Address Cambria Drainage Report Comments from Paul Ryn with Sedgwick County

Comments from Paul Ryn, Oct. 25, 2007

Pat and Jim

We have reviewed the drainage plan for Cambrian Addition. The plat and drainage plan should have the floodway and floodplain boundaries, with elevations, as they are on shown on the FEMA maps. The ponds need an area around them for maintenance equipment. The drainage on the north boundary of the plat and easements of Block 3 need to have calculations for the channel depths and width. The channel elevation should be noted on the drainage plan, and they need to contained in the easement. The drainage plan does not show how he storm water is exit from Blocks1, 2, or 3. The drainage plan does not indicate how the storm water goes under or around the cul-de-sac. Drainage easements from Block 3 to Block 4 do not line up.

Paul Ryn

Per the email from Paul, the following issues have been addressed:

The plat and drainage plan should have the floodway and floodplain boundaries, with elevations, as they are on shown on the FEMA maps. The floodway, floodplain, and elevations are shown on the grading plan and drainage plan.

The ponds need an area around them for maintenance equipment. The ponds have been revised to allow the access around these ponds. Detention pond calculations and peak runoff have been revised to incorporate these changes.

The drainage on the north boundary of the plat and easements of Block 3 need to have calculations for the channel depths and width. The channel elevation should be noted on the drainage plan, and they need to contained in the easement. The drainage plan does not show how he storm water is exit from Blocks1, 2, or 3. The drainage plan does not indicate how the storm water goes under or around the cul-de-sac. The north channel calculations are shown on the drainage plan and the hand calculations and method are included in the proposed drainage calculations in the appendix. Runoff is to be routed by 2-36"RCP under the road, the pipe size graph is included with the proposed drainage appendix. The easement is 60' and only 20' is required for the channel. The remaining portion will allow existing trees to be preserved. The runoff from Block 3 will be routed through the storm sewer system in the street, as shown. The storm water system will daylight inside the platted boundary and surface drain in the channels that existing today.

Drainage easements from Block 3 to Block 4 do not line up. The easement on block 4 will allow the runoff to daylight and drain through the reserved at the existing drainage channel. Block 3's runoff will be routed through the street storm sewer system and through the easement on Block 4.

Sincerely,

Patrick Baer, PE

DRAINAGE REPORT
FOR
CAMBRIA ADDITION
WICHITA, SEDGWICK COUNTY, KANSAS

November 16, 2007

Ruggles & Bohm P.A.
Engineering, Surveying, Land Planning

Adopted: February 23, 2007

Public Works, Engineering Division
Final Drainage Plan Submittal Checklist

Reviewer: _____ Date: October 17, 2007

Subdivision Name: Cambria Location: SW ¼ Sec. 36, T27S, R2E

Total Land Area Of Ownership: 46.9 Acres

Type: X Residential _____ Commercial _____ Industrial _____ Recreation _____ Municipal _____ Other

Applicant: LCS Enterprises Contact: Cory M. Shackelford Phone #: 213-8766

Engineer: Ruggles & Bohm PA. Contact: _____ Phone # 264-8008

Please check the appropriate box: I = Included; NA = Non-Applicable; R= Required prior to development
(If "NA" is checked, an explanation must be entered)

	Applicant			Engr	
Tab 1. Project Narrative	**I**	**NA**	**Explanation / Location in Plan**	**I**	**NA**
A. Site Location Map, using USGS Map	✓				
B. Discussion of development, existing conditions, and proposed impacts on stormwater, wetland, riparian, and flood plain	✓				
C. Discussion of offsite conditions	✓				
D. Summary of runoff calculations (pre/post development) No increase in peak discharge for all storm series	✓				
E. Narrative description of the type and function of the permanent best management practices that are incorporated into the site design	✓				
F. Copy of the plat	✓				
G. Preliminary grading plan (The final grading plan shall be sealed, signed and dated prior to Engineering receiving the final sanitary sewer plans. One plan sheet and PDF shall be submitted to the Subdivision Engineer.)	✓				
H. Professional Engineer seal, signature and date on cover of report	✓				
I. CD of drainage plan in PDF format (one file) and one paper copy bound with this checklist included behind the cover	✓				

	Applicant			Engr	
Tab 2. Existing Conditions Runoff Calculations	**I**	**NA**	**Explanation / Location in Plan**	**I**	**NA**
A. Copy of applicable orthophoto showing proposed project boundaries (preferable in color)	✓				
B. Runoff Method (Rational, Hydrograph Method, or other approved methods by Engineering)	✓				
C. Existing topography (no greater than 2-foot contours, 1-foot recommend)	✓				
D. Total Site Area and Total Impervious Area (acres)	✓				
E. Benchmarks used for site control	✓				
F. Streams, creeks, and waterway labeled	✓				
G. Predominant soils from USDA soil surveys, and/or on site soil borings	✓				
H. Location and boundaries of natural features such as wetlands, lakes, and ponds with the normal water elevation noted	✓				
I. Location of existing roads, buildings, parking lots and other impervious areas.	✓				

