

-2012-000-

Bank of Kansas City

Lee's Summit, Missouri

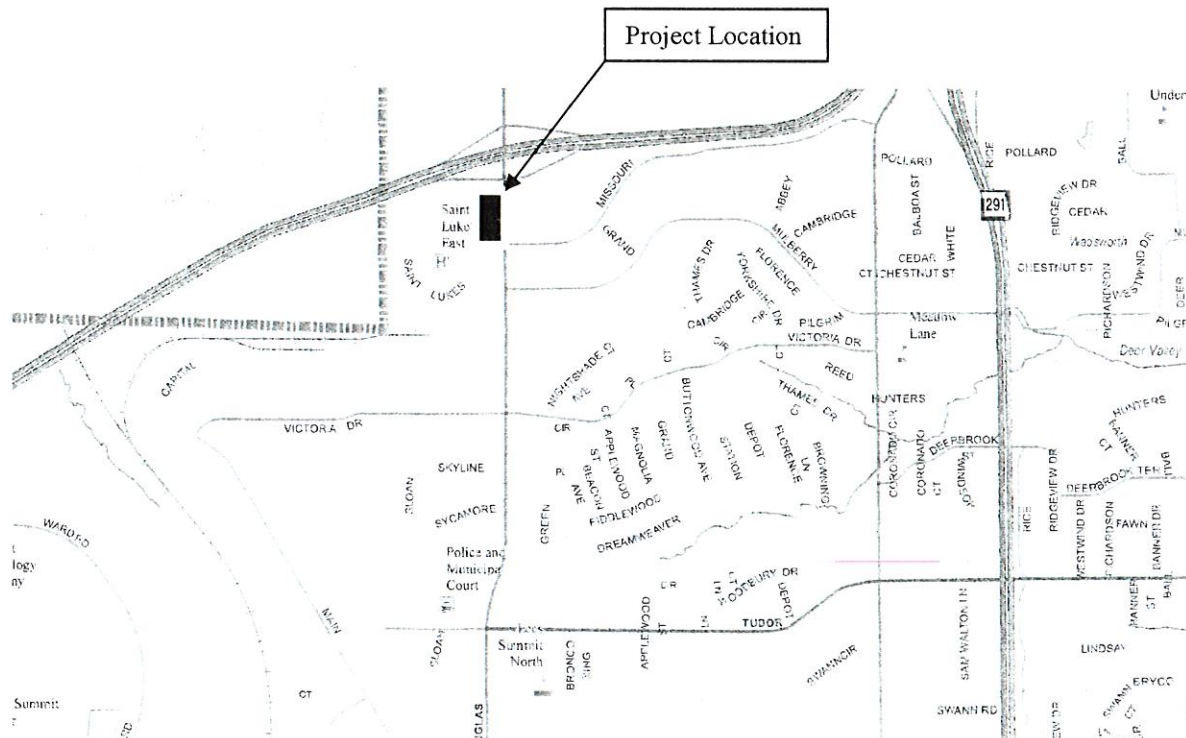
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Drainage Study and Detention Report

JUL 6 2012

Planning & Development

July 5, 2012



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MO. C of A # 2006031328, Exp. 12/31/2012

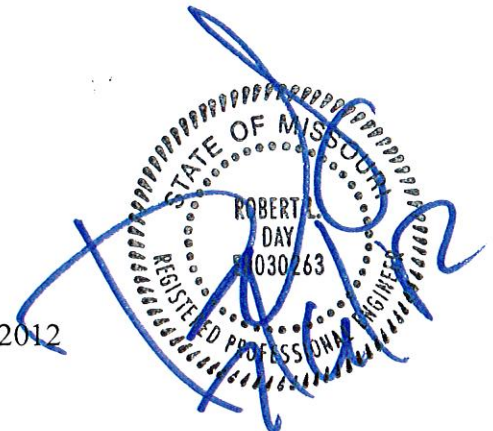


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Bank of Kansas City, Lee's Summit MO.

Drainage Study

I. Purpose of Study

This study will analyze the impact of the development of approximately 2.2 acres located at the northeast corner of St. Luke's East Hospital campus. The 2.2 acres will be used for a new drive through bank that will cover approximately 1 acre and the future parking lot for the hospital on the remaining 1.2 acres.

A site plan is included in Appendix A showing the two sites and a proposed detention pond to regulate storm water generated by the two sites.

