

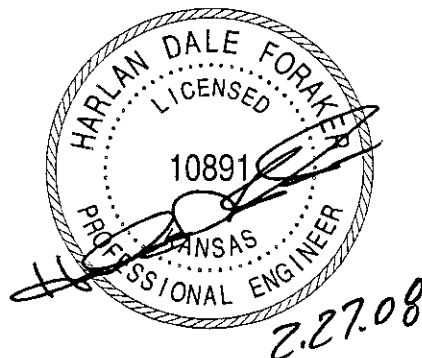
# **DRAINAGE PLAN AND SUPPORTING CALCULATIONS**

**FOR  
PROPOSED FIRE STATION #22 ADDITION  
WICHITA, KANSAS**

**PREPARED FOR:  
CITY OF WICHITA  
c/o Mr. NORMAN R. JAKOVAC  
SPECIAL PROJECTS COORDINATOR  
BUILDINGS DIVISION  
455 NORTH MAIN-8<sup>TH</sup> FLOOR  
WICHITA, KS 67202  
(316)268-4474**

**FEBRUARY 27, 2008**

**PREPARED BY:  
CERTIFIED ENGINEERING DESIGN, P.A.  
810 WEST DOUGLAS, SUITE C  
WICHITA, KANSAS 67203-6105  
(316)262-8808 PHONE  
(316)262-1669 FAX**



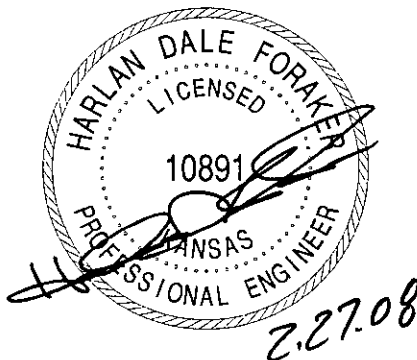
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**Public Works, Engineering Division  
Final Drainage Plan Submittal Checklist**

Reviewer: \_\_\_\_\_ Date: 2-27-08  
 Subdivision Name: FIRE STATION #22 ADDITION Location: SOUTH HYDRAULIC & DENKER  
 Total Land Area Of Ownership: 0.81 Acres  
 Type: \_\_\_\_\_ Residential \_\_\_\_\_ Commercial \_\_\_\_\_ Industrial \_\_\_\_\_ Recreation \_\_\_\_\_ Municipal X Other FIRE STATION  
 Applicant: CITY OF WICHITA Contact: NORMAN JAKOVAC Phone #: 268-4474  
 Engineer: CERTIFIED ENG. DESIGN Contact: HARLAN FORAKER Phone #: 262-8808

Please check the appropriate box:

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

Tab 1. Project Narrative	Applicant			Engr	
	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.)			REQ'D PRIOR TO DEVELOPMENT		
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				✓	

Tab 2. Existing Conditions Runoff Calculations	Applicant			Engr	
	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.				✓	



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					✓
T. Ground water elevations, if applicable					✓

Tab 3. Post-Development Hydrologic Analysis	Applicant			Engr	
	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			LOT LINES		
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					✓



**Final Drainage Plan Submittal Checklist**  
Adopted: February 23, 2007

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 plat's text. (e.g. HOA, Lot Owners Association, or lot)					✓
W. Off-site drainage easements or agreements required, where necessary					✓

Tab 4. Floodplain Submittal	Applicant			Engr	
	I	NA	Explanation / Location in Plan	I	NA
A. Provide source of flood profile					✓
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					✓

Tab 5. Federal, State and Local Permits (to be provided prior to construction unless otherwise specified)	Applicant			Engr	
	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					✓

Fire Station #22 Addition Drainage Plan(Con't)  
Ms. Vicki Huang, P.E.  
February 27, 2008

**CERTIFIED ENGINEERING DESIGN, P.A**  
810 West Douglas, Suite C  
Wichita, KS 67203-6105  
(316)262-8808 Office  
(316)262-1669 Fax