Consulting Engineer Initials RB

J. Location of existing utilities (e.g., water, sewer, gas, electric) and easements	✓				
K. Location of existing conveyance systems such as storm drains, inlets, catch basins, channels, swales, and areas of overland flow	✓				
L. Flow paths	✓				
M. Location and dimensions of existing channels, bridges or culvert crossings	✓				
N. Existing conditions hydrologic analysis for runoff rates, volumes and velocities showing methodologies used and supporting calculations (2, 5, 10, 25 & 100 year, 24-hour storm events) or Critical Duration	✓				
O. Assumed pre-developed runoff curve numbers	✓				
P. Existing time of concentrations used in calculations	✓				
Q. Evaluate immediate downstream drainage capacity, not to exceed more than 0.25 miles downstream of site	✓				
R. Existing structural elevations (e.g., invert of pipes, manholes, etc.)	✓				
S. Cross-section data for open channels		✓	no on-site stream		
T. Ground water elevations, if applicable		✓	unknown @ this time		

	Applicant			Engr	
Tab 3. Post-Development Hydrologic Analysis	**I**	**NA**	**Explanation / Location in Plan**	**I**	**NA**
A. Proposed (post-development) conditions hydrologic and hydraulic analysis for runoff rates, volumes, HGL, and velocities showing the methodologies used and supporting calculations for all applicable design storms (2, 5, 10, 25 & 100 year, 24-hour storm events)	✓				
B. Proposed time of concentrations used in calculations	✓				
C. Assumed post-developed runoff curve numbers	✓				
D. Proposed contours for detention facilities (to equal area used in outlet rating curves)	✓				
E. Preliminary sizing calculations for stormwater controls including contributing drainage area, storage, and outlet configuration	✓				
F. Stage-storage-discharge or outlet rating curves and inflow and outflow hydrographs for storage facilities	✓				
G. Final analysis of potential upstream/downstream impact/effects of project, where necessary	✓				
H. Existing and proposed structural elevations (e.g., invert of pipes, manholes, etc.)	✓				
I. Design water surface elevations and normal pool elevation for ponds.	✓				
J. Typical detail for outlet structures, embankments, spillways, grade control structures, conveyance channels, etc. To include height, width, elevation, and/or diameter.	✓				
K. Proposed limits of clearing and grading	✓				
L. Location of existing and proposed roads, buildings, parking lots and other impervious areas.	✓				
M. Location of existing and proposed utilities (e.g., water, sewer) and easements	✓				
N. Location of existing and proposed conveyance systems such as storm drains, inlets, catch basins, channels, swales, and areas of overland flow	✓				
O. Preliminary location and dimensions of proposed channel modifications, such as bridge or culvert crossings	✓				

Consulting Engineer Initials

P. Preliminary selection and location of stormwater controls	✓				
Q. Emergency overflow structure's flow path	✓				
R. Detention facility provides one-foot of freeboard above the HWL and emergency outfall shown (top of berm elevation shown)	✓				
S. The 100-year 24-hour HWL delineated on the plan for detention pond	✓				
T. Lowest opening elevations table on the plat for structures located adjacent to channels or ponds	✓				
U. Stormwater Management Facilities located within a Reserve	✓				
V. Maintenance responsibility of stormwater management facility shall be specified in the platters text. (e.g. HOA, Lot Owners Association, or lot)	✓				
W. Off-site drainage easements or agreements required, where necessary		✓	drains into exist. tributary		

	Applicant			Engr	
Tab 4. Floodplain Submittal	**I**	**NA**	**Explanation / Location in Plan**	**I**	**NA**
A. Provide source of flood profile		✓	site is outside adjacent floodplain		
B. Nearest base flood elevations		✓			
C. Delineation of pre-developed regulatory floodplain/floodway limits		✓			
D. Delineation of post-developed regulatory floodplain and floodway limits		✓			
E. Floodplain boundary determination per elevation (project limits shown)		✓			
F. Provide source of floodway data table and discharges		✓			
G. Provide all hydrologic and hydraulic study information for site-specific floodplain studies, unnumbered Zone A area elevation determinations and flood plain map revisions or required permits		✓			
H. Provide regulatory floodway and four natural profile models (10,50,100, and 500-yr) for existing and future watershed conditions		✓			
I. Location of floodplain/floodway limits and relationship of site to upstream/downstream properties (floodplain limits to be per elevation and scaled location)		✓			
J. Flood plains and floodways located within a Reserve, where necessary		✓			

	Applicant			Engr	
Tab 5. Federal, State and Local Permits (to be provided prior to construction unless otherwise specified)	**I/R**	**NA**	**Explanation / Location in Plan**	**I/R**	**NA**
A. US Army Corps of Engineers - Regulatory program permits (404 water quality certification)		✓			
B. Kansas Department of Agriculture - Division of Water Resources Permits (Stream Obstruction, Channel Change, Flood Plain Fill, Levee, Water Appropriations, Dam safety permit, etc.)		✓			
C. Federal Emergency Management Agency (FEMA) Letter of Map Changes (LOMA, LOMR, LOMR-f, CLOMR, etc.) Shall be included and approved when project modifies the limits of the floodway.		✓			
D. Kansas Department of Transportation		✓			
E. Sedgwick County Right-of-way Permit		✓			

Consulting Engineer Initials

TABLE OF CONTENTS

CAMBRIA ADDITION
DRAINAGE ANALYSIS
November 16, 2007

INTRODUCTION

This report contains supporting documentation and calculations for the proposed plat Cambria Addition. The existing site is a triangle shaped undeveloped 46.9-acre tract of land located approximately ½ mile south of Harry on the east side of 143th Street East. The area is currently pasture land and drains easterly to a Spring Branch Tributary #1. Existing off-site drainage enters the site in two location, on the north and west side of the property. FEMA map 20173C0395E, effective date Feb. 2, 2007 shows the proposed project site is located outside of and on the edge of the Zone AE. Approximately 64.9 acres of offsite area currently flow through the site, 29.9 acres from the north and 35.0 acres from the east. The site will be graded to direct 14.9 acres of the site and 35.0 acres of offsite area to a series of detention ponds while the remaining 32.2 acres and 29.9 acres of offsite drainage will drain directly into the Spring Branch Tributary.