This analysis calculates the developed storm water run-off conditions for the drainage area based on the 50%, 10% and 1% storm frequencies and the detention pond will regulate the outflow to meet the City of Lee's Summit design criteria.

II. Site Conditions and Drainage

The site is located at the northwest corner of the intersection of Northeast Douglas Street and an entrance road leading into St. Luke's Hospital that will be referred to as St. Luke's Entrance Road.

The site is currently undeveloped with a small area being used for temporary parking for construction workers.

A storm drain pipe and open drainage channel traverses the southern portion of the site and are part of St. Luke's private storm drain system. The storm pipe will be extended to the west line of the proposed bank site. The channel will have rip rap installed to dissipate storm water velocity to prevent erosion. The outflow from this storm drain pipe and channel will not be routed through the proposed detention pond.

The future parking lot for the hospital is being included to appropriately size the detention pond. The drainage area of the parking lot is assumed to be the entire 1.2 acres and will be routed to the detention pond. This assumption is used to allow St. Luke's to use the 1.2 acre parcel as needed. This study will apply a developed condition to the future parking area that represents the potential maximum amount of storm water run-off that can be generated by the 1.2 acre site.

III. Method of Study

This analysis was developed in accordance with the City of Lee's Summit design criteria which is a supplement to the Kansas City Metropolitan Chapter of APWA Design Criteria.

Hydrographs used in this study were generated using U. S. Army Corps of Engineers HEC-HMS software. The Soil Conservation Service (SCS) method was used to describe the

watershed parameters. The rainfall amounts were obtained from the National Weather Service Technical Paper No.-40 (TP-40 1961) and HYDRO-35 (1977). A comparison was made to the Johnson County Kansas Depth/Duration/Frequency Table published online. This information was used to generate the meteorological model of storm frequencies within the HEC-HMS program. The 1% (100yr.) chance storm data was input into the model with ratios applied for the 50% (2 yr.) and 10% (10 yr.) storm events.

IV. Calculations of Input Data

Basin Lag Time

Basin lag time was calculated using Figure 5602-2 of Section 5600.

The results are as follows:

Lag Time (min)

Basin	C	Length	Slope	Ti
DA 1	0.9	318'	1%	6.3
DA 2	0.9	233'	1%	5.4

Basin Input Data

Drainage Area	Area (MI ²)	CN Number	% Impervious	Lag Time (min)
BOKC Lot - DA 1	0.001484	91	66	6.3
SLH P-Lot - DA 2	0.001969	95	80	5.4

Rainfall Depth - Duration - Frequency

Storm Duration (hh:mm)	2 year	10 year	100 year
24:00	3.6"	5.29"	7.8"
Precipitation Ratio	0.4615	0.6782	1.0000

Pond Volume

Elevation (FT)	Area (AC)
969	0
970	0.12144
971	0.14612
972	0.17238
973	0.1997
974	0.26138

V. Storm-Water Design and Results

The SCS HEC-HMS run (ref. Attached) has storm water data and hydrographs calculated for the following storm frequencies:

2yr (50%), 10yr (10%) and 100yr (1%).

A Drainage Map is included showing the drainage areas for the two sites along with the parameters applied to the HEC-HMS model. The results for each storm frequency and the peak release rate of the detention pond are included in Appendix "A".

The storage volume required for the 40-hour extended detention of runoff from the local 90% mean annual rainfall is as follows:

APWA / MARC BMP Manual – Chapter 6 – Short Cut Method

Water Quality Volume

$$WQv = P * Rv$$

	P	Rv	I
	1.37	0.725	75
WQv (in)	0.99325		

The variety of BMP's referenced in the APWA / MARC BMP manual will use to achieve Storm Water Quality required for the site. The primary BMP used will be a riprap lined channel in the bottom of the detention pond.

VI. Summary of Pond Design

Pond outlet elevation = 969.00

5" Orifice @ 969.00

14" Orifice @ 970.92

Refer to the Detention Pond Plan (Appendix A) for the outlet structure detail.