## **LETTER OF TRANSMITTAL**

DATE: February 27, 2008

TO: Ms. Vicky Huang, P.E.  
Engineering Division  
455 North Main  
Wichita, KS 67202

RE: Drainage Plan  
Fire Station #22 Addition  
Wichita, KS

FROM: Harlan D. Foraker, P.E. *HDF*

### **I. PROJECT NARRATIVE**

The site is located on the west side of Hydraulic Avenue and on the north side of Denker Avenue. The property is located at an address of 2659 Denker and is currently undeveloped with an existing grass cover on the property. The SCS soil type present within Fire Station #22 Addition is Urban Land-Canadian Complex which is a SCS Type B Soil.

### **II. EXISTING CONDITIONS RUNOFF CALCULATIONS**

The rational method will be used to determine the peak discharges from the subareas of the study area. Rational 'C' Factors were assigned to the existing site and proposed improvements from "Interim Drainage and Storm Sewer Policy for Design Criteria and Documentation" for the City of Wichita, Kansas.

The rainfall intensity tables for the Sedgwick County, Kansas which were obtained from the Kansas Department of Transportation were utilized to determine the rainfall intensity for the 5 and 100 year design storms.

The Soil Conservation Service TR-55 manual was used to compute the Time of Concentration for the drainage subareas. A design assumptions was made as follows that the minimum subarea time of concentration is 15 minutes. Soil types were determined from the SCS Soil Survey for Sedgwick County, Kansas.

Fire Station #22 Addition Drainage Plan(Con't)  
 Ms. Vicki Huang, P.E.  
 February 27, 2008

The developed drainage subareas have been delineated on the 1" = 20' site and topographic mapping survey performed for this site by Savoy Company.

Design Storm Events Evaluated: 2, 5, 10, 25, 50 and 100 yr. storm events

The runoff calculations for the street, drainage channel design, drainage pipe design and detention pond storage have been completed utilizing the 10 year storm. A check of the drainage system has been made using the 100 year storm event.

The following tables summarize the peak discharges for the existing lot area within Fire Station #22 Addition which is 0.82 acres.

<b>EXISTING PEAK RUNOFF</b>					
Description	C	Tc	I	Area	Q(cfs)
Existing Lot Area(2 yr.)	.20	30	2.89	0.82	0.47
Existing Lot Area(5 yr.)	.22	30	3.92	0.82	0.71
Existing Lot Area(10 yr.)	.28	30	4.56	0.82	1.05
Existing Lot Area(25 yr.)	.32	30	5.31	0.82	1.39
Existing Lot Area(50 yr.)	.37	30	6.08	0.82	1.84
Existing Lot Area(100 yr.)	.41	30	6.79	0.82	2.28

The runoff from the existing site drains from west to east by sheet flow over and into the west curb drainage system on Hydraulic Avenue. An existing curb inlet and storm sewer system is located at the northwest corner of the intersection of Hydraulic and Denker Avenue and collects the storm water runoff from this site.

**DVELOPED HYDROLOGIC ANALYSIS**

Design Storm Events Evaluated: 2, 5, 10, 25, 50 and 100 yr. storm events

The runoff calculations for the storm sewer pipe design have been completed utilizing the 10 year storm. A check of the drainage system has been made using the 100 year storm event.

Storm sewer was analyzed for full flow conditions was using "Flowmaster" by Haestad Methods Inc.

The following tables summarize the peak discharges for developed conditions. The developed site has been subdivided into two subareas of 0.41 acres each for Fire Station #22 Addition which has a total area of 0.82 acres.

Fire Station #22 Addition Drainage Plan(Con't)

Ms. Vicki Huang, P.E.