The site will be developed into single family residential lots (approx. ¾ acre) with on-site detention provided at the southern central area of the site with a series of three retention/detention ponds.

HYDROLOGY

Peak flow rates for the tributary areas were determined using HEC-HMS. The hydrological soil group for the site is D. The times of concentration were calculated using the velocity method and overland flow rates from Attachment E of the City of Wichita Drainage Criteria. The parameters and results of the existing and proposed analysis are shown in the tables below.

Existing	Area	CN	TC (min.)	Q2 (cfs)	Q5 (cfs)	Q10 (cfs)	Q25 (cfs)	Q100 (cfs)
N. Offsite (A)	29.9 ac.	83	20	35.1	51.7	62.0	78.1	108.9
N. Onsite (C)	24.4 ac.	83	20	28.6	42.3	50.7	64.8	89.0
S. Offsite (B)	35.0 ac.	83	20	41.0	60.6	72.6	92.9	127.6
S. Onsite (D)	22.5 ac.	83	20	26.4	39.0	46.7	59.8	82.1
Entire Site	111.8ac.	83	20	131.0	193.7	232.2	297.1	408.1

Proposed	Area	CN	TC (min.)	Q2 (cfs)	Q5 (cfs)	Q10 (cfs)	Q25 (cfs)	Q100 (cfs)
N. Offsite (A)	29.9 ac.	83	20	35.0	51.7	62.0	79.6	108.9
N. Onsite (E&F)	28.1 ac.	85	20	35.9	52.0	61.7	78.1	106.0
S. Offsite (B)	35.0 ac.	83	20	41.0	60.6	72.6	92.9	127.6
S. Onsite 1(G)	6.5 ac.	85	10	11.0	16.1	19.2	24.4	33.5
S. Onsite 2(H)	8.4 ac.	85	10	15.5	22.3	26.4	33.3	45.2
S. Bypass (J)	4.0 ac.	85	10	7.5	10.8	11.4	16.1	21.9
Entire Site	111.8 ac.	83.9	25	94.2	143.9	175.2	227.9	319.0

HEC-HMS computer modeling was used to determine peak flow rates for the series of basins located within the plat. The attached Drainage Plan shows the on site drainage calculations.

Pond Routing Information:

A series of 3 ponds will provide the detention required for this development. The upper pond detention will not be taken into account, since the waterfall feature will be architectural and will not detain runoff in any large amount. The retention ponds will be located at the southern central area of the property and will outlet into Tributary #1 of Spring Branch.

Rainfall Data: The SCS Type II Rainfall Distribution as modeled by the HEC-RAS program is used for analysis, with a total 100 year – 24 hour rainfall event of 7.8 inches (TR-55). This rainfall model is used for all basins.

The schematic hydraulic model indicates the modeling parameters for each of the basins draining to the detention pond area. A summary of the ponds' performance in the various design storms can be found in the tables below.

POND 1(upper pond omitted)

Design Storm	Peak Inflow (cfs)	Peak Outflow (cfs)	Allowable Release (cfs)	Peak Storage (ac-ft.)	Peak Elevation
2-yr	48.2	38.7	NA	3.0	1305.4
5-yr	71.0	58.8	NA	3.4	1305.9
10-yr	84.9	71.3	NA	3.6	1306.2
25-yr	108.5	92.5	NA	4.0	1306.6
100-yr	148.9	128.6	NA	4.6	1307.2

The stage-storage data was calculated by HEC-HMS using the parameters located in the table below.

Stage	Area (ac-ft)
1304.0	0.70
1305.0	0.79
1306.0	0.88
1307.0	0.97
1307.5	1.13

The outlet of this pond shall be controlled by 3'x 9' Rein. Concrete Box Culvert that will release to Pond 2.

POND 2

Design Storm	Peak Inflow (cfs)	Peak Outflow (cfs)	Allowable Release (cfs)	Peak Storage (ac-ft.)	Peak Elevation
2-yr	44.0	32.9	52.6	1.6	1302.4
5-yr	67.1	52.2	79.2	2.2	1302.9
10-yr	81.1	64.3	95.7	2.6	1303.2
25-yr	105.2	85.2	123.6	3.2	1303.6
100-yr	146.8	121.3	171.2	4.2	1304.3

The stage-storage data was calculated by HEC-HMS using the parameters located in the table below.

Stage	Area (ac-ft)
1301.00	1.10
1302.00	1.20
1303.00	1.31
1304.00	1.42
1304.5	1.50

The outlet of this pond shall be controlled by a 6' wide weir structure that will release to the southeast into Spring Branch Tributary #1. The minimum foundation elevation is shown on the mass grading plan and these elevations have been developed to ensure a minimum 2' elevation over the existing adjacent floodway elevation.