100 year water elevation = 972.6

Top of Berm elevation = 974.00

HEC-HMS Output Summary

Element	2 year	10 year	100 year
DA 1	2.9	4.3	6.5
DA 2	4	5.9	8.7
Pond	1.1	4.3	6.6

Allowable Peak Discharge (CFS) per Acre

Frequency	2 year	10 year	100 year
CFS	0.5	2	3
Total Drainage Area (AC)	2.21	2.21	2.21
Total Peak CFS Allowed	1.105	4.42	6.63

VII. Conclusions

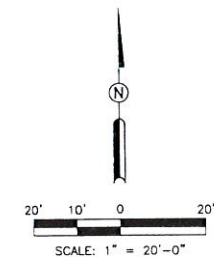
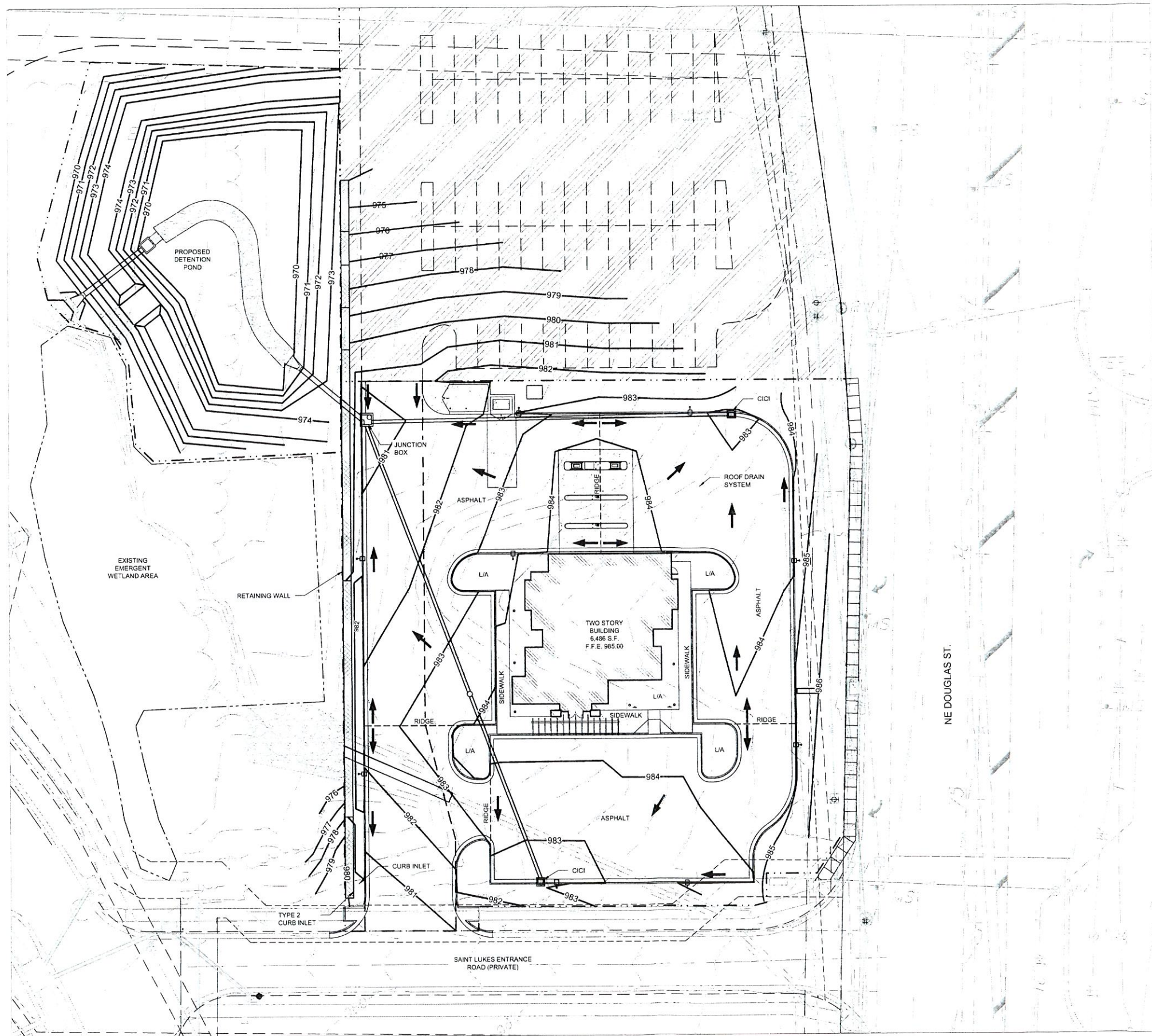
The allowable peak discharge rates were calculated for the combined drainage areas and compared the HEC-HMS results of the peak discharge of the detention pond outlet structure for the 2 year, 10 year and 100 year frequency events..

A spillway is provided to protect the detention pond embankment from overtopping in the event of 0.2% (500 year) or greater storm.