February 27, 2008

<b>DEVELOPED PEAK RUNOFF</b>					
Description	C	Tc	I	Area	Q(cfs)
Developed West SubArea(2 yr.)	.68	15	4.06	0.41	1.1
Developed West SubArea(5 yr.)	.69	15	5.21	0.41	1.5
Developed West SubArea(10 yr.)	.78	15	6.08	0.41	1.9
Developed West SubArea(25 yr.)	.79	15	6.95	0.41	2.3
Developed West SubArea(50 yr.)	.80	15	7.97	0.41	2.6
Developed West SubArea(100 yr.)	.81	15	8.98	0.41	3.0
Developed East SubArea(2 yr.)	.68	15	4.06	0.41	1.1
Developed East SubArea(5 yr.)	.69	15	5.21	0.41	1.4
Developed East SubArea(10 yr.)	.78	15	6.08	0.41	1.9
Developed East SubArea(25 yr.)	.79	15	6.95	0.41	2.3
Developed East SubArea(50 yr.)	.80	15	7.97	0.41	2.6
Developed East SubArea(100 yr.)	.81	15	8.98	0.41	3.0

The construction of the new Fire Station #22 building will subdivide the property into two drainage subareas. The west subarea will be 0.41 acres and will drain to the southwest corner of the proposed parking. At this location a curb inlet will be constructed to collect the parking lot runoff. A 15" storm sewer will be installed from this curb inlet to drain east to an existing curb inlet located on the north side of Denker. The east portion of the Fire Station #22 site development will drain east to the west curb and gutter along Hydraulic Avenue and then drain south to a curb inlet located on the west side of Hydraulic Avenue.

**IV. FLOODPLAIN SUBMITTAL** – No FEMA floodplain is located on this plat.

**V. FEDERAL, STATE AND LOCAL PERMITS**

- A. US Army Corp of Engineers-Not Applicable
- B. Kansas Dept. of Agriculture-Not Applicable
- C. FEMA- Not Applicable
- D. Kansas Department of Transportation-Not Applicable
- E. Sedgwick County Right-of-Way Permit-Not Applicable