EXISTING CONDITIONS

Project: Shackleford Simulation Run: 01 Exist 2

Start of Run: 01Jan2007, 12:00
End of Run: 02Jan2007, 12:05
Compute Time: 17Oct2007, 08:59:33

Basin Model: Existing
Meteorologic Model: Wichita 2
Control Specifications: Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
North	0.08507	63.7	02Jan2007, 00:20	8.3
North Offsite	0.04690	35.1	02Jan2007, 00:20	4.6
North Onsite	0.03817	28.6	02Jan2007, 00:20	3.7
South	0.08988	67.3	02Jan2007, 00:20	8.8
South Offsite	0.05469	41.0	02Jan2007, 00:20	5.4
South Onsite	0.03519	26.4	02Jan2007, 00:20	3.5
Total Site	0.17495	131.0	02Jan2007, 00:20	17.2

Project: Shackleford Simulation Run: 02 Exist 5

Start of Run: 01Jan2007, 12:00 Basin Model: Existing
End of Run: 02Jan2007, 12:05 Meteorologic Model: Wichita 5
Compute Time: 17Oct2007, 09:26:41 Control Specifications: Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
North	0.08507	94.2	02Jan2007, 00:20	12.3
North Offsite	0.04690	51.9	02Jan2007, 00:20	6.8
North Onsite	0.03817	42.3	02Jan2007, 00:20	5.5
South	0.08988	99.5	02Jan2007, 00:20	12.9
South Offsite	0.05469	60.6	02Jan2007, 00:20	7.9
South Onsite	0.03519	39.0	02Jan2007, 00:20	5.1
Total Site	0.17495	193.7	02Jan2007, 00:20	25.2

Project: Shackleford Simulation Run: 03 Exist 10

Start of Run: 01Jan2007, 12:00
End of Run: 02Jan2007, 12:05
Compute Time: 04Oct2007, 17:22:14

Basin Model: Existing
Meteorologic Model: Wichita 10
Control Specifications: Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
North	0.08507	112.9	02Jan2007, 00:20	14.7
North Offsite	0.04690	62.2	02Jan2007, 00:20	8.1
North Onsite	0.03817	50.7	02Jan2007, 00:20	6.6
South	0.08988	119.3	02Jan2007, 00:20	15.5
South Offsite	0.05469	72.6	02Jan2007, 00:20	9.4
South Onsite	0.03519	46.7	02Jan2007, 00:20	6.1
Total Site	0.17495	232.2	02Jan2007, 00:20	30.2

Project: Shackleford Simulation Run: 04 Exist 25

Start of Run: 01Jan2007, 12:00 Basin Model: Existing
End of Run: 02Jan2007, 12:05 Meteorologic Model: Wichita 25
Compute Time: 17Oct2007, 09:33:45 Control Specifications: Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
North	0.08507	144.5	02Jan2007, 00:20	18.8
North Offsite	0.04690	79.6	02Jan2007, 00:20	10.4
North Onsite	0.03817	64.8	02Jan2007, 00:20	8.4
South	0.08988	152.6	02Jan2007, 00:20	19.9
South Offsite	0.05469	92.9	02Jan2007, 00:20	12.1
South Onsite	0.03519	59.8	02Jan2007, 00:20	7.8
Total Site	0.17495	297.1	02Jan2007, 00:20	38.7

Project: Shackleford Simulation Run: 05 Exist 100

Start of Run: 01Jan2007, 12:00 Basin Model: Existing
End of Run: 02Jan2007, 12:05 Meteorologic Model: Wichita100
Compute Time: 04Oct2007, 17:22:20 Control Specifications: Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
North	0.08507	198.5	02Jan2007, 00:20	26.0
North Offsite	0.04690	109.4	02Jan2007, 00:20	14.4
North Onsite	0.03817	89.0	02Jan2007, 00:20	11.7
South	0.08988	209.7	02Jan2007, 00:20	27.5
South Offsite	0.05469	127.6	02Jan2007, 00:20	16.7
South Onsite	0.03519	82.1	02Jan2007, 00:20	10.8
Total Site	0.17495	408.1	02Jan2007, 00:20	53.6