As shown in the design summary the peak discharge from the detention pond meets the allowable peak discharge rates in Section 5608.4, Paragraph C.

Appendix A

Grading Plan, Drainage Map and Detention Pond Plan



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 ENGINEER OF RECORD

PROJECT INFORMATION	
PROJECT ADDRESS: 1710 NE DOUGLAS STREET LEE'S SUMMIT, MO 64086	
PROJECT NO.	BOK 110005002
DATE	07/06/2012
DRAWN BY	CHECKED BY
SAT	TMK

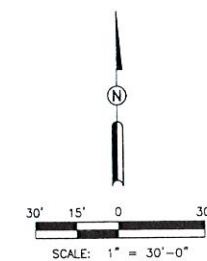
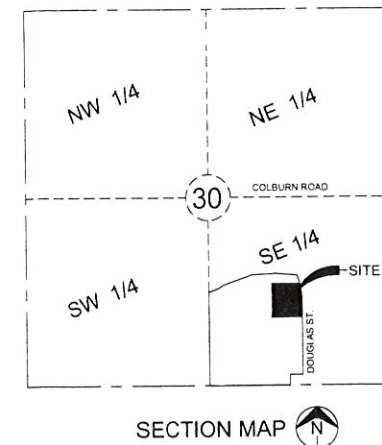
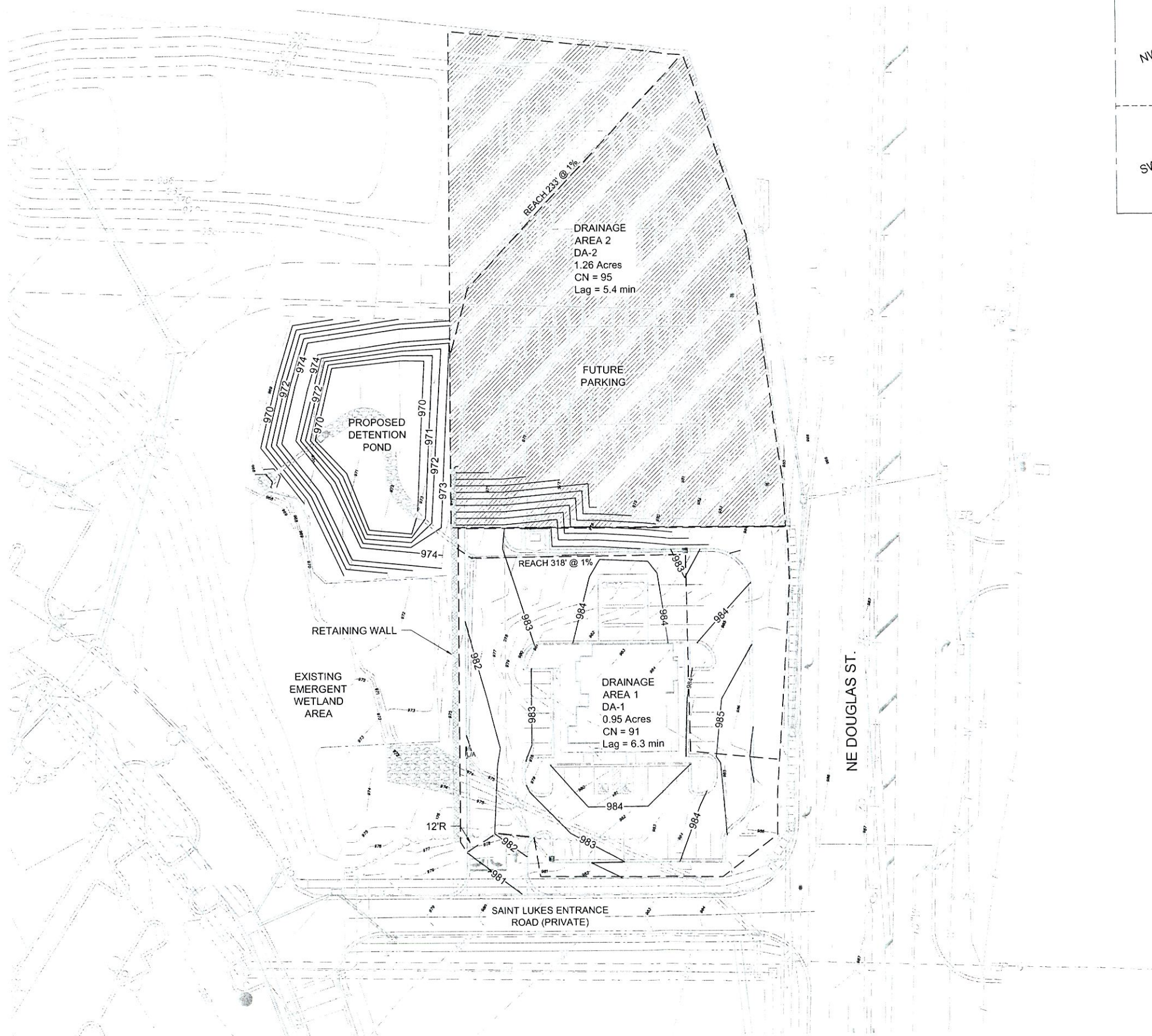
**BANK OF KANSAS CITY,
 LEE'S SUMMIT MO.**