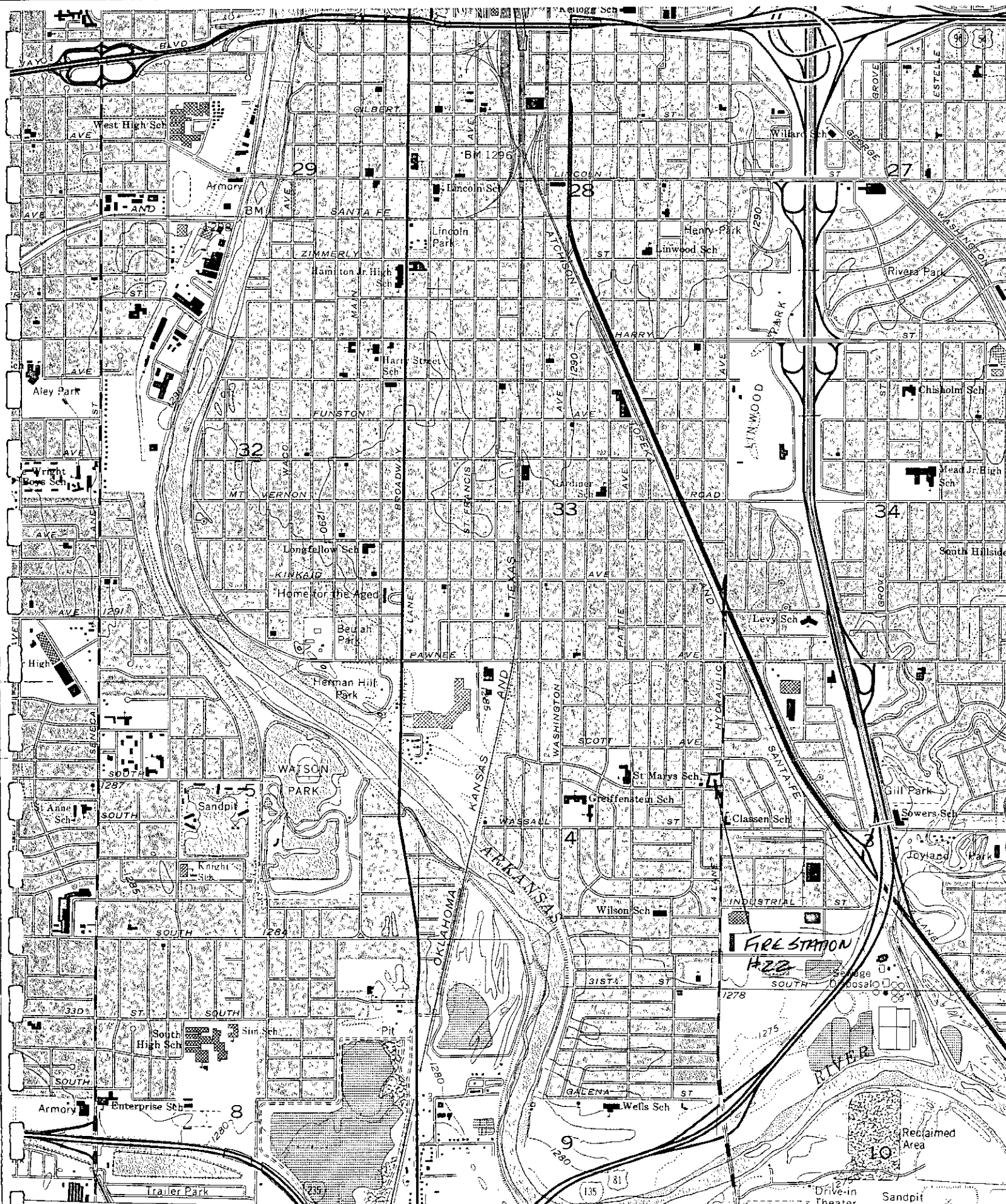
**VII. APPENDIX I:**

All charts, graphs, tables including a 1"=20' scale drainage plan map are included for review.

**VI. SUMMARY DISCUSSION:**

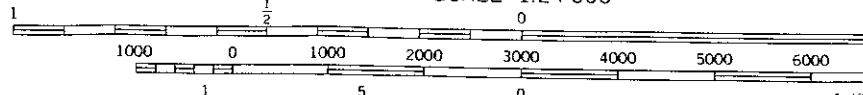
The existing drainage area of Fire Station #22 Addition is 0.82 acres and the peak 10 year discharge is 1.05 cfs. Stormwater runoff(Q10=1.9 cfs) from the west half of the site(0.41 acres) will be collected in storm sewer and conveyed via proposed storm sewer into an existing storm sewer system within Hydraulic Avenue. Stormwater runoff of 1.9 cfs from the east half of the site(0.41 acres) will sheet drain into the west curb of Hydraulic Avenue into an existing storm sewer inlet. An existing 18" pipe which has a conveyance capacity of 5.8 cfs conveys the storm water drainage across Hydraulic Avenue.





SOUTH WICHITA INTERCHANGE 1.9 MI. MIDLAND 0.8 MI. (DERBY) SOUTH WICHITA INTERCHANGE 1.7 MI. 6559 III SE WELLINGTON INTERCHANGE  
 646 81 648

SCALE 1:24 000



photographs  
 GN MN



PROJECT: FIRE STATION #22 Addition

DATE 2-27-08

LOCATION: HYDRAULIC & DESIGN

BY ADP CKD

CLIENT:

JOB NO. SHEET NO. OF

EXISTING TIME OF CONCENTRATION

$$T_T = \frac{.007 (0.24 \times 230)^{.78}}{(3.5)^{.15} (.015)^{.4}} = .50 \text{ HR} = 30 \text{ MIN.}$$

