af	**2.50'D x 3.00'H Vertical Cone/Cylinder** x 3
		0.229 af	Total Available Storage

Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	820.25'	**18.0" Round Culvert** L= 22.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 820.25' / 820.03' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.77 sf

Primary OutFlow Max=14.57 cfs @ 12.18 hrs HW=823.93' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 14.57 cfs @ 8.25 fps)

Summary for Pond 19P: Pipe

Inflow Area = 2.704 ac, 98.61% Impervious, Inflow Depth = 7.08" for 100-Year event
Inflow = 21.33 cfs @ 12.06 hrs, Volume= 1.596 af
Outflow = 14.61 cfs @ 12.18 hrs, Volume= 1.596 af, Atten= 31%, Lag= 7.0 min
Primary = 14.61 cfs @ 12.18 hrs, Volume= 1.596 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.03 hrs
Starting Elev= 821.00' Surf.Area= 0.154 ac Storage= 0.154 af
Peak Elev= 824.10' @ 12.18 hrs Surf.Area= 0.154 ac Storage= 0.410 af (0.256 af above start)

Plug-Flow detention time= 110.4 min calculated for 1.442 af (90% of inflow)
Center-of-Mass det. time= 14.6 min (761.0 - 746.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	818.50'	0.000 af	**29.50'W x 227.00'L x 6.00'H Field A** 0.922 af Overall - 0.409 af Embedded = 0.513 af x 0.0% Voids
#2A	819.00'	0.409 af	**CMP Round 60** x 44 Inside #1 Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf Overall Size= 60.0"W x 60.0"H x 20.00'L 4 Rows of 11 Chambers 27.50' Header x 19.63 sf x 1 = 540.0 cf Inside
#3	824.00'	0.001 af	**3.00'D x 3.00'H Vertical Cone/Cylinder** x 3
#4	819.25'	0.001 af	**18.0" Round Pipe Storage** L= 25.0'
		0.412 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	820.40'	**18.0" Round Culvert** L= 11.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 820.40' / 820.39' S= 0.0009 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.77 sf
#2	Device 1	821.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=14.58 cfs @ 12.18 hrs HW=824.09' (Free Discharge)
└**1=Culvert** (Inlet Controls 14.58 cfs @ 8.25 fps)
└**2=Sharp-Crested Rectangular Weir** (Passes 14.58 cfs of 60.02 cfs potential flow)

Summary for Link 15L: Total to West Side Storm

Inflow Area = 2.948 ac, 95.19% Impervious, Inflow Depth = 6.45" for 100-Year event
Inflow = 14.86 cfs @ 12.18 hrs, Volume= 1.585 af
Primary = 14.86 cfs @ 12.18 hrs, Volume= 1.585 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.03 hrs