ISSUE / REVISIONS	
05/03/2012	PDP SUBMITTAL
06/01/2012	PDP SUBMITTAL #2
07/06/2012	FDP SUBMITTAL

A NEW PROJECT AT:
**BANK OF KANSAS
 CITY, LEE'S
 SUMMIT MO.**

FOR:
**BANK OF KANSAS
 CITY**


C-201
 GRADING AND STORM
 DRAINAGE PLAN



NOT FOR CONSTRUCTION

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PROJECT ADDRESS:
 17XX NE DOUGLAS STREET
 LEE'S SUMMIT, MO 64086

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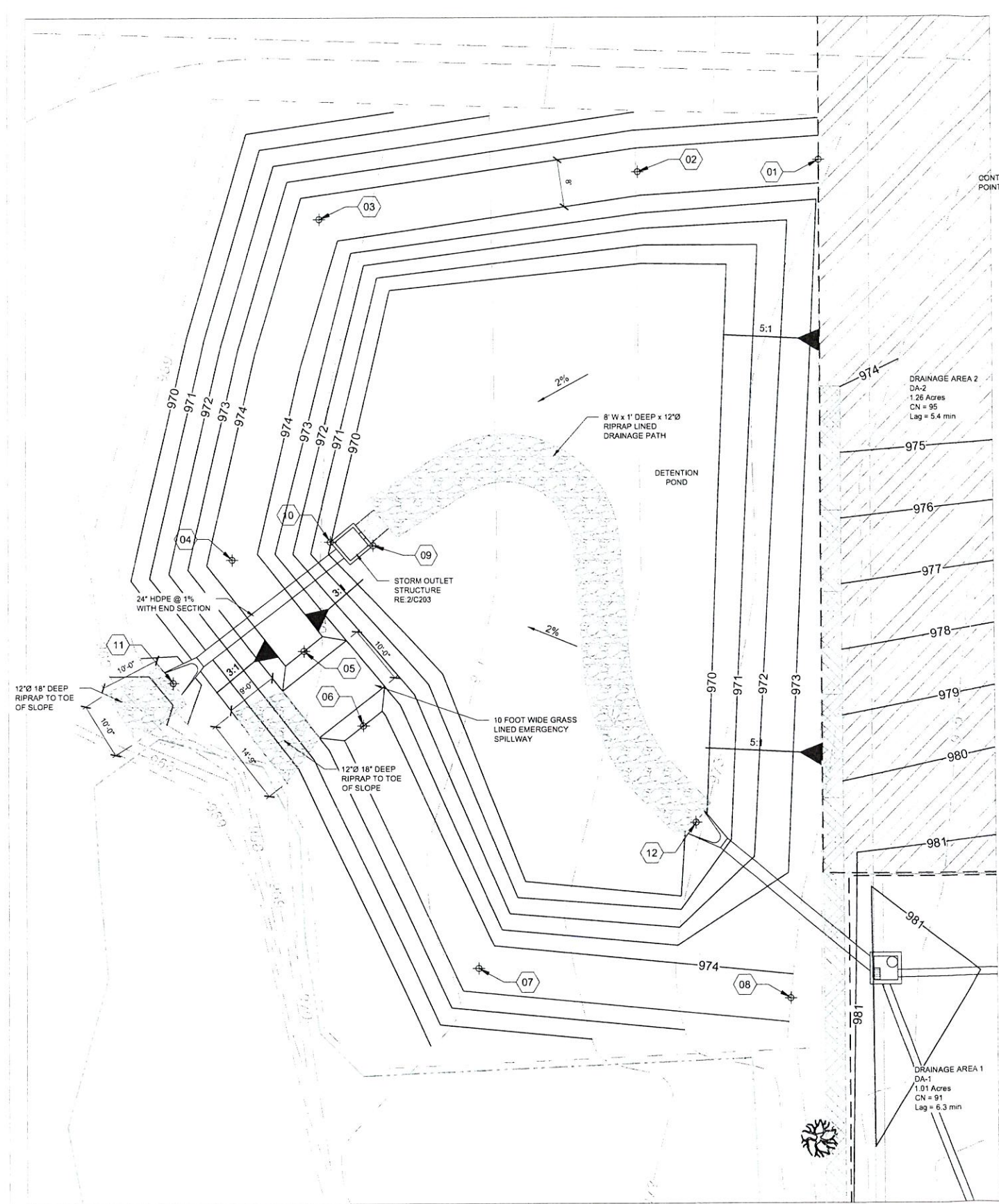
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05/02/2012	PDP SUBMITTAL