DEVELOPED TIME OF CONCENTRATION  $T_C = 15 \text{ min. Assumed}$

WEIGHTED RUNOFF FACTORS

$$\text{Impervious Area} = \frac{29403}{43500} = 0.675$$

$$\text{WTD } C_{10} = \frac{0.88(.675) + .20(.82-.675)}{.82} = 0.78$$

$$\text{WTD } C_{100} = \frac{0.89(.675) + .41(.82-.675)}{.82} = 0.81$$

$$\text{WTD } C_2 = 0.68$$

$$\text{WTD } C_5 = 0.69$$

$$\text{WTD } C_{25} = 0.79$$

$$\text{WTD } C_{50} = 0.80$$

# 15" Outfall Storm Sewer Pipe Worksheet for Circular Channel

---

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Capacit

---

---

Input Data	
Mannings Coeff	0.013
Slope	003800 ft/ft
Diameter	15 in

---

---

Results	
Depth	1.25 ft
Discharge	3.98 cfs
Flow Area	1.2 ft <sup>2</sup>
Wetted Perime	3.93 ft
Top Width	0.00 ft
Critical Depth	0.81 ft
Percent Full	100.0 %
Critical Slope	006758 ft/ft
Velocity	3.24 ft/s
Velocity Head	0.16 ft
Specific Energ	1.41 ft
Froude Numbe	0.00
Maximum Disc	4.28 cfs
Discharge Full	3.98 cfs
Slope Full	003800 ft/ft
Flow Type	N/A

---

18" Outfall Storm Sewer Pipe  
Worksheet for Circular Channel

SWS ACROSS HYDRAULIC  
AVENUE

---

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Capacit

---

---

Input Data	
Mannings Coeffic	0.013
Slope	003000 ft/ft
Diameter	18 in

---

---

Results	
Depth	1.50 ft
Discharge	5.75 cfs
Flow Area	1.8 ft <sup>2</sup>
Wetted Perime	4.71 ft
Top Width	0.00 ft
Critical Depth	0.93 ft
Percent Full	100.0 %
Critical Slope	006104 ft/ft
Velocity	3.26 ft/s
Velocity Head	0.16 ft
Specific Energ	1.66 ft
Froude Numbe	0.00
Maximum Disc	6.19 cfs
Discharge Full	5.75 cfs
Slope Full	003000 ft/ft
Flow Type	N/A

---

(SECTION 5.10, B. - CONTINUED)

FIGURE 5-3

RAINFALL INTENSITY TABLE for SEDGWICK COUNTY, KANSAS

The following tabulation contains rainfall intensity in inches per hour as derived from ESSA Weather Bureau Technical Paper 40.