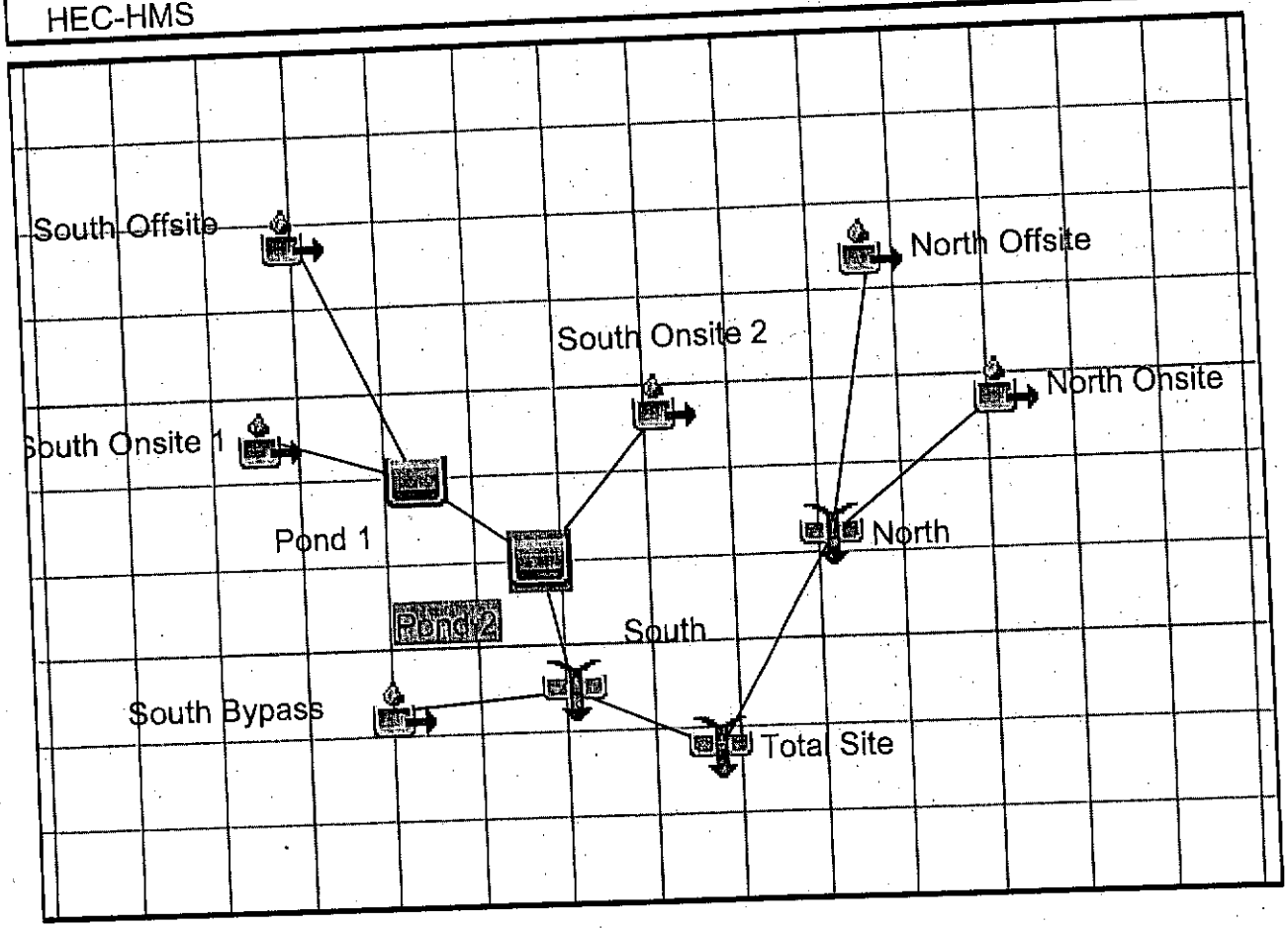
PROPOSED CONDITIONS

HEC-HMS

Project : Shackleford

Basin Model : Proposed

Oct 17 09:49:43 CDT 2007



Project: Shackleford Simulation Run: 06 Prop 2

Start of Run: 01Jan2007, 12:00
End of Run: 02Jan2007, 12:05
Compute Time: 16Nov2007, 13:56:51

Basin Model: Proposed
Meteorologic Model: Wichita 2
Control Specifications: Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
North	0.090630	70.9	02Jan2007, 00:20	9.3
North Offsite	0.046700	35.0	02Jan2007, 00:20	4.6
North Onsite	0.043930	35.9	02Jan2007, 00:20	4.7
Pond 1	0.064720	38.7	02Jan2007, 00:35	6.2
Pond 2	0.077786	32.9	02Jan2007, 00:55	7.5
South	0.084106	34.1	02Jan2007, 00:55	8.2
South Bypass	0.006320	7.5	02Jan2007, 00:10	0.7
South Offsite	0.054690	41.0	02Jan2007, 00:20	5.4
South Onsite 1	0.010030	11.0	02Jan2007, 00:10	1.0
South Onsite 2	0.013066	15.5	02Jan2007, 00:10	1.4
Total Site	0.174736	94.2	02Jan2007, 00:25	17.4

Project: Shackleford Simulation Run: 07 Prop 5

Start of Run: 01Jan2007, 12:00
End of Run: 02Jan2007, 12:05
Compute Time: 16Nov2007, 13:56:54

Basin Model: Proposed
Meteorologic Model: Wichita 5
Control Specifications: Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
North	0.090630	103.7	02Jan2007, 00:20	13.5
North Offsite	0.046700	51.7	02Jan2007, 00:20	6.7
North Onsite	0.043930	52.0	02Jan2007, 00:20	6.8
Pond 1	0.064720	58.8	02Jan2007, 00:30	9.2
Pond 2	0.077786	52.2	02Jan2007, 00:50	11.0
South	0.084106	54.0	02Jan2007, 00:50	12.0
South Bypass	0.006320	10.8	02Jan2007, 00:10	1.0
South Offsite	0.054690	60.6	02Jan2007, 00:20	7.9
South Onsite 1	0.010030	16.1	02Jan2007, 00:10	1.5
South Onsite 2	0.013066	22.3	02Jan2007, 00:10	2.0
Total Site	0.174736	143.9	02Jan2007, 00:25	25.5

Project: Shackleford Simulation Run: 08 Prop 10

Start of Run: 01Jan2007, 12:00
End of Run: 02Jan2007, 12:05
Compute Time: 16Nov2007, 13:57:40