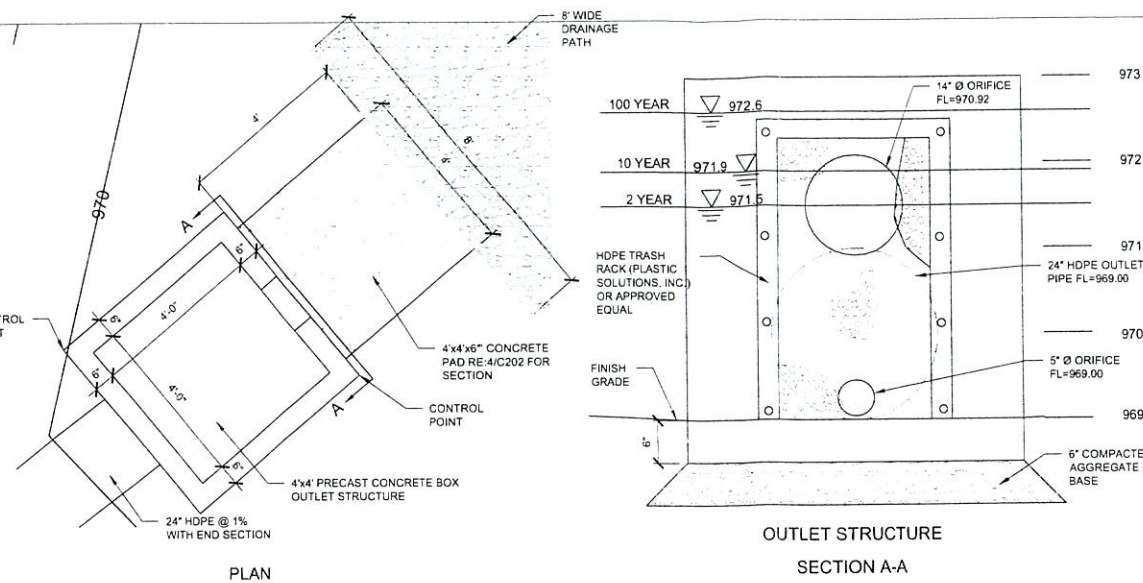
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FOR:
BANK OF KANSAS CITY

C-202
 DRAINAGE MAP



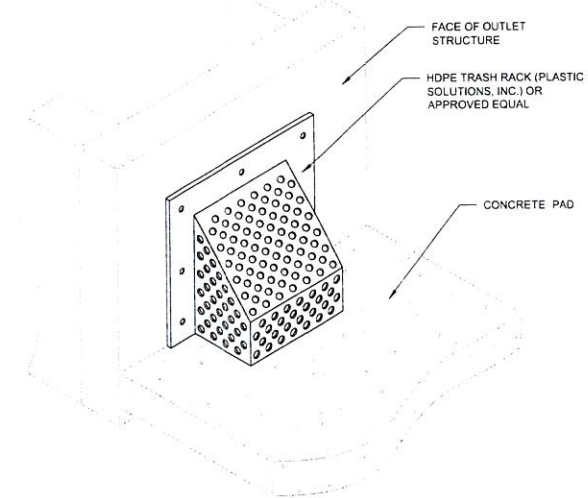
1 ENLARGED DETENTION POND PLAN
 SCALE: 1"=10'-0"
 NOTES:
 REFER TO THE BANK OF KANSAS CITY DRAINAGE STUDY AND DETENTION REPORT DATED MAY 3, 2012 FOR DETENTION POND SIZING AND CALCULATIONS.