DURATION IN MINUTES	RETURN PERIODS OF						
	1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5	4.67	6.23	8.00	9.34	10.67	12.23	13.79
6	4.35	5.80	7.45	8.70	9.94	11.39	12.84
7	4.09	5.46	7.02	8.19	9.36	10.72	12.09
8	3.88	5.18	6.66	7.77	8.89	10.18	11.48
9	3.71	4.95	6.36	7.43	8.49	9.72	10.96
10	3.56	4.75	6.11	7.13	8.15	9.33	10.52
11	3.43	4.58	5.89	6.87	7.85	8.99	10.14
12	3.32	4.40	5.69	6.64	7.59	8.69	9.80
13	3.21	4.29	5.51	6.43	7.35	8.42	9.50
14	3.12	4.17	5.36	6.25	7.14	8.18	9.23
15	3.04	4.06	5.21	6.08	6.95	7.97	8.98
16	2.96	3.96	5.09	5.93	6.78	7.77	8.76
17	2.90	3.86	4.97	5.79	6.62	7.59	8.55
18	2.83	3.78	4.86	5.67	6.48	7.42	8.37
19	2.77	3.70	4.76	5.55	6.34	7.27	8.19
20	2.72	3.63	4.66	5.44	6.22	7.12	8.03
21	2.67	3.56	4.57	5.34	6.10	6.99	7.88
22	2.62	3.49	4.49	5.24	5.99	6.86	7.74
23	2.57	3.43	4.41	5.15	5.89	6.74	7.60
24	2.53	3.38	4.34	5.07	5.79	6.63	7.48
25	2.49	3.32	4.27	4.99	5.70	6.53	7.36
26	2.45	3.23	4.21	4.91	5.61	6.43	7.25
27	2.42	3.18	4.15	4.84	5.53	6.33	7.14
28	2.38	3.05	4.09	4.77	5.45	6.25	7.04
29	2.35	2.97	4.02	4.68	5.38	6.16	6.95
30	2.32	2.89	3.92	4.56	5.31	6.08	6.79
31	2.29	2.82	3.82	4.44	5.19	6.00	6.62
32	2.26	2.75	3.73	4.33	5.07	5.87	6.45
33	2.24	2.68	3.64	4.23	4.95	5.73	6.30
34	2.19	2.62	3.55	4.13	4.83	5.60	6.16
35	2.14	2.57	3.47	4.04	4.73	5.47	6.02
36	2.09	2.51	3.40	3.95	4.62	5.35	5.89
37	2.05	2.46	3.33	3.87	4.52	5.23	5.76
38	2.00	2.41	3.26	3.79	4.43	5.13	5.64
39	1.96	2.36	3.19	3.71	4.34	5.02	5.53
40	1.92	2.32	3.13	3.64	4.26	4.92	5.42
41	1.89	2.27	3.07	3.57	4.18	4.83	5.32
42	1.85	2.23	3.01	3.51	4.10	4.74	5.22
43	1.82	2.19	2.96	3.44	4.02	4.65	5.13
44	1.78	2.15	2.91	3.38	3.95	4.56	5.03
45	1.75	2.11	2.86	3.32	3.88	4.48	4.95

## SOIL LEGEND

<u>SYMBOL</u>	<u>HYDROLOGIC GROUP</u>	<u>NAME</u>
Aa	B	Albion-Shellabarger sandy loams, 1 to 4 percent slopes
Ab	B	Albion and Shellabarger sandy loams, 7 to 15 percent slopes
Ba	C	Blanket silt loam, 0 to 1 percent slopes
Bb	C	Blanket silt loam, 1 to 3 percent slopes
Ca	B	Canadian fine sandy loam
Cb	B	Canadian-Waldeck fine sandy loams
Cc	D	Carwile fine sandy loam
Cd	B	Clark-Ost clay loams, 1 to 4 percent slopes
Ce	C	Clime silty clay, 3 to 6 percent slopes
Ea	B	Elandco silt loam
Eb	B	Elandco silt loam, occasionally flooded
Ec	B	Elandco silt loam, frequently flooded
Fa	B	Farnum loam, 0 to 1 percent slopes
Fb	B	Farnum loam, 1 to 3 percent slopes
Fc	B	Farnum loam, sandy substratum, 0 to 1 percent slopes
Ga	D	Goessel silty clay, 0 to 1 percent slopes
Gb	D	Goessel silty clay, 1 to 2 percent slopes
Ia	D	Irwin silty clay loam, 1 to 3 percent slopes
Ib	D	Irwin silty clay loam, 3 to 6 percent slopes
Ic	D	Irwin silty clay loam, 2 to 6 percent slopes, eroded
La	C	Lesho loam
Lb	A	Lincoln soils
Ma	B	Milan loam, 1 to 3 percent slopes
Mb	B	Milan form, 3 to 6 percent slopes
Mc	B	Milan clay loam, 2 to 6 percent slopes, eroded
Na	B	Naron fine sandy loam
Oc	D	Owens clay loam, 1 to 3 percent slopes
Od	D	Owens-Rock outcrop complex, 3 to 10 percent slopes
Pa		Pits
Pb	D	Plevna fine sandy loam
Pc	A	Pratt loamy fine sand, undulating
Pd	A	Pratt-Tivoli complex, rolling
Ra	D	Renfrow silty clay loam, 1 to 3 percent slopes
Rb	D	Renfrow silty clay loam, 3 to 6 percent slopes
Rc	D	Renfrow-Owens clay loams, 1 to 4 percent slopes
Rd	D	Rosehill silty clay, 1 to 3 percent slopes
Sa	B	Shellabarger sandy loam, 1 to 3 percent slopes
Sb	B	Shellabarger sandy loam, 3 to 6 percent slopes
Sc	B	Shellabarger sandy loam, 3 to 6 percent slopes, eroded
Ta	D	Tabler silty clay loam
Tb	D	Tabler-Drummond complex
Ua	B	Urban land-Canadian complex
Ub	B	Urban land-Elandco complex
Uc	B	Urban land-Farnum complex, 0 to 3 percent slopes
Ud	D	Urban land-Irwin complex, 1 to 3 percent slopes
Ue	D	Urban land-Tabler complex
Va	B	Vanoss silt loam, 0 to 1 percent slopes
Vb	B	Vanoss silt loam, 1 to 3 percent slopes
Vc	B	Vanoss silt loam, 3 to 6 percent slopes
Vd	B	Vanoss silt loam, 3 to 6 percent slopes, eroded
Ve	D	Vernon sandy loam, 1 to 3 percent slopes
Vf	D	Vernon sandy loam, 3 to 6 percent slopes
Wa	C	Waldeck sandy loam
Wb	D	Waurika silt loam