Basin Model: Proposed
Meteorologic Model: Wichita 10
Control Specifications: Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
North	0.090630	123.7	02Jan2007, 00:20	16.1
North Offsite	0.046700	62.0	02Jan2007, 00:20	8.1
North Onsite	0.043930	61.7	02Jan2007, 00:20	8.0
Pond 1	0.064720	71.3	02Jan2007, 00:30	11.0
Pond 2	0.077786	64.3	02Jan2007, 00:45	13.2
South	0.084106	66.8	02Jan2007, 00:45	14.4
South Bypass	0.006320	12.8	02Jan2007, 00:10	1.2
South Offsite	0.054690	72.6	02Jan2007, 00:20	9.4
South Onsite 1	0.010030	19.2	02Jan2007, 00:10	1.7
South Onsite 2	0.013066	26.4	02Jan2007, 00:10	2.4
Total Site	0.174736	175.2	02Jan2007, 00:25	30.5

Project: Shackleford Simulation Run: 08 Prop 25

Start of Run: 01Jan2007, 12:00
End of Run: 02Jan2007, 12:05
Compute Time: 16Nov2007, 13:57:01

Basin Model: Proposed
Meteorologic Model: Wichita 25
Control Specifications: Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
North	0.090630	157.4	02Jan2007, 00:20	20.6
North Offsite	0.046700	79.3	02Jan2007, 00:20	10.3
North Onsite	0.043930	78.1	02Jan2007, 00:20	10.2
Pond 1	0.064720	92.5	02Jan2007, 00:30	14.2
Pond 2	0.077786	85.2	02Jan2007, 00:45	16.9
South	0.084106	88.3	02Jan2007, 00:45	18.4
South Bypass	0.006320	16.1	02Jan2007, 00:05	1.5
South Offsite	0.054690	92.9	02Jan2007, 00:20	12.1
South Onsite 1	0.010030	24.4	02Jan2007, 00:10	2.2
South Onsite 2	0.013066	33.3	02Jan2007, 00:05	3.1
Total Site	0.174736	227.9	02Jan2007, 00:25	39.0

Project: Shackleford Simulation Run: 10 Prop 100

Start of Run: 01Jan2007, 12:00
End of Run: 02Jan2007, 12:05
Compute Time: 16Nov2007, 13:57:04

Basin Model: Proposed
Meteorologic Model: Wichita100
Control Specifications: Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
North	0.090630	215.0	02Jan2007, 00:20	28.3
North Offsite	0.046700	108.9	02Jan2007, 00:20	14.3
North Onsite	0.043930	106.0	02Jan2007, 00:20	14.0
Pond 1	0.064720	128.6	02Jan2007, 00:30	19.6
Pond 2	0.077786	121.3	02Jan2007, 00:45	23.4
South	0.084106	125.7	02Jan2007, 00:40	25.5
South Bypass	0.006320	21.9	02Jan2007, 00:05	2.0
South Offsite	0.054690	127.6	02Jan2007, 00:20	16.7
South Onsite 1	0.010030	33.5	02Jan2007, 00:05	3.1
South Onsite 2	0.013066	45.2	02Jan2007, 00:05	4.2
Total Site	0.174736	319.0	02Jan2007, 00:25	53.8

Cambria Drainage Calculations (North Channel Design)

Prepared by Ruggles & Bohm PA (Pat Baer PE)
10/17/2007

Channel Drainage

Channel Base Width =	4 ft	Side Slope =	4.00 Run/Rise
Height =	**1.82 ft**	Manning N =	0.035
		Hydraulic Gradiant =	2.26%
Top Width=	**18.56 ft**	**Flow =**	**137.94 cfs**
		Velocity =	**6.72 f/s**

The flow and velocity has been calculated using the Hazen-Willams Equation.