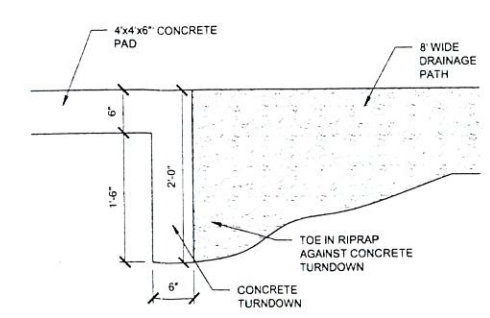
2 STORM OUTLET STRUCTURE DETAIL
 NOT TO SCALE

HORIZONTAL CONTROL


#	N	E	DESC.
01	101101.21	283584.43	DESC. TOP OF DIKE CENTERLINE
02	1011099.25	2823553.50	DESC. TOP OF DIKE CENTERLINE
03	1011091.37	2823499.48	DESC. TOP OF DIKE CENTERLINE
04	1011034.11	2823484.52	DESC. TOP OF DIKE CENTERLINE
05	1011018.77	2823496.62	DESC. TOP OF DIKE CENTERLINE
06	1011006.20	2823506.53	DESC. TOP OF DIKE CENTERLINE
07	1010985.52	2823525.87	DESC. TOP OF DIKE CENTERLINE
08	1010960.41	2823578.67	DESC. TOP OF DIKE CENTERLINE
09	1011036.51	2823508.27	DESC. STORM OUTLET STRUCTURE
10	1011037.12	2823501.23	DESC. STORM OUTLET STRUCTURE
11	1011013.43	2823474.37	DESC. 24" END SECTION CONTROL POINT
12	1010989.87	2823562.84	DESC. 24" END SECTION CONTROL POINT



3 TRASH RACK ISOMETRIC
 NOT TO SCALE



4 CONCRETE PAD SECTION
 NOT TO SCALE



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A NEW PROJECT AT:
BANK OF KANSAS CITY, LEE'S SUMMIT MO.

FOR:
BANK OF KANSAS CITY

C-203
 DETENTION POND DETAILS

Appendix B

HEC-HMS Output Data

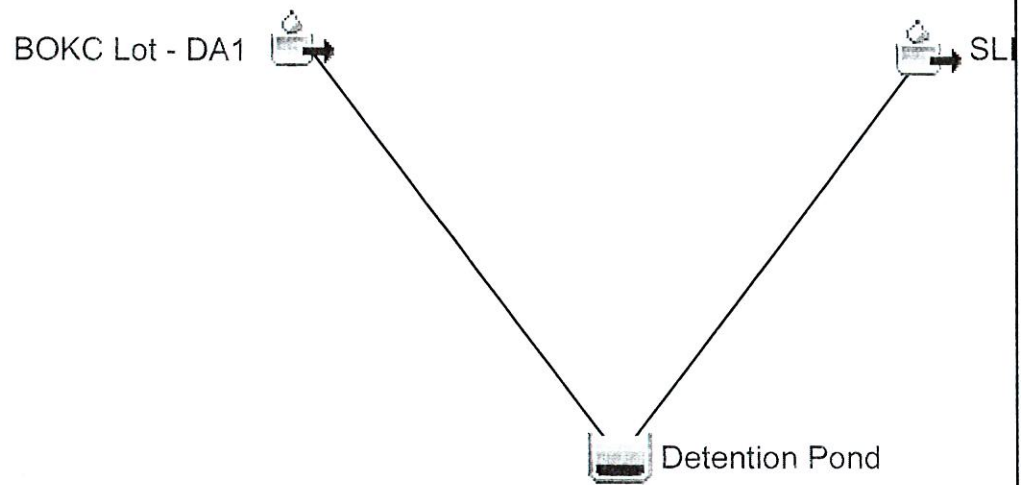


HEC-HMS

Project : BOKC Lee's Summit

Basin Model : BOKC

Jul 05 13:18:42 CDT 2012



Project: BOKC Lee's Summit Simulation Run: 2 year

Start of Run: 28Mar2012, 00:00 Basin Model: BOKC
End of Run: 29Mar2012, 00:00 Meteorologic Model: KCMO
Compute Time: 05Jul2012, 13:11:42 Control Specifications: 24 Hour

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
SLH P-Lot - DA 2	0.001969	4.0	28Mar2012, 12:10	3.46
BOKC Lot - DA1	0.001484	2.9	28Mar2012, 12:10	3.29
Detention Pond	0.003453	1.0	28Mar2012, 12:45	3.34