Land Use or Surface Characteristics	Percent Impervious	Frequency			
		2	5	10	100
<u>Single Family (Soil Group A)</u>					
1/3 Acre	50	0.47	0.50	0.54	0.60
1/4 Acre	38	0.39	0.41	0.45	0.52
1/3 Acre	30	0.33	0.35	0.39	0.47
1/2 Acre	25	0.30	0.31	0.35	0.44
3/4 Acre	22	0.28	0.29	0.33	0.42
1 Acre	20	0.26	0.28	0.32	0.40
<u>Multi-Family (Soil Group A)</u>					
Multi-Unit (detached)	60	0.55	0.57	0.61	0.67
Multi-Unit (attached)	65	0.58	0.60	0.64	0.70
Apartments	75	0.65	0.68	0.72	0.77
3. Industrial:					
Light Areas	70	0.68	0.69	0.73	0.80
Heavy Areas	80	0.74	0.76	0.79	0.84
4. Playgrounds:					
	15	0.33	0.35	0.42	0.55
5. Schools:					
	40	0.49	0.51	0.56	0.66
6. Railroad Yard Areas:					
	30	0.43	0.45	0.50	0.62
7. Undeveloped Urban Areas: Offsite Flow Analysis (when land use not defined)					
	45	0.52	0.54	0.59	0.68
8. Streets:					
Paved	99	0.87	0.88	0.90	0.93
Gravel	00	0.24	0.26	0.33	0.48
9. Drive, Parking Lots and Walks:					
	96	0.87	0.87	0.88	0.89
10. Roofs:					
	90	0.80	0.85	0.90	0.93
11. Urban Lawn Areas (See Note No. 1 below):					
<u>Soil Group A</u>					
Slope less than 1%	00	0.08	0.09	0.13	0.23
Slope 1% to 4%	00	0.12	0.13	0.17	0.27
Slope more than 4%	00	0.16	0.17	0.21	0.31
<u>Soil Group B</u>					
Slope less than 1%	00	0.16	0.18	0.24	0.37
Slope 1% to 4%	00	0.20	0.22	0.28	0.41
Slope more than 4%	00	0.24	0.26	0.32	0.45
<u>Soil Group C</u>					
Slope less than 1%	00	0.24	0.27	0.35	0.51
Slope 1% to 4%	00	0.26	0.29	0.37	0.53
Slope more than 4%	00	0.28	0.31	0.39	0.55