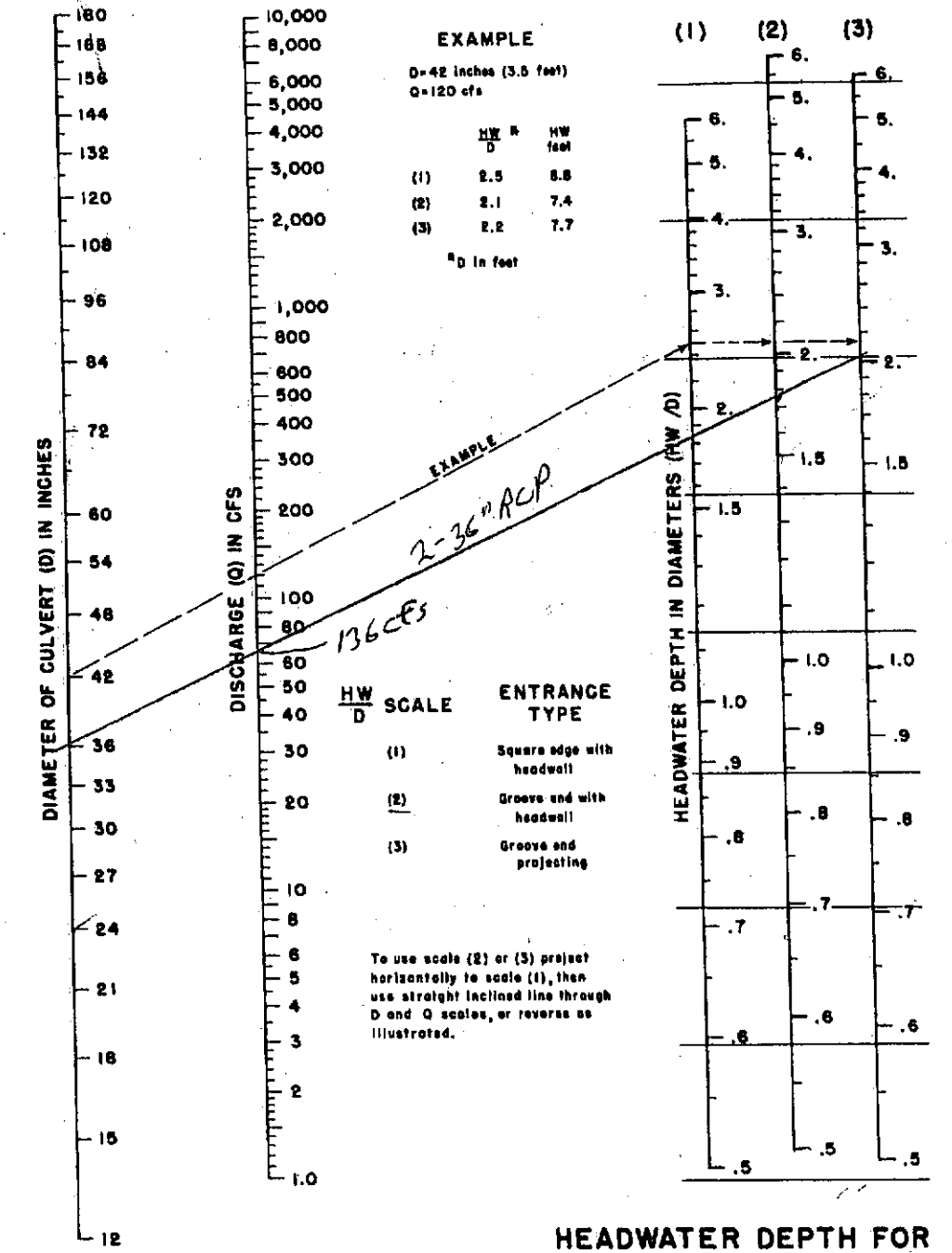

DIAMETER OF CULVERT (D) IN INCHES
DISCHARGE (Q) IN CFS
HEADWATER DEPTH IN DIAMETERS (HW/D)
EXAMPLE
D=42 inches (3.5 feet)
Q=120 cfs
HW/D
HW feet
(1) 2.5 8.8
(2) 2.1 7.4
(3) 2.2 7.7
D in feet
EXAMPLE
2-36" RCP
136 cfs
HW/D SCALE
ENTRANCE TYPE
(1) Square edge with headwall
(2) Groove end with headwall
(3) Groove end projecting
To use scale (2) or (3) project horizontally to scale (1), then use straight inclined line through D and Q scales, or reverse as illustrated.
(1) (2) (3)
HEADWATER SCALES 2&3
REVISED MAY 1964
BUREAU OF PUBLIC ROADS JAN. 1963
HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

Figure 4-1

DETENTION POND

Project : Shackleford Simulation Run : 06 Prop 2 Reservoir: Pond 1

Start of Run :	01Jan2007, 12:00	Basin Model :	Proposed
End of Run :	02Jan2007, 12:05	Meteorologic Model :	Wichita 2
Compute Time :	16Nov2007, 13:56:51	Control Specifications :	Control 1

Volume Units : AC-FT

Computed Results

Peak Inflow :	48.2 (CFS)	Date/Time of Peak Inflow :	02Jan2007, 00:20
Peak Outflow :	38.7 (CFS)	Date/Time of Peak Outflow :	02Jan2007, 00:35
Total Inflow :	6.4 (AC-FT)	Peak Storage :	3.0 (AC-FT)
Total Outflow :	6.2 (AC-FT)	Peak Elevation :	1305.4 (FT)

Project : Shackleford Simulation Run : 07 Prop 5 Reservoir: Pond 1

Start of Run :	01Jan2007, 12:00	Basin Model :	Proposed
End of Run :	02Jan2007, 12:05	Meteorologic Model :	Wichita 5
Compute Time :	16Nov2007, 13:56:54	Control Specifications :	Control 1

Volume Units : AC-FT

Computed Results

Peak Inflow :	71.0 (CFS)	Date/Time of Peak Inflow :	02Jan2007, 00:20
Peak Outflow :	58.8 (CFS)	Date/Time of Peak Outflow :	02Jan2007, 00:30
Total Inflow :	9.3 (AC-FT)	Peak Storage :	3.4 (AC-FT)
Total Outflow :	9.2 (AC-FT)	Peak Elevation :	1305.9 (FT)

Project : Shackleford Simulation Run : 08 Prop 10 Reservoir: Pond 1

Start of Run :	01Jan2007, 12:00	Basin Model :	Proposed
End of Run :	02Jan2007, 12:05	Meteorologic Model :	Wichita 10
Compute Time :	16Nov2007, 13:57:40	Control Specifications :	Control 1

Volume Units : AC-FT

Computed Results

Peak Inflow :	84.9 (CFS)	Date/Time of Peak Inflow :	02Jan2007, 00:20
Peak Outflow :	71.3 (CFS)	Date/Time of Peak Outflow :	02Jan2007, 00:30
Total Inflow :	11.2 (AC-FT)	Peak Storage :	3.6 (AC-FT)
Total Outflow :	11.0 (AC-FT)	Peak Elevation :	1306.2 (FT)

Project : Shackleford Simulation Run : 08 Prop 25 Reservoir: Pond 1

Start of Run :	01Jan2007, 12:00	Basin Model :	Proposed
End of Run :	02Jan2007, 12:05	Meteorologic Model :	Wichita 25
Compute Time :	16Nov2007, 13:57:01	Control Specifications :	Control 1