Project: BOKC Lee's Summit
Simulation Run: 2 year Reservoir: Detention Pond

Start of Run:	28Mar2012, 00:00	Basin Model:	BOKC
End of Run:	29Mar2012, 00:00	Meteorologic Model:	KCMO
Compute Time:	05Jul2012, 13:11:42	Control Specifications:	24 Hour

Volume Units: IN

Computed Results

Peak Inflow :	6.9 (CFS)	Date/Time of Peak Inflow :	28Mar2012, 12:10
Peak Outflow :	1.0 (CFS)	Date/Time of Peak Outflow :	28Mar2012, 12:45
Total Inflow :	3.39 (IN)	Peak Storage :	0.3 (AC-FT)
Total Outflow :	3.34 (IN)	Peak Elevation :	971.5 (FT)

Project: BOKC Lee's Summit Simulation Run: 10 year

Start of Run: 28Mar2012, 00:00 Basin Model: BOKC
End of Run: 29Mar2012, 00:00 Meteorologic Model: KCMO
Compute Time: 05Jul2012, 13:12:10 Control Specifications: 24 Hour

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
SLH P-Lot - DA 2	0.001969	5.9	28Mar2012, 12:10	5.12
BOKC Lot - DA1	0.001484	4.3	28Mar2012, 12:10	4.93
Detention Pond	0.003453	4.3	28Mar2012, 12:25	4.98

Project: BOKC Lee's Summit
Simulation Run: 10 year Reservoir: Detention Pond

Start of Run:	28Mar2012, 00:00	Basin Model:	BOKC
End of Run:	29Mar2012, 00:00	Meteorologic Model:	KCMO
Compute Time:	05Jul2012, 13:12:10	Control Specifications:	24 Hour

Volume Units: IN

Computed Results

Peak Inflow :	10.2 (CFS)	Date/Time of Peak Inflow :	28Mar2012, 12:10
Peak Outflow :	4.3 (CFS)	Date/Time of Peak Outflow :	28Mar2012, 12:25
Total Inflow :	5.04 (IN)	Peak Storage :	0.3 (AC-FT)
Total Outflow :	4.98 (IN)	Peak Elevation :	971.9 (FT)

Project: BOKC Lee's Summit Simulation Run: 100 Year

Start of Run: 28Mar2012, 00:00 Basin Model: BOKC
End of Run: 29Mar2012, 00:00 Meteorologic Model: KCMO
Compute Time: 05Jul2012, 13:13:01 Control Specifications: 24 Hour

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
SLH P-Lot - DA 2	0.001969	8.7	28Mar2012, 12:10	7.60
BOKC Lot - DA1	0.001484	6.5	28Mar2012, 12:10	7.40
Detention Pond	0.003453	6.6	28Mar2012, 12:25	7.45

Project: BOKC Lee's Summit
Simulation Run: 100 Year Reservoir: Detention Pond

Start of Run:	28Mar2012, 00:00	Basin Model:	BOKC
End of Run:	29Mar2012, 00:00	Meteorologic Model:	KCMO
Compute Time:	05Jul2012, 13:13:01	Control Specifications:	24 Hour

Volume Units: IN

Computed Results

Peak Inflow :	15.1 (CFS)	Date/Time of Peak Inflow :	28Mar2012, 12:10
Peak Outflow :	6.6 (CFS)	Date/Time of Peak Outflow :	28Mar2012, 12:25
Total Inflow :	7.51 (IN)	Peak Storage :	0.4 (AC-FT)
Total Outflow :	7.45 (IN)	Peak Elevation :	972.6 (FT)

Project: BOKC Lee's Summit
Simulation Run: 500 Year Reservoir: Detention Pond

Start of Run:	28Mar2012, 00:00	Basin Model:	BOKC
End of Run:	29Mar2012, 00:00	Meteorologic Model:	KCMO
Compute Time:	05Jul2012, 13:11:14	Control Specifications:	24 Hour

Volume Units: IN

Computed Results

Peak Inflow :	18.4 (CFS)	Date/Time of Peak Inflow :	28Mar2012, 12:10
Peak Outflow :	8.2 (CFS)	Date/Time of Peak Outflow :	28Mar2012, 12:25
Total Inflow :	9.12 (IN)	Peak Storage :	0.5 (AC-FT)
Total Outflow :	9.06 (IN)	Peak Elevation :	973.1 (FT)