Volume Units : AC-FT

Computed Results

Peak Inflow :	108.5 (CFS)	Date/Time of Peak Inflow :	02Jan2007, 00:20
Peak Outflow :	92.5 (CFS)	Date/Time of Peak Outflow :	02Jan2007, 00:30
Total Inflow :	14.3 (AC-FT)	Peak Storage :	4.0 (AC-FT)
Total Outflow :	14.2 (AC-FT)	Peak Elevation :	1306.6 (FT)

Project : Shackleford Simulation Run : 10 Prop 100 Reservoir: Pond 1

Start of Run :	01Jan2007, 12:00	Basin Model :	Proposed
End of Run :	02Jan2007, 12:05	Meteorologic Model :	Wichita100
Compute Time :	16Nov2007, 13:57:04	Control Specifications :	Control 1

Volume Units : AC-FT

Computed Results

Peak Inflow :	148.9 (CFS)	Date/Time of Peak Inflow :	02Jan2007, 00:15
Peak Outflow :	128.6 (CFS)	Date/Time of Peak Outflow :	02Jan2007, 00:30
Total Inflow :	19.8 (AC-FT)	Peak Storage :	4.6 (AC-FT)
Total Outflow :	19.6 (AC-FT)	Peak Elevation :	1307.2 (FT)

Project : Shackleford Simulation Run : 06 Prop 2 Reservoir: Pond 2

Start of Run :	01Jan2007, 12:00	Basin Model :	Proposed
End of Run :	02Jan2007, 12:05	Meteorologic Model :	Wichita 2
Compute Time :	16Nov2007, 13:56:51	Control Specifications :	Control 1

Volume Units : AC-FT

Computed Results

Peak Inflow :	44.0 (CFS)	Date/Time of Peak Inflow :	02Jan2007, 00:30
Peak Outflow :	32.9 (CFS)	Date/Time of Peak Outflow :	02Jan2007, 00:55
Total Inflow :	7.6 (AC-FT)	Peak Storage :	1.6 (AC-FT)
Total Outflow :	7.5 (AC-FT)	Peak Elevation :	1302.4 (FT)

Project : Shackleford Simulation Run : 07 Prop 5 Reservoir: Pond 2

Start of Run :	01Jan2007, 12:00	Basin Model :	Proposed
End of Run :	02Jan2007, 12:05	Meteorologic Model :	Wichita 5
Compute Time :	16Nov2007, 13:56:54	Control Specifications :	Control 1

Volume Units : AC-FT

Computed Results

Peak Inflow :	67.1 (CFS)	Date/Time of Peak Inflow :	02Jan2007, 00:30
Peak Outflow :	52.2 (CFS)	Date/Time of Peak Outflow :	02Jan2007, 00:50
Total Inflow :	11.2 (AC-FT)	Peak Storage :	2.2 (AC-FT)
Total Outflow :	11.0 (AC-FT)	Peak Elevation :	1302.9 (FT)

Project : Shackleford Simulation Run : 08 Prop 10 Reservoir: Pond 2

Start of Run :	01Jan2007, 12:00	Basin Model :	Proposed
End of Run :	02Jan2007, 12:05	Meteorologic Model :	Wichita 10
Compute Time :	16Nov2007, 13:57:40	Control Specifications :	Control 1

Volume Units : AC-FT

Computed Results

Peak Inflow :	81.1 (CFS)	Date/Time of Peak Inflow :	02Jan2007, 00:25
Peak Outflow :	64.3 (CFS)	Date/Time of Peak Outflow :	02Jan2007, 00:45
Total Inflow :	13.4 (AC-FT)	Peak Storage :	2.6 (AC-FT)
Total Outflow :	13.2 (AC-FT)	Peak Elevation :	1303.2 (FT)

Project : Shackleford Simulation Run : 08 Prop 25 Reservoir: Pond 2

Start of Run :	01Jan2007, 12:00	Basin Model :	Proposed
End of Run :	02Jan2007, 12:05	Meteorologic Model :	Wichita 25
Compute Time :	16Nov2007, 13:57:01	Control Specifications :	Control 1

Volume Units : AC-FT

Computed Results

Peak Inflow :	105.2 (CFS)	Date/Time of Peak Inflow :	02Jan2007, 00:25
Peak Outflow :	85.2 (CFS)	Date/Time of Peak Outflow :	02Jan2007, 00:45
Total Inflow :	17.2 (AC-FT)	Peak Storage :	3.2 (AC-FT)
Total Outflow :	16.9 (AC-FT)	Peak Elevation :	1303.6 (FT)

Project : Shackleford Simulation Run : 10 Prop 100 Reservoir: Pond 2

Start of Run :	01Jan2007, 12:00	Basin Model :	Proposed
End of Run :	02Jan2007, 12:05	Meteorologic Model :	Wichita100
Compute Time :	16Nov2007, 13:57:04	Control Specifications :	Control 1

Volume Units : AC-FT

Computed Results

Peak Inflow :	146.8 (CFS)	Date/Time of Peak Inflow :	02Jan2007, 00:25
Peak Outflow :	121.3 (CFS)	Date/Time of Peak Outflow :	02Jan2007, 00:45
Total Inflow :	23.8 (AC-FT)	Peak Storage :	4.2 (AC-FT)
Total Outflow :	23.4 (AC-FT)	Peak Elevation :	1304.3 (FT)

USGS MAP
PRELIMINARY PLAT
FEMA FIRM
ORTHOPHOTO OF